

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

This basic design study aims at formulating an afforestation plan adapted to the natural (terrain, soil, geology, meteorology and vegetation) and social (village families and RRA survey) conditions of Myethindwin protected public forest, which is prioritised as important area for protecting against desertification. The scope of project should be suitable to DZGD's administrative system and capacity.

2-1-1 Afforestation Plan

This afforestation plan shall include establishing protection forest (749ha), fuel wood forest (723ha), silvo-pastoral (481 ha) and community forest (65ha), a total of 1,537ha, within a 5 years period. However, the community forest will be established under the soft component. The silvo-pastoral will be established by DZGD after completion of this Grant aid project.

Table 2.1 Annual Afforesting Plan

Unit: ha

Annual Plan	Multipurpose Forest			Total	Community Forest
	Protection forest	Fuel wood Forest	Silvo-Pastoral		
The 1 st Year	30.2	179.9		210.1	32.4
The 2 nd Year	274.4	167.1		441.5	32.4
The 3 rd Year	142.5	257.0		399.5	0.0
The 4 th Year	302.2	119.1		421.3	0.0
The 5 th Year	Tending	Tending			
Total	749.3	723.1	(481.0)	1,472.4	64.8

2-1-2 Construction Facilities

An administration and extension activities office for afforestation sites will be constructed in Myethindwin. Water supply facilities necessary for the project will be constructed in Myethindwin and Letpande based on the results of geophysical profiling. The main facilities to be constructed are as follows:

Table 2.2 Facilities Plan

Facilities	Plan
Office	Administration and Extension Activities Office (storage and rest room are included as an annex) with area of 64m ² will be constructed in Myethindwin.
Workshop	The workshop will be constructed in Myethindwin
Tube-wells and Water basin	Tube-wells will be constructed in Myethindwin and Letpande. An elevated 20ton water tank will be constructed at both sites.

2-1-3 Equipment to be procured

Equipment necessary for planting (25 items) and for operation and maintenance (13 items) for the afforestation sites will be procured and sent to DZGD Nyaung Oo District Office (refer to Table 2.28). The staff will be responsible for the equipment.

Table 2.3 Equipment to be procured

A. Equipment for Planting	25 items	Survey equipment, Tractor, Track, Back hoe, Bulldozer, etc.
B. Equipment for Administration and Extension	13 items	Meteorological observation unit, Personal computer, video, Portable wireless communication unit, 4 × 4 vehicle, etc.

2-1-4 Soft Component

The soft component consists of: 1) the planting of community forest (65ha) and 2) the formulation of an Action Plan for the Nyaung Oo District office regarding the sustainable management of the 1500ha of multipurpose forest. DZGD shall establish management committees for the afforestation sites at each level (Department, Division, District and Township) and the Action Plan will provide the framework of their activities. The plan aims to establish a community participatory management system.

2-2 Basic Design of the Requested Japanese Assistance

2-2-1 Design Policy for the Afforestation Sites

2-2-1-1 Basic Design Policy

(1) Forest Classification

The multipurpose forest and the community forest (CFI) will be planted on approx. 7,550 ha of land, 6,700ha in the Myethindwin protected public forest and 850ha in the extended area adjoining to the northern boundary of Myethindwin protected public forest. Residential areas, reservoir pond, cultivated land and forests in which villages exist are excluded from the proposed project area. Multipurpose forest which is mainly for greening and soil conservation, is classified into three types in terms of utilization purpose: the protection forest, the fuel wood forest and the silvo-pastoral. The protection forest aims to support the forming of reservoirs, prevention of soil erosion and natural collapse. The protection forest should also be effective as a windbreak and for temperature regulation, air purification, and the absorption of carbon substances and generation of oxygen. Residents' entry is restricted into the protection forest. The fuel wood forest aims at mainly greening and soil conservation and will be used for the basic needs (fuel, feed, etc.) of residents. The planting of the fuel wood forest in village should be implemented in yearly phases. Access by residents to the fuel wood forest soon after planting should be restricted. The silvo-pastoral should be selected from common grazing land being used by residents. The community forest in terms of CFI should be planned for purposes of fuel wood, timber as well as grazing.

(2) Construction Policy for Multipurpose Forest

- ◆ The plan for constructing the multipurpose forest should take into consideration both protecting against soil erosion, and distributing the forest in surrounding villages for fuel wood and grazing.
- ◆ As the proposed fuel wood forest is an area being used by resident for fuel wood collection, planting should be implemented in yearly phases. While afforestation work is being conducted in one area, the remaining area will be used for fuel wood collection. Entry into the fuel wood forest should be limited after planting (i.e. for collecting dry grasses only). After tending work is complete, the area will be open for limited use under management.
- ◆ Considering the fact that the common grazing area is being used with high frequency at present according to the RRA result, planting for the silvo-pastoral will be

implemented by DZGD 6 years after commencement of the project, in order to minimise the damage by cattle to other planting areas. The equipment and watering facilities necessary for establishing the silvo-pastoral will be provided within this Grant Aid Program.

- ◆ Wire and/or bamboo fences will be installed around the circumference of the protection forest and the fuel wood forest.

(3) Construction Policy of Community Forest

The community forest shall be established according to CFI for purpose of effective utilization by residents for basic needs. The user group consists not only of landowners, but also of non-owner, livestock farmers and other participants who have the possibility of using forest resources. Planting of the community forest will be implemented after confirmation of area, conditions, agreement between users and approval by DZGD. Seedlings for the community forest will be supplied by the project. Planting of the community forest will be implemented by the soft component.

(4) Administration and Extension Activities Office

An office should be constructed in Myethindwin for administrative use and extension activities in order to promote effective management of the afforested land.

(5) Water Supply Facilities

Tube wells and elevated water tanks necessary for watering to planted trees and seedlings will be constructed in Myethindwin and Letpande.

(6) Policy for Rehabilitation of Road for Planting

The existing cart roads linking the villages within the project site will be rehabilitated to up-grade some necessary parts for temporary use for implementation. A by-pass around the residential area will be constructed, in the event that the cart road runs through the centre of the residential area.

(7) Equipment Procurement Policy

Procurement of the equipment necessary for O/M of afforestation sites and planting by DZGD for the silvo-pastoral should be considered. The equipment should be procured during the first year of implementation. Heavy machinery and tractors to be procured shall be used for the establishment of the multi-purpose forest. In principle, equipment made in Japan and made in Myanmar shall be procured. However, if superior equipment in view of cost and technical

operation is available in a third country, it can be procured upon approval by the Government of Japan.

2-2-1-2 Policies for Natural Conditions

- ◆ Areas of shifting sand, floods, steep slopes, cart roads, residential areas, and cultivated lands where the tree growing is obstructed shall not be used for planting sites.
- ◆ In the afforestation sites, existing trees that preserve the forest floor will be maintained.
- ◆ Existing trees to be pressured per ha should be calculated at planting sites. Specified tree species shall be planted in the remaining area, preserving the existing trees.
- ◆ The temporary nursery will be carefully managed so that the seedlings/trees will not be influenced by heavy rain or inundation in the rainy season or drought and evaporation in the dry season.
- ◆ In the Dry Zone, trenches will be excavated to collect and store rainwater and the pits for planting will be excavated in the middle of the trenches.
- ◆ Seedlings will be planted immediately after the excavation of pits. Every effort should be made to complete excavation just before the rainy season so as not to allow the pits to dry up.
- ◆ For achieving the sound growth of the planted trees, the planting will be executed intensively during four months from May to August in the rainy season. In the event that this period was missed for the planting work, it should be executed in September and October during the last of the rainy season.
- ◆ Planting shall not be executed at sites where the slope might collapse by the excavation of trenches and pits.
- ◆ The sandy soil is not suitable for the growth of plants because it contains more than 90% of inorganic substances. Therefore, the appropriate mixture of organic fertilizer, clay, and mountain soil should be used to refill the pots to improve soil quality.

2-2-1-3 Policies for Social Conditions

- ◆ Adequate fences or buffer zones will be provided for the planting sites that are adjacent to residential area or farms in order to avoid damage by grazing cattle, goats

and pigs.

- ◆ The afforestation/planting zones will be planned in consideration of the village boundaries and Kwin.
- ◆ Village boundaries and Kwin will be plotted on the topographic map in accordance with the cadastral maps owned by the Land Registration and Settlement office, Ministry of Agriculture and Irrigation. Planting zones and village boundaries should be confirmed by DZGD at the project site.
- ◆ The non-registered cultivated lands customarily used by residents will be used as the community forest in terms of CFI in consultation with residents.
- ◆ The existing forests possessed by villages are excluded from the proposed afforestation sites in the project.
- ◆ In order to raise resident's understanding about tree planting in the Dry Zone, participation in afforestation activities (i.e. management, tree planting, etc.) will be encouraged.
- ◆ Proper training programs hosted by DZGD will be planned so that residents who will cooperate for or participate in the afforestation management can improve their knowledge of technology and safety management (disaster and fire prevention).
- ◆ DZGD has neither field administration offices nor storage facilities in the project site at present. In addition, there are no facilities for operation and maintenance of equipment or rest facilities for residents engaged in planting. An administration facility will, therefore, be constructed to improve the work efficiency of the residents.
- ◆ DZGD shall make a guideline or rules for use of constructed tube wells for resident use.
- ◆ A land use plan will be formulated reflecting the RRA survey results

2-2-1-4 Policies for the Cooperation by Local Companies and Community

- ◆ In the target villages, there are communities dealing with water supply and women's issues. Therefore, a proposed management system of the community forests will be built, using existing systems of these communities.
- ◆ Involvement of local consultants or relevant local community or government enterprises in the implementation of the community forest and the soft component will be considered after surveying their capability.

2-2-1-5 Policies for Implementation Phases and the Construction Period

- ◆ The project will be implemented over a five-year period and the planned afforestation area should be divided into zones suitable (in scale) for completion within one fiscal year.
- ◆ The construction of facilities, and procurement of equipment necessary for planting will be executed in the first year. Construction of facilities such as temporary nurseries, water tanks, tube-wells, administration offices and the improvement of the cart roads will be also implemented in the first year.
- ◆ Planting zones that are easy to access will be selected for the first year.
- ◆ The yearly implementation schedule should be suitable to DZGD's annual budget and capability.
- ◆ The planting and tending work shall be executed and completed in accordance with the Japanese fiscal year from April to March the following year.

2-2-1-6 Basic Policies for the Operation and Maintenance (O/M)

In order to conduct adequate and efficient O/M for afforestation, the basic policy should be set up as follows:

- ◆ All the completed facilities and equipment procured through the Grant Aid Program shall belong to DZGD in the Ministry of the Forestry.
- ◆ DZGD shall fully control afforestation sites, the facilities and equipment as the responsible agency for O/M by reinforcing its managerial capability.
- ◆ DZGD shall allocate sufficient budget and personnel with appropriate technical skill to ensure sustainable O/M for afforestation sites.
- ◆ DZGD shall endeavour to maintain the facilities and afforestation sites in good conditions for natural environment and basic needs of residents.
- ◆ DZGD shall organise a committee consisting of FD Township office staff, Nyaung Oo District office staff and residents concerned with O/M for afforestation sites, and have periodical meetings to exchange information and opinions with each other as well as to promote resident participation in management of afforestation sites.
- ◆ DZGD shall establish rules, regulations and/or guidelines for resident access to the fuel wood forest and the silvo-pastoral to build the management system for the afforestation sites.

- ◆ DZGD and the Nyaung Oo District Office shall carefully patrol and strictly monitor afforestation sites and villages, focusing on the planting condition, deforestation, the burning of farm fields, and the behaviour of residents.
- ◆ DZGD shall carry out training, guidance and education for residents in order to ensure the establishment of an O/M system based on resident participation.

2-2-1-7 Policies for Responsibility and Obligations of the Government of Myanmar

- ◆ The Ministry of Forestry shall coordinate government authorities concerned, especially the Ministry of Finance and Revenue, the Ministry of National Planning and Economic Development, the Ministry of Foreign Affairs, the Ministry of Border Area and National Races and Development Affairs, the Ministry of Agriculture and Irrigation and the Ministry of Commerce for smooth implementation of the project.
- ◆ DZGD shall hold an explanatory meeting about the outline of the project for the residents understanding soon after submission of the final report, to promote residents' participation in the project.
- ◆ Demarcation between planting zones and farmland shall be clarified by DZGD in the presence of village representatives before commencement of implementation of the project. Planting sites shall be free from compensation and restriction.
- ◆ The Ministry of Forestry shall secure permission from authorities concerned before commencement of the project (soon after Exchange of Notes) for the following:
 - To establish afforestation sites in Myethindwin protected public forest.
 - To construct facilities (Administration and extension activities office, nursery and tube-wells, rehabilitation of cart path for temporary road and others).
 - To import equipment from Japan and a third country to Myanmar.
 - To be exempt from taxes, custom duties and other duties that may be levied on importing equipment.
 - To be exempt from taxes and duties on Japanese consultants and contractors to be engaged in the project.
 - To carry out works such as quarry site development and the construction of temporary nurseries, irrigation facilities and roads as well as to secure a stock yard lot.
 - To transport equipment and heavy machines from Yangon /port to project site.
 - To bring foreign currency into Myanmar and bring out remaining currency from Myanmar.

2-2-2 Basic Plan (Afforestation, Facilities and Equipment)

2-2-2-1 Afforestation Plan

(1) Selection of the Candidate Afforestation Sites

1) Selection of the Candidate Afforestation Sites by Natural Conditions Survey

Selection of the Candidate Afforestation Sites by Using a GIS

In the Study, the candidate afforestation sites were selected, using the overlay method with TN Timps. The candidate sites were selected based on the following criteria.

Steep slopes of gradient over 10 degrees

Slopes with more than 10 degrees of gradient are likely to cause slope collapse according to the field survey results. Steep slopes with more than 10 degrees are excluded.

Gullies in the head of the valley

There are sandy gullies in the head of the valley that are likely to collapse. Therefore, the areas of width of 5 meters of gullies were excluded.

Dry riverbed

On the riverbed of the main stream, there is a thick deposit of soil and sand that was flown from the upper stream and valleys. Dry riverbed is excluded because it is not stable due to flushing soil deposit at the heavy rain.

Areas restricted for planting

- ◆ Cultivated land of sesame, peanut and toddy palm, which can be identified in aerial photos and satellite images.
- ◆ General roads and paths for ox carts 6 meters in width.
- ◆ Village residential areas surrounded by fences.
- ◆ Forests and reservoirs in the villages after confirmation of sites by field survey.

Consideration of Soil Condition

Sites covered by red brown savannah soil (Chromic luvisol) are identified as not suitable for growing vegetation and tall trees through the year. The sites in the USLE map indicate the high volumes of soil loss. The sites have been selected for the protection forest to prevent soil erosion.

Confirmation by Field Survey

Since a topographic map made by aerial photographs taken in 1984 was different from the current land use condition, the candidate afforestation sites were confirmed by field reconnaissance along with verification of the excluded areas at sites and a vegetation survey. The candidate afforestation sites were plotted on the topographic map using the GPS data and the field reconnaissance results. As for the pit excavation plan, the flat sites that may be cultivated by heavy equipment and the slopes that have to be excavated by manpower were identified separately by the field survey, and those areas were accurately indicated on the topographic map. Existing trees in the candidate sites were also surveyed to calculate the number of trees to be planted (Refer to Figure 2.1, Table 2.4 and Table 2.8).

Candidate Planting Areas

The following areas were excluded from the candidate planting areas, as they are not suitable.

- ◆ Slopes more than 10 degrees in the gradient: about 409 ha
- ◆ Gully and dried riverbed: about 676 ha
- ◆ Restricted areas such as cultivated lands, roads, residential areas, village forests: about 3,453 ha
- ◆ Chaukkan is also excluded from the project because all village land is registered.

Therefore, the planting candidate area will be 2,763.03ha.

Table 2.4 Candidate Planting Area

(unit: ha)

	Myethindwin	Zio	Letpande	Aungtha	Wetlu	Chaukkan	Nyaunggyi	Yanzan	Indaing	Total	Except Chaukkan	
Project area	700.49	1,128.52	1,979.81	462.01	336.28	1,254.55	312.04	855.40	613.73	7,642.83	6,388.28	
Slope more than 10°	1.32	45.61	100.78	19.16	19.28	68.11	22.33	62.72	69.84	409.15	341.04	
Gully	33.38	63.50	63.53	34.00	23.00	92.54	18.89	25.20	29.65	383.69	291.15	
Dry river	19.96	52.31	58.81	25.32	11.02	33.37	17.49	40.62	32.93	291.83	258.46	
Sub-total	53.34	115.81	122.34	59.32	34.02	125.91	36.38	65.82	62.58	675.52	549.61	
Exclusion	Cultivation	483.26	480.53	518.64	289.70	166.91	687.02	66.40	422.34	103.63	3,218.43	2,531.41
	Road	2.52	8.16	11.90	2.10	1.20	6.72	0.01	2.10	2.52	37.23	30.51
	Residential	11.95	8.50	12.88	4.06	13.84	22.40	25.75	0.00	30.35	129.73	107.33
	Vill-forest	20.40	16.30	0.00	2.40	0.00	0.00	6.00	0.00	0.00	45.10	45.10
	Lake	6.01	3.37	4.86	0.15	0.00	3.11	0.71	1.85	3.30	23.36	20.25
Sub total	524.14	516.86	548.28	298.41	181.95	719.25	98.87	426.29	139.80	3,453.85	2,734.60	
Possible area = -(+ +)	121.69	450.24	1,208.41	85.12	101.03	341.28	154.46	300.57	341.51	3,104.31	2,763.03	

Source: Natural Condition Survey in June-July 2001

2) Social Condition Survey

Classification of the Afforestation sites

Through the Rapid Rural Appraisal (hereinafter called RRA) Survey and the subsequent analyses, an attempt was made to process the information obtained by the resource mapping and transect walk into the proposed land use plan. The following classifications of the afforestation sites are recommended based on the findings of the RRA Survey.

Table 2.5 Classification of Afforestation Sites

Category	Primary purpose	Management measures	Current ownership and land use	Biophysical aspects
Protection Forest	Greening and land conservation	Management by DZGD. Resident access is prohibited.	Less land use at present.	Area is large and less vegetation. Critical watershed for conservation. Potential for planting.
Fuel wood Forest	Greening and land conservation Limited access is allowed for fuel wood collection.	Management by DZGD. Collection of fuel wood and fodder is allowed. Logging and felling are prohibited. Access by resident is limited for maintaining long period use.	Near by residential area. Mixed ownerships (customary / traditional rights, non-registered lands, etc.).	More bare land, less natural vegetation. Land quality varies from poor to good. On average, moderately suitable for forest plantation.
Silvo-pastoral	Greening and land conservation. Grazing allowed.	Management by DZGD. Collection of fuel wood and fodder is allowed. Logging and felling are prohibited. Grazing allowed on rotational basis. Access by resident is limited for maintaining long period use.	Mainly used for grazing., but complex land use due to expansion of grazing and agricultural land. Traditional ownership exists on trees and land.	Area is large enough for rotational grazing. Soil is preferably suitable for grazing, rather than forest.
Community Forest	Multiple uses of forest resources (non-wood, fuel wood, pole, post, timber).	Management by User Group. Right for use is identified through CFL. Resident is able to collect fuel wood and fodder continuously.	Ownership under customary/traditional rights exist, mostly by individuals but also include monastery / community forests.	Partial / sporadic vegetation remains. Land is degraded. Soil is good enough for forestry.

Source: Social Condition Survey in June-July, 2001

Aside from the multipurpose forest and the community forest, there are the existing village forests and agro-forestry. The existing forests include monastery forests, village forests, and some privately established forests. These areas are excluded from the afforestation project, because relatively healthy vegetation remains in these areas, and there is no need for intensive planting. Agro-forestry will not be directly included in the afforestation plan.

The Particulars for Selection of Planting Sites

The following measures were taken based on the above classification. Demarcation of the sites was carried out with residents present.

◆ Grazing area

The grazing area for Indaing village use is planned to remain in the proposed the protection forest area in consideration of their request.

◆ Farmland

All farmland within the project area will be excluded regardless of whether it is registered or not.

◆ Conventional Ownership of Forest

Countermeasures for conventional ownership of forest is taken as follows.

- Private forest customarily managed by residents is excluded from planting area except for the following two cases.
 1. Private forest is included into proposed fuel wood forest upon an agreement with conventional owner (e.g. proposed fuel wood forest in Auntha and the community forest for Letpande).
 2. Private forest is necessary to promote planting trees because of low vegetation (i.e parts of Zio).

- As for private forest excluded from planting area, guidance on CFI application will be given through the soft component.

◆ Community Forest

Ideas by residents for location and area of the community forest are shown as follows:

Table 2.6 Ideas of Community Forest by Villages

Village	Intention	Location and Area	Remark
Myethindwin	Positive	-14.8ha in an area between Kwin1499 and Kwin1501B. -Area of 30-50ac (12ha) is selected suitable for easy management.	-Positive in all residents for the community forest. -Fence is required to protect livestock passing.
Zio	Negative	-Village chief is interested in the community forest, but the Chief did not obtain an agreement from residents. -In village meeting, selection of area was tried, but not settled.	-Leadership of chief is not so strong. -Understanding by residents on the community forest was a little in village meeting due to low education other than neighbour villages. -Expectation of the community forest was low because of their hesitation of assignment of management. -Residents are interested in especially direct benefits that residents may obtain from the project, because residents are most poor in the target area.
Letpande	Positive	-Area of 50ac in southern part of Kwin1501A.	-Private forests are included. Relation between conventional owners of forest and other residents was very good. Idea was settled between residents. -Planting ratio will be not much because good vegetation site is included. -Chief and residents are strongly interested in the community forest.
Auntha	Negative	-Understanding of difficulty for management by residents because of limitation in village residents in small village. -Fuel wood forest of 25ha in east Kwin 1459 (Letpande territory) was proposed and grazing area was also proposed to remain in Kwin 1459. -Existing village private forest was requested to apply CFI	-Area of Kwin 1459 is used for grazing and fuel wood. The grazing area will be remained for long terms use. -In consideration of above circumstance, proposed area for grazing and fuel wood by residents stated in left side column will be included in the fuel wood forest in the project. -CFI application will be supported by the soft component
Wetlu	Positive	-Area of 11.7ha in central Kwin 1489. -Exclusion of area in Kwin 1489 and 1487 proposed in July was accepted due to inconvenience of transportation.	-Non-registered farmland of 14 residents is included. 14 farmlands to be changed into the community forest were agreed. -Demarcation between farmland and proposed the community forest was confirmed at the sites because some farmland owner wanted to continue farmland use. -Positive in the community forest construction
Nyaunggi	Positive	-Area of 24.9ha extended in Kwin 1452 and 1453.	-Remaining area by excluding the fuel wood forest, farmland and existing private forest in Kwin 1453 and a part of the fuel wood forest in Kwin 1452 will be the community forest.

Source: Resident participatory survey in October 2001.

3) Final Afforestation Site

Final afforestation plan in consideration of both natural and social conditions is planting sites of 1,537ha consisted of the protection forest of 749 ha, the fuel wood forest of 723 ha and community forest of 65ha shown on Table 2.7.

Table 2.7 Afforestation Area

Village Name	Village Area(ha)	Multipurpose Forest				CFI	Total (ha)
		Protect-F	Fuel-w/F	Grazing/F	Sub-Ttl	Comm. F	
Myethindwin	700.49	0	0	0	0	15	15
Zio	1,128.52	143	237	0	380	0	380
Letpande	1,979.81	212	319	334	865	13	878
Aungtha	462.01	0	139	0	139	0	139
Wetlu	336.28	0	0	0	0	12	12
Nyaunggyi	165.59	0	28	0	28	25	53
Indaing	855.40	302	0	47	349	0	349
Yanzan	613.73	92	0	100	192	0	192
Total	6,241.83	749	723	481	1,953	65	2,018
Plantation		749	723	0	1,472	65	1,537

Source: Field Survey in October 2001

(2) Preserving Existing Trees and Planting Plan

1) The required number of trees to be planted

An investigation of the vegetation density for every coded area was conducted by field survey. A code number was assigned to planting zones in the every forest category (refer to Figure 2.1). The investigation was made as follows: The number of existing trees that exceeded 1m in height was calculated for each 400m² area of every planting zone in the coded areas. The number of trees to be planted was calculated by comparing the number of existing trees and the basic number of trees to be planted for each 770/ha. During the study, the area available for using a ripper and backhoe for every coded area was surveyed.

Table 2.8 Vegetation Density of Protection and Fuel wood forests
(Number of Trees to be Planted in Coded areas)

Village	Code Number	Area (ha)	Vegetation Density (Number/400 m ²)	Planting Density (%/ha/770)	Number of trees to be planted	Ripper		Backhoe		Number of trees
						%	ha	%	ha	
Zio	ZP3	78.8	12.5	59.4	36,042	57.2	45.1	85.8	67.6	
	ZP4	63.7	1.0	96.8	47,479	100.0	63.7	100.0	63.7	
	ZF7	57.8	13.3	56.8	25,279	34.6	20.0	51.9	30.0	
	ZF8	98.5	11.7	62.0	47,024	40.5	39.9	60.8	59.9	
	ZF9	80.4	11.0	64.3	39,807	30.5	24.5	45.8	36.8	
Subtotal		379.2		67.2	195,631		193.2		258.0	(291,984)
Letpande	LP2	182.2	10.4	66.2	92,875	39.8	72.5	59.7	108.8	
	LP7	30.2	16.0	48.1	11,185	20.0	6.0	30.0	9.1	
	YP5	65.4	21.1	31.5	15,863	20.7	13.5	31.1	20.3	Yanzan
	YP6	26.8	10.0	67.5	13,929	80.0	21.4	100.0	26.8	Yanzan
	LF2	134.8	14.1	54.2	56,257	25.0	33.7	37.5	50.6	
	LF3	6.8	5.0	83.8	4,388	100.0	6.8	100.0	6.8	
	LF4	8.0	14.0	54.5	3,357	20.0	1.6	30.0	2.4	
	LF5	27.7	14.0	54.5	11,624	20.0	5.5	30.0	8.3	
Subtotal		623.2		59.9	286,183		189.8		276.3	(479,864)
Aungtha	AF10	34.5	4.0	87.0	23,112	85.0	29.3	100.0	34.5	
	AF11	5.2	17.0	44.8	1,794	60.0	3.1	90.0	4.7	
	AF12	40.5	17.4	43.5	13,565	55.1	22.3	82.7	33.5	
	AF13	13.2	13.0	57.8	5,875	70.0	9.2	100.0	13.2	
	AF14	12.3	15.0	51.3	4,859	30.0	3.7	45.0	5.5	
	AF15	9.7	15.0	51.3	3,832	40.0	3.9	60.0	5.8	
	AF16	11.5	7.0	77.3	6,854	80.0	9.2	100.0	11.5	
	AF17	12.5	16.0	48.1	4,630	70.0	8.8	100.0	12.5	
Subtotal		139.4		60.4	64,512		89.5		121.2	(107,338)
Nyaunggyi	NF1	28.4	17	44.8	9,797	20	5.7	30	8.5	(21,868)
Indaing	IP1	302.2	8.6	72.1	167,772	3.9	11.8	5.9	17.8	(232,694)
Total		1,472.4		64.1	723,895		490.0		681.8	(1,133,748)

Source: Field Survey in October, 2001

(3) Annual Implementation Program

The annual implementation plan is established to complete the project within a few successive years, dividing the project area into zones suitable for completion within a year without any difficulties. Planting and tending for the zones should be completed within 1 to 2 years. The afforestation sites will be handed over to DZGD when tending work is complete and the survival rate is checked by the Consultant and DZGD. The scale of the project site of

each year will be different depending on the infrastructure conditions such as roads, water supply, and nursery facilities. In the first year stage when infrastructure and facilities are not available, about 200ha accessible by existing road will be a suitable area to complete in a year. After the infrastructure and facilities are established, about 500ha will be suitable for completion in a year. The following factors should be considered in the formulation of the yearly implementation plan.

- ◆ Since there will be a lack of the nursery and water supply facilities equipment, etc., the seedlings for the 210ha for the first year should be provided from seedlings available in existing nursery. However, the seedling from the second year stage should be provided from the temporary nursery to be constructed.
- ◆ Tending work for the planting trees will be carried out to the following year. After the completion of the supplementary planting in the following year, the afforestation site will be handed over. At the time of handing over of the afforestation site, the survival rate of more than 70% is approved as the completion rate.
- ◆ In the 5th year, only tending work will be executed.
- ◆ As for watering the planted trees, a detailed plan to use procured equipment such as water tankers, oil drums, watering pots, and hand tractors should be made.

Table 2.9 Annual Implementation Program for Multipurpose Forest

Phase	Afforestation				Facilities		
	Village Name	Forest Use	Code Number	Area (ha)	Village etc.	Item	Quantity
1 st	Letpande	Protect/F	LP7	30.2	Myethindwin	Admin. office	1
		Fuel-W/F	LF2-1	67.4	Myethindwin	Workshop	1
		Fuel-W/F	LF5	27.7	Mye, Letpande	Water Supply	2sites
		Fuel-W/F	LF6-1	70.6	Temporary roads	A –section	6,231m
	Nyaunggyi	Fuel-W/F	NF1-1	14.3		B-section	2,554m
	Total			210.1		D-section	3,356m
						E-section	2,177m
						F-section	4,828m
						Total	19,146 m
					Equipment Procurement		1 set
2 nd	Letpande	Protect/F	LP2	182.2	Temporary roads	G-section	4,915m
		Protect/F	YP5	65.4			
		Protect/F	YP6	26.8			
		Fuel-W/F	LF2-2	67.4			
		Fuel-W/F	LF3	6.8			
		Fuel-W/F	LF4	8.0			
		Fuel-W/F	LF6-2	70.7			
	Nyaunggyi	Fuel-W/F	NF1-2	14.2			
Total			441.5				
3 rd	Zio	Protect/F	ZP3	78.8	Temporary roads	H-section	2,514
		Protect/F	ZP4	63.7		I-section	4,405
		Fuel-W/F	ZF7-1	28.9		K-section	3,565
		Fuel-W/F	ZF7-2	28.9		Total	10,484m
		Fuel-W/F	ZF8	98.5			
	Aungtha	Fuel-W/F	AF10	34.5			
		Fuel-W/F	AF12	40.5			
		Fuel-W/F	AF13	13.2			
Fuel-W/F		AF17	12.5				
Total			399.5				
4 th	Indaing	Protect/F	IP1	302.2	Temporary roads	C-section	3,188
	Zio	Fuel-W/F	ZF9	80.4		J-section	5,561
	Aungtha	Fuel-W/F	AF11	5.2		Total	8,749m
		Fuel-W/F	AF14	12.3			
		Fuel-W/F	AF15	9.7			
	Fuel-W/F	AF16	11.5				
Total			421.3				
Grand Total				1,472.4	Temporary roads	Grand Total	43,294m

Table 2.10 Annual Implementation Program for Community Forest

Phase	Afforestation			
	Village Name	Forest Use	Code Number	Area (ha)
1 st	Myethindwin	Community Forest	MC3-1	7.4
	Letpande	Community Forest	LC2-1	6.7
	Wetlu	Community Forest	WC4-1	5.8
	Nyaunggi	Community Forest	NC1-1	12.5
	Total			32.4
2 nd	Myethindwin	Community Forest	MC3-2	7.4
	Letpande	Community Forest	LC2-2	6.7
	Wetlu	Community Forest	WC4-2	5.9
	Nyaunggi	Community Forest	NC1-2	12.4
	Total			32.4
Grand Total				64.8

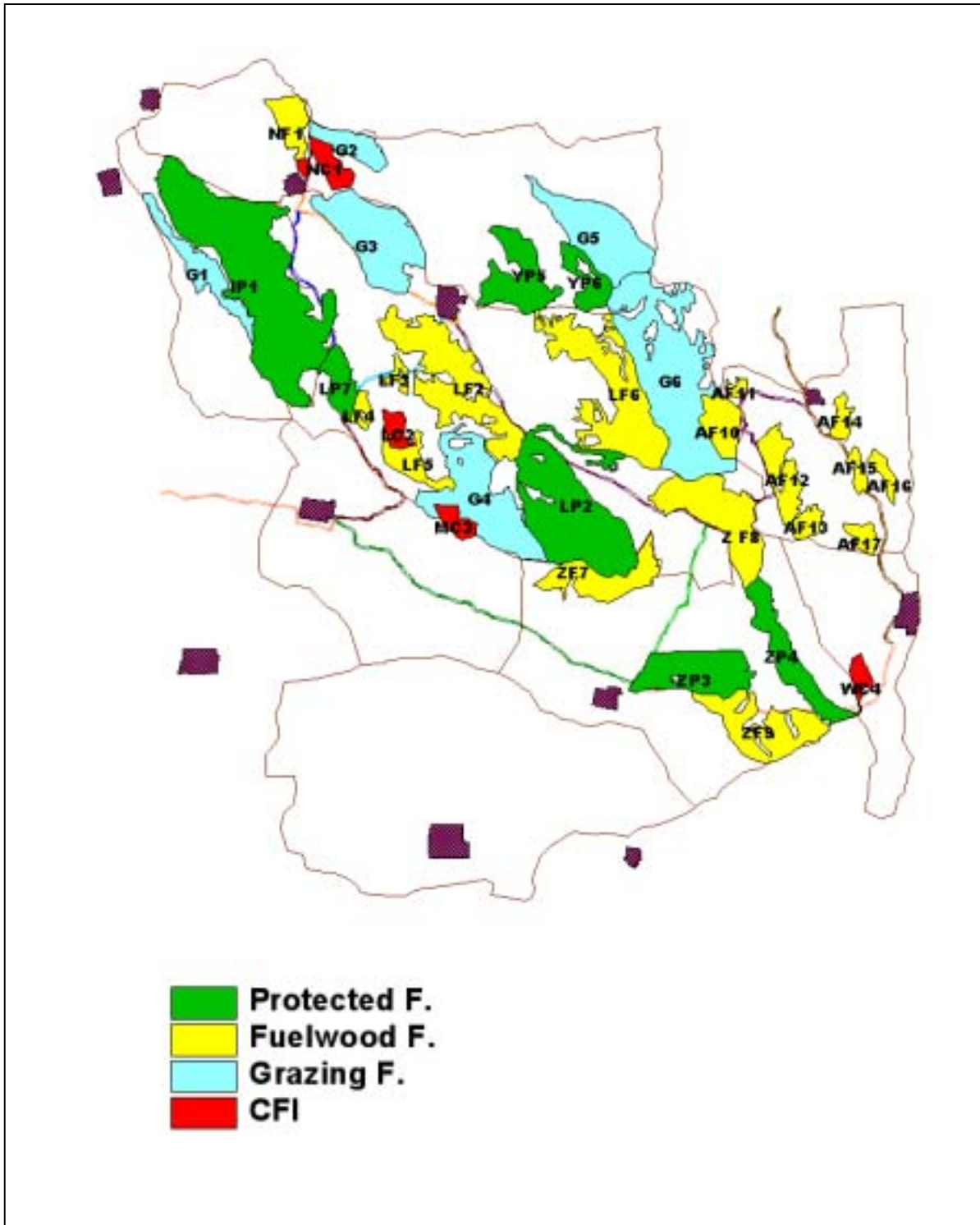


Figure 2.1 Afforestation Planning Map

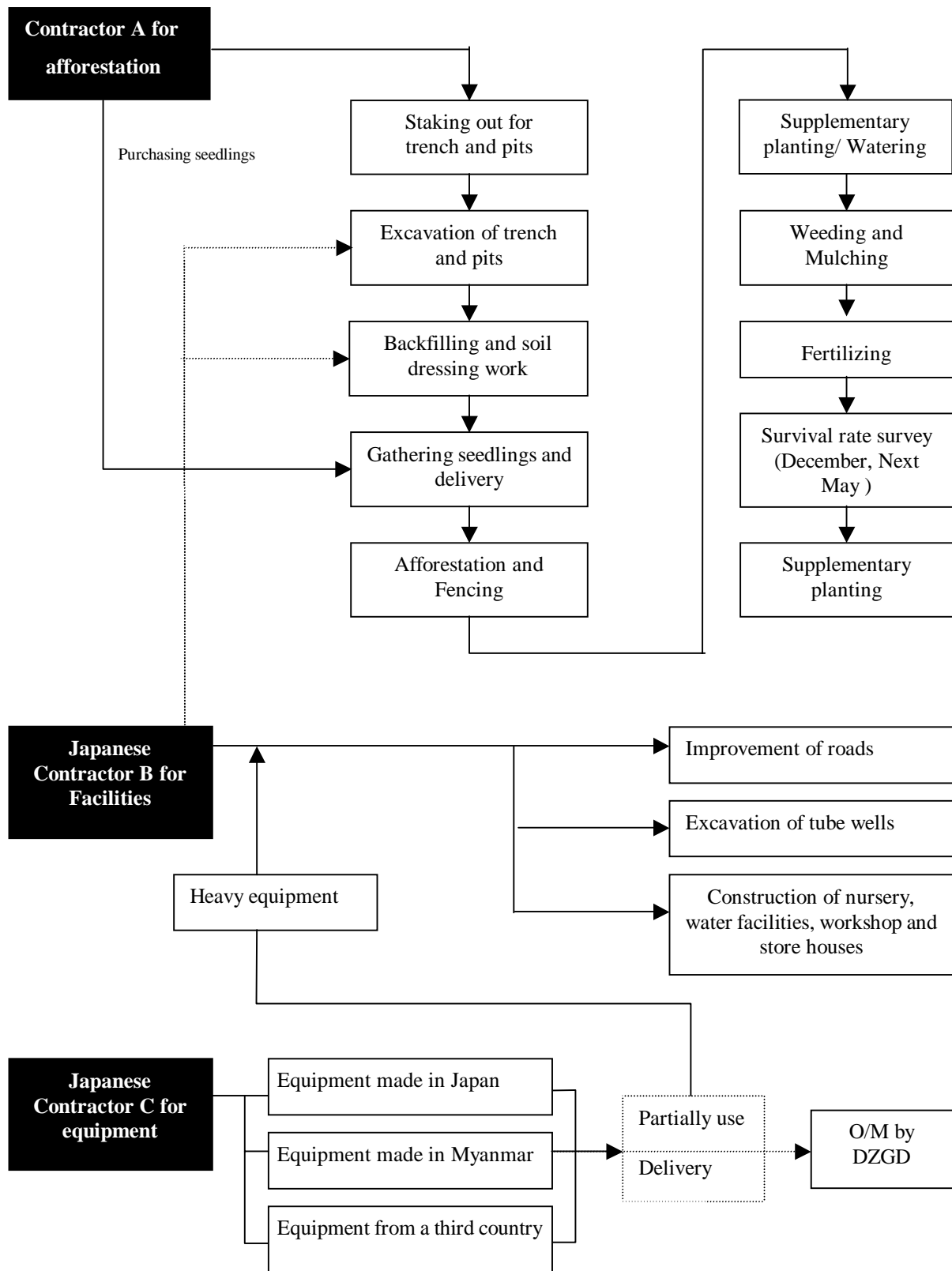


Figure 2.2 Work Flow for the First Year

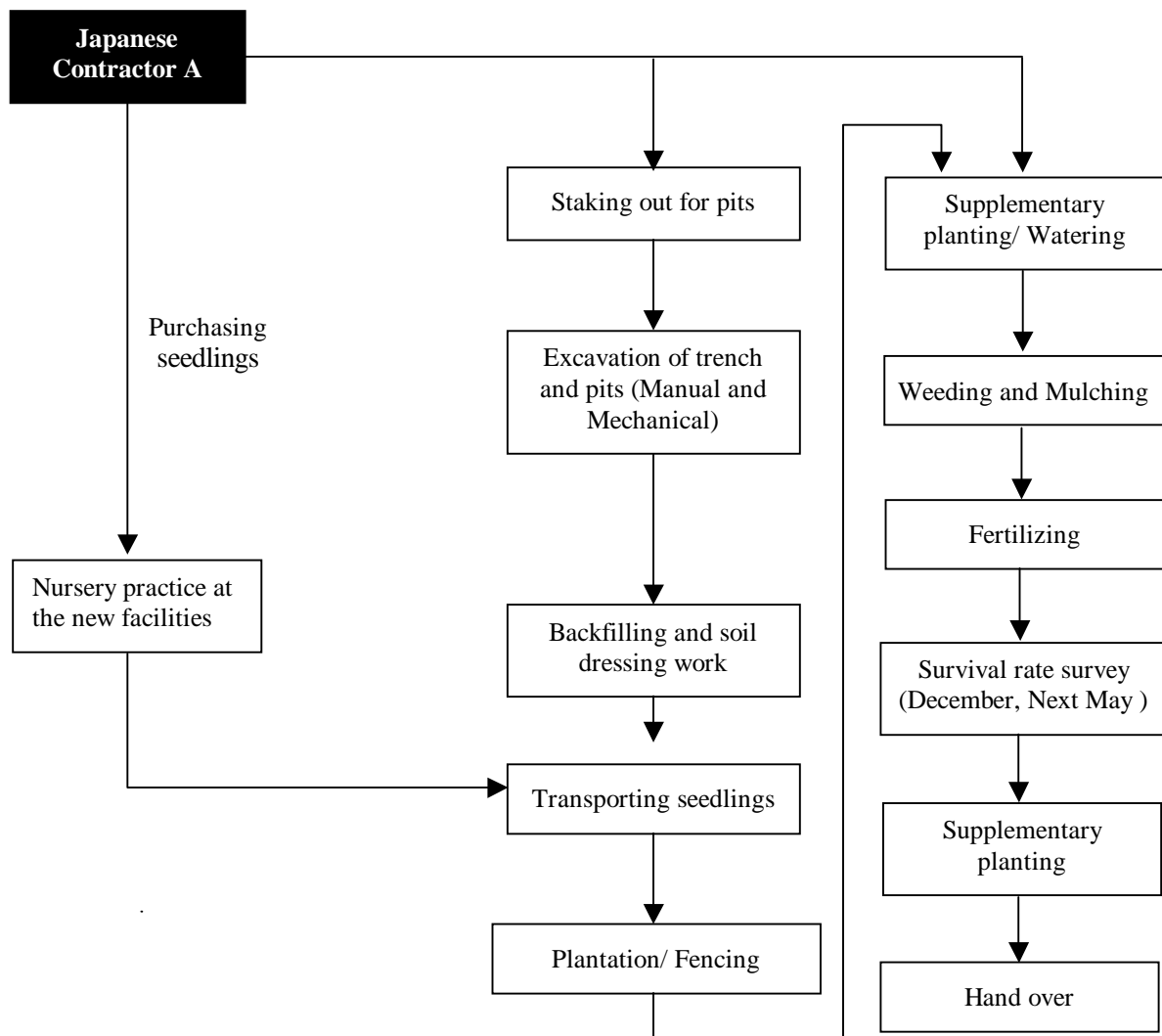


Figure 2.3 Work Flow for Successive Years

(4) Planting schedule and Implementation program

Seedlings necessary for planting in the first year will be procured and those for the following years will be provided utilizing the temporary nurseries constructed for this project. Procured heavy machineries are to be used for the excavation of trenches and planting pits. In the Dry Zone, nursery production, delivery of seedlings and planting should be carried out in a timely manner considering the natural conditions. For example, delivery of required seedlings to the sites should be completed before the end of May when the rainy season starts.

The most adequate schedule for the establishment of afforestation in the Dry Zone is shown in the Table 2.11. This project should be implemented following the schedule as closely as possible. The implementation work necessary for establishment of afforestation shall be executed, according to the details in the following pages.

Table 2.11 Working Schedule for the Afforestation

Work items	month																												
	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	
Planting	Staking out																												
	Excavation																												
	Refilling																												
	Delivery, Planting																												
Tending	Weeding, Mulching																												
	Fertilization																												
	Supplementary planting																												
	Watering																												
	Fencing																												
	Fireprevention																												
	Survival rate survey																												

- Note: 1) Refilling with excavated soil will be arranged from February to March. For soil dressing work, dung and soil are mixed together in the proportion of 1 to 4 and a full bucket per pit.
 2) Weeding is carried out in July and September in the first year, while in July and October in the second year, two times per year respectively.
 3) Fertilizing is carried out in August and September in the first year.

1) Seedling Production Plan (Necessity for Nursery Construction)

The Kyawkphyahla nursery facilities of DZGD are producing 400,000-500,000 seedlings yearly for the afforestation of the Dry Zone. Since there is a limit for the number of seedlings to purchase from the facilities, the required seedlings for this project will be produced by the temporary nursery facilities to be constructed. Nursery facilities will be constructed in

Myethindwin and Letpande where wells for irrigation use are to be newly established.

2) Surveying and Staking Out

Reference points should be established using a GPS and stakes should be laid for trenches and pits, fire prevention zones and access roads. Thirty cm (30cm) bamboo stakes made from quartering a bamboo will be used.

3) Site Preparation

Site preparation involves removing weeds and plants at the planting sites in order to make the planting easier as well as to improve the survival rate and growth of the seedlings. Since the planting sites have generally little vegetation, existing trees will be preserved as much as possible. Only vegetation that disturbs the excavation of the pits and the growth of the planting trees shall be removed.

4) Trench and Pit Digging

The project site is mainly covered with Red Brown Savannah Soils. The site has mostly turned into sandy area because of fragile soil and low water retention. In the Dry Zone, trenches are usually dug for gathering rain around the planting pits.

The interval of planting tree shall be 3.6m × 3.6m as used by DZGD. Therefore, 770 seedlings are estimated for planting per ha, however, the number of trees to be planted shown in Table 2.8 is the minimum considering the existing vegetation.

In general, excavation work will be conducted manually. However, heavy machinery will be used in part (about 15-20%) in order to complete work within the construction period.

A 30 cm square pit is to be excavated at centre of the trench with dimensions of 1.5m x 30cm x 30cm. In order to make use of rainwater effectively, the construction of small embankments or retaining walls might be needed. The pits should be positioned so that they are alternatively at the right side of the upper slope and the left side of the lower slope. Staking work should be conducted with full consideration of these matters.

5) Refilling and Soil Dressing Work

It is essential to maintain development of the roots of trees one year after planting. Soil which is porous and consists of a mixture of mountain soil and humus (organic fertilizer) is the most suitable soil structure for maintaining the roots. However, the sandy soil in the project site is hard and has poor water holding capacity through the year. The soil structure should be improved (small soft grains and porous soil with a capacity to hold water) in order to ensure root development and the survival of planted trees.

DZGD has confirmed the importance of root development in the first year through field studies. Therefore, soil-dressing work shall be carried out to maintain development of the horizontal and vertical roots over a period of one year. As the rhizosphere is 30cm deep with a 12cm radius, the volume of soil required for each pit is 13,000cm³ (12cm x 12cm x 3.14 x 30cm) as shown in Figure 2.4.

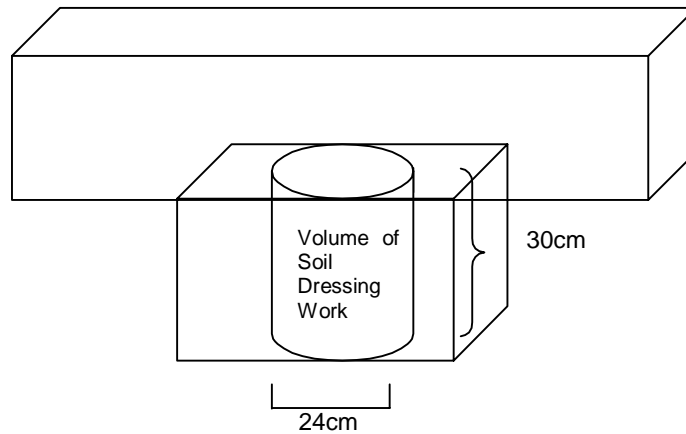


Figure 2.4 Soil Dressing Work

In this project, organic fertilizer and mountain soil will be mixed at a ratio of 1:4. The organic fertilizer will be procured in surrounding villages (The organic fertilizer being used in DZGD will be used for the project). Mountain soil for soil dressing work is available in the suburb of Nyaung Oo. One bucket of 0.013 m³ (25cm x depth of 28cm=0.013 m³/ pit) for a pit will be used for soil dressing work.

Excavated soil, which is hard should be loosed before refilling into the pit so that the roots can develop freely. Mountain soil and the organic fertilizer should be prepared in February and March before planting in April and May.

6) Planting

The dampness of the soil should be checked after the first rain in May to judge the commencement of planting work.

a. Transportation of seedlings to the planting site

Seedlings shall be handled carefully while they are carried to the site from the nursery (no strong vibrations). Be sure to adequately water the seedlings and cover the seedlings with a sheet (cloth or paper or vinyl) before transportation to the sites.

Plastic boxes are to be prepared for transportation of seedlings. Handling of seedlings during unloading at the site and transportation to the pits from the vehicle should be done carefully. Delivery of seedlings to the sites should be carefully carried out in consideration of

the progress of planting work, because the excessive supply of seedlings makes seedlings dried up before the planting, and short supply of seedlings causes interruptions in the planting work schedule. As pits have already been dug, time can be lost due to waiting for the seedlings. Therefore, careful arrangement of the delivery of seedling and preparation of the site are needed.

In principle, the amount of seedlings necessary for one day of planting is transported to the site on the same day. If planting could not be finished on that day, the remaining seedlings should be covered by sheet for storage. The tractors are more applicable than the trucks for the terrain condition at the site from the vehicle (truck) to the pits.

b. Planting

Planting is done in the rainy season from May to August. The standard of seedlings to be transported to the sites are 45 cm high (it varies by species, DZGD is adopting this standard).

Seedlings should be treated carefully so as not to collapse the covering soil in the pot. Furthermore, covering soil in the pit should be carefully maintained so that roots don't dry up. Pots should not be pressed down because it might damage roots. Refilling soil, twigs and small rocks must be removed from the pits. The workers should keep sharp edged tools like a knife to cut and remove the pot covers. Seedlings should be planted in all the pits. When taking a break, the seedlings must be protected from drying by covering with a sheet. The guidance and instruction to workers must be given in advance.

7) Watering during the Planting

Since the project area is very wide, planting work must be carried out even in the dry season. In this case, about 4L of water should be given to each planted seedling to help it survive and for the growth in the early stage. Watering can prevent the soil from washing away and exposing the roots.

8) Mulching and Weeding

The main objective of this work is to protect the planted trees in dry areas from having to compete with weeds for water.

In July after the planting, the ground around the pits is scarified with a spade to remove weeds, and all weeds removed are piled around the trees to prevent drying. Roots of the weeds that are dug out are exposed to the sunshine. This work should be conducted twice a year, between July and September in the year of planting and in July and October in the second year.

This work should be carried out for an area of 30 cm surrounding planted trees. If weeds are growing around the tree that may affect planted trees, they should be also removed. Special attention not to hurt planted trees should be given.

9) Fertilizing

As rainwater infiltrates into the ground in the Dry Zone, the fertility rate decreases because the soil becomes acidic due to leaching bacification. Moreover, the incipient decomposition of fallen leaves on the forest floor becomes inefficient. Supplementing new bases such as Ca, Mg, and K, is necessary for plants. DZGD is supplementing the chemical fertilizer to the planted trees in the rainy season, twice a year, in August and September.

Fertilizer is also necessary for this plan. Fertilizing is conducted after the rain, twice a year, in August and September of the planting year.

Three holes should be dug around each planted tree with a digging bar and filled with fertilizer. The holes should be 5cm deep and 15cm away from the tree. In case of chemical fertilizer, one spoonful is put in each hole. The holes are covered with soil so that the fertilizer does not come out of the holes. At slopes, fertilizing is carried out upslope of the planted trees.

Analyses for the chemical fertilizers that are available at Yangon and Nyaung Oo and the chemical and organic fertilizers obtained at the Nyaung Oo district office of the DZGD are shown below:

Table 2.12 Analysis results of the Chemical Fertilizer

Name of Products	Manufacturing Country	Nitrogen %	Phosphorus %	Potassium (G Kalium) %	Comments
A	Myanmar	6.1	0.04	0.89	Not-recommend
B	Myanmar	6.0	0.06	1.05	Not-recommend
C	China	17.1	4.87	0.20	Not-recommend
D	Thailand	25~15	5~15	5~15	Recommend
E	Germany	12	12	12	Recommend
F	Nepal	17.15	17.56	8.03	Recommend

Note: The analysis for Phosphorus and Potassium was done by X-ray analysis. Products in Myanmar are not recommended however those in Nepal and Thailand are recommended. As results of analysis for the organic fertilizer used by Nyaung Oo office of the DZGD, it is clarified that 30% organic matter, a little phosphorus, potassium and organic carbon are included. Therefore it is recommended to use instead of the cow dung that is not easy to collect.

Above analysis and results are certified by the Japan Fertilizer & Feed Inspection Association

10) Patching (Supplemental Planting)

In the criterion for the planting of the Myanmar Forestry Sector of the National Action Plan for the Prevention of Desertification, it is indicated that the planting with more than 70% survival rate should be deemed as successful. In this project, more than 70% survival rate after

the tending should be approved as completed afforestation and can be handed over to DZGD. Patching work should be executed in July and August, in parallel with planting in June, July and August. If any place that had not been planted is found or if dead seedlings are found during the patrol, patching should be conducted there.

If the survival rate is found to be less than 70% according to survey results in December and May, patching should be conducted to cover the whole areas planted in the previous year, preceding the new planting work in May and June. In patching work, adding soils is not needed, while watering and weeding are done for patching trees.

11) Watering

In the Dry Zone, the necessary volume of water for each planted tree (30cm x 30cm) for survival is at least 3.6 L per month. The necessary volume per ha is 2,520 L. Every day 40~50 tons of water is necessary for the 500 ha planting at the planting time and during the dry season (December to April). To survive through the dry season for the newly planted seedlings, their roots should have extended vigorously before the dry season. For this purpose, watering in May to August is necessary, i.e., twice in June, once in July and once in August, a total of 4 times. Watering is planned for a planted seedling of more than 3.6 L every time. If there is enough rainfall in May to August, watering will be executed in the dry season.

For this watering, it is necessary to establish detailed plan. Water is transported by a water tank vehicle from a water tank constructed in the nursery to the temporarily constructed prefabricated water tank at the sites. Water from prefabricated tank should be pumping up to hand tractors with a loaded drum. At the sites, watering to trees is done by bucket and watering pot.

12) Fencing

The fence with concrete pole and wires should be used to construct the boundary of planting zones in order to prevent trees being trampled or eaten by domestic animals. The height of the fence is about 1m supported by coconut trees so that small goats cannot go inside. Fences are constructed along zones of the protection and the fuel wood forest, roads and cart paths, and the details will be drawn on the map.

13) Fire protection

In the protection forest near Indaing and the fuel wood forest in Letpande, firebreak zones that are 20m wide will be provided.

14) Survival Counting Survey

DZGD records the survival rates through the field survey conducted in December of the

planting year and in May of the following year. The survey is conducted at beginning and end of the dry season. The survival rate survey for this project should be conducted in the same method of DZGD. About 10 to 20% of the total planting areas (zones) should be selected upon completion of the field survey. Assuming the selected area is standard conditions of planting, the average survival rate will be calculated through a survival counting survey for selected areas. The desired shape of the selected area is square or rectangular, and every standard site is recorded and indicated on the map. Then, the survival counting survey is conducted twice at the same places.

In case that the different trends in survival rates are found within the one standard area, that area is divided into few parts for settlement of survival rate counting.

Information of withered and dead trees, species, place (geographical features and soils), conditions and reasons are checked and analysed and result should be used for the next patching work.

15) Divisional Mangement

The afforestation sites in each village should be divided into code numbered zones according to forest type, the year planted, etc. Information concerning the species, number of trees, patching work, fertilizer, etc. should be thoroughly recorded.

2-2-2-2 Planning of Species Selection and Nursery Practice

(1) Characteristics of Trees in the Dry Zone

Trees practiced in the nursery by DZGD, trees recommended by the Forestry Research Institute and the Forestry University, and trees requested by residents are shown in Table 2.13. The organizations concerned with forestry have neither specific seed orchard nor standards manuals of nursery practice about native species. In order to increase the rates of budding and survival as well as growing and effects of the afforestation, characters of the trees are to be grasped, and trees are to be selected according to purpose of the afforestation, such as the protection forest, the fuel wood forest, and the community forest, while manuals (basic plans and manuals) about the nursery practice and the planting are formulated.

The planting tree species will be selected according to DZGD and Forest Research Institute recommendations and consideration the residents' requests. In general, species that have a high growth rate, sprouting strength, a strong root system and are strong against dry weather should be selected.

Table 2.13 Recommended Plants for Afforestation in the Dry-Zone

University Of Forestry	Forestry Research Institute	DZGD (for afforestation)	DZGD (for residents)	Expected by residents	
Acacia catechu	Acacia arabica	Acacia senegal	Acacia spp.	Acacia catechu	Leucaena glauca
Albizzia chinensis	Acacia	Acacia spp.	Albizzia lebbek	Acacia leucophloea	Limonea acidissima
Albizzia lebbek	auriculiformis	Albizzia lebbek	Eucalyptus spp.	Albizzia lebbek	Malvaceae spp.
Areca catechu	Acacia catechu	Azadirachta indica	Leucaena spp.	Annona squamosa	Mangifera indica
Bauhinia acuminata	Albizzia lebbek	Eucalyptus camaldulensis	Prosopis spp.	Azadirachta indica	Mangifera spp.
Cassia auriculata	Albizzia procera	Mango		Bauhinia racemosa	Milletia multiflora
Cassia fistula	Azadirachta indica			Bougainvillea glabra	Milium spp.
Cassia glauca	Leucaena leucocephala	Prosopis juliflora		Buchanania lanzan	Orchidaceae spp.
Cassia siamea	Tamarindus indica	Tamarind		Cassia renigera	Pentacme siamensis
Holoptelea integrifolia	Note: All plants belong to Leguminosae family except Azadirachta indica			Cassia siamea	Psidium guajava
Prosopis juliflora				Chukrasia tabularis	Pterocarpus macrocarpus
Tamarindus indica				Clerodendrom phlomidis	Rhus paniculata
Terminalia chebula				Dipterocarpus tuberculatus	Shorea oblongifolia
				Emblica officinalis	Tamarindus indica
				Ficus spp.	Terminalia Chebula
				Jasminum arborescens	Terminalia oliveri
				Jasminum auriculatum	Vitex pubescens
				Lanea grandis	Ziziphus jujuba
					Xylia dolabriformis

Source: FRI, DZGD

1) Characteristics of tree for each forest category

As the protection forest aims at conservation of soil and land, trees which grow rapidly and have a high survival rate on bare land and will help to rapidly cover the degraded land and land damaged by natural disaster have to be selected for planting.

As for the fuel wood forest that only allows limited access to the forest resources, trees that can also be utilized for food and medical purposes should be selected. It is preferable that the trees have sprouting strength and a high growth rate and are easy to grow by the residents. Residents do not mind if trees have thorns.

As for the community forest, the trees should be the species requested by residents and the seeds should be obtained easily.

2) Selection of Tree Species

Selection Based on Characteristics of Species

A study results conducted on the characteristics, suitability and use of each species are summarized in Table 2.14. The suitability of the tree species was classified based on the forest type: protection forest, fuel wood forest, grazing forest and community forest.

Organizations such as FD, DZGD, and FRI have recommended about 10 trees as the suitable species for the Dry Zone based on the long-term research results. However the number of trees requested by residents is about 40~50 types, and included those species of which seeds are difficult to collect, those species difficult to raise and do not grow naturally. Initially, 14 species (Left-hand column) are selected and that number is narrowed down to 7 for the multi-purpose forest and 5 for the community forest (Right-hand column) based on the difficulty of raising seedlings and obtaining seeds. The evaluation of the appropriateness for planting is shown in Table 2.15.

Table 2.15 Selection of Species

Plants Candidate	Selected Species and Comments
1. <i>Acacia arabica</i>	<for Multipurpose forest>
2. <i>Acacia catechu</i>	1. <i>Acacia catechu</i>
3. <i>Acacia leucophloea</i>	Many trees grow naturally in the Project Area.
4. <i>Albizzia lebbek</i>	2. <i>Albizzia lebbek</i>
5. <i>Azadirachta indica</i>	Very common planting tree in the Project Area.
6. <i>Cassia fistula</i>	3. <i>Azadirachta indica</i>
7. <i>Cassia siamea</i>	Withstand dryness and coppice well.
8. <i>Chukrasia tabularis</i>	4. <i>Eucalyptus camaldulensis</i>
9. <i>Eucalyptus camaldulensis</i>	Have the high growth rate and high ability for sprouting.
10. <i>Ficus spp.</i>	5. <i>Leucaena glauca</i>
11. <i>Leucaena glauca</i>	Have the high growth rate, ability for sprouting and fix nitrogen.
12. <i>Prosopis juliflora</i>	6. <i>Prosopis juliflora</i>
13. <i>Tamarindus indica</i>	Soil improving tree. Aim at rapid greening the Indaing degraded area.
14. <i>Ziziphus jujuba</i>	7. <i>Tamarindus indica</i>
	Grow slowly at the early stages, while withstand dryness very much. Mainly used for fodder and shadow, Very common planting tree in the Project Area.
	<For community forest>
	1. <i>A.catechu</i>
	2. <i>A.lebbek</i>
	3. <i>A.indica</i>
	4. <i>Z.jujuba</i>
	5. <i>C.Tabularis</i>

Trees Species for Protection forest and Fuel wood Forest

Table 2.16 shows the species to be planted and number of trees for each code numbered place of the project site. For selecting the species for planting, the following special considerations are made:

- ◆ As *Acacia catechu* grows naturally in the largest numbers in the project site, it has been selected as the main species to be planted in both the protection forest and the fuel wood forest.
- ◆ *Albizzia lebbek*, having a high sprouting strength and also a function of fixing nitrogen, has been selected for both the protection forest and the fuel wood forest.
- ◆ *Tamarindus indica*, which grows slowly at the early stages and withstands dryness very well, will be planted in the protection forest,.
- ◆ *Azadirachta indica*, which has a high sprouting strength will be planted in the protection forest.
- ◆ *E.camaldulensis* will be planted in some gaps of the *Eucalyptus* plantation area.

- ◆ *Prosopis juliflora* will be planted in the great valley of Indaing, known as the Grand Canyon, aiming at early greening (*P.juliflora* grows naturally in many parts of these cultivated lands).
- ◆ In the fuel wood forest, *Leucaena glauca*, which is considered to be one of the native trees of Myanmar and has a high growth rate, will be planted and will help to supply fuel materials faster.

Table 2.16 Planting Species for Protection and Fuel wood Forest

Village	Code No	Area Ha	Planting Density % Planting Number	Planting Species (upper section : planting rate %) (lower section : planting number)						
				<i>Acacia catechu</i>	<i>Albizia lebbek</i>	<i>Azadirachta indica</i>	<i>E.camaldulensis</i>	<i>Leucaena glauca</i>	<i>Prosopis juliflora</i>	<i>Tamarindus indica</i>
Zio	ZP3	78.8	59.7 36,224	50 18,112	20 7,245	10 3,622				20 7,245
	ZP4	63.7	96.8 47,479	50 23,740	20 9,496		10 4,748			20 9,495
	Sub-total	142.5	83,703	41,852	16,741	3,622	4,748			16,740
	ZF7	57.8	57.1 25,413	40 10,165	30 7,624			30 7,624		
	ZF8	98.5	62.3 47,251	40 18,901	30 14,175		30 14,175			
	ZF9	80.4	64.5 39,931	40 15,973	30 11,979			30 11,979		
	Sub-total	236.7	112,595	45,039	33,778		14,175	19,603		
	Total	379.2	196,298	86,891	50,519	3,622	18,923	19,603		16,740
Leipande	LP2	182.2	66.5 93,296	25 23,324	25 23,324	25 23,324				25 23,324
	LP7	30.2	48.4 11,252	25 2,813	25 2,813	25 2,813				25 2,813
	YP5	65.4	31.9 16,064	50 8,032	20 3,213	20 3,213	10 1,606			
	YP6	26.8	67.7 13,971	50 6,986	30 4,191					20 2,794
	Sub-total	304.6	134,583	41,155	33,541	29,350	1,606			28,931
	LF2	134.8	54.5 56,569	50 28,285	30 16,971			20 11,313		
	LF3	6.8	83.9 4,393	50 2,197	30 1,318			20 878		
	LF4	8.0	54.8 3,376	50 1,688	30 1,013			20 675		
	LF5	27.7	54.8 11,688	50 5,844	30 3,506			20 2,338		
	LF6	141.3	70.6 76,814	50 38,407		30 23,044		20 15,363		
	Sub-total	318.6	152,840	76,421	22,808	23,044		30,567		
	Total	623.2	287,423	117,576	56,349	52,394	1,606	30,567		28,931
	AF10	34.5	87.1 23,138	40 9,254	20 4,628	20 4,628		20 4,628		

Village	Code No	Area Ha	Planting Density % Planting Number	Planting Species (upper section : planting rate %) (lower section : planting number)						
				<i>Acacia catechu</i>	<i>Albizia lebbek</i>	<i>Azadirachta indica</i>	<i>E.camaldulensis</i>	<i>Leucaena glauca</i>	<i>Prosopis juliflora</i>	<i>Tamarindus indica</i>
				Aungtha	AF11 ~ AF17	104.9	51.6 41,659	40 16,663	30 12,498	
	合計	139.4	60.4 64,797							
Nyaunggyi	NF1	28.4	45.2 9,884	40 3,954	30 2,965			30 2,965		
Indaing	IP1	302.2	72.3 168,238	20 33,648	20 33,648	20 33,648			40 67,294	
Grand Total	Pro-F	749.3	391,061	116,999	84,274	66,964	6,354		73,612	42,858
	Fuel-F	723.1	340,116	151,331	76,677	27,672	14,175	70,261		
	Ha	1,472.4	726,640	267,986	160,607	94,292	20,529	70,261	67,294	45,671

Note: P: Protection forest

F: Fuel wood forest

ZP4: *E.camaldulensis* will be planted at the central ridge. ZF8: There exists some Eucalyptus plantation, so *E.camaldulensis* will be planted at the gap parts of the planted area.

LP2&LP7: Belong to the upper reaches of the river, 4 species will be planted at the equal rate.

YP5: There exists some Eucalyptus plantation, so *E.camaldulensis* will be planted at the gap parts of the planted area.

AF10: Although it belongs to one of the Letpande Kwins, the residents of Aungtha use it. It is a bare land.

AF11~AF17: summed up small groups.

IP1: There are many degraded parts in Indaing. *Prosopis juliflora* has been selected for the planting tree at the very degraded part aiming at rapid greening.

Planting trees for Community Forest

Although requested trees are different among villages, as many of them as possible they will be planted.

Table 2.17 shows the planting species and number of trees for each village, excluding species of which seeds are difficult to obtain.

Table 2.17 Planting Species for Community Forest

Village Code No	Area: ha (Nr. of Tree)	Trees requested by Residents	Planting Trees (%) & Number
Myethindwin MC3	14.8 (6,245)	<i>A.catechu</i> 40%, <i>C.tabularis</i> 20%, <i>Z.jujuba</i> , <i>P.siamensis</i> , <i>A.indica</i> , Bamboo, each 10%	<i>Acacia catechu</i> (45): 2,810 <i>Chukrasia tabularis</i> (25): 1,561 <i>Azadirachta indica</i> (15): 937 <i>Ziziphus jujuba</i> (15): 937 Total 6,245
Letpande LC2	13.4 (5,654)	<i>Z.jujuba</i> 50%, <i>A.catechu</i> 30%, <i>P.siamensis</i> , <i>C.tabularis</i> , each 10%	<i>Ziziphus jujuba</i> (50): 2,827 <i>Acacia catechu</i> (30): 1,696 <i>Chukrasia tabularis</i> (20): 1,131 Total 5,654
Wetlu WC4	11.7 (8,721)	<i>A.catechu</i> 50%, <i>Z.jujuba</i> 30%, <i>A.indica</i> , <i>C.tabularis</i> , each 10%	<i>Acacia catechu</i> (50): 4,361 <i>Ziziphus jujuba</i> (30): 2,616 <i>Azadirachta indica</i> (10): 872 <i>Chukrasia tabularis</i> (10): 872 Total 8,721
Nyaunggyi NC1	24,9 (12,367)	<i>A.catechu</i> , <i>A.indica</i> , <i>Z.jujuba</i> , each 20%, <i>C tabularis</i> , <i>A.squamosa</i> , <i>A.lebbek</i> , each 10%, <i>P.siamensis</i> , <i>Diospyros burma-</i> <i>nica</i> , each 5%	<i>Acacia catechu</i> (25): 3,092 <i>Azadirachta indica</i> (25): 3,092 <i>Ziziphus jujuba</i> (25): 3,092 <i>Chukrasia tabularis</i> (15): 1,855 <i>Albizzia lebbek</i> (10): 1,236 Total 12,367
Total	64.8 ha (32,987)		Grand Total 32,987
		(local name)	
		<i>Acacia catechu</i> (Sha)	11,959
		<i>Ziziphus jujuba</i> (Zi)	9,472
		<i>Chukrasia tabularis</i> (Yinma)	5,419
		<i>Azadirachta indica</i> (Tama)	4,901
		<i>Albizzia lebekk</i> (Kokko)	1,236
		Total	32,987 trees

(2) Nursery Practices

The most appropriate schedule for nursery practices in the Dry Zone is shown as follows:

Table 2.18 Work Schedule of Producing Seedlings

Work item	Month																													
	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12		
1 Procurement of seeds				■	■					□																				
2 Collection of dung, soil, river sand			■	■																										
3 Fill pots with soil				■	■			□																						
4 Seeding (Germination tray)										□																				
5 Seeding (Pots)					■	■																								
6 Transplantation											□																			
7 Tending (sunshade, watering, weeding)						■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
8 Stiffening									■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
9 Delivery of seedlings										■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Source: DZGD

Note: White lines show work for *Azadirachta indica*. It is transplanted to larger pots in November.

To produce high quality seedlings, the nursery methods mentioned below need to be followed.

1) Preparation of Soil for Potting

Soils to fill the pots have to be moderately cohesive and permeable since they need to be removed smoothly. Normally, the soils used for pots are made by mixing topsoil taken from nearby forests with river sand, dung, etc. The soils have to be fully packed in the pots by lightly dropping them a few times on the ground.

Soils are made by mountain soil, river sand, and dung, and the ratio is 3:1:2 respectively, which is the same as in the nursery of Nyaung Oo. Soils are available from Mt. Tuyin, which is 5km south from the project site. Dung from the project sites and surrounding villages should be collected and river sand can be obtained from the nearby Irrawaddy River.

2) Transplantation to Pots

Seedlings germinated in the germination trays have to be transplanted to the pots at the right time. Normally, they are transplanted when they have one or two leaves.

Close attention should be paid to the following items:

- ◆ Transplanting should be always executed in a shady place on a calm day.
- ◆ Infant seedlings should be picked up and carried by holding the leaves, and roots of

seedlings have to be kept in water.

- ◆ A hole is made at the centre of the pot by using the transplanting bar (Diameter: about 6.5mm).
- ◆ Deep and shallow transplanting, and air pockets have to be avoided.

In the nursery of Nyaung Oo, transplanting work that is executed together with sowing in the germination tray is normally limited to *Azadirachta indica*. (As *A. indica* is sown in July, it is carried to the planting site the following year. In that case, it needs to be transplanted to larger pots in about November)

3) Shade Management

Normally, seedlings should be kept in the shade 50% of the time at the beginning and thereafter they should be exposed to sunshine as early as possible to strengthen them. Materials such as cloth, grass, leaves of coconut palms, and woven bamboo are often used for shade. The cover should be able to be easily taken on and off.

4) Sprinkling Water

In the plan, nurseries are watered evenly throughout the tending period. The required minimum volume of water (to keep seedlings or planted trees growing) is 60 millimetres a month under the condition of a monthly mean temperature of 25 to 30 (annual precipitation 700 millimetres)

- ◆ Moisture of the pot lines should be maintained (not keeping them wet). It should be properly adjusted depending on how dry the pots are.
- ◆ When sprinkling water on seedlings, be careful not to damage seedlings with the water pressure. Water should be given softly by using watering can, etc.
- ◆ Do not let water stay in the surroundings of the nursery because it could cause pathogenic bacteria.
- ◆ Always check if water has been given evenly to all of seedlings after sprinkling.
- ◆ If germination trays are used, water should be given with either a fine spray or the boxes should be immersed in water so that it can be absorbed from the bottom.
- ◆ When the time of delivering seedlings to the planting sites is nearing, the amount of sprinkled water should be reduced to make the seedlings more wooden.

5) Fertilization

If the quality of soil in the pots has been improved to a fair condition, composting is ordinarily not necessary since seedlings stay in the nursery only for 6 months. However,

composting is sometimes necessary for trees, such as the native species that grow slowly.

Composting may be considered if seedlings are observed to grow yellowish or unusually slow.

Composting is executed in DZGD's Nyaung Oo Nursery because the soil in the pots generally doesn't have enough nutrients. Therefore, composting in this project should be considered. The proper ratio of N, P, and K, are believed to be 5:1:5. It is important that micro quantity elements such as copper, zinc, boron and molybdenum are included in compost. Boron is especially necessary for eucalyptus.

Table 2.19 Nutrients of Animal Excrement

Animal	Nutrients (%)		
	N	P	K
Cow, Ox	2 – 8	0.2 - 1.0	1.0 - 3.0
Fowls and ducks	5 – 8	1.0 - 2.0	0.5 - 1.0
Pigs	3 – 5	0.5 - 1.0	1.0 - 2.0

Resource: FRI

Table 2.20 shows how to mix N,P, and K in the proportion of 5:1:5. The described amounts of three kinds of fertilizers are dissolved in 200 L of water for use. However, fertilizers left on leaves should be washed away by water. Fertilizer should be given early in the morning or in the evening in order to prevent tanning.

Table 2.20 Mixed fertilizer of N, P and K

Fertilizer	(g)	Quantity to Supply
Ammonium sulphate	87	92.5mg/L N
Diammonium sulphate	34	40mg/L P
		36mg/L N
Potassium nitrate	104	200mg/L K
		71.5mg/L N

Resource: FRI

6) Weeding

Weeding is important part of tending work. If weeds are not removed, they struggle with infant seedlings to obtain moisture, nutrients and sunshine, resulting in the occurrence of disease and the generation of vermin. Weeds should be removed immediately. Therefore, a nursery guard man has to check weeds all the time.

7) Preventive Measures against Diseases and Vermin

Diseases and vermin in the nursery can cause great loss. Prevention is the most effective countermeasure. Daily checking is essential and the surroundings of the infant seedlings should be kept clean.

- ◆ A chemical to prevent mold should be sprayed right away if diseases like damping-off are found out.
- ◆ If termites start to breed, first remove their favourite food such as withered grass and woods. In addition, termites tend to get inside the pots from the ground and eat out the roots of the infant seedlings. This should be prevented as best as possible. The best solution is to make an elevated concrete table and put the pots on it although a thick plastic sheet can also be used. In extreme cases, chemical insecticide should be used.

8) Standards of Seedlings

Seedlings with the same growing conditions should be placed together because the competition will be equal among them, which will avoid the smaller seedlings being suppressed by the larger ones.

Seedlings of different sizes should be put in different nursery beds separately. This is because seedlings which grow fast can take more sunshine and moisture and will suppress others growing slowly. Although every seedling grows at a different speed, those that are big enough to be carried to the field should be separated from others of small or medium size.

The DZGD's standard for seedlings to be carried to the field is at least 45 cm height and more than 4 months old. The project shall adopt the same standard.

9) Carrying Seedlings to Plantation Sites

All the time and labour spent on making viable seedlings will be wasted if the seedlings are not carefully transported to the sites.

- ◆ Only healthy seedlings should be carried to the sites while bad ones should be abandoned at the nursery.
- ◆ Seedlings should be fully protected during transportation and they should be transported to the sites by covered vehicle.
- ◆ Enough water should be given to the seedlings before the transportation.
- ◆ In loading seedlings on trucks, they should be carefully handled so as not to damage their leaves, stems, and roots.
- ◆ In packing the seedlings, each of them should be carefully handled so that it does not cover others.
- ◆ At the planting sites, seedlings should be kept in the shade.

- ◆ Only seedlings that are to be planted on that day should be carried to the sites.

When planting work starts, it is very important to carry the seedlings to the sites smoothly in order to speed up planting efficiently. Therefore, a detailed plan for transportation of seedling should be made.

10) Topping of Seedlings

When seedlings grow up to tall (more than two or three times the height of the pot) before planting, the upper part of the stem is often cut off. The ratio of the roots to the stem can be improved and a larger survival rate of the seedlings can be expected.

However, topping is a technique for managing the seedlings during normal growth period. It should not be done to remaining seedlings for the next season. These plants should either be abandoned or replanted into bigger pots.

- ◆ Use sharp garden shears.
- ◆ Sterilized the garden shears beforehand (by bleach, etc.)
- ◆ Cut to a height of less than twofold the height of the pots and leave healthy leaves.
- ◆ Leave a minimum of four leaves.
- ◆ If a second topping is needed, cut off the upper part of the first topping spot.

11) Root Pruning and Transfer of Seedlings

Roots of seedling often grow down through the soil and out of the pots. It not only hurts the seedlings when pulling out of the pot strongly, but also disturbs the smooth workflow. Therefore, roots should be cut by scissor as soon as roots growing outside the pots are found. At the same time, since every seedling is growing differently, small and large seedlings should be kept separately or the pots should be sometimes moved so that the effect of root pruning, and even sunlight and water can be acquired.

12) Hardening

Hardening management is necessary for the seedlings to get the high survival rate in the fields. Treatment mentioned below should be done about 3 weeks before the start of the planting.

- ◆ Composting should be stopped. Shade should not be given. Quantity of sprinkle water should be gradually decreased. Water should not be sprinkled in the morning (It gives them stress against the heat of the daytime).
- ◆ Water should be sprinkled after the seedlings are withered. Next, water should be sprinkled one hour after the seedlings are withered again.

- ◆ Sprinkling water should be made later and later, while waiting for the time that the seedlings are withered every day.

13) Plan for Experimental Forest and Direct Seeding

Since this Project will be executed over several years, the experiment should be carried out by DZGD so that characteristics of main native species can be understood. Results of the test will be utilized in the third year and after. The test is to investigate growth and survival records of each main tree, by changing such conditions as soils, sizes of trenches and pits, quantity of water and borrow soils, and fertilizers. All operation and data shall be fully executed and recorded by DZGD (Operation terms will be over long periods).

1. Plan of Experiments

- 1) Comparison of different conditions of pit size, watering, soil and excavated soil
- 2) Direct sowing
- 3) Analysis of vegetation transition

2. Comparison of Test

a. Test Items

- 1) Soil type (3 types)
- 2) Size of pits and trench (2 types)
- 3) Watering (3 types)
- 4) Excavated soil (2 types)

b. Method of Test

- 1) From the proposed afforestation sites, 3 testing sites of different soils are set up on bare land.
 - Red Brown Eroded Savannah Soil (near Indaing)
 - Red Brown Dark Savannah Soil (near Letpande)
 - Turfy Primitive Soil (near Wetlu)
- 2) Afforested Trees
 - 7 species of trees, which are highly promising for the afforestation in the current investigation stage, are to be tested.

Table 2.21 Experiment Tree Species

Code	Scientific name	Local name	Code	Scientific name	Local name
Ac	<i>Acacia catechu</i>	Sha	Lg	<i>Leucaena glauca</i>	Bawzagaing
Al	<i>Albizia lebbek</i>	Kokko	Ti	<i>Tamarindus indica</i>	Magyi
Ai	<i>Azadirachta indica</i>	Tama	Zj	<i>Ziziphus jujuba</i>	Zi
Ct	<i>Chukrasia tabularis</i>	Yinma			

3) Planting Intervals

3.6 m interval will be adopted in the site.

4) Weeding, mulching and tending

Weeding, mulching and tending will be executed as usual.

c. Types of Experimental Forest

1) Size of Pits

Pit Size (2 types)

- ◆ $0.3 \times 0.3 \times 0.3\text{m}$
- ◆ Use a pit ($0.3 \times 0.3 \times 0.3\text{m}$) excavated in the centre of a trench that is $0.6 \times 0.6 \times 0.3\text{m}$ deep.

2) Test of watering, and excavated soil

3 different volumes of watering and 2 cases of excavated soil will be tested at three sites.

Please refer to the table of the Test Matrix.

Table 2.22 Test Matrix for Experiment Plots

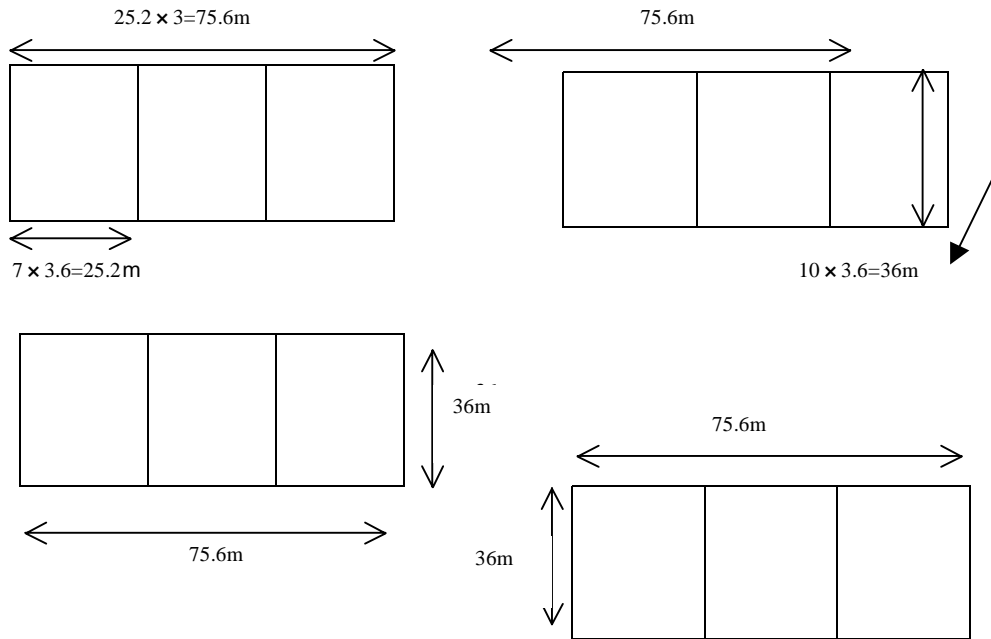
Pit		0.3x0.3x0.3m only						Same pit in trenches 0.3x0.6x0.6					
Excavated Soil		Nil			1 bucket			Nil			1 bucket		
Watering		Nil	1.8L	3.6L	Nil	1.8L	3.6L	Nil	1.8L	3.6L	Nil	1.8L	3.6L
Plot													
Village name	a. species												
	b.												
	⋮												
	f.												

- ◆ Watering is not necessary soon after planting in rainy season. Watering will be required from May to August.
- ◆ Watering of two different volumes (1.8L and 3.6L) should be tested in a month.
- ◆ One bucket of soil should be excavated (about 13.0L) and the mixture ratio of soil to dung should be 4:1.
- ◆ 12 plots will be tested. 10 seedlings for each species should be planted in each plot

(please refer to the table of Matrix).

- ◆ The same species should be planted in one same line.
- ◆ A total of 2,520 seedlings will be required (12 plots x 70 trees x 3 sites)
- ◆ The total required area will be 3.3ha (1plot = $25.2 \times 36=907\text{m}^2$, 907×12 plots x 3sites = 3.3ha)

3) Plot Arrangement



3. Direct Sowing

- ◆ Test site will be established near the Administration office where it can be easily managed.
- ◆ Seeds of which the origin is clear should be used for sowing. The pit dimension is $0.3 \times 0.3 \times 0.3\text{m}$ and excavated soil can be used. Loosen the soil in the pit to facilitate root development. The sowing period is the rainy season in May, and a few seeds are sown into every pit. A second sowing for pits with no budding is done at an early time. Watering should be carried out according to the project's planting procedure but at three times the frequency. The other works are the same as the testing. When the seedlings are of adequate size they should be separated. The germination rate, growth conditions, tending work, etc should be recorded.
- ◆ The trees should be placed 3.6m apart and the mountain soil:dung ratio should be 4:1.
- ◆ DZGD recommends the following tree species:

Acacia catechu

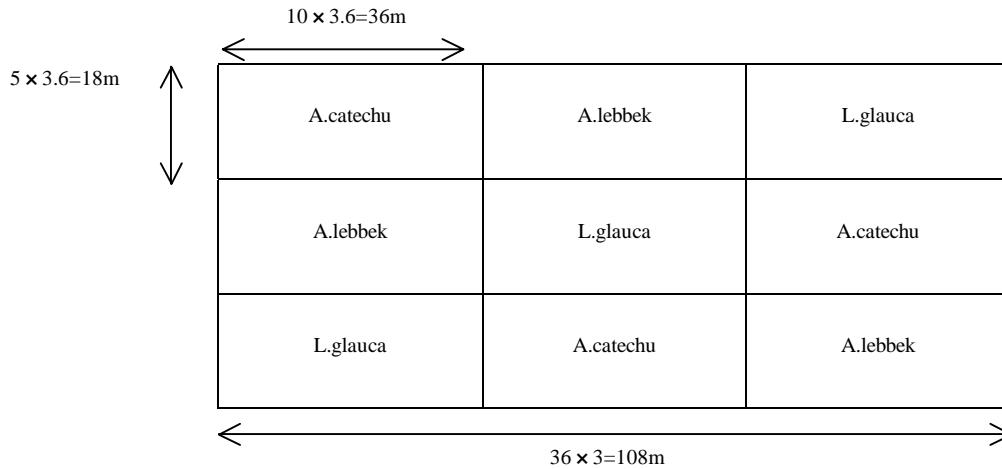
Leucaena glauca

Albizia lebbek

- ◆ Three plots will be established for each species. Each plot will have 50 trees (5 rows x

10 seeds). The plot arrangement is shown below.

Plot Arrangement



- ◆ 150 trees of each species will be planted (5 rows x 10 trees x 3 plots), totaling 450 trees. Therefore, the required sowing area is 0.58 ha (770 trees/ha arranged 3.6m apart, $450/770 = 0.58$).

4. Survey of Vegetation's Transition of the Project Area

As a target division for comparison of growing, the current vegetation is left as it is, and it is surveyed which vegetation is appeared and which trees are grown. 5m x 5m area will be chosen for comparison near the experimental sites. 75m² (5mx5mx3species) is necessary.

5. Others

- ◆ Recording of data (such as; growth, survival, conditions) should be done in detail.
- ◆ Observation of changes of the growing should be made.
- ◆ Experimental sites should be surveyed in detail (terrain and soil and vegetation)
- ◆ Characteristics of the excavated soil should be analysed.
- ◆ A fence should be built to clearly mark and protect the test site.

2-2-2-3 Facility Design

The Administration and Extension Activities office will be constructed to manage afforestation sites and extension activities extended to target villages. Tube wells and water supply facilities will be constructed in Myethindwin and in Letpande where it is possible to obtain groundwater. Main facilities to be constructed will be as follows:

Table 2.23 Facilities Plan

Facilities	Outline	
Administration and Extension Activities Office	Area:	64m ²
	Column/ Floor:	Concrete
	Wall:	laying brick
	Roof:	wooden truss, slate tiles
	Toilet:	World Bank improved type
Workshop	Area:	70m ²
	Columns/ Floor:	Concrete
	Wall:	None
	Roof:	wooden truss, slate tiles
Tube-well and Elevated water tank	Capacity:	20 m ³ (made of concrete)
	Height:	5m

(1) Administration and Extension office

The administration and extension office is necessary to manage afforestation sites and to promote resident participation and understanding of desertification. Administration such as guarding, monitoring, evaluation, follow up and survival survey has to be executed. Participatory services will be expected for 30,000 residents. At present, temporary workers have been engaged in guarding in Myethindwin. An office with 64m² for two permanent officers will be constructed during this project.

(2) Workshop

A workshop in Myethindwin is necessary for not only management, but also meetings with workers and extension activities. Storage is necessary to provide an open space in the workshop. Parking spaces are necessary for the patrolling vehicle, water tank vehicle and other vehicles.

(3) Water Supply Facility**1) Required water volume for nurseries**

In the plan, nurseries are watered evenly throughout the period of nursery practice. The required precipitation for trees is 60 millimetres/cm² per month under the condition of the monthly mean temperature of 25 to 30 °C (annual precipitation 700 mm). A nursery bed of 1 m² (278 seedlings based on 20 seedlings arrangement between 1.2 metres length in a DZGD nursery) needs 60 L / month of water. One nursery bed (14.4 square metres, 456,000 seedlings) needs 864 L / month of water (60L x 14.4 m²). Therefore, 98,500 L per month (= 864 L x 114 nursery beds (about 456,000 seedlings) and 3,283 L per day (= 98,500 L / 30 days) are needed, which is about 3.3 tons of water to maintain 114 nursery beds. However, it is cool at the project site during the dry season. Especially in cold days during December - February

(temperature falls down to around 15°C), water should be sprinkled taking the low temperature into consideration.

New tube wells with a depth of 200 to 250m will be constructed in Myethindwin and Letpande to pump groundwater at the rate 1,000 to 1,500 gallons / hour (75 to 100 L / minute). 1,000 gallons / hour of water can be supplied at Myethindwin. Water of 1,260 tons for planted tree will be necessary for a month. This means 42 tons per day will be needed. So, an elevated concrete water tank with 20 tons capacity is to be constructed at each place as well. Water supply pipelines powered by gravity for nurseries will be constructed. The installation of water tanks (1 to 2 tons) is also planned at necessary places in the nursery.

2) Watering plan for Multi Purpose forest

The watering volume for 100ha (100ha x 500trees x 0.0036m³) is estimated to be about 180m³ per month. In June, 360m³ of water will be needed, as watering will be carried out twice.

6m³ per day will be supplied to planted trees from tube wells (180/30days=6m³). Prefabricated water tanks are also provided for watering in the Multi Purpose forest.

(4) Utilization of the existing pumps

There are two types of pumps being used in and around the project area at present: 1) a diesel engine vertical pump for boreholes and 2) a submersible pump. Pumps are selected based on groundwater levels (static groundwater levels) measured during the borehole excavation. When the groundwater level is about 400 to 500 feet and 700 feet, a submersible pump and a vertical pump are used, respectively. The characteristics of each pump are mentioned in the following table.

Table 2.24 Specifications of the existing pumps

Item \ Pump	Submersible pump	Mono-pump
Well diameter	100 millimetres or more	100 millimetres or more
Yield	Maximum 25 cubic metres/hour (417 L /minute)	150 L /minute or 1,950 gallons/hour
Total head	150 metres	150 metres or 500 feet
Diameter of riser pipe	2 inches	2 and 1/2 inches
Groundwater level	400 - 500 feet	700 feet
Casing diameter	6 inches	6 inches

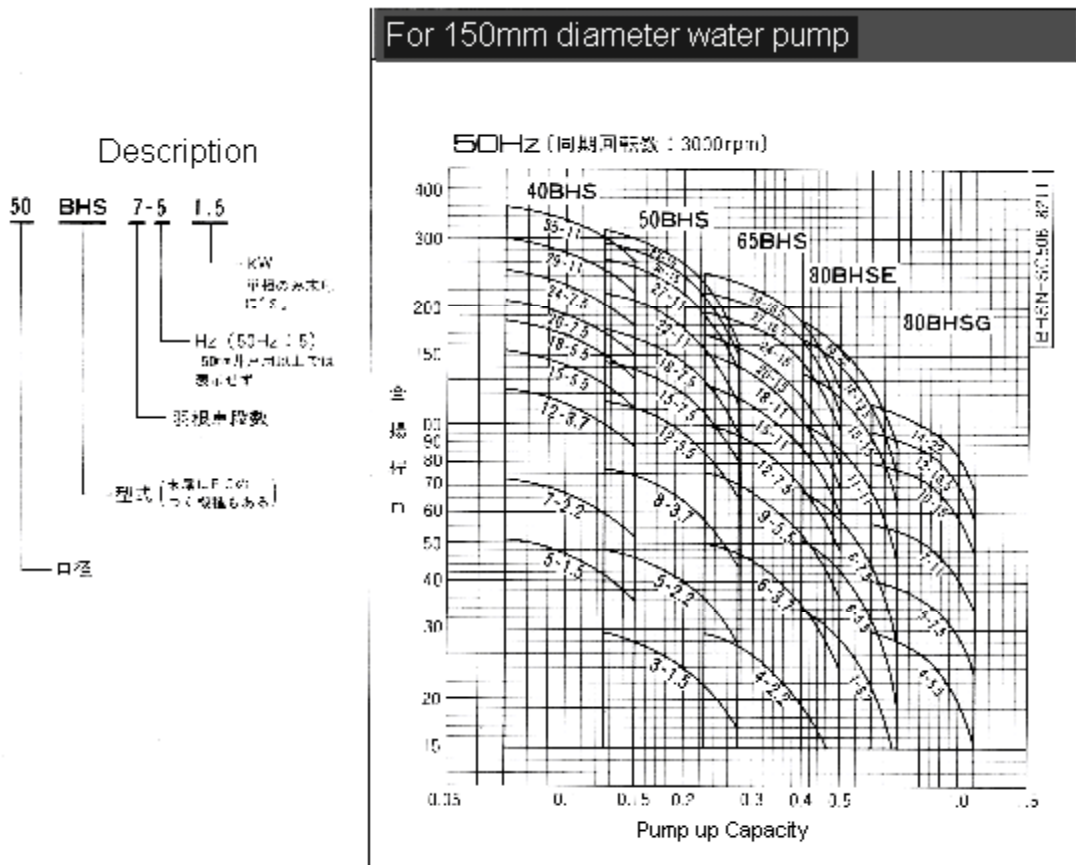
Source: Field Survey in October, 2001

After a borehole of 5 and 5/8 inches in diameter reaches to the bottom, the hole is reamed twice. The reaming diameters are 8 and 1/2 inches and 9 and 7/8 inches. The diameter of the casing that is installed afterwards is usually 6 inches.

1) Comparison and examination of pumps

Generally, submersible pumps are selected after examining a proper yield through pumping tests and the intake depth is decided after taking the dynamic water level and yield into consideration. Since a submersible pump needs always to be immersed in water in order to dissipate the heat, it is set about 5 metres below the dynamic water level. The total head is the total vertical distance from the position of the pump to the reservoir tank on the ground. The diameter, the number of stages and capacity are determined from a selection chart of submersible pumps. As an example, a selection chart of submersible pumps used in Japan is shown below (a well with a diameter of 150 mm (about 6 inches)).

According to this graph, a pump with a diameter of about 40 millimetres does not show any problem to pump 0.1 cubic metres / minute to 300 metres of a total head. However, since the size of a pump is 150 millimetres, well diameter of more than 150 millimetres of well diameter would be needed. The diameter of a riser pipe is 115 millimetres.



As shown above, the capacity of the existing pump does not significantly differ from that of a submersible pump due to a high total head in either case. Even if a during diameter were widened (for example 8 inches), available pumps would be limited because the total head would be over 200 metres. Ultimately, the yield and capacity of the aquifer will be important elements to select the proper pump.

A planted tree needs an average of 3.6 L / pit of water per month. Through electric sounding, two sites in Letpande (#2), Zio (#1) are proposed for new well construction and a site in Myethindwin is proposed for the plan to utilize an existing well. The total yields of the three sites would be about 13.6 tons / hour judging from the existing data (1,000 gallons /hour/site x three sites = 3,000 gallons / hour (13,638 L / hour)). If water is pumped 5 hours per day, about 68 tons could be acquired each day. About 26 days of pumping up and storage would be enough for nursery trees that need 1,764 tons of water each month. 1,000 gallons / hour is equivalent to about 75 L / minute and this amount of water could be acquired by either the existing pump or an submersible pump made in Japan after conducting 6 inches casing excavation (final boring diameter is more than 8 and 1/2 inches). However, pumping tests should be carried out after the excavation to collect the characteristics of the aquifer.

2) Examination of pumping power

A diesel pump and generator (37 KVA) with a starter are advisable as a power source for pumping because a high total head is expected.

Operation of the pump for 8 hours consumes about 4 to 5 gallons of diesel at the existing wells (data from BAJ). The approximate consumption of diesel during four to five months (150 days) is 600 to 750 gallons. 1 gallon of diesel costs 160 Kyats (as of July, 2001), which amounts to 96,000 to 120,000 Kyats (about US\$200. -) for 150 days.

3) Tube wells construction plan and Casing program

The results of the electric sounding show a possibility of tube well development in most of the places except for Letpande-1, Aungtha and Zio-2. Considering the annual planting of 500ha, two sites for tube wells are enough for the well construction.

The depth of the groundwater level was estimated with reference to the resistivity values. The expected excavation depths are estimated considering that the gap between the depth of the existing well and the static groundwater level is about 40 to 80 metres (Table 2.25).

Table 2.25 Plan of excavation depth at each site

Area	Item	Planning depth (m)	Estimated depth of screen
Methindwin		300	175 to 250 m
Letpande-#2		300	125 to 200 m

Source: Electric Sounding in July, 2001

Table 2.24 is just an estimate from results of the electric sounding and the final position of screen will be determined after examining well logging data and borehole chips. The depth to be drilled is also determined after confirming the groundwater level. The distance between each well is more than 1 kilometre and no influence to each other is expected. However, the influence needs to be checked during the pumping test.

2-2-2-4 Temporary Works

(1) Temporary Road Rehabilitation Plan

Although there are many cart paths for ox carriages spreading in all directions in the project area, 4 x 4 vehicles and heavy-duty trucks cannot drive on them. Rehabilitation of the present cart roads in the planting areas is, therefore, necessary to make access possible for vehicles for tube well construction, transportation and watering.

A logical road rehabilitation plan to provide access within a distance of 1.5 km from the existing cart roads and forest sites is shown below.

Table 2.26 Temporary Road Rehabilitation plan

Section	Distance (m)
A. West side of Simply paved road – Myethindwin	5,238
B. Myethindwin – Cross section 1 of Nyaunggyi and Letpande	2,554
C. Cross section 1 – Nyaunggyi	3,188
D. Nyaunggyi – Letpande	3,356
E. Cross section 1 – Letpande	2,177
F. Letpande – Auntha Pump station	4,828
G. Myethindwin – Zio	4,915
H. Zio – Auntha pump station	2,514
I. Zio – Wetlu	4,405
J. Wetlu – North District road	5,561
K. Auntha – Auntha pump station	3,699
Total	43,435

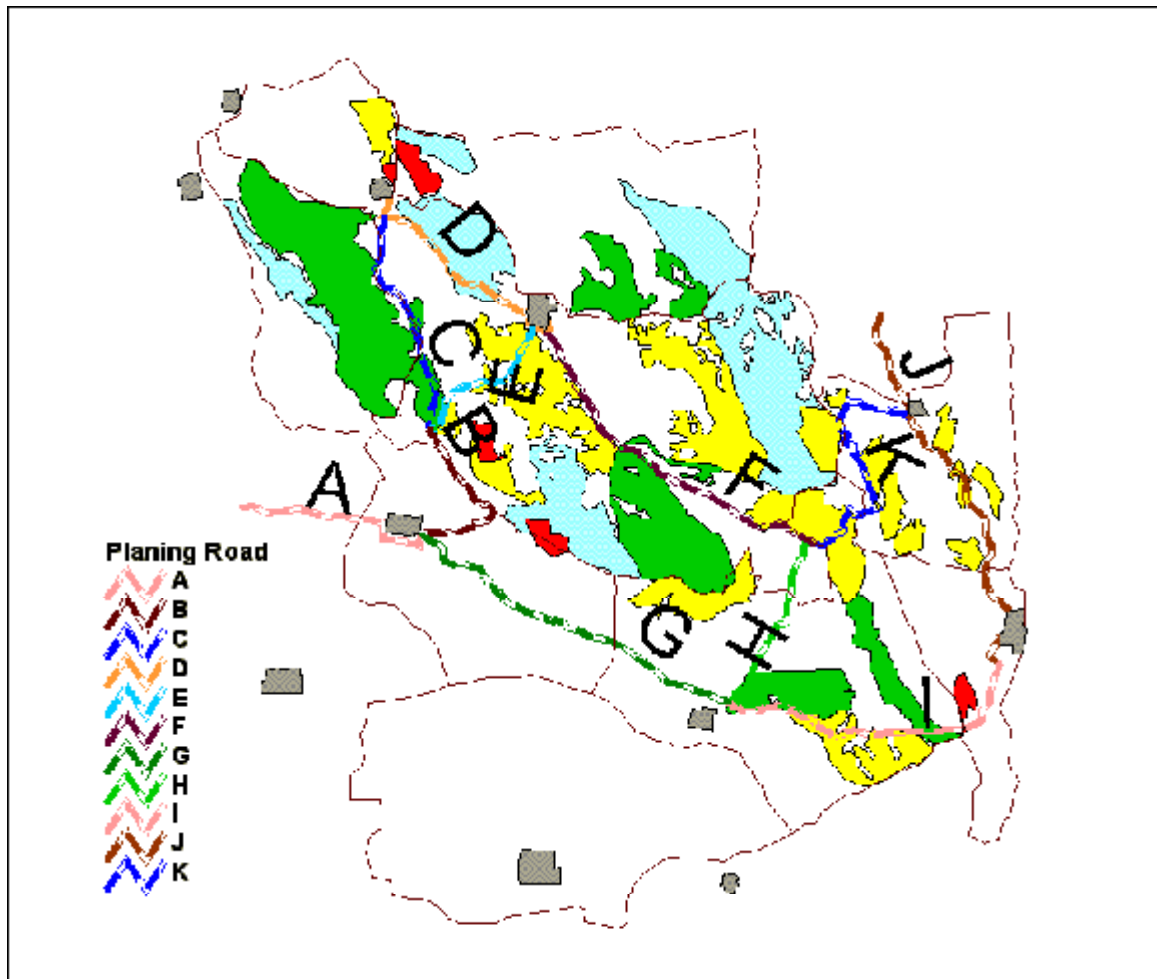


Figure 2.5 Temporary Road Rehabilitation Planning Map

2-2-2-5 Equipment to be procured

The project plans to procure the equipment necessary for the planting, O/M for afforestation sites and annual planting of the silvo-pastoral of 200ha to be established by DZGD. The equipment needed for planting is considered based on 200ha/yr of planting. The following equipment is excluded from the plan because of low requirement.

Table 2.27 Equipment to be excepted from the plan

Equipment	Reason of Exclusion																																																
Crawler tractor	There is no site to require use of the Crawler tractor in planting sites of the silvo-pastoral because of relatively flat area.																																																
Fuel Tank	<p>It is not necessary to procure a fuel tank. The total fuel consumption necessary for equipment operation in the project is estimated as follows:</p> <p style="text-align: center;">Fuel Consumption by Vehicle</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>Power (kW)</th> <th>Consumption ratio (l/kW/hr)</th> <th>Consumption/day</th> <th>Unit</th> <th>Total consumption (L)</th> </tr> </thead> <tbody> <tr> <td>Compressor</td> <td>2.2</td> <td>0.173</td> <td>2.7</td> <td>1</td> <td>2.7</td> </tr> <tr> <td>2wheel tractor</td> <td>10</td> <td>0.054</td> <td>3.8</td> <td>6</td> <td>22.8</td> </tr> <tr> <td>4wheel tractor</td> <td>30</td> <td>0.054</td> <td>11.3</td> <td>3</td> <td>33.9</td> </tr> <tr> <td>Pump</td> <td>5</td> <td>0.329</td> <td>11.5</td> <td>3</td> <td>34.5</td> </tr> <tr> <td>Backhoe</td> <td>40</td> <td>0.188</td> <td>37.6</td> <td>1</td> <td>37.6</td> </tr> <tr> <td>Bulldozer</td> <td>80</td> <td>0.188</td> <td>75.2</td> <td>1</td> <td>75.2</td> </tr> <tr> <td colspan="4" style="text-align: center;">Total</td> <td></td> <td>206.7</td> </tr> </tbody> </table> <p>In case of 7 hours operation, the 206.7L will be needed in total same as one drum can. This consumption volume can be transported by a pickup. The fuel tank is excluded from the procurement plan.</p>		Power (kW)	Consumption ratio (l/kW/hr)	Consumption/day	Unit	Total consumption (L)	Compressor	2.2	0.173	2.7	1	2.7	2wheel tractor	10	0.054	3.8	6	22.8	4wheel tractor	30	0.054	11.3	3	33.9	Pump	5	0.329	11.5	3	34.5	Backhoe	40	0.188	37.6	1	37.6	Bulldozer	80	0.188	75.2	1	75.2	Total					206.7
	Power (kW)	Consumption ratio (l/kW/hr)	Consumption/day	Unit	Total consumption (L)																																												
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Bulldozer	80	0.188	75.2	1	75.2																																												
Total					206.7																																												
Submergible pump and moter	The submergible pump and moter are included in plan of facilities construction. Therefore, this item is excluded from the procurement plan.																																																
Auto video van	4x4 wheel drive vehicle planed to procure can be used for extension activities. In addition, in case of trouble occurance in a part of audio equipment, the Audio van cannot be used for other purposes. The auto video van is inconvinience in economical use.																																																

As the result of justification on the requested equipment, the equipment to be procured shall be as follows.

Table 2.28 List of Equipment and Procurement Plan

No.	Equipment	Mandalay	Nyaung Oo	Myethindwin	Total
		Plan	Plan	Plan	Plan
A. Planting					
A-1	Pocket Compass		2		2
A-2	Pole		5		5
A-3	Measure Tape		2		2
A-4	Potable GPS		1		1
A-5	Shovel			15	15
A-6	Vinyl pot (small)			250,000	250,000
A-7	Vinyl pot (large)			50,000	50,000
A-8	Seedling container			120	120
A-9	Knock-down nursery (400m ²)			1	1
A-10	Overlay net (400m ²)			1	1
A-11	Track 4 ton			3	3
A-12-1	2 Wheel Tractor			4	4
A-12-2	4 Wheel Tractor			2	2
A-13	Pick up			1	1
A-14	Air Compressor			1	1
A-15	Scoop			50	50
A-16	Hoe			30	30
A-17	Back Hoe		1		1
A-18	Bulldozer			1	1
A-19	Water tanker			1	1
A-20	Portable water Tank			7	7
A-21	Knockdown water tank			3	3
A-22	Water pump			5	5
A-23	Watering Pot			40	40
A-24	Water Bucket			20	20
B. Administration and Extension					
B-1	Meteorological observation unit			1	1
B-2	Personal Computer	1	1	1	3
B-3	Printer	1	1	1	3
B-4	Television		1		1
B-5	Video		1		1
B-6	Video Camera		1		1
B-7	Portable Wireless Communication unit		2	2	4
B-8	Facsimile		1		1
B-9	Motor cycle			2	2
B-10	4x4 vehicle		1		1
B-11	Back shooting			30	30
B-12	Firebreak tool			15	15
B-13	Locker			1	1

A. Planting Equipment

1) Survey instrument

A1 Pocket compass, A2 pole, A3 measuring tape, and A4 GPS

A survey instrument is used for positioning of cart paths, facilities and zoning for the silvo-pastoral. Two survey parties will be engaged in surveying and 2 pocket compasses, 5 poles and 2 measuring tapes are required for two survey parties. It is necessary to clear boundary between grazing area and studded cultivated areas. Because grazing area will be limited to use after planting. In order to complete the annual planting area of 200ha, candidate areas of the silvo-pastoral with 6 blocks will be further divided into smaller areas to set up planting zones with participation of residents. The boundary of 20 km will have to be surveyed by dividing the 200 ha into smaller areas (100m/ha and 700 survey points) with consideration of present land use for grazing. In addition, boundary definition between the silvo-pastoral planting area and the access road will be necessary to define the zoning. It takes 3.5 months for one survey team to complete planting zones of 700 points by completing 10 points survey norm. Surveying of the planting zone should be completed before commencement of the pit and trench survey, in order to avoid weeding activities and soil erosion due to raining. At same time, another survey team should be engaged in surveying of cart road, facilities, firebreaks and fences.

As for the master survey, GPS is used for confirmation of positions. The survey instrument shall be used for monitoring, extension activities and guarding.

2) Nursery practice Equipment

210,000 seedlings are required for 200ha. 15% of seedling for planting (31,500) will be Azadirachta India that needs to be transferred from small pot (65mm) to large pot (200mm).

Table.2.29 Number of trees to be planted for the silvo-pastoral

Area (ha)	Number/ha	Planting	Patching (20%)	Patching (30%)	Total
200	700	140,000	28,000	42,000	210,000

A5 Shovel

15 shovels are to be provided. The shovel is used for filling soil into the pot. According to our site survey and nursery practices in tropical forest issued by JIFPRO, the potting norm is 1000 pot/man. 210 workers are needed for 210,000 pots in one day. In addition, as 284 workers are needed to fill the large pots for Azadirachta India (31,500x9/1000man/day), 494 men in total are needed for potting in one day. Potting is carried out from December to January for 40 days and 13 workers are needed to complete its work within 40 days.

A6 Vinyl pot (small)

As per shown Table 2.28, 210,000 pots are needed for annual planting of 200 ha. In order to proceed with planting for the silvo-pastoral after completion of this Grant Aid plan, 250,000 pots have to be provided, in considering 20% allowance for broken pots and no sprouting.

A7 Vinyl pot (large)

40,000 large pots are to be provided for 31,500 Azadirachta India that is necessary to transfer from small pot.

A8 Seedling container box

60 boxes for a truck are needed. 120 container boxes for two trucks planned to use are needed to procure based on procurement plan of 3 units of 4ton trucks. Container box with 40cmx60cm of 20 units is possible to lay flat on 4tons truck with 2mx3m standard carrier space. Accumulating 3 lay comes 60 boxes in total for one time carrying by a truck.

A9 Knock down nursery and A10 Shade net

210,000 seedlings and 31,500 for the silvo-pastoral of 200ha needs 2,000m² temporary nursery. 2,000m² temporary nursery that will be prepared for this plan, can be used for the silvo-pastoral planting. So, 400 m² of the Knock down nursery for 20% allowance of 2000m² is to be provided in consideration of further use of 2000m² nursery.

Table.2.30 Nursery area for the silvo-pastoral

Pot	Size of pot	Number of seedling	Nursery area
Small Pot	65mm x 65mm	210,000	887m ²
Large Pot	200mm x 200mm	31,500	1,260m ²
		Total	2,147m ²

3) Transportation vehicle

Procurement plan for transportation equipment is to be based on actual transportation plan of materials (Table 2.31) needed for planting of the silvo-pastoral. Actual use of transportation equipment for materials carrying is made based on the following volume, norm and computation basis.

Table 2.31 Transportation plan

Transportation material	Volume to be transported	Terms	Norm of transporting	Remark
Excavated soil for dressing work	1,820m ³	3.7 months from February to May	25m ³ /day	
Container box	6,800 boxes	3.5 months from May to August	97 boxes/day	
Watering at planting (1 st)	560m ³	3.5 months from May to August	8m ³ /day	
Watering at tending (2 nd)	1,008m ³	1 month in June	50m ³ /day	Max. volume of watering is applied. Watering in July and August will be half volume.
Computation basis				
Excavated soil	0.013m ³ x 200ha x 700 seedling = 1,820m ³			
Seedling container box	(Small): 178,500 x 54/one container = 3,300 units (Large): 31,500/9/one container = 3,500 units			
Watering at planting	0.004m ³ x 200ha x 700 seedling/ha = 560 m ³			
Watering at tending	0.0036m ³ x 200ha x 700ha x 2times = 1,008m ³			

Table 2.32 Monthly Transportation volume

Material	February	March	April	May	June	July	August
Excavated soil	25m ³	25m ³	25m ³	25m ³			
1 st watering				8m ³	8m ³	8m ³	8m ³
2 nd watering					50m ³	25m ³	25m ³
Watering in total				8m ³	58m ³	33m ³	33m ³
Seedling container box				97 boxes	97	97	97

Combination use of vehicles for transporting materials such as soil, seedling and water to the sites should be considered because truck and water tanker are difficult to drive on the small road in the planting sites. Therefore, means of transportation for materials are classified into three categories due to road conditions as follows;

Table 2.33 Means of transportation

Scale	Means of Transportation
Large scale	Transportation by truck, pickup and water tanker through public road 15km and access road 3km at the sites (Possible transportation distance on public road should be within 15km. For access road at the sites, possible distance should be about 3km)
Medium scale	Transportation by tractor, crawler tractor through access at the sites (max. 3km and average is 1km)
Small scale	Transportation by man power at planting sites (max. 200m. average is 100m)

A11 Truck

3 trucks are planned to procure. As the roads in the project area are 3m wide, trucks of max. loadings of 4 tons (large-scale transportation) should be selected. The trucks are mainly used for transportation of the excavated soil for dressing works from February to May and seedling containers from May to August. Necessary unit of trucks for daily transporting 25m³ of excavated soil and 97 container boxes is shown on Table 3.33. Although 4 units of trucks in total, 3 trucks for excavated soil and 1 truck for container box are required, one truck among 3 for excavated soil can be used for container box transportation in May. 3 trucks are enough for the excavated soil and container box transportation.

Table 2.34 Necessary Unit of Truck

Material	Necessary Unit
Condition	Possible transportation volume/hour= V_t $V_t = 60 \times 1 \text{ truck loading} \times \text{work norm} / 1 \text{ cycle time}$
Excavated soil of 25m ³	2.2m ³ /one 4 tons truck is possible for carrying. Efficiency of transportation is 90%/job One round trip takes 89 minutes
97 boxes of seedling containers	60 boxes for one 4 tons truck are possible to carry. Efficiency of working is 90%/job. One trip takes 31.4 minutes. Therefore, $V_t = 60 \times 0.9 / 31.4 = 103$ containers One truck of 4 tons is enough for transportation of 97 boxes.

A12 Tractor

Tractors are used for medium scale transportation at the sites. Materials transported by tractor will be excavated soil from February to May and container boxes of 97 and water of 8m³/day for planting and water of 58m³/day for tending from May to August as shown Table 2.35.

Two-wheels tractors and four-wheels tractors will be used for the silvo-pastoral planting. The transport capacity per day for the tractor is shown in following Table.

Table 2.35 Transferable volume

	Transferable volume of excavated soil	Transferable volume of water	Transferable volume of container box
Tractor with 2 wheels	3.0m ³	6.7m ³	170 units
Tractor with 4 wheels	5.3m ³	14.1m ³	220 units

The necessary unit of tractors for transportation of materials mentioned in above is shown below. In consideration of daily works and type of transportation materials, the combination use of two types of tractors with 2 wheels and 4 wheels is economic way than one type use, because of variety of daily works. The above two types of tractors are to be procured for this project.

Table 2.36 Necessary Unit

Transferring Materials	Necessary unit for transferring
Excavated soil of 25m ³	2 wheel tractor: $25/3 = 9$ 4 wheel tractor: $25/5.3 = 5$
58m ³ water	2 wheel tractor: $58/6.7 = 13$ 4 wheel tractor: $58/14.1 = 6$ 2 wheel and 4 wheel tractor: $6.7 \times 4 \text{ units and } 14.1 \times 2 \text{ units} = 55 \text{m}^3$
97 containers	2 wheel: $97/170 = 1$ 4 wheel: $97/210 = 1$

A13 Pickup

A pickup used for the small scale transportation for planting tools, small volumes of materials and others during planting and for staff member mobilization will be procured. Medium scale transportation and mobilization of staff members are required for daily works while planting including nursery practice are carried out from November to next September. A pickup is also necessary for patrolling in October and November. The planting terms (10 months x 20 days = 200 days) from November to next September is exceed than the normal operation day of 170 days. Therefore, one unit of the pickup will be necessary to procure.

A14 Compressor

Although access road will be improved within the project, the road condition of the branches will remain bad in some areas. A compressor is necessary for the operation and maintenance of vehicles and machines that will have trouble with sand and dust.

4) Civil work

The civil works necessary for the planting of the silvo-pastoral will be the construction of trenches, pits, access roads and firebreaks and the excavation of soil. The soil volume for

planting work of 200ha is estimated as follows:

Table 2.37 Soil volume

Civil works	Total work	Soil volume
Trench and pit excavation	200ha x 700 x 0.162m ³ /tree	22,680m ³
Pit excavation works	200ha x 700 seedling x 0.013m ³	1,820m ³
Soil collection	40,000m ³ x 0.2m (surface)	8,000m ³
Fire prevention	Taking off surface soil 3,000m x 20m x 0.1m	6,000m ³
Path improvement in planting sites	6,000m x 2m x 0.1m	1,200m ³
Rehabilitation of roads	10,000m x 3m x 0.1m	3,000m ³

A15 Scoop and A16 Pickaxe

The volume of soil excavation for trenches and pits is estimated at about 22,680m³ for annual planting of the silvo-pastoral 200ha. Manpower and machines are used for the excavation of trenches and pits. In order to complete the excavation for 4 months from middle of January to middle of May, about 200 peoples and machine operation for 10% of whole area are expected to use for the excavation. As 50% of manpower will be expected farmers with equipment, equipment at least 50% of 200 manpowers is needed. 50 scoops and 50 pickaxes are to be procured.

Table 2.38 Excavation by Manpower and Machine

	Area (200ha)	Excavation volume	Work day	Reference
Machine	20ha (10%)	2,268m ³	60 days	35m ³ /day for digging 0.2m ³ of Backhoe
Man power	180ha (90%)	20,412m ³	80 days	M/Power: 1.2m ³ /day

A17 Backhoe

A backhoe is used for the excavation of trenches and pits and the backfilling of pits for 10% of 200ha. 60 days of operation for a backhoe is estimated from the above table. In addition, 55 days for the backfilling of pits is needed (2,268m³/41days). Also 52 days are needed for the excavation of pits (1,820m³) at 35m³ per day norm. The total operational days of one unit will be 167 days per year. A backhoe of 0.2m³ class is suitable for the sites to maintain. A backhoe of 0.3m³ class will be planned to procure.

A18 Bulldozer

The bulldozer is used for the excavation of soil and pits, construction of firebreaks and improvement of cart paths. The total volume of soil to be moved is estimated about 18,200m³. The actual operational days are 113 days per year for excavation of 18,200m³. In addition, 50

times operation for rehabilitation of cart path will be expected in a year. Operation day in total will be over 150days. Therefore, a bulldozer of 10 tons is to be procured for this project.

5) Water supply

The watering plan both in planting and tending for the silvo-pastoral will be as follows;

Table 2.39 Monthly Watering Plan

	May	June	July	August	Total
Watering at planting	8m ³	8m ³	8m ³	8m ³	32m ³
Watering at tending		50m ³	25m ²	25m ³	100m ³
Watering in total	8m ³	58m ³	33m ³	33m ³	132m ³

A19 Water tanker

In area of the silvo-pastoral, water supply facility is not available. Water is required to transport by water tanker from the facility constructed. Water tanker of 5000L class will be suitable for small cart path of 3m width. Possible transportation volume by a water tanker is 63m³ per day based on 7 hours operation per day at a norm of 9.0m³ per trip. One trip takes 30 minutes (4.8 x 3km +16). A water tanker of 5,000L calss is needed to carry water from the elevated water tank to the silvo-pastoral sites.

A20 Portable water tank (2,000 L) and A21 Knock down water tank (8,000 L)

Irrigation water will be transported to the planting sites by a water tanker and distributed to afforestation sites by tractor and then watering work will be carried out by manpower. Portable water tanks are necessary to save time in watering work.

The tractors have a loading capacity of 1,000L and the water tanker is 5,000L. Therefore, water tanks (portable and knockdown) of about double volume are suitable for works respectively (2,000L and 8,000L).

The afforestation site is divided into three locations and two sets of 2,000L tanks and one set of 8,000L tank is planned for each location. In addition, one set of 2,000L tank is planned for the nursery.

A22 Pump and A23 Motor

Five sets of pumps and motoers need to be procured: One set for a water tanker, three sets for the 8,000L knock down water tanks and one set for the 2,000L knock down water tank for the nursery. Water pump with motor will be procured. Water pump for 2,000L is unnecessary because of watering by manpower services.

A24 Watering pot and A25 Bucket

Watering pots and buckets are used for planting and tending. In order to supply water to 140,000 seedlings per month, 7,000 seedlings/day should be watered every day. 100 workers are needed for watering for daily norm of 70 seedlings/person. 60 watering pots and buckets will be needed to procure, on assumption that with 40 or more units could be supplied by residents. 5 L watering pots and 20 L buckets are the most common size in Myanmar.

B. Administration and Extension Activities

B1 Meteorological observation unit

It is very important to record meteorological data for analysis to understand and extend the effects. A meteorological observation unit will be planned to install for temperature observation, rainfall and wind direction.

6) Data Management

B2 Personal Computer and B3 Printer

Analysis of recorded data is needed for DZGD to grasp changes and trends of afforestation sites, personal management, operation and maintenance of equipment and others. The data and analysis results should be informed to staff and residents. Monitoring and extension activities to be executed once in a week will use collected data and evaluation results.

The Action plan to be supported by the soft component will be made in details. One set of P/C for management will be installed at Mandalay, Nyaung Oo and Myethindwin respectively. Three sets of P/C will be procured.

B4 Television, B5 Video, B6 Video camera

Extension activities will be carried out once in a week for residents to use television, video, camera and text. Procurement of televisions, videos and cameras are useful for extension activities.

7) Communication equipment

B7 Portable wireless communication unit

At present, there is no communication system in the project site of about 7,000ha. Nyaung Oo office has faced with problems to call for help in case of forest fire, illegal logging and illegal cultivation in afforestation sites.

The communication system is essential to carry out implementation management and security management while planting of silvo pastral is being done. 2 units at both sites of Nyaung Oo office and Myethindwin will be procured.

B8 Facsimile

Fax. is available in Mandalay head office. There is no fax in the Nyaung Oo office, but telephone is installed. Instruction and reporting will be daily works between the head office Mandalay and Nyaung District office while planting is implemented. Communication by fax is best system in order to avoid mistaken communication.

The DZGD Yangon office is not directly concerned with the project (afforestation). Therefore, a fax for Yangon office is to be excluded from procurement plan.

8) Monitoring Equipment

B9 Motorcycle

Two guard men are now stationed in the Myethindwin by DZGD. However, effective monitoring and guarding have not been carried out due to lack of transportation at the project site. This was one of the reasons for the degradation of forest in the project site. DZGD plans two guard men to be stationed continuously for patrolling. Two motorcycles are to be procured in Myethindwin for guarding and patrolling for the project.

B10 4x4 vehicle

4x4 wheel drive car will be used for extension activities and the mobilization of extension activities equipment at the sites. The car will also be used for participating in meetings for three of Steering Committee to be held once per month, staff trips to Mandalay and the mobilization of equipment to Mandalay. The car will be used for 219 days annually, based on 14 days in a month for extension activities, 3 days for participation of meeting and one day for mobilization to Mandalay. Demand on car is quite high. One unit of car will be procured.

9) Fire fighting equipment & accessories

B11 Back-shooting and B12 Portable fire prevention tool

Loss of forest by fire causes a lot of damage to fields and residents. There were no significant fires in the project site. It is feared that afforestation sites will be in danger because of the dry conditions of the sites, especially in the dry season. Fire prevention by daily patrolling is one of the important duties. 100 workers will be necessary for fire fighting in early stage fires. 30 back shoulder type extinguishers and 15 sets of simple tools, such as saws, hoes, sickles, hatchets and scoops, will be procured.

10) Equipment container

B13 Locker

Small equipment to be procured by this Aid should be kept and locked up. One locker is to be installed in Myethindwin.

Table 2.40 Specification of Main Equipment

No.	Equipment	Specification	Unit	Purpose of Use Justification
A9	Knockdown Nursery	Color: Black Net shading: 51% Size: 400m ²	1	Use to put shading net for nurseries. Knockdown style adopted in consideration of mobilization.
A11	Truck	Pay load: 4,000kg class	3	Wide-use to carry soil for seedlings, soil dressing and seedlings.
A12-2	Tractor (4 Wheel)	Output: 30HP class Trailer load: 1,000kg class	2	Use to carry soil, seedlings and water in planting sites.
A14	Pickup	Displacement: 2,700cc class 4 wheel drive Double cabin Engine type: Diesel	1	Use to carry soil and planting equipment and staff (for guarding and monitoring in planting sites). 4 wheel drive and 2,700cc class adopted in consideration of unpaved roads in planting sites.
A19	Back hoe	Engine output: 54HP class Bucket size: 0.2m ³	1	Use for pit diggings and soil dressing works. Small type adopted in consideration of pit size (approx. 0.5m × 0.5m × 1.8m).
A20	Bulldozer	Weight: 12t class Engine Output: 110HP class Ripper type ROPS canopy	1	Use for improvement of roads and paths, and forest firebreak. Small type adopted in consideration of the width (approx. 2m) of roads.
A23	Water Tank Trailer	Tank Capacity: 5,000L class Engine displacement: 6,900cc class	1	Use to carry water in planting sites. 5,000L class adopted in consideration of road condition (approx. 3m in width) and essential volume of water.
B1	Meteorological observation unit	Contents: Wooden shelter, Hygro-thermograph, Wind recorder, Rain gauge, Evaporograph	1	Use to continuous-record weather data in planting sites. Simple type adopted in consideration of maintaining standard in Myanmar.
B10	4 x 4 vehicle	Engine type: Diesel, Engine displacement: 2,700cc class 4 wheel type	1	Use to carry equipment for workshops and staff (for guarding and monitoring in planting areas).

2-2-3 Basic Design Drawing

Please refer to Figure 2.6 and Figure 2.7.

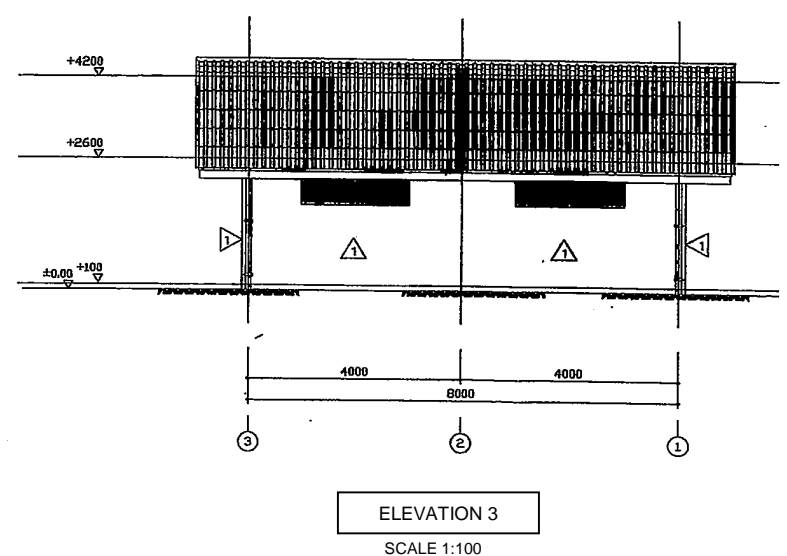
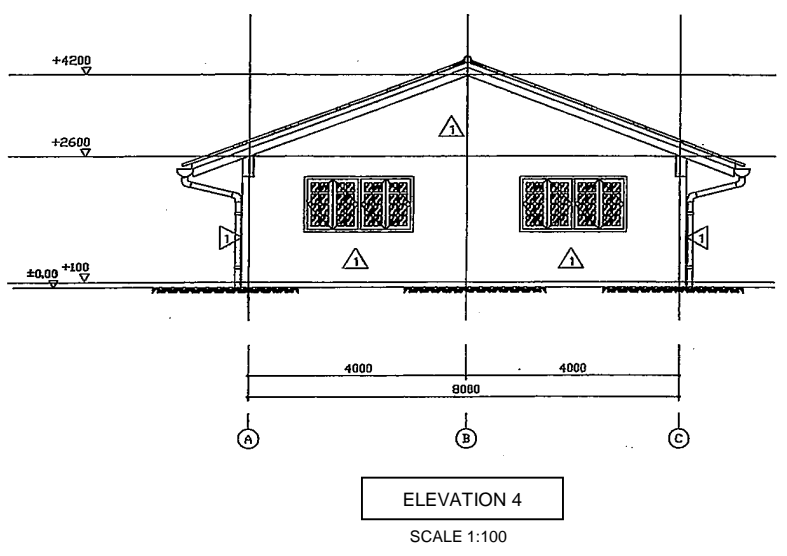
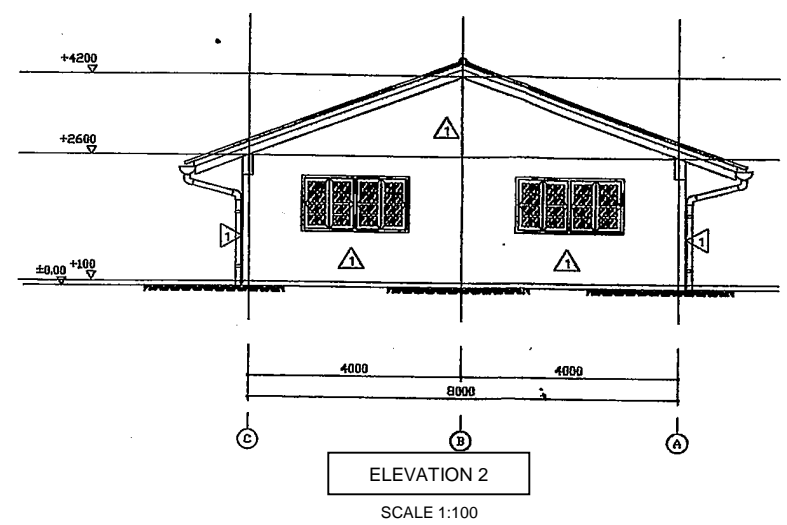
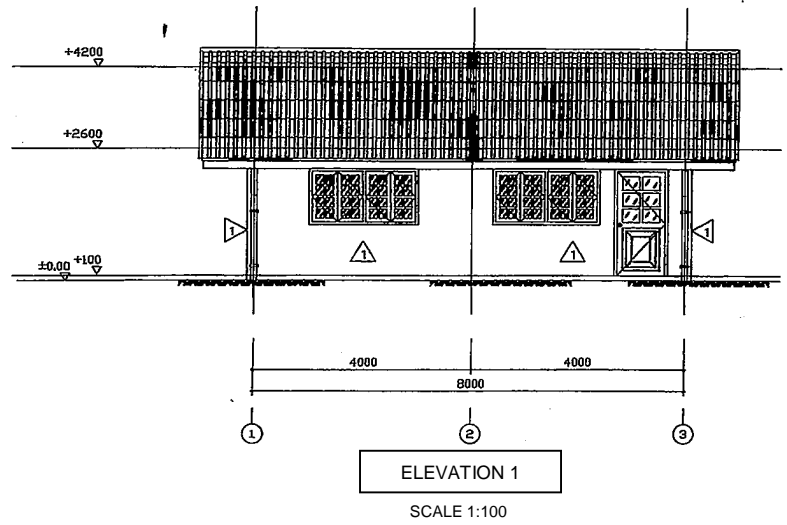


Figure 2.6 Work Shop

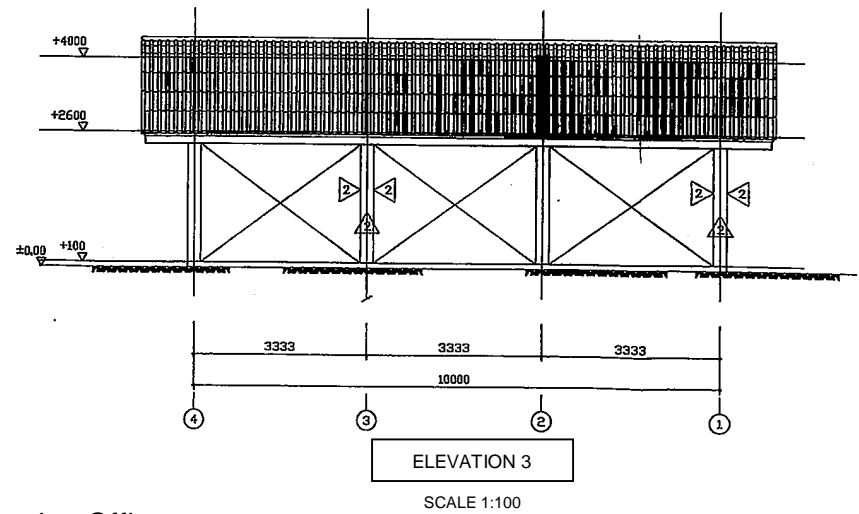
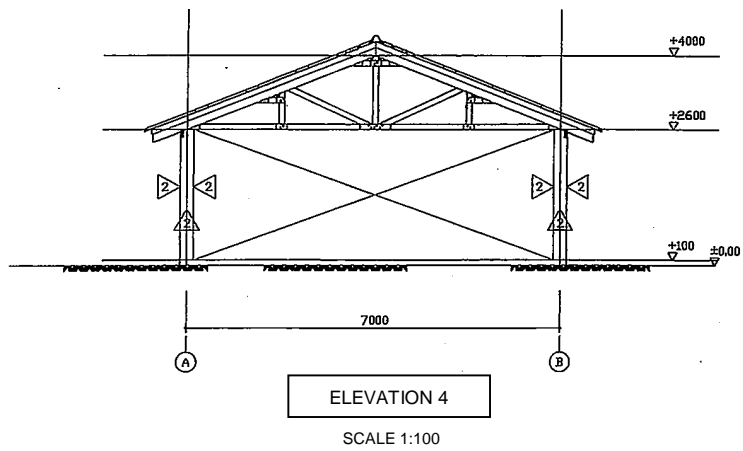
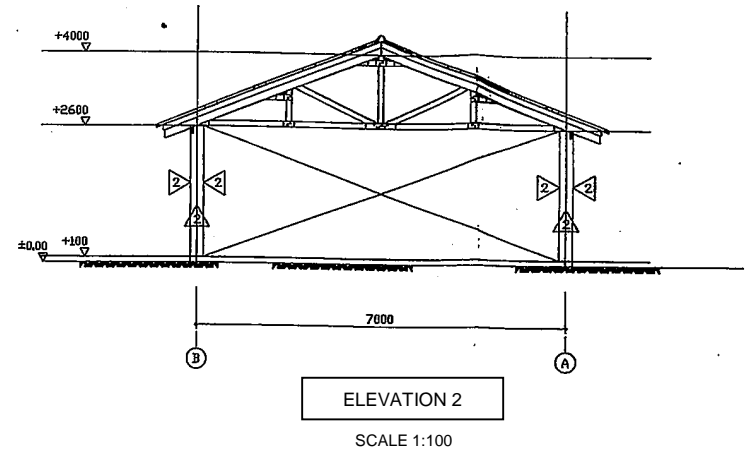
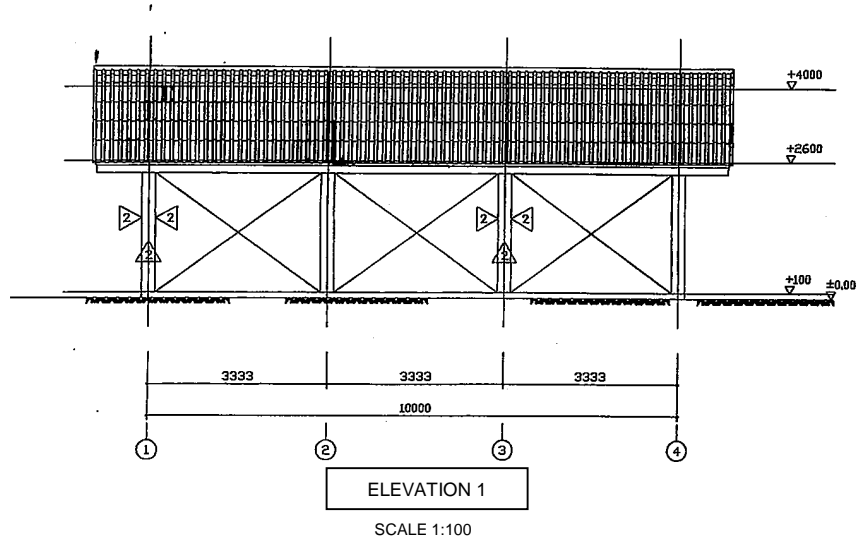


Figure 2.7 Administration Office

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

After signing of the Exchange of Notes (E/N) between the Government of Japan and the Government of Myanmar, the Government of Myanmar shall enter into an agreement with a Japanese consulting firm recommended by JICA for the detail design, provision of documents for tender and contract, and execution of supervision for the project.

Based on the agreement, the Consulting firm shall provide the necessary documents for the detail design, tendering, contract and standard qualification of tenderers on the project. After screening the documents provided and before tendering, pre-qualification for interested tenderers shall be executed in order to judge the reliability of the tenderer's qualification. Qualified tenderers only are able to participate in the tendering. Contractor(s) responsible for planting, construction of facilities and procurement of equipment shall be selected and decided basing on results of tendering in the attendance of a representative of the Government of Myanmar.

The selected contractor(s) shall carry out nursery practice, planting and tending to establish afforestation sites and construct necessary facilities such as temporary nursery facilities, roads and tube-wells and procure necessary equipment under the instruction and supervision of the Consultant.

The supervision of the project, planting work, construction of the facilities and procurement of equipment shall be carried out based on the following policies:

- (1) The project shall be implemented within twelve (12) months from the date of contracting to the work completion date. Planting work, construction of facilities and procurement of equipment shall be executed within the one fiscal year.
- (2) In order to successfully complete various work (afforestation, construction of facilities and procurement of equipment) within the contract term, the contractor to be selected shall be a Japanese firm, having considerable experiences in planting work, construction work and many similar experiences in South-East Asian countries including Myanmar.
- (3) Tenderer of trading firm shall have a registered branch office in Myanmar. Tenderer for planting firm and construction firm shall have a representative or liaison office in Myanmar.
- (4) Prior to commencement of the project, all necessary undertakings by the Government of Myanmar such as acquisition of land lots, removal of existing unnecessary facilities and the clearing of the land lots shall be completed by negotiating with the relevant agencies and people. Any hindrance to the progress of the project shall be eliminated.

- (5) Preparations shall be secured in advance in cooperation with the Government of Myanmar to ensure smooth progress of the project. Necessary procedures shall be fully taken before commencement.
- ◆ visa issuance for long-term stay in Myanmar for Japanese consultant and contractor personnel.
 - ◆ smooth custom clearance for equipment and materials necessary for the project.
 - ◆ working permits for engineers and workers of third countries for the construction work and import and export permits for equipment and materials from a third countries.
 - ◆ Tax and duties exemption for Japanese personnel and imported equipment.
- (6) A project office shall be established in Yangon or Nyaung Oo to ensure close communication with the JICA Myanmar Office and their head office in Japan.
- (7) The Consultant and the Contractor shall station representative personnel responsible for the project in Yangon or Nyaung Oo.
- (8) The construction of the administration and extension offices, the workshops, and the facilities of water supply necessary for planting work will have a priority.
- (9) Stationed supervisor of the Consultant

The construction management and supervision by the Consultant aims at ensuring that all executed work comply with the requirements stipulated in general conditions, special conditions, technical specifications and drawings in the contract.

- ◆ The supervision for planting and construction work shall be carried out from the beginning to completion of the work.
 - ◆ The Consultant shall stationed experts to be able to supervise various work such as: nursery practice, planting, construction of administration office, workshop, nursery, watering facility and rehabilitation of road, and procurement of equipment
 - ◆ The Consultant shall examine potting soil, size of digging pit, watering, excavated soil, planting, tending and tree species and give suggestions and instructions to the Contractor.
 - ◆ The Consultant shall execute various inspections on positioning of all facilities, verification of the concrete work, material testing and check the finishing work at every stage of construction and planting work (preparation, procurement of materials, construction planning, construction, land fill, completion). The Consultant shall give suggestions and instructions to the Contractor.
 - ◆ The Consultant shall submit monthly reports to the representative of the Government of Myanmar and the JICA Office for timely dissemination of the information to them.
-

2-2-4-2 Implementation Conditions

(1) Transportation and Communication

Highway from Nyaung Oo to Chaupadan is paved with asphalt. Road from Nyaung Oo to Nateyork through northern part of the project site is sandy road and not paved. Road in the project site is very hard to drive even with 4x4 wheel drive vehicle and truck because of deep ruts from the ox cart.

Telephone and facsimile for international calling are only available for a few hotels in Nyaung Oo. In Myethindwin, only domestic calling between Nyaung Oo is available.

(2) Electricity

In Nyaung Oo, black out occurred many times. In the project site, independent generation of electric power is available for few villages.

(3) Materials

Materials for construction are available for Mandalay and Yangon. Most of GI pipes and PVC pipes are made in Thai and Australia.

(4) Well Construction

The rig for construction of tube well is available from Irrigation Dept. and Public Development Dept.

Operation and maintenance condition for the rig should be checked before using because they are old machines. Spare parts should be provided before commencement. Rotation of operation in both organizations should be carefully checked.

(5) Excavation Pit

Excavation pit for refilling the pit is near the project site. Useful chemical fertilizer and organic compound imported from the third country is available.

2-2-4-3 Implementation and Procurement Planning

In case this project is implemented under the Grant Aid Program of the Government of Japan, the scope of works and responsibilities shared by both Japan and Myanmar sides will be as shown in the following table.

Table 2.41 Scope of Work

Japanese Side	Myanmar Side
(1) Construction of all facilities necessary for the afforestation work in the project sites <ul style="list-style-type: none"> • Construction of temporary nurseries • Construction of the administration offices necessary for the proper management of afforestation sites • Improvement of access roads (2) Construction of water supply facilities <ul style="list-style-type: none"> • Construction of tube wells • Installation of water pumps • Installation of diesel motors • Elevated and underground water tanks (3) Nursery practice, planting, and tending practice (4) Procurement of equipment necessary for nursery practice and planting such as vehicles, water tankers, and water pumps (5) Off-shore and inland transportation of construction equipment, materials and vehicles (6) Insurance	(1) Acquisition of land lots for the planting, the nursery practice, and the administration facilities (2) Acquisition of approval necessary for the construction and planting work <ol style="list-style-type: none"> 1) Approval of improving temporary roads for transporting necessary equipment and materials to the project site 2) Approval of acquiring a borrow pit(s) 3) Approval of construction and using tube wells (3) Distribution of electricity and water supply utilities up to the project sites (4) Construction of proper access roads from the trunk road to the project sites (5) Exemption from taxation imposed on construction equipment, materials, vehicles, and miscellaneous items required for the project implementation (6) Exemption from taxation imposed on Japanese working for this project (7) Preparation of required budget for the operation and maintenance, stationery, furniture and materials for the effective use of all facilities, equipments and materials to be provided in the project (8) Transactions of necessary procedures for the Bank Arrangement (B/A) and the Authorisation to Pay (A/P) to be required by the Grant Aid Program (9) Workshop for Action Plan Establishment

2-2-4-4 Detail Design Study, Supervision and Soft Component

The work to be executed by the Consultant after signing of the Exchange of Notes (E/N) between the Government of Japan and the Government of Myanmar is divided into two stages. One is for detail design to provide tender and contract documents and the other is for supervision of construction and afforestation work. In the supervision stage, Engineering consultant for construction, forester for plantation and consulting services for the soft component to support DZGD with establishment of sustainable Operation and Maintenance will be dispatched to project sites.

(1) Detailed design stage

During detailed design stage, the consultant services to be rendered shall be as follows:

- ◆ Provision of the afforestation implementation plan indicating planting zones.
- ◆ Provision of contract, conditions of contract, special conditions, technical specifications, and a working plan for establishment of the afforestation sites.
- ◆ Provision of detailed drawings for road rehabilitation plan.
- ◆ Provision of drawings of facilities for nursery and water supply.
- ◆ Provision of contract documents, technical specifications, and tentative schedule for the construction work.
- ◆ Provision of tender documents, specifications, and tentative schedule for procurement of Equipment.
- ◆ Estimation and breakdown of the project prices.
- ◆ Execution of the tender(s).

Field Survey

- ◆ Surveying and investigation of afforestation sites, the construction sites, and verification of land for all facilities for the administration, the nursery, the water supply, and the workshop for the project.
- ◆ Survey and investigation of the locations for water tanks and pipeline to be installed.
- ◆ Survey and investigation of the transporting routes for equipment and materials including loading and unloading ports.
- ◆ Investigation of other unknown items.

(2) Construction Supervision

During the supervision stage, the services to be rendered are as follows:

- ◆ Examination and approval of seeds and seedlings.
- ◆ Approval of the afforestation plan including the afforestation sites and planting trenches and pits.
- ◆ Approvals of excavated soil, fertilisation, supplemental planting and survival survey.
- ◆ Approval of fire protection and fence
- ◆ Examination and approval of construction drawings, equipment and materials.
- ◆ Examination and approval of shop drawings for equipment and materials.
- ◆ Confirmation of shipping of equipment and materials.
- ◆ Confirmation of the progress of undertakings by the Government of Myanmar.
- ◆ Monitoring the construction progress.
- ◆ Supervision of finishing work of each facility.
- ◆ Reporting the construction progress to both Myanmar and Japanese organizations involved in the project.

- ◆ Inspection of the completion.
- ◆ Inspection of equipment and materials procured and confirmation of their delivery to the designated sites.
- ◆ Assistant services such as issuing certificates of payment to the Contractor.

(3) Consulting Experts

The consulting experts required for the above services are as follows:

A. Detailed Design Stage

Expert	Person	Tasks
Chief engineer	1	Overall management
Forester	1	Afforestation and nursery practice plan, planting, zone survey, check list
Facility Engineer	1	Design of the administration building, design of water supply facilities, design of nursery, access roads, and drainage, etc.
Equipment engineers	1	Design of equipment procured
Tender documentation experts	1	Preparation of tender and contract documents
Specification and cost estimate	1	Preparation of specifications and cost estimation
Soft component	1	Action plan

B. Supervision Stage

Expert	Person	Tasks
Chief engineer	1	At fixed times (at the start, the intermediate stage, and the completion.)
Forestry engineer	2	Be stationed permanently.
Facility engineer	2	At fixed times (colour planning, intermediate stage, inspection of the completion), For the construction of the nursery (Be stationed permanently)
Equipment engineer	1	For the delivery of the vehicles and heavy equipment.
Soft component	2	At fixed times (at the commencement of the implementation of the project, intermediate stage, and the completion)

(4) Instruction Program

Following instructions shall be given to residents.

- ◆ Nursery Management
Sowing, nursery practice, management of the nursery beds and operation of watering facilities will be provided.
- ◆ Instruction of Seeding Growing

Following points in accordance with the types of trees will be given.

- seed collection, seed storage and sowing, collection of breeding materials such as clone seedlings (ex. seedlings originated from seeds, clone seedlings such as grafting, cutting, and layering.), collection of cow dung, fertilization, mixture of fertile soils, providing necessary amount of water, germination, carrying seedlings to the plantation site and water tanks

◆ Management of planting work and Tending

Following items will be provided.

- Surveying, excavating trenches and pits, watering, education of fertile soil, weeding, vines cutting, and cleaning cutting, pruning and thinning

◆ Management of the afforestation site

Following items will be given.

- the patrol by residents paying attentions to fire fighting and prevention, stealing trees, reclamation, exterminating noxious insects, and supplementary planting; and the action plan for the effective implementation of the operation and maintenance system

(5) Construction Stage

The construction programme is prepared according to the following construction sequence.

First Stage

- ◆ Temporary office
- ◆ Administration office
- ◆ Workshop and store room
- ◆ Toilet

Second Stage

The construction during the second stage will be mainly for the nursery facilities.

- ◆ Construction of tube wells
- ◆ Construction of water tanks

(6) Afforestation Work

- ◆ Preparation for the afforestation such as purchase of seedlings
- ◆ Excavation of pits for seedlings
- ◆ Backfilling pits with excavated soil
- ◆ Afforestation

- ◆ Tending

(7) Procurement of Equipment

The procurement of the equipment will be commenced by the Contractor after verification and the approval by the Government of Japan. The required periods are planned as follows.

- ◆ 3.0 months: From ordering until the completion of the manufacturing equipment and materials:
- ◆ 2.5 months: For packing them in Japan, sea and land transportation from Japan to Myanmar, the customs clearance and the reception of them in Myanmar, and land transport to the destination in Myanmar.

The delivery place shall be in designated building(s) in the Nyaung Oo District Office.

2-2-4-5 Quality Control Plan

(1) Checking of Planting

- ◆ Check of planting boundary
- ◆ Check of planted trees (species, condition of branches and leaves)
- ◆ Check of soil and borrow pit sites
- ◆ Check of Watering and fertilizer
- ◆ Survival check (checking sites, species and survival trees)

(2) Checking of Facility

1) Administration and Extension Offices

- ◆ Foundation check
- ◆ Shop drawing check
- ◆ Concrete check (Sieve analysis, Los Angeles test, water content test)

The mix ratio will be planned by the result of trial mixing. The slump test, air contents test, moisture test and salinity test will be done for quality control of the concrete.

- ◆ The mil sheet will be used to examine the quality of the reinforcement bar and roofing steel.

2) Construction of Tube well

- ◆ Location check

- ◆ Check of the Rig (Capacity, Operation conditions, Spare parts)
- ◆ Element check: Casing: Material (6" of STM), Unit and Length
Riser pipe: Quality, Units and Length
Strainer manufacturing
Screen Length
Pump capacity and quality
Generator capacity and quality
- ◆ Boring depth check, Cementing check, Hole and platform check
- ◆ Pumping test (over 1000gallon/hour), Water quality
- ◆ Concrete Water basin, check drawing, materials iron and cements, gravel).

(3) Equipment Check

- ◆ Specification Check
- ◆ Factory Check in Japan

2-2-4-6 Soft Component

(1) Background

The problem concerning the afforestation in the Dry Zone implemented by FD and/or DZGD is that the government has been planting trees on unregistered farmland within the protected public forest areas without agreement from users (residents). The residents have spent a long time cultivating the wasteland abandoned by the government into productive farmland. However, the non-registered cultivated lands customarily used by residents were not allowed to use, and were requisitioned without consultation or residents consent. As the result, their antipathy toward the government policy for greening has been interfering with the reforestation sites. Even in the areas of Yomiuri and JIFPRO, activities such as illegal logging, snapping twig and illegal grazing can be seen. Moreover, resident participatory management systems for afforestation sites in Myanmar are very limited and are not common in the FD and DZGD projects.

Land use plan in the Basic Design Study report which reflects residents' opinions obtained through social condition surveys and RRA (conducted twice), has dispelled the residents' ill feeling mentioned above and has raised their awareness of the importance of reforestation and participation in management. Success of the Project depends not only on planting all of the target area but also creating a sustainable management system based on community participation.

In order to achieve this goal, the soft component is essential to establish participatory management system (formulating Action Plan) for DZGD, by transferring the approaching from site selection to land use plan (site selection, surveys of registered and non-registered land, confirmation of Kwin, a community-based land use plan, etc.) to DZGD.

(2) Output (Direct Impact)

The DZGD is responsible for sustainable resident participatory management system to follow patching, fire prevention, tending and survival surveying, by means of periodical patrolling for the afforested areas of 2,000ha including the silvo-pastoral to detect illegal logging, extension of farmland, dead trees, forest fires, etc. at an early stage. Action plan aimed at followings shall be formulated:

- 1) An Action Plan to maintain the fuel wood forest and the protection forest will be formulated and adequately functioned.
- 2) A community forest of 65 ha and an effective management system will be established.
- 3) DZGD staff and residents will be trained in the technical skills required to effectively maintain the fuel wood forest, the protection forest and the community forest.
- 4) The demand for forest resources (fuel wood) will be decreased.

(3) Supporting Plan

Two Japanese consultants will be dispatched; one is to assist in formulating the Action Plan for smooth O&M of afforestation sites, and the other is to assist in establishing the community forest.

Direct impact item 1) mentioned above is concerned with Action Plan assistance. Support to the DZGD will mainly be given to the Nyaung Oo District Offices, which are responsible for O&M of the afforestation sites.

Direct impact items 2)-4) are concerned with tree planting and tending for the community forest and other Multi purpose forest. DZGD staffs and the surrounding villages will be trained and supported.

(4) Plan of Activities

1) Activities Plan of DZGD

- ◆ The DZGD shall hold a meeting to explain to concerned officials and persons (the Ministry of Forestry, all members of DZGD, FD, the village communities) about the

Project until E/N. Moreover, the DZGD shall establish Management Committees and appoint the responsible members at each level as stated below (refer to Chapter 4).

- ◆ A meeting shall be held for all the target villages (7-8 villages) at once to explain about the Project as well as to dispel any feeling of distrust towards the policy, encourage a feeling of community and promote the establishing of a Management Committee.
- ◆ In order to form the Action Plan, a workshop shall be held once in a month for the first year at Nyaung Oo office and understanding by staffs shall be promoted. The responsible member from Mandalay shall participate in the workshop at Nyaung Oo.
- ◆ The workshop in Mandalay shall be held 3 times/year when the Japanese expert for the soft component is assigned to come to Myanmar. The responsible member from Nyaung Oo shall participate in the workshop at Mandalay.
- ◆ DZGD will cover the expenses required the workshops.

2) Japanese Consultants

- ◆ Actual assistance will be for two years. Evaluation of O&M and follow up activities will be conducted in the 3rd-4th years.
- ◆ After E/N, experts (Action Plan assistance and tree planting) will be sent to assist in formulating the Action Plan and establishing the community forests when the Agreement for the Consultant is signed.
- ◆ The expert in charge of the Action Plan will assist in formulating and implementing the Action Plan and in the 3rd-4th years, the evaluation on O&M will be executed. Concerning the workshops, the Japanese consultant will act as coordinator to organize meeting for problem tree establishment, the input, PDM, operation plan. The assignment of the Japanese consultant is 5 man/months/year for the 1st-2nd years in total and 2 man months in total for the 3rd-4th years.
- ◆ The expert in charge of tree planting for the community forest will complete the community forests within two years. However, activities for planting will be depend upon either the counterparts or the local consultants. The assignment of the Japanese consultant for the 1st-2nd years will be 6.5/man months/year and 2 man months/year for the 3rd-4th years for follow up studies.

Table 2.42 Plan of Activities

Period	DZGD's Activities	Consultants Activities
The period from the receiving of the Basic Design Report until E/N	0-1. Meeting to explain the Project to all members of DZGD: preparation of place and materials, and dispatch of technical expert shall be transacted. 0-2. Meeting to explain the Project to the residents: -ditto-	Submission of the Basic Design Study Report (Final)
After the Signing of the Agreement until Implementation of Tree Planting (A period of 1 ~ 2 years)	1-1. Workshop(s) - DZGD Mandalay 3 times/yr - Nyaung 12 times/yr -Annual expenses (15 times/ year) 1-2. Material Preparation Expenses - Project Explanation - Research (CFI) - Extension Activities - Improvements of stove and oven 1-3. Dispatch Expenses - Mandalay staff, 12 times/yr - Nyaung Oo staff, 3 times/yr 1-4. Equipment and Fuel Expenses (Refer to 2-4-2) 1-5. Personnel Expenses of Staff 1-6. Others - Driver fee - Allowances for resident participation (bus, meals, etc.) - Training of staff/resident (Yangon)	Japanese Consultants - Expert (Action Plan assistance) Year 1: 5 mos x 1 yr = 5M/M Year 2: 5 mos x 1 yr = 5M/M Year 3: 2 mos x 1 yr = 2M/M Year 4: 2 mos x 1 yr = 2M/M -Expert (Tree Planting) Year 1: 6.5mos x 1yr= 6.5M/M Year 2: 6.5mos x 1yr=6.5M/M Year 3: 2 mos x 1yr = 2M/M Year 4: 2 mos x 1yr = 2M/M -Local Consultants Initial 1-2 years (Interpreters, agents, assistants) 12mos x 2yrs = 24M/M -Community Forest Planting Expenses Dispatch of local technical expert Purchasing of 45,500 saplings Labour (driver and engineer) Materials and Equipment (Irrigation, Transport of Saplings, Transport to each area, Fertilization, etc.) Vehicle (4 wheel drive)

(5) Selection of Local Consultants

1) Local Consultants (Action Plan Assistance)

Present Conditions: The local consultants available in Yangon have dominant characteristic in merits and demerits. The consultants have FAO experience with community-based management systems but are not in close contact with the Ministry of Forestry (FD and DZGD). On the other hand, FD and DZGD are enthusiastic and there are no problems concerning negotiations but they have little or no experience community-based project management systems.

Selection: Under such circumstances, DZGD's counterparts need to enthusiastically participate in the Project and take leadership in running the workshops to promote Project activities so that the selected local consultants is cooperative and able to work well with DZGD.

Moreover, the local consultants should participate in all the DZGD workshops, not only

when the Japanese consultant is present, and should make detailed reports of progressing. Most important points for the local consultants should be proficient in English and have experiences with forestry and technology transfer and PC skills.

2) Local Consultant (Tree Planting)

Present Conditions: There are about 4-5 consultants (including NGO's) that have experience in forestry.

Selection: The project is to establish 65 ha of the community forest in two years. In the first year, the project has to be implemented with a shortage of facilities and equipment. Therefore, DZGD cooperation is essential. The selected consultants should be able to work well with the DZGD. The local consultants available in Yangon are listed below:

- ◆ SUNTAC TECHNOLOGIES

This company has a wealth of technical experts in such fields as aerial photography, soil and forest surveying, GIS and remote sensing.

- ◆ FREDA

The former Director General and DDG of FD are members of this organization. There are over 200 registered members that can be mobilized for forestry and soil surveying.

- ◆ ECODEV Group

This company has FAO experience. It is a small group to gather experts when necessary. (This group is also registered with FREDA)

(6) Project Design Matrix (Soft Component)

Please refer to the attached sheets for PDM and the work schedule.

Table 2.43 Project Design Matrix (Soft Component)

Name of the project : Project for the Afforestation in the Dry Zone in the Union of Myanmar

Term : 5 years

Target area : Afforestation site for the project

Target group : Staff of DZGD and the people around the project site

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal To afforest the target area (the fuel wood forest, the protection forest, the community forest) and ensure adequate O&M by DZGD of the afforested area upon completion of the project.	Illegal logging in afforested areas ceases.	Records of trees in afforested areas	The Greening Policy in the central Dry Zone is not revised.
Project Purpose To establish an O&M system for the areas forested by the project.	All of the concerned staff and residents understand afforested land management	Records of activities.	There is no change in the basic strategy of afforested land management.
Outputs 1. The formation and functioning an Action Plan for the O&M of the fuel wood and the protection forest. 2. The establishment and effective maintenance of the community forest. 3. The training of DZGD staff and residents in the skills required to effectively maintain the fuel wood forest, the protection forest and the community forest. 4. A reduction in the demand for forest resources.	<ul style="list-style-type: none"> • Greater understanding by DZGD and the residents in the region of the Action Plan • 65 ha of the community forest is established • Skill of staff • Fuel wood demand is cut by 10 % 	Action Plan Area of the community forest Records of logging	The residents in the region cooperate in management of afforested land.
Activities 0-1. <u>DZGD will establish a Central Committee, a District Level Project Management Committee, and an Action Plan Control Committee (After Minutes are recorded, before project implementation)</u> 0-2. <u>Upon receiving the report, DZGD will hold a meeting for the residents to explain the project (After Minutes are recorded, before project implementation)</u> 0-3. <u>DZGD will organize village committees. (Year 1)</u> 1-1. <u>DZGD and the residents will form and effectively implement an Action Plan for the fuel wood forest.</u> 1-1-1. DZGD and the residents will form an Action Plan. (Year 1) 1-1-1-1. Rules will be established for residents' use of fuel wood, based on their opinions obtained through DZGD workshops, and will be incorporated in the Action Plan. 1-1-1-2. The village committees will form a management plan for O&M of fuel wood and incorporate it in the Action Plan. 1-1-2. DZGD and the residents will implement the Action Plan. (From Year 2) 1-1-2-1. DZGD will put rules for fuel wood forest use into effect and conduct monitoring. 1-1-2-2. The village committees will implement the plan and conduct monitoring. 1-2. <u>DZGD will form and effectively implement an Action Plan for the protection forest.</u> 1-2-1. DZGD will form an Action Plan. (The Year 1) 1-2-2. DZGD will implement the Action Plan. (From Year 2) 1-2-2-1. DZGD will make sure residents have and understanding of O&M of the protection forest. 1-2-2-2. DZGD will monitor O&M of the protection forest. 2-1. <u>The User Group (Residents) will form a forest management plan for the community forest and carry out CFI registration. (Year 1)</u> 2-1-1. DZGD will explain to the residents about CFI. 2-1-2. Residents will form a User Group along with selecting an area for the community forest. 2-1-3. The User Groups will form a CFI forest management plan. DZGD will give technical guidance. 2-1-4. The User Groups will make a CFI request. DZGD will give guidance on the required documentation. 2-2. <u>The User Groups will sufficiently manage the community forest. (From Year 2)</u> 2-2-1. The Users will build the community forest. 2-2-2. The User Groups will implement the forest management plan and conduct monitoring. 3-1. <u>DZGD staff will receive training in the Resident Participatory Development Approach (Combined with project type technical cooperation training. (Year 1)</u> 3-1-1. DZGD will form a Resident Participatory Development Approach Manual. 3-1-2. DZGD will introduce the Resident Participatory Development Approach in the workshops. 3-2. <u>Residents will receive technical training in nursery management, tree planting, forest management, etc. (Year 1)</u> 3-2-1. DZGD will make pamphlets for the residents on forest management. 3-2-2. DZGD will instruct residents on methods of nursery management. 3-2-3. DZGD will instruct residents on cultivating saplings 3-2-4. DZGD will instruct residents on tree planting 4-1. <u>Improved stoves will be popularised. (Year 1)</u> 4-2. <u>Residents will be instructed on agroforestry (Year 1)</u>	Inputs Japanese Side [Personnel] Consultant (Participatory Management) :3M/M × 2yrs (Years 1,2) :1M/M × 2yrs (Years 3,4) Consultant (Afforestry) : 6M/M × 2yrs (Years 1,2) [Costs] Japanese consultant/DZGD staff activities Training of DZGD staff/residents Local NGO services [Materials] Materials and equipment for community forest Materials for activities and training Improved stove Saplings for agroforestry [Project Type Technical Cooperation] Training Myanmar Side [Personnel] Central committee, District Level Project Management Committee, Activities Committee, Township Control Committee, and Village Committee members(DZGD and FD staff, etc.) Staff from Nyaung Oo District Offices DZGD will cover the following costs: Meeting to explain the Project Workshops Creation of activities materials Personnel training Personnel Miscellaneous		
			Preconditions: Residents in the region do not oppose afforestation activities

Source: Field Survey in October, 2001

2-2-4-7 Implementation Schedule

(1) Implementation Plan

The Implementation Plan will be formulated after the consultant's agreement is signed and verified by the Government of Japan. Field surveys will be conducted and work will be carried out in Japan based on the Basic Design, and the tendering documents including the Detailed Design and specifications, will be prepared. Discussions will be held with the Myanmar side for approval of the contents. The Implementation Plan is expected to require five months.

(2) Implementation of Construction Work

Six (6) months is necessary for the production of seedlings, ten (10) months for the measurement/excavation of planting pits and planting work and seven (7) months for tending work. However, as the measurement/excavation work will commence simultaneously with seedling production, the total construction period is expected to be 17 months.

(3) Procurement of Equipment

Orders for the equipment will be placed after the contractor's agreement is signed and verified by the Government of Japan. It is expected to require three (3) months for the production of the equipment once the orders have been placed, and two and a half (2.5) months for packaging, shipment by sea and passing through customs and delivery in Myanmar, a total of five and a half (5.5) months. The equipment should be stored at the location they are delivered to.

Table 2.44 Phased Implementation Programme

		1	2	3	4	5	6	7	8	9	10	11	12	
Phase I	Detailed design	■ (Work in Myanmar)		□ (Work in Japan)	■ (Work in Myanmar)									
						■ (Work in Myanmar)		(Total 4 months)						
		[Afforestation]												
		■ (Staking out)					■ (Preparation of seedlings)							
	Afforestation, Construction, Procurement of equipment	■ (Excavation)			■ (Borrow soil)			■ (Planting)						
		[Construction]				■ (Tending)		■						
		■ (Improvement of access roads, Nursery facilities)					■ (Tube wells)							
		[Procurement of equipment]				■ (Preparation)		■ (Transportation)						
		■									(Total 12 months)			
Phase II - IV	Detailed design	■ (Work in Myanmar)		□ (Work in Japan)	■ (Work in Myanmar)									
						■ (Work in Myanmar)		(Total 4 months)						
		[Afforestation]												
		■ (Preparation of seedlings)					■ (Staking out)							
	Afforestation, Construction	■ (Excavation of pits)			■ (Borrow soil)			■ (Planting)						
		[Construction]				■ (Tending)		■						
		■ (Preparation of seedlings for patc					■ (Patching)							
		■ (Improvement of access roads, Nursery facilities)							(Total 12 months)					
Phase V	Detailed Design	■ (Work in Myanmar)		□ (Work in Japan)	■ (Work in Myanmar)									
						■ (Work in Myanmar)		(Total 4 months)						
		[Afforestation]												
Phase V	Afforestation	■ (Preparation of seedlings for patc					■ (Patching)							
													(Total 5 months)	

2-3 Responsibility and Obligations of the Government of Myanmar

2-3-1 Responsibility and Obligations of the Government of Myanmar

The executing agency of the Government of Myanmar for this project shall be the Dry Zone Greening Department (DZGD) under the Ministry of Forestry. The DZGD shall be a coordinating organization to promote the Project. If the Project is implemented as one of the Japanese Grant Aid Programs, it must be carried out in conformity with the budgetary system of the Government of Japan. Therefore, the Ministry of Forestry, Government of Myanmar is requested to conduct the following tasks and to ensure that every task is carried out without delay:

- ◆ Entrance into an Agreement with a Japanese consultant firm based on the E/N.
- ◆ Entrance into a Contract with Japanese contractor firm(s) based on the E/N.
- ◆ Immediate issuance of an Authorization to Pay (A/P) to a registered Japanese foreign exchange bank after the signing of the Agreement and Contract.
- ◆ Payment of charges imposed by the bank in accordance with the Banking Arrangement (B/A) soon after the issuance of the A/P.
- ◆ Opening of a project office necessary for supervisory work and arranging personnel.
- ◆ Issuance of visas to Japanese consultant and contractor staffs for their entry into Myanmar and their stay therein for their work, immediately upon their requests.
- ◆ Acquisition of land lots necessary for construction, and stockyards for construction machines for the contractor.
- ◆ Construction of access roads for mobilization and demobilization of the machines.
- ◆ Construction machines and equipment shall be exempted from taxes and duties imposed by the Government of Myanmar.
- ◆ Prompt unloading and clearance of customs of the machines, equipment and materials imported from Japan and/or a third country, and payment of duties, internal taxes and other fiscal levies imposed in Myanmar.
- ◆ Upon request by the consultant, inspections of afforestation, constructed facilities and equipment delivered at each stage shall be conducted by the executing agency of the Government of Myanmar.
- ◆ Prompt issuance of certificates for completion of work required at every stage.
- ◆ Training, guidance, educational activities, and support about the nursery practice

Representative official by the Government of Myanmar shall be authorised to conduct execution of tendering, signature for entrance into Consultant Agreement and Contract with

Contractor(s), Payment of foreign currency for issuing B/A and A/P.

2-3-2 Cost to be covered by the Myanmar side

Currency: Ks

Item	Unit Cost	Plan	Cost	Conversion to yen: 700Ks=¥120
Workshop Activities	350,000/ time	15 times/ year × 2 years	10,500,000	¥1,800,000
Material Preparation	70,000/ time	15 times/ year × 2 years	2,100,000	¥ 360,000
Dispatch	35,000/ time	15 times/ year × 2 years	1,050,000	¥ 180,000
Personnel	70,000/ time	12 months × 4 years	3,360,000	¥ 576,000
Other	210,000/ time	12 months × 4 years	10,080,000	¥1,728,000
Total cost			27,090,000	¥4,644,000

Source: Data based on information obtained from DZGD

2-3-3 Estimation Conditions

Time of Estimation	January 2002
Exchange rate	1US\$=123.97 yen
Implementation Period	The project will be implemented in 5 Phases. The Detailed Design and construction periods are summarized in Table 2.44.

2-4 Project Operation Plan

2-4-1 Steering Committee for Operation and Maintenance (O/M)

DZGD shall establish the Steering Committee for operation and maintenance for the project in central and provincial level respectively. The Steering Committee shall be established soon after completion of the basic design study (acceptance of the Draft final report).

Nyaung Oo District office shall establish the Steering Committee under leadership by Assistant Director. Nyaung Oo Steering Committee shall initiate direct meeting with leaders of villages to promote and establish villages level Steering Committee. Nyaung Oo district Steering Committee will be assisted by Japanese side under the soft component, a target section to build the Action Plan for effective management and to conduct monthly meeting for exchanging information, training, instruction, establishment of rule and regulation for Multi purpose forest (the follow up, monitoring and evaluation based on the Action Plan will be also carried out). Nyaung Oo district Steering Committee shall regularly report the results of follow up, monitoring and evaluation to Mandalay DZGD.

◆ Central Steering Committee

- | | |
|---------------------------------|-----------------|
| 1. Director General of DZGD | Chairman |
| 2. Diputy Director General | Vice Chairman |
| 3. Director (Admin) | Member |
| 4. Director (Engineer) | Member |
| 5. Director (Planning) | Secretary |
| 6. Director (Mandalay Division) | Joint Secretary |

◆ District Level Project Management Committee

- | | |
|--|-----------|
| 1. Assistant Director (Nyaung Oo District) | Chairman |
| 2. Assistant Director (Mandalay Division) | Member |
| 3. Staff Officer (Project) | Member |
| 4. Staff Officer (Township) | Secretary |

◆ Township Level Supervision Committee

- | | |
|----------------------------|-----------|
| 1. Staff Officer (Project) | Chairman |
| 2. Range Officer | Member |
| 3. Range Officer | Member |
| 4. Range Officer | Secretary |

◆ Village Level Operation and Maintenance Committee

- | | |
|-------------------------|----------|
| 1. Range Officer (DZGD) | Chairman |
|-------------------------|----------|

2. Village Representatives (1 from each village) 7 members
3. Range Officer (FD) Secretary

2-4-2 Member to be assigned

Staff members for O/M for the project in Nyaung Oo district office to be assigned will be as follows:

Table 2.45 Members to be Assigned

Duty	Function	Member
Chairman	Responsible for all management	1 Assistant Director
Administration and Accounting (Nyaung Oo)	<ul style="list-style-type: none"> - Facilities O/M - Equipment O/M - Seedling - Vehicle and fuel - Water supply and Electricity - Budget and fund - Others 	1 member
Planting and Extension activities (Myethindwin)	<ul style="list-style-type: none"> - Management for afforestation sites - Monitoring - Seedling practice and management - Silvo-pastoral and CFI management - Experiment forest - Mother tree and seed management - Meeting with chief residents - Exhibition and Plantation fare - Others- 	1 member
Training, Monitoring and Evaluation activities (Nyaung Oo)	<ul style="list-style-type: none"> - Management of Action Plan - Training program - Extension, Instruction and Education - P/R and text book plan - Monitoring and Evaluation 	1 member
Afforestation sites Guard and Forest watching (Myethindwin)	<ul style="list-style-type: none"> - Reconnaissance fields - Tube-well management - Office cleansing and management - Nursery practice - Take caring of tool and equipment 	3 members

2-4-3 O/M Cost

2-4-3-1 O/M Cost

(1) Summary of O/M Costs

Budget of Nyaung Oo office was 9,140 mil Ks for current budget and 8,643 mil Ks for capital budget and 17,783 Mil Ks total for 2000-2001. O/M charges for the project will be estimated about 13,417,000 Ks /year(2,300,000yen) consisting of mainly tube wells and vehicle operation. It will be 75% of the annual budget and not so heavy a burden. Budget for O/M for the project should be considered in addition to annual budget.

(2) Annual O/M Cost

O/M budget necessary for patrolling, nursery practice and supplemental planting, and extension activities should be considered to allocate for a long time span. Computation for O/M charges mentioned in table is based on mainly depreciation cost for machines, vehicles and pump for tube well, including repairs and fuel. Management, training, extension activities, business trip, transportation fee, materials are added in. Machines depreciation estimates are based on operation of the silvo-pastoral of 200ha/year.

Water supply from tube-well constructed under the project will be charged to users the same as others. 40.Ks /barrel is recommended fee to collect. Cost per litter for estimate of fuel consumption mentioned in table is used for official unit price.

Actual exchange rate in the commercial market up to October 2001 is used for computation for references.

Table 2.46 Annual Necessary Fee (Budget) for Operation and Maintenance for Afforestation

Rate: ¥120 = US\$1 = Ks700

Item	Explanation	Annual O/M Fee (¥)
1. Water Supply Facility		
(1) Pump and Motor	Lease (Repayment) for Two places	187,270
(2) Fuel	Diesel	123,760
Sub total		<u>311,030</u>
2. Heavy Machine		
(1) Back hoe	One unit	172,610
(2) Bulldozer	One unit	246,830
Sub total		419,440
2. Fuel		
(1) For Back Hoe	Annual fuel charge for heavy machines= 14,400(Ks)	85,680
(2) For Bulldozer	$14,400 \times 35(\text{Ks/L}) \times 0.17 =$ 85,680(¥)	
Sub total		85,680
Total		<u>505,120</u>
3. Vehicles		
1. Annual Repayment		
(1) 4tTruck		352,110
(2)Tractor		233,020
(3) Pickup		90,620
(4) Water bozer (4t)		155,350
(5) Auto bicycle		25,380
(6) 4x4 Wagon type		144,990
Sub total		1,001,470
2. Fuel		
(1) 4tTruck	$1,190(\text{L}) \times 35(\text{Ks/L}) \times 0.17 =$ 7,081(¥)	7,090
(2) Tractor	$(560(\text{L})+200(\text{L})) \times 35(\text{ks/L}) \times 0.17 =$ 4,522(¥)	4,530
(3) Pick up	$1,100(\text{L}) \times 35(\text{Ks/L}) \times 0.17 =$ 6,545(¥)	6,550
(4) Water Bozer (4t)	$580(\text{L}) \times 35(\text{Ks/L}) \times 0.17 =$ 3,451(¥)	3,460
(5) Auto bicycle	$200(\text{L}) \times 35(\text{Ks/L}) \times 0.17 =$ 1,190(¥)	1,190
(6) 4x4 wagon type	$1,020(\text{L}) \times 35(\text{Ks/L}) \times 0.17 =$ 6,069(¥)	6,070
Sub total		28,890
Total		<u>1,030,360</u>
4. Administration		
• Building Maintenance	Administration and Extension Office in Myethindwin and Workshop 1,000(Ks/yr)	
• Miscellaneous (Fertilizer, seed, etc.)	$6.5(\text{Ks}) \times 140,000(\text{trees}) =$ 910,000(Ks)	
	$10(\text{Ks}) \times 140,000(\text{trees}) =$ 1,400,000(Ks)	
	Total Annual 2,311,000(Ks)	
	$2,311,000(\text{Ks}) \times 0.17 =$ 392,870(¥)	<u>392,870</u>
5. Business Trip for Meeting	$12(\text{trips/yr}) \times 2,000(\text{Ks}) =$ 24,000(Ks)	
	$24,000(\text{Ks}) \times 0.17 =$ 4,080(¥)	<u>4,080</u>
6. Seminar for extension	$3 \times 50 \times 2,000(\text{Ks}) =$ 300,000(Ks)	
	$300,000(\text{Ks}) \times 0.17 =$ 51,000(¥)	<u>51,000</u>
7. Guard (for Office)	$1(\text{人}) \times 600(\text{Ks}) \times 12(\text{month}) =$ 7,200(Ks)	
	$7,200(\text{Ks}) \times 0.17 =$ 1,224(¥)	<u>1,224</u>
8. Labour (nursery and others)	$4(\text{人}) \times 600(\text{Ks}) \times 12(\text{month}) =$ 28,800(Ks)	
	$28,800(\text{Ks}) \times 0.17 =$ 4,896(¥)	<u>4,896</u>
Total (4+5+6+7+8)		<u>454,070</u>
Grand Total		<u><u>2,300,580</u></u>

(3) Depreciation Cost of Equipment**Repayment for Water Supply Facility**

Tube wells with depth of 200m and elevated water tank will be constructed in Myethindwin and Letpande. Pumping water volume is expected about 4,546L/hr

(1,000gallon). As for watering to trees and seedling, pumping for 4hours in a day is necessary to be operated. $4,546 \times 4 \text{ hr} = 18,184\text{L}$

Annual operation with 20 days for 4 months (80days) comes $\text{¥}12,693/\text{day} \times 80\text{days} = \text{¥}1,008,540$.

Annual fuel consumption is $6.5\text{L}/\text{hr} \times 4\text{hr} \times 20\text{days} \times 4\text{months} = 20,800\text{L}/\text{yr}$. $35\text{Ks}/\text{L}(160\text{Ks}/\text{Gallon})$, $20,800\text{L}/\text{yr} \times 35\text{Ks} = \text{Ks } 728,000$, from rate $\text{Ks}1=\text{¥}0.17$, $\text{Ks}728,000 \times 0.17=\text{¥}123,760$

Repayment= $[(1/2 \times \text{Repayment rate } (1-0.1) + \text{repairing rate } 1.2)/\text{operation years of } 15] \times 1/\text{annual operation days } 100 = 0.0036$

Computation basis is 15 years for pump repayment. Price of pump is as of June 2001. Repairing rate is 1.2% of annual repayment of pump.

Table 2.47 Repayment (including O/M) of Water Supply Facility

Item	Price (¥/unit)	Repayment (¥/year)	Repayment (¥/year)	
			Repayment (Repayment + repair) x unit x Annual operation days/365 (day)	Total
Pump with motor for 200m x 5units	2,411,000	2,169,900/15 =144,660	$(144,660+7,233) \times 90(\text{day}) \times 5(\text{units})/365(\text{day}) = 187,265$	187,270
Sub total				187,270

(4) Heavy Machine

Computation for the repayment is based on as follows; Repayment term for the heavy machine is 15 year with remainder price of 10%. Repairing fee is 5% of repayment and price is shown in table. Annual operation day is 100days without insurance.

Table 2.48 Repayment Computation (including repairing fee)

Item	Price (¥/unit)	Repayment (¥/yr)	Repayment(¥/yr)	
			Repayment (Repayment + Repair) x unit x Annual operation day/365 (day)	Total
Back hoe x 1unit	10,000,000	$9,000,000/15 = 600,000$	$(600,000+30,000) \times 100(\text{day}) \times 1(\text{unit})/365(\text{day})=172,603$	172,610
Bulldozer x 1unit	13,000,000	$11,700,000/15 = 780,000$	$(780,000+39,000) \times 110(\text{day}) \times 1(\text{unit})/365(\text{day})=246,822$	246,830
Total (¥)				419,440

(5) Repayment for Vehicle

Repayment term is 15years, remaining remainder of 10% price. Repair fee is 5% of repayment. Price of vehicle is shown on following table except insurance.

Table 2.49 Repayment of Vehicle (including repairs fee)

Item	Price (¥/unit)	Repayment (¥/yr)	Repayment (¥/yr)	
			Repayment (Repayment + repairs) x unit x annual operation day/365(day)	Total
Track 4ton x 3units	4,000,000	$3,600,000/15=240,000$	$(240,000+12,000) \times 170(\text{day}) \times 3(\text{unit})/365(\text{day})=352,110$	352,110
Tractor x 6units 2 wheel hand tractor x 4units 4 wheel hand tractor x 2units	2,500,000	$2,250,000/15=150,000$	$(150,000+7,500) \times 90(\text{day}) \times 6(\text{unit})/365(\text{day})=233,014$	233,020
Pick up x 1unit	2,500,000	$2,250,000/15=150,000$	$(150,000+7,500) \times 210(\text{day}) \times 1(\text{unit})/365(\text{day})=90,616$	90,620
Water bowzer (4t) x 1unit	6,000,000	$5,400,000/15=360,000$	$(360,000+18,000) \times 150(\text{day}) \times 1(\text{unit})/365(\text{day})=155,342$	155,350
Auto bicycle x 2units	350,000	$315,000/15=21,000$	$(21,000+1,050) \times 210(\text{day}) \times 2(\text{unit})/365(\text{day})=25,373$	25,380
4x4 wagon type x 1unit	4,000,000	$3,600,000/15=240,000$	$(240,000+12,000) \times 210(\text{day}) \times 1(\text{unit})/365(\text{day})=144,986$	144,990
Total (¥)				1,001,470

(6) Operation hours and fuel consumption

Item	Condition	Computation
4t track	<ul style="list-style-type: none"> Annual transporting capacity for excavated soil is 1,820(m³)(refer to table) Annual transporting capacity for seedling container is 6,800(units) (refer to table) Borrow soil of 2.2(m³) for 4t track (refer to table) Container of 60 units for 4t track Excavated soil of 9.38(m³)/day (refer to table) Transporting distance for a day (15(km)+3(km)) x 2 =36(km) Diesel consumption for 4 ton track is 5(km/L)) 	<ul style="list-style-type: none"> Excavated soil per a track =1,820/3= 610(m³) Operation day for a track =610/9.38=66(day/unit) Annual transportation distance= 66 x 30 x 7(month) x 20(day/month)= 1,980(km) Total distance for 3units for year = 1,980 x 3=5,940(km) Total consumption for 3 units per year =5,940(km)/5(km/L) =1,188(L) <p>Annual fuel consumption: <u>1,190L</u></p>
Tractor a) 2 wheel b) 4 wheel	<ul style="list-style-type: none"> Necessary unit per a month (refer to table) a) Borrow soil: 2 wheel of 9units and 4 wheel of 5units for carrying borrow soil of 25 m³ b) Water: 2 wheel of 13units and 4 wheel of 6units c) Seedling container: 2 wheel of 1unit and 4 wheel of 1 unit Transportation distance for a month (2 and 4 wheel) (3(km)+1(km)) x 2 x 20(day/month) = 160(km/month) Annual operation day(refer to table) <ul style="list-style-type: none"> a) Borrow soil:4 month x 20day=80 days b) Watering:3 months x 20days=60 days c) Seedling container: 4months x 20days Fuel consumption (refer to table) <ul style="list-style-type: none"> a) 2 wheel is 22.8L/day b) 4 wheel is 33.9L/day 	<ul style="list-style-type: none"> Annual fuel consumption <ul style="list-style-type: none"> a) 2 wheel =(9(units) x 4(month)+13(unit) x 3(month)+1(unit) x 4(month)) x 160(km)/22.8(km/L)×=554(L) b) 4 wheel=(5(unit) x 4(month)+6(unit) x 3(month)+1(unit) x 4(month)) x 160(km)/33.9(km/L)=198(L) Annual fuel consumption 2 wheel: <u>560L</u> 4 wheel: <u>200L</u>
Pick up	<ul style="list-style-type: none"> Annual operation day 12(month) x 20(day/month)=240(day) Annual carrying distance (15(km)+3(km)) x 2 x 240(day)=8,640(km) Fuel consumption is 8km/L 	<ul style="list-style-type: none"> Annual fuel consumption per a unit 8,640(km)/8(km/L) x 1(unit)=1,080(L) <p>Annual fuel consumption: <u>1,100L</u></p>
Water Tanker	<ul style="list-style-type: none"> Annual operation day (refer to table): 4(month) x 20(day/month) = 80(day) Annual carrying distance (refer to table) (15(km)+3(km)) x 2 x 80(day) =2,880(km) Fuel consumption is based on 5(km/L) 	<ul style="list-style-type: none"> Annual fuel consumption for one unit 2,880(km)/5(km/L) = 576(L) <p>Annual fuel consumption: <u>580L</u></p>
Motor cycle	<ul style="list-style-type: none"> Annual operation day: 12(month) x 20(day/month) =240(day) Annual driving distance (3(km)+1(km)) x 2 x 20(day/month) x 12(month) =1,920(km) Fuel consumption is based on 10(km/L) 	<ul style="list-style-type: none"> Annual fuel consumption for one unit: 1,920 (km)/10 (km/L) = 192(L) Annual fuel consumption (2unit): <u>400L</u>
4x4 wagon type	<ul style="list-style-type: none"> Annual operation day is 219(day) Annual driving distance: One way 30km from Nyaung Oo office to extension act for 14 day/month One way 30 km for monitoring for 0.3day/month One way of 250(km) for reporting to Mandalay for 1 day/month Basic fuel consumption is 8(km/L) 	<ul style="list-style-type: none"> Fuel consumption for 1unit: <ul style="list-style-type: none"> <u>Extension</u> 30(km) x 14(day/month) x 12(month/yr)/8(km/L) = 630(L) <u>Monitoring</u> 30(km) x 0.3(day/month) x 12(month/yr)/8(km/L) = 13.5(L) <u>Reporting</u> 250(km) x 1(day/month) x 12(month/yr)/8(km/L) = 375(L) Total 1018.5(L) Annual consumption <u>1,020L</u>

2-4-3-2 Extension use of Heavy Machine and vehicles in near Future

Benefit for operation of the heavy machine and vehicles will be expected not only from the silvo-pastoral plantation use but also from future uses. DZGD is planning to use procured heavy machine and some vehicles for not only for the silvo-pastoral, but also for implementation of the other project within Mandalay Division along the Integrated Greening Dry Zone 5 year Program.

Uses of Bulldozer and Back Hoe: Land reclamation, construction of trench and pit, road improvement, construction of forest firebreak and check dam.

Use of Tractor (2 wheel and 4 wheel): Transporting seedling, soil and water in rainy season.

Water tanker and 4ton Track: Whole the year use.

Table 2.50 Future use of Heavy Machines (5 yr plan)

	Total	1 st . yr	2 nd . yr	3 rd . yr	4 th . yr	5 th . yr
Plantation	10,000ha	2,000	2,000	2,000	2,000	2,000
Protection Forest	360,000ha	72,000	72,000	72,000	72,000	72,000
Reservoir	245	49	49	49	49	49
Check dam	400	80	80	80	80	80
Road	416km	85	85	85	85	85
Forest firebreak	500km	100	100	100	100	100

Source: DZGD