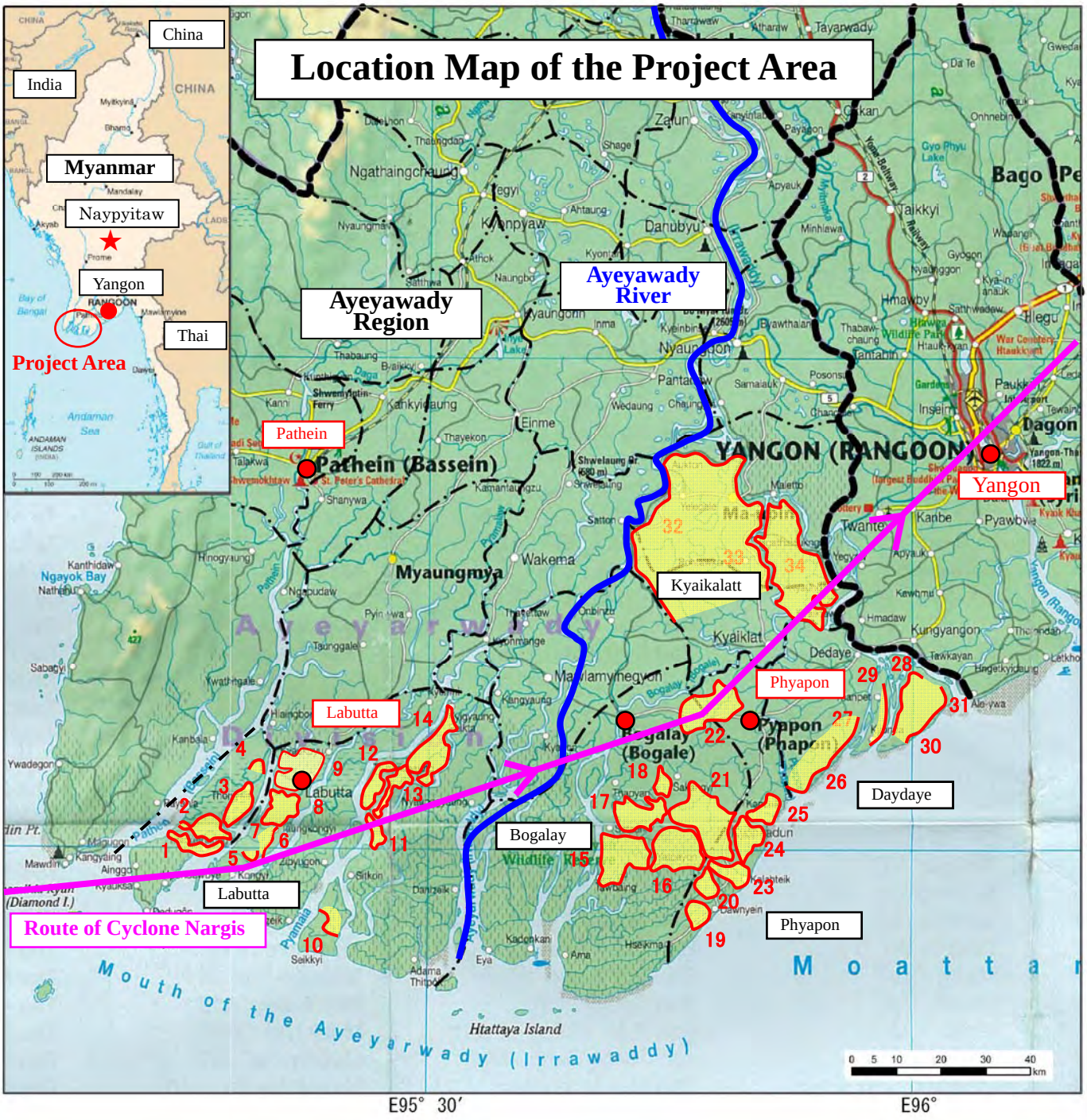
Ministry of Agriculture and Irrigation
The Republic of the Union of Myanmar

THE PROJECT
FOR
PRESERVATION OF FARMING AREA FOR URGENT REHABILITATION OF AGRICULTURAL PRODUCTION AND RURAL LIFE IN AREAS AFFECTED BY CYCLONE NARGIS
IN
THE REPUBLIC OF THE UNION OF MYANMAR

FINAL REPORT
SUMMARY REPORT

OCTOBER 2011

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
SANYU CONSULTANTS INC. NIPPON KOEI CO., LTD.



Polders in Project Area

【Labutta】
1.Alegyun(1)polder
2.Alegyun(2)polder
3.Alegyun(3)polder
4.Magyibinmadaukan

【Labutta】
5.Thingangyi
6.Zinywe
7.Leikkwin
8.Labutta(South)
9.Labutta(North)
10.U Gaungpu
11.Bitud Island(1)
12.Bitud Island(2)
13.Bitud Island(3)
14.Bitud Island(4)

【Bogalay】
15.Daunggyi poder
16.Daunggyi(East)
17.Daunggyi (West)
18.Daunggyi(Upper)

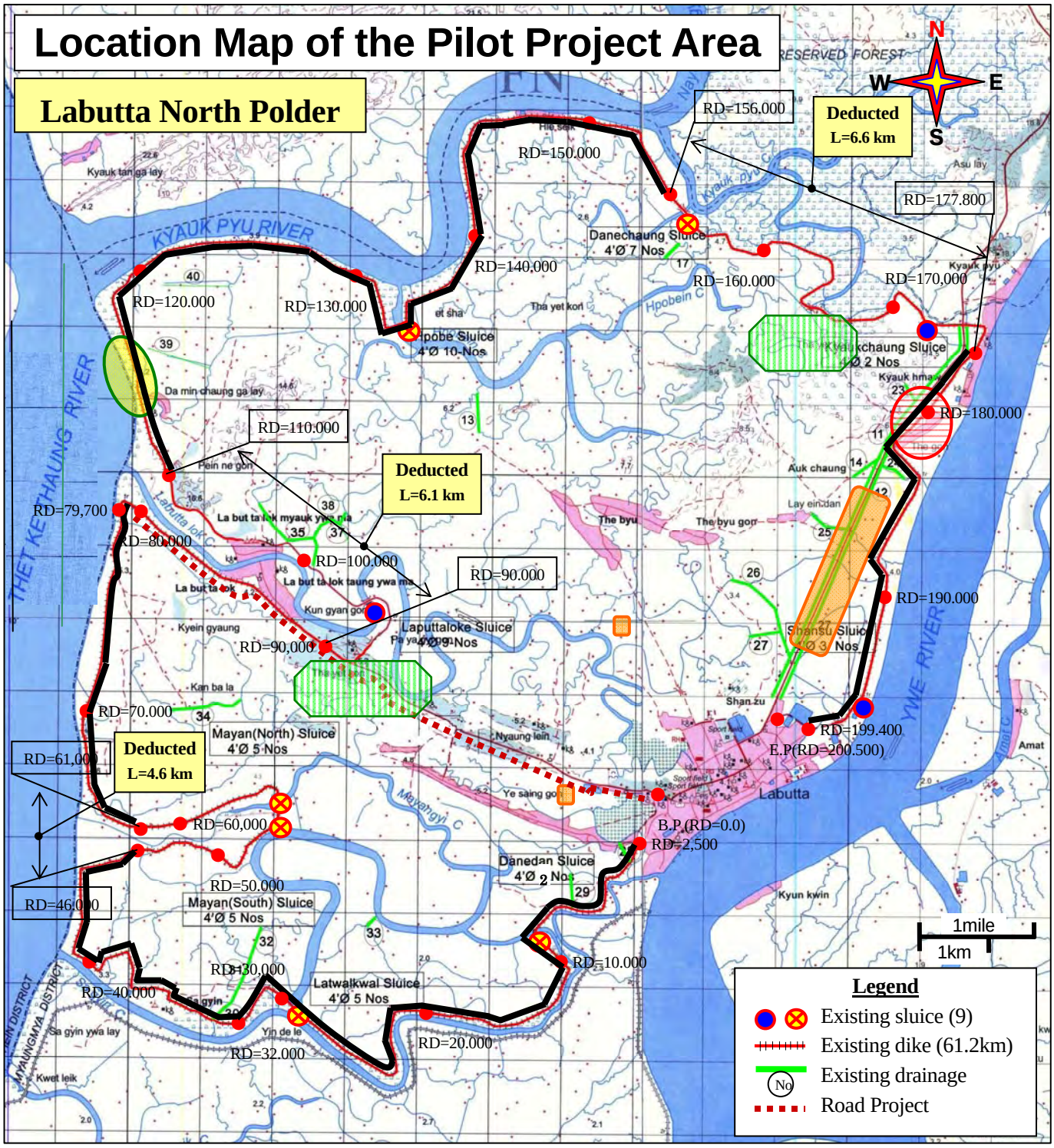
【Phyapon】
19.Dawnyein polder
20.Myokone polder
21.Kyetphamwezaung
22.Banbwezu
23.Daydalu
24.Letpanbin
25.Zinbaung

【Daydaye】
26.Myaseinkan
27.Thandi
28.Suclubbaluma
29.Hleseikchaunggyi
30.Tamatakaw
31.Kyonsoat

【Kyaiklatt】
32.Maubin Island(North)
33.Maubin Island(South)
34.Thonegwakyun

LEGEND
: Region boundary
: Major city/town
: Township boundary
: Township
: Project area
: Polders (34 places)

To Myaungmya, Yangon



Outline of Pilot Projects

Pilot Projects	Mark	Description	Implementation
1. Polder Dike Rehabilitation			
1) Polder Dike Embankment		Dike rehab section L=40 km : Test embankment site	2011/3 Completed
2) Sluice Gate Rehabilitation		Rehab - 6 sluices for 68 gates	2011/3 Completed
2. Mangrove Windbreak Rehabilitation		5 ha planting along dike L=500 m	2011/3 Completed
3. On-Site Seed Production		Paddy for 50 acres for 28 farmers	2011/4 Completed
4. Income Generation Vegetable Cultivation		2 sites for 54 landless villagers	2011/4 Completed

SUMMARY REPORT

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List of Abbreviations and Acronyms

ACL	Authorized Crest Level
ADPC	Asian Disaster Preparedness Centre
AE	Assistant engineer
AES	Assistant engineering surveyor
AMD	Agricultural Mechanization Department
ASEAN	Association of Southeast Asian Nations
B/C	Benefit/cost
CDN	Consortium of Dutch NGO's
CF	Conversion factor
CIF	Cost, insurance and freight
C/Ps	Counterpart(s)
CS	Certified seed
DAP	Department of Agricultural Planning
DAR	Department of Agriculture Research
DG	Director general
DMH	Department of Meteorology and Hydrology
DOF	Department of Fisheries
D/P	Development Plan
DPDC	District Pease and Development Council
DS	Dry season
DYDG	Deputy director general
EC	Electric conductivity
ECL	Existing crest level
EIA	Environmental Impact Assessment
EIRR	Economic internal rate of return
ES	Engineering surveyor
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FD	Forest Department
FIRR	Financial internal rate of return
FOB	Free on board
FW	Future with project
FW/O	Future without project
GL	Ground level
GoJ	Government of Japan
GoUM	Government of the Republic of the Union of Myanmar
HHs	Household(s)
HWL	High water level
HYV	High yielding variety
IBM	Irrigation benchmark
ID	Irrigation Department
IDE	International Development Enterprise
IEE	Initial environmental examination

IndOOS	Indian Ocean Observation System
INGOs	International non-governmental organisation(s)
IRR	Internal rate of return
ITC	Irrigation Technology Center
JICA	Japan International Cooperation Agency
LBVD	Livestock Breeding and Veterinary Department
LNGOs	Local non-governmental organisation(s)
MADB	Myanma Agricultural Development Bank
MAS	Myanma Agriculture Service
MIMU	Myanmar Information Management Unit
M/M	Minutes of meeting
MMC	Mangrove management committee
MOAI	Ministry of Agriculture and Irrigation
MOD	Ministry of Defense
MOF	Ministry of Forestry
MOHA	Ministry of Home Affairs
MOLF	Ministry of Livestock and Fisheries
MONP	Ministry of National Planning
MRRC	Myanma Rice Research Centre
NCEA	National Commission for Environmental Affairs
NGOs	Non-governmental organization(s)
NPOs	Non-profitable organization(s)
NPV	Net present value
OJT	On-the-job training
O&M	Operation and maintenance
PDC	Pease and Development Council
pH	Potential of hydrogen
PMU	Project Management Unit
PONJA	Post-Nargis Joint Assessment
PR	Periodic Review
ROW	Right of way
RS	Registered seed
SAE	Sub-assistant engineer
S/C	Steering committee
SCF	Standard conversion factor
SD	Survey Department
SLRD	Settlement and Land Records Department
SPDC	State Pease and Development Council
SUS	Stainless steel
S/W	Scope of work
SWOT	Strengths, Weaknesses, Opportunities and Threats
TBM	Temporary bench mark
TCG	Tripartite Core Group

TPDC	Township Pease and Development Council
Tsp	Township
USAID	United States Agency for International Development
UN	United Nations
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
VFRDC	Vegetable and Fruits Research Development Centre
VPDC	Village Pease and Development Council
VTs	Village-tract(s)
WS	Wet season
YAU	Yezin Agriculture University

List of Unit Conversions

1 basket (Paddy)	=	20.88 kg	=	46 pounds
1 basket (Groundnuts)	=	11.4 kg		
1 basket (Soybeans)	=	32.7 kg		

1 inch (in.)	=	2.54 cm	=	1/12 feet		
1 foot (ft.)	=	30.48 cm	=	1/3 yard	=	12 inches
1 yard (yd.)	=	0.9144 m	=	3 feet	=	36 inches
1 meter (m)	=	3.28 feet	=	1.09 yard		
1 mile	=	1.61 km				
1 kilometer (km)	=	0.62 miles				
1 square-foot (sq-f)	=	929 sq-cm	=	0.093 sq-m		
1 acre (ac)	=	0.405 ha	=	4048 sq-m		
1 hectare (ha)	=	2.47 acres				
1 acre-foot	=	1233.4 cum				
1 gallon (gal. UK)	=	8 pints	=	4.546 litter (UK)		
1 sud	=	2.83 cum	=	100 cu-feet		

1 mS/cm (milli-Siemens per centimeter)= 1 dS/m (deci-Siemens per meter)
= 1000 μ S/cm (micro-Siemens per centimeter)
(e.g. EC = 0.1 – 0.3 mS/cm = 100 – 300 μ S/cm for normal tap water)

Currency Equivalents as of March 2011

1 US$	=	869.00 Myanmar Kyats (TTB)
1 US$	=	81.73 Japanese Yens (TTB)
1 Kyats	=	0.094 yens

Myanmar Fiscal Year

1st April to 31st March

Summary Report

Chapter 1 Background and Objectives of the Project

1.1 Authority

This Final Report is prepared in accordance with the Scope of Work (S/W) and the Minutes of Meeting (M/M) for the Study on "The Preservation of Farming Area for Urgent Rehabilitation of Agricultural Production and Rural Life in Areas Affected by Cyclone Nargis in the Union of Myanmar" dated on October 6th 2009.

1.2 Background of the Project

On 2 - 3 May 2008, a huge cyclone named 'Nargis' which originated in Bengal Bay hit directly the southwestern part of the Ayeyawady Delta, affecting 2.4 million that included 140 thousand dead and missing persons. The Ayeyawady Delta is one of the major rice producing areas in Myanmar, and 770,000 ha of paddy field were damaged by salt water intrusion and flood and living condition in the polders was seriously affected as a result of the Cyclone. Under these circumstances, the "Government of the Republic of the Union of Myanmar" requested the "Government of Japan" to conduct the D/P study for the restoration of agricultural production and rural life through rehabilitation of polder dikes and preservation of farming area.

1.3 Objectives of the Project

1) To formulate the Development Plan (D/P) for the preservation of farming area for urgent rehabilitation of agricultural production and rural life in areas affected by Cyclone Nargis.
2) To develop the capacity of counterparts for project implementation and technical skills as well as to rehabilitate agricultural production and rural life in pilot project area.

1.4 Expected Outputs of the Project

1) The D/P for the preservation of farming area will be formulated.
2) Agricultural production and rural life will be rehabilitated in Labutta North polder through preservation of farming area by pilot projects such as rehabilitation of polder dike.
3) Capacity of counterparts for project implementation and technical skills will be developed.

1.5 The Project Area

The project covers 34 polder/embankment areas in Ayeyawady Region that were seriously affected by the Cyclone Nargis in the Ayeyawady Delta. The total area is 1,342 km^2 (134,200 ha) and the total length of the polder dike is 942 km. Population in the area is estimated at 248,000.

1.6 Implementation Organization for the Project

In implementing the Study, JICA dispatched a Project Team to the Union of Myanmar. The Project Team carried out the Project in collaboration with counterparts from the Ministry of Agriculture and Irrigation (MOAI). Main C/P departments of the MOAI are DAP, ID and MAS.

Chapter 2 The Project Area

2.1 Natural Condition

2.1.1 Climate and meteorology: The Ayeyawady Delta has tropical and monsoon climate with four seasons distinguished as; Cool Season from December to March, Pre-monsoon Hot Season from April to May, Monsoon Season from June to September, and Post-monsoon Season from October and

November. Annual rainfall at Pathein is reported at 3,040 mm as on the average from 1998 to 2007.

2.1.2 Rivers and hydrology: Due to monsoonal rains, which occur between mid-May and mid-October, the flow of Ayeyawady River and its tributaries varies greatly throughout a year. The average discharge near the head of the delta at Seiktha is between 32,600 m^3/sec as high in August and 2,300 m^3/sec as low in February and March, with an annual average of 13,000 m^3/sec. The tidal regime along the coast of the delta is mainly semi-diurnal in character, but with significant diurnal variations. In total, 12 ocean outfalls of the delta, such as Bassein, Thetkethaung, Ywe, Pyanmalaw, Pinsalu, Ayeyawady, Bogalay, Phyapon, Thandi, China Bakir and Yangon, are spread along about 250 km of coastline. The spring tide range varies from a minimum of 1.5m at the Phyapon River entrance to a maximum of 5m at the entrance to the Yangon River (Elephant Point).

2.1.3 Topography: The delta system of the Ayeyawady River extends in a great alluvial fan from the limit of tidal influence near Myanaung to the Andaman Sea. Except for a few scattered hills and terraces the total area of flood plain of the delta covering about 31,000 km^2 is about 15m above mean sea level. About 5,200 km^2 are below high spring tide level. The upper and central portions of the delta are almost entirely under cultivation, principally for rice. Following the rush of settlers from upper to lower Myanmar in the late 19th Century, the construction of embankments and reclamation of land for agriculture has kept pace with the increase in population. Dike building was initiated by the Government as early as 1861, and many embankments were constructed around 1880 and 1920. At present, there are 1,300 km of major embankments in the delta, protecting over 600,000 ha of paddy field. The heights of embankment are designed to protect a flood of 20 years recurrence period only.

2.1.4 Soils and water: The entire area is overlain by a thick layer of alluvium brought down by the Ayeyawady River. Three main types of soil have been developed, namely meadow gleyey clay soils, meadow swampy soils and saline gleyey soils. There is a general uniformity to the soils of the whole delta.

2.1.5 Cyclone: The Bay of Bengal is frequently subject to severe cyclonic storms, some of which cross the Arakan coast of Myanmar, and very occasionally the delta coast. When this happens, however, the surge induced leads to widespread flooding, which could be protected by extensive polder construction. Cyclone “Nargis” crossed the Ayeyawady Delta on 2nd May, 2008 with a death toll of 133,000 including missing persons. The recent maximum devastated cyclone “Bhola” in Bangladesh caused 550,000 casualties in 1970. Damage of the cyclone “Nargis” is ranked at 8th in terms of magnitude of the damages and therefore ranked as one of the most severe disasters in South-Asia.

2.2 Socio-economic Condition

2.2.1 Land Area and Population: The Project area is 34 polders/embankments in Ayeyawady Region, with protected area of 1,342 km^2 and a total population of 248,000. It covers 2 districts, namely, Labutta and Phyapon Districts.

2.2.2 Rural economy: Ayeyawady Region is known as the rice bowl of Myanmar because of its active rice growing economy. Annual rice production of Ayeyawady Region accounts for 30% of the total production in Myanmar which about 22 million tons. In addition to growing rice, aquaculture is being operated; therefore, it can be said that this region is very important for Myanmar in terms of food supply. On the other hand, since the development process of the delta has been started in early 20th century, other industries are not fully developed apart from agriculture and fishery.

Landless people: The average farm size per household in the Ayeyawady Delta is 11.2 acre (= 4.5 ha), which is ranked at 1st among the Union. However, due to the high rate of population increase, the ratio of landless farmers in the delta reaches to considerably high level: that is over 50% in Labutta and Bogalay townships. If people do not own farmland nor fishing tools, their job opportunity is limited to daily labor. In addition, poorer people face difficulty locating lands to construct their houses. Sometimes, they have no choice but to stay in prohibited area for residence even though they know it

is illegal.

Table 2.2-1 Land Occupancy Status and Farm Size

Sr. No.	Township	Land occupancy status				Average farm size (acre/farm household)
		Land Holder (%)	Tenant (%)	Farm worker (Landless) %	Non-farm %	
1	Labutta (14 Polders)	26.1%	1.1%	65.2%	7.6%	18.5
2	Bogalay (4 Polders)	22.6%	1.4%	53.1%	22.9%	21.9
3	Phyapon (7 Polders)	31.2%	1.0%	28.3%	39.5%	25.6
4	Daydaye (6 Polders)	30.7%	0.8%	34.6%	33.9%	16.2
5	Kyaiklatt (3 Polders)	39.7%	0.0%	44.6%	15.7%	8.5

Source: Present Condition Survey, JICA Study Team, 2010

Table 2.2-2 Average 2009 Income of Tiller's Right Holders and Landless Households in 34 Polders

Township	Landholder (Kyat/hh/year)	Landless households (Kyat/hh/year)
Labutta	4,353,986	1,804,961
Former Labutta	*2,386,598*	*1,219,861*
Former Ngaputaw	*1,967,388*	*585,100*
Bogalay	3,705,438	1,893,917
Phyapon	6,643,200	1,931,857
Daydaye	4,342,898	2,414,917
Kyaiklatt	2,206,367	1,354,333
All townships	3,541,981	1,566,664

Source: Present Condition Survey JICA Study Team, Jan. 2010

2.2.3 Ethnic distribution: Majority of the residents in the Project Area are Burmese, with minority such as Kayin, Rakhine and so on. They have established own community, sometimes they combined with other people to organize villages. The relationships among these groups in a village are relatively good in spite of some cultural differences.

2.2.4 National and local government: According to the Notification of No.8/2011 issued by the SPDC on 30th March 2011, PDCs of the district, township, village-tract were dissolved and all their duties and functions were handed over to the General Administration Department or head of village-tract.

2.2.5 Gender: Adult literacy rate of Ayeyawady Region is ranked as 3rd among 17 States / Regions in the Union. The literacy rates of male and female in the Region are 91.6% and 88.2%, respectively. Generally, women in Myanmar society have equal position to men, and wives keep and manage the house income. Women's main tasks are housekeeping, taking care children and water fetching and so on. If husbands own land tiller's right, wives assist farming their lands. Women can attend official meeting and express their opinions, however, they are not very active, and in general only men are supposed to fill seat of public position such as village head. Cash income women can get as labor is small compared to men, since wage of female is generally half of men's.

2.2.6 Disaster occurred by Cyclone Nargis;

Victims: The amount of damage by Nargis was unprecedented, and many human lives were lost in the Project Area. According to TCG (July 2008), the number of dead and missing in the six target townships was about 129,348. Labutta Township was the most severely damaged area by Nargis and its population was decreased by around 20%.

Housing: Before Nargis, around half of construction materials of houses were made of bamboo and wooden, about 35% of structures were all wooden and 15% of were brick or concrete structures. Many houses were vulnerable to storms, which led to the significant damage by Nargis. It is estimated that around 450,000 houses were totally destroyed and 350,000 houses were slightly damaged in the whole

affected area. The total damage and losses in both the Ayeyawady Region and the Yangon Region was estimated to be around 686 billion Kyats (TCG, 2008, PONJA).

Water supply: Before Nargis, the most common water source in Ayeyawady Region was pond; other water sources are river and open well. During rainy season, most houses collect water by using roof-rainwater system. Only handful people have access to piped water supply system before and after Nargis. The communal ponds were affected by Nargis significantly, as 43% of communal ponds were damaged in Ayeyawady Region according to PONJA. Many households were forced to shift water sources from pond to rain water tanks due to high salinity of ponds.

Transport and communications: The damage to the transport and communication sector covering road, rail, water and air transport is estimated at over 120 billion Kyats with total losses estimated at nearly 63 billion Kyats in the whole area affected by the cyclone. Most affected area was water transport, the damage and losses of which is about 100 billion and 31 billion Kyats, respectively.

Rice mill factories: Around two-thirds of small scale rice mills and more than 80% of medium-large mills in the six (6) target townships were damaged by the cyclone. The sector was seriously affected losses due to suspension of business, destruction of paddy stocks, lower expected yields and deterioration in quality of the next paddy crop.

Fishery: Fishery is the second important income source in this area. For instance, 32.9% of households in Labutta Township had fishing gear items before Nargis. However, many fishery gears were lost by the cyclone and the worst record is 28.4% loss in Labutta which leads to the serious impact on the fishery sector.

Salt farms: Most of salt production farms are located in the coastal area, which was severely affected by Nargis. Around 80% of salt farm area was destroyed by Nargis and many workforces of this business and their families passed away. After Nargis, salt price increased from 200 Kyats to 1,300 Kyats at peak time due to shortage of salt.

Income source: According to a survey by FAO in February 2009, main income sources distribution was changed by the Cyclone Nargis. Percentages of farming and fishery sectors decreased; the rate of daily labors increased into the 2nd main income source. The reasons of income source changes were considered to be due to damages of farmland by salt intrusion, loss on fishery tools and so on.

2.3 Present Condition of Agriculture in the Project Area

2.3.1 Agricultural Production: Agriculture in Ayeyawady Region is characterized particularly by paddy cultivation in polder dikes. Sowing area of paddy is significant as compared with the area of other major crops. Paddy sown area in 2007-08 is 4.9 million acres equivalent to 24.8% of total sown area in the country, which is the largest rice production area in Myanmar.

Cropping pattern depends on natural condition especially rainfall. Farmers start wet season paddy cultivation at the beginning of wet season in May to June and, harvest in the beginning of dry season in November to December. Farmers in irrigated areas practice dry season paddy cultivation between December and April. In the farming land with high moisture contents, cultivation of legumes such as black gram, green gram, ground nuts etc is practiced during the dry season.

2.3.2 Paddy cultivation: Cropping yield of paddy in Ayeyawady Region is still low. According to the Agricultural Census of 1985-86 to 1995-96, the average cropping yield of paddy in Ayeyawady Region is 63 baskets / acre. However, cropping yield at 34 polders in 2007-2009 wet seasons is 30-42 baskets / acre, much lower than the average in the Region.

Paddy variety: In Ayeyawady Region, Local varieties commonly used are Hnan Gar and Paw San Yin. Especially, the share of local variety in Phyapon and Labutta Districts located in downstream of the delta where many polders are located is very high (more than 60%). There are many reasons for the preference of cultivation of local variety such as high quality of milled rice (taste and flavor) and high price, low agricultural input comparing with HYV and, high appropriateness to natural condition. Of the cited reasons, “appropriateness to natural condition” is the most important reason. As a result of

interview survey by the JICA project team at selected 10 polders, 70.5% of farmers answered that natural condition such as rainfall is major criteria for variety selection.

Seed and cropping method: Usually, farmers use previously harvested paddy as seed for the next cropping without selection and disinfection. Quality of such seed is very low genetically and physically. From the survey conducted in the pilot project, 47.8% of farmers have problems of mixture of red rice. Most farmers practice traditional cropping method (plow by buffalo, broadcasting or non-regular transplanting, non systematic fertilization etc). According to MAS staff, many farmers shifted to broadcasting from non-regular transplanting after Nargis attack to reduce production cost.

2.3.3 Other crops: Apart from paddy, maize, beans, chili and sesame are widely cultivated in the region. Particularly, production of legumes, which can be grown using residual soil moisture of wet season, has been increasing strongly. The production has increased more than 400% during 22 years between 1985 and 2007 while increase of paddy production in the same period was 53%.

2.3.4 Support service: The MAS under the MOAI has the responsibility to provide extension work. The MAS Extension Division assigns offices in district and township. Recently, the number of MAS staff including extension worker was reduced drastically with a current staff of 7,538 as of March 2007.

There are five main MOAI farms for paddy seed production in Ayeyawady Region. Based on production amount of breeder's, foundation and registered seeds by the farms, potential production amount of certified seed in 2010 are estimated at 403,500 baskets for 269,000 acres. This amount can covers only 5.4% of total paddy sowing area of wet and dry seasons in Ayeyawady Region (5,020,779 acres in 2009-2010).

There are government and private agricultural finances in rural area. Government agricultural finance is provided by MADB. Many farmers utilize MADB loan with interest rate of 17% per year. However, amount of MADB loan is limited to 20,000 Kyats/acre for paddy (10,000 Kyats/acre for other crops) equivalent to only 10-20% of total production cost. Consequently, farmers have to borrow the money from private agricultural finance even though its interest rate is high (5-15% per month).

2.3.5 Damage by Nargis: Agriculture in Ayeyawady Region was seriously damage by Nargis. It was reported by MOAI that 130,000 households, 1.59 million ha of farming land (34% of total paddy area) and 149 thousands of livestock (33% of total population) were affected and/or died due to Nargis. According to the Present Condition Survey, number of farmers who face constraint of farming input such as lack of draft animal, fertilizer and farming tools was increased after Nargis attack.

In addition, agricultural production was decreased seriously due to intrusion of saline water into the paddy field. According to the interview with farmers in Labutta North Polder, paddy yield after Nargis disaster was decreased by 10-20 baskets/acre equivalents to minus 50-75% from 40-50 baskets before Nargis for local variety.

Table 2.3-1 Farming Constraint before and after Cyclone Nargis Attack

Constraint	No. of Sample Farmer	Before Nargis		After Nargis		Difference
a)	b)	c)	d)	e)	f)	g)=f)-d)
Lack of Labor	189	16	8%	29	15%	+7%
Lack of Farming Tech.	189	13	7%	18	10%	+3%
Pest & Disaster	189	35	19%	63	33%	+15%
Lack of Water	189	18	10%	25	13%	+4%
Flooding	189	43	23%	72	38%	+15%
Salt Injury	**189**	**23**	**12%**	**75**	**40%**	**+28%**
Lack of OM of Polder (Muddy)	189	1	1%	9	5%	+4%
Lack of Extension	189	14	7%	25	13%	+6%
Lack of Access to Finance	**189**	**43**	**23%**	**109**	**58%**	**+35%**

Constraint	No. of Sample Farmer	Before Nargis		After Nargis		Difference
a)	b)	c)	d)	e)	f)	g)=f)-d)
Lack of Market	189	6	3%	12	6%	+3%
Low Price of Product	189	9	5%	20	11%	+6%
Lack of Farming Tool	**189**	**20**	**11%**	**57**	**30%**	**+20%**
Lack of Draft Animal	**189**	**7**	**4%**	**74**	**39%**	**+35%**
Low Quality Seed	**189**	**9**	**5%**	**42**	**22%**	**+17%**
Lack of Fertilizer	189	28	15%	82	43%	+29%
Others	189	3	2%	29	15%	+14%

Source: Present Condition Survey by JICA Project Team, March 2010

2.4 Present Condition of Irrigation and Drainage in the Project Area

2.4.1 Irrigation: As the annual rainfall is more than 3,000 mm and concentrates in the monsoon season from May to October, no irrigation is practiced for monsoon paddy cultivation. On the other hand, the rainfall amount in the dry season is not sufficient for growing of any kind of crops and irrigation is necessary for dry season crop cultivation. Generally the dry season irrigation is practiced by using water pumped up by portable pumps from the drainage canal and lifted water is conveyed through small ditches or in plot-to-plot method. The irrigation areas and available water are limited. The slide gates of the sluice are opened on 15 May and are kept open until mid-September when the monsoon season is terminating and the water inside the drainage canal keeps the stable level.

Water quality: The EC values measured at the vicinity of the sluices were high and not suitable for irrigation use because of the intrusion of saline water from the riversides. Whereas the EC values in the drainage canal at several hundred meters far from the sluices were low enough for irrigation use.

2.4.2 Drainage: As the annual rainfall is more than 3,000 mm, the role of drainage is very important. There is no need to store abundant rainwater in monsoon season. The slide gates of the sluices are kept open from 15 May to mid-September and the drainage is controlled by the frap gates of the sluices to keep the water level of the drainage canals as low as possible. The old river courses are functioning as major drainage channels and artificial drainage canals are connected as required. The density of drainage canal is generally insufficient. The drainage problems are sometimes encountered in the low-lying areas. The salt water intrusions are occasionally found through the degraded frap gates and the water impounded in the drainage canal is contaminated with salt water.

Canal water level: The water levels of the drainage canals fluctuate according to the rainfall discharge, riverside water level and the gate operations, Judging from the observed data from October 2008 to March 2011 at eight (8) sluices in Labutta North Polder, the water levels of the drainage canal exceeded the lowest paddy field level for several days in September 2009.

Table 2.4-1 Summary of Drainage Conditions at the 8 Sluices in Labutta North Polder

No.	Sluice Name	R.D. (feet)	River Name	Lowest Paddy Field Level (feet)	Year	Max. Water Level of Drainage Canal			
						Water Leve (feet)	Date	Water depth (feet)	Duration above Paddy Field (Days)
1	Danedan	9,220	Sa Gyin	2.5	2009	3.8	9.9.2009	1.3	6
					2010	0.5	5.8.2010	no	0
2	Latwalkwal	28,800	Sa Gyin	2.0	2009	4.1	7.9.2009	2.1	10
					2010	2.5	5.8.2010	0.5	2
3	Mayan	57,600	Thet Ke Thaung	2.0	2009	3.8	8.9.2009	1.8	7
					2010	2.3	9.8.2010	0.3	1
4	Laputttaloke	94,700	Thet Ke Thaung	5.0	2009	5.6	7.9.2009	0.6	2
					2010	3.1	5.8.2010	no	0
5	Hpobe	135,200	Kyauk Pyu	2.5	2009	3.8	9.9.2009	1.3	11
					2010	3.0	21.7.2010	0.5	10
6	Danechaung	156,400	Kyauk Pyu	2.0	2009	3.8	9.9.2009	1.8	50
					2010	2.0	15.7.2010	no	0
7	Kyaukchaung	173,700	Kyaukchaung Yae Kyaw	2.6	2009	3.8	10.9.2009	1.2	7
					2010	2.2	24.8.2010	no	0
8	Shansu	195,500	Ywe	3.2	2009	4.5	7.9.2009	1.3	3
					2010	2.7	5.8.2010	no	0

The peak water level in the drainage canals went down slowly for several weeks. The drainage capacity of both canals and sluices seems to be insufficient. However the insufficient drainage capacity would not give vital damage to monsoon paddy cultivation.

Soil salinity was surveyed at 34 polders. The samples from 6 polders show EC value of less than 3 mS/cm which seems harmless and suitable for crop cultivation. However, 28 samples show EC value greater than 3 mS/cm including over 10 mS/cm at 10 polders. The soils where drainage conditions are poor and water remains after the harvesting of paddy, the salinity of soil will be increased by the condensation of stagnant water. Fortunately, the area is blessed with affluent rainfall, and leaching before the paddy transplanting in June would be practically possible. Judging from the rain distribution pattern, one or one and half months of rainfall from the monsoon starting in May would be sufficient for the leaching.

Table 2.4-2 Rank of Soil Salinity in 34 Polders

EC(e) (mS/cm)	No. of Polders	Leaching Water Requirement (mm)	Equivalent Duration of Rainfall (month)
Less than 3	6	Non	non
3<EC(e)<10	18	300	1
10<EC(e)<25	9	600	1,5
Greater than 25	1	900	2

2.5 Present Condition of Agricultural and Rural Infrastructure in the Project Area

2.5.1 Dike and sluice: It is assessed from the field inspection that crest elevation of polder dikes had been lowered considerably by about 0.6 – 0.9 m (2.0 – 3.0 ft) before the Cyclone Nargis, from their original heights when constructed by Lower Burma Paddy Land Development Project, Phase I & II in 1980's, due to settlement of embankment, erosion by rainfall, wind-drift and others. Under these conditions, high tides and tidal wave of the river induced by the Nargis had overflowed the polder dikes and caused a great deal of damage inside the polder. Since just after the Nargis, emergency restoration works for all damaged polder dikes have been implemented to recover the original height of embankment by ID.

Sluice gates: Water leakage is commonly seen through both flap and slide gates. At some sluices, entire gates have disappeared or gates are not operational due to damaged gate hoist including broken concrete structure and running out of life span of the facility. Rehabilitation or reconstruction of such facilities has not taken place yet by the government or donors except a few cases.

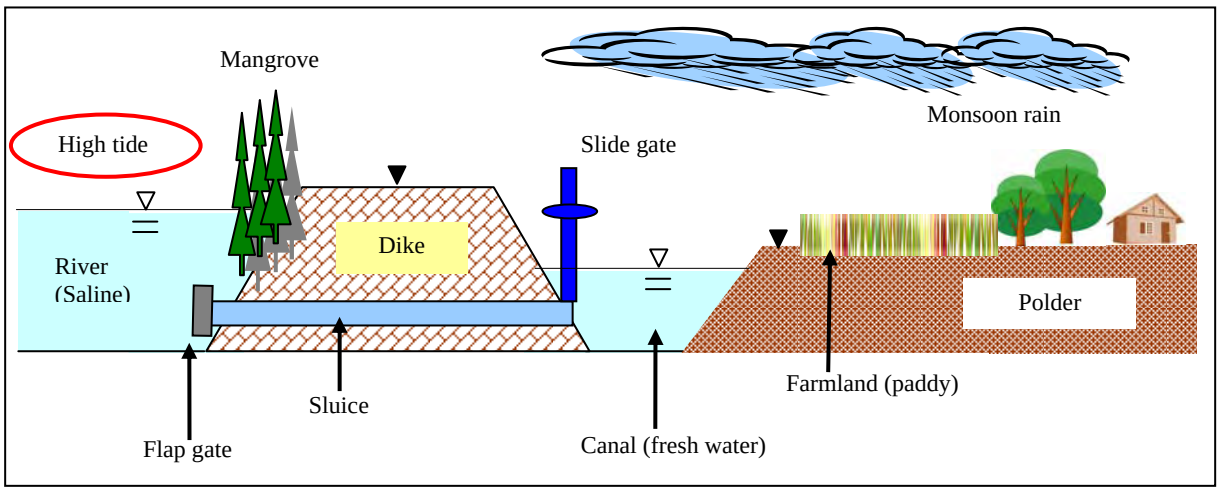


Figure 2.5-1 Polder Dike Schematic Section

2.5.2 Roads: The Yangon-Pathein road is fairly good. However, this road runs in the north out of the project area. Even the major roads which connect the project area with the Yangon-Pathein road or the roads connecting between townships are poor. Tar paved sections are limited. Most of the sections are paved with small cobble or gravel and paving is under progress. Most of the gravel paved sections are left without compaction and grading. The roads are very bumpy and only four wheel drive vehicles and large buses and trucks can traverse the road area.

Ponds: The dominant source of drinking water prior to the cyclone was rainwater harvested by households in large earthen pots (used during rainy season) or in large community ponds (used more in dry season). The ponds are square shaped (30mx30m-50mx50m) with bottoms excavated 5 ft deep and surrounding bank of 5 ft high. After Nargis, the water of most of the ponds has been drained and new fresh rainwater is stored and the water is used for drinking and domestic purposes. The most common water treatment method in the affected area is by straining the water through the use of a cloth, 39%, followed by boiling, 29% and letting the water stand and settle, 22%. (Post Nargis PR II)

2.6 Emergency Rehabilitation and Reconstruction implemented by the Government and Donors

2.6.1 Government rehabilitation: Emergency rehabilitation to restore the crest elevation of the dike to its original height before the Nargis has been already completed by the Government. It is, however, considered that the crest elevations are not safe enough, and reconstruction of dikes with necessary height to protect the service area from river flooding has been implemented by ID. As of March 2011, 13 polders have already been completed and 9 polders are still under construction.

2.6.2 Donors rehabilitation: It is reported that some donors have expressed their willingness to participate in the rehabilitation and reconstruction works of polders. As of now, however, only the Consortium of Dutch NGO's (CND) has undertaken partial rehabilitation for whole sluice gates and a part of polder dike in Bitud Island (1).

2.6.3 Reconstruction plan: Reconstruction works of polder dikes have already been undertaken by ID, and bi-annual program covering the period 2010 to 2012 has been announced also by ID.

2.6.4 Design and construction standards: Technical standards on civil work as to polder dike and sluice gate have not yet been established by ID. At present however, design standards for three civil engineering fields, namely fill dam, head works and canal works, were made in 1997 by ITC under ID with technical cooperation from JICA.

2.6.5 Procurement procedure and condition: Government projects in relation to polder dike are normally executed in combination of force account work by ID and contracted work by private contractors. Private contractors are usually procured through either international tender or domestic tender depending on project nature and funding source.

2.6.6 Government budget: The Government allocates annual budget in two categories, namely current and capital. The current budget is used for O&M and staff salary. The capital budget is for new project, extensions and renovations. The total budget of ID was 110,811 million Kyats in the year 2010 – 2011.

2.7 Identification of Problems on Preservation of Farming Area for Urgent Rehabilitation of Agricultural Production and Rural Life

2.7.1 Problems on agricultural and rural infrastructure can be summarized as follows:

1) Low height of polder dike: Emergency rehabilitation work to restore the crest elevation of the dike to its original height before the Nargis has been completed already by the Government (ID). It is, however, considered that the crest elevations are not safe enough, because at the original design and construction in the early 1980s, the heights of embankment are designed to protect a flood of 20 years recurrence period only. Intrusion of saline water occurred several times in the past causing considerable damages to the farming of the empoldered area. It seems that an occurrence similar to

Nargis will greatly affect the delta area again.

2) Poor water tightness of sluice gates: In accordance with non-rehabilitation of damage and leakage on most of sluice gates, salt concentration of water in the drainage are kept high due to saline water intrusion through damaged sluice, making difficult to improve farming activities in the served areas. In addition, inundation on farm occurs due to poor drainage caused by uncontrolled sluice gate in wet season. The said condition makes it difficult to improve the preservation of farming area and farming activities in the served areas. These problems are usually caused by astronomical tide through wet/dry season at present.

2.7.2 Problems on farming will be categorized into three major issues as follows:

1) Poor farming technique: Since natural condition of polder areas has been deteriorated in terms of soil, adequate farm management is very essential. Most farmers in the project area have been practicing traditional farming, hence the low farm productivity.

2) Lack of support on farming technique: Extension services to farmers have not been efficiently provided by MAS since their extension officers / workers have drastically decreased during the past 10 years.

3) Lack of farm input: lack of farming input such as seed, fertilizer and animal-power has become a serious concern after Nargis attack. Supply of such inputs shall be secured to attain agricultural recovery and further improve the project area on medium- to long-term basis.

2.7.3 Problems on livelihood and income sources: Inhabitants in the project area are divided into tiller's right holders and landless people. Landless households account for 73% in 34 polders. The income generation plan shall target these landless households. Five issues are accounted as follows:

1) Low income: This is very obvious issue to landless people. Present Condition Survey (2010) revealed that average annual income in 2007 (before Nargis) for farmer household is 5,381,009 Kyats while that of landless household is 1,743,234 Kyats. In 2009 (after Nargis) it was 3,866,402 Kyats for tiller's right holders and 1,422,448 Kyats for landless.

2) Low opportunity for income generation: Most landless people are paddy and/or fishery workers as casual labour. There are very few cottage industries like salt production and traditional manufacture in the Project Area. Some rural development projects such as construction of new district centre in Labutta District and road projects will provide work opportunity for landless people.

3) Lack of skills for production: They have low capability to generate income by themselves due to low educational level and little opportunity to learn modern techniques.

4) Less accessibility to outside support: Even various support (in-kind, projects) has been provided to the Nargis affected area they hardly reach landless people.

5) Limited natural resources: Land in the Project Area is widely used for paddy production under the tiller's right. Water in the canal inside polders is actually saline but can be improved after dike and sluices are rehabilitated.

2.7.4 Problems on mangrove windbreak: According to the survey for current situation of mangrove windbreak along dike embankment at 34 polders conducted by the Study team, only 50% of dike embankment has been currently protected by mangrove trees due to severe damage by Nargis. Problems on mangrove windbreak in the project area are pointed out as; 1) Natural regeneration of mangrove trees is not rapid as expected, 2) Lack of government office to implement forestation / rehabilitation of mangrove windbreak trees along polder dike embankment.

Chapter 3 Challenges and Measures on Preservation of Farming Area for Urgent Rehabilitation of Agricultural Production and Rural Life

3.1 Challenges and Measures on Agricultural and Rural Infrastructure

(1) Challenges: For the preservation of farming area, reconstruction of polder dikes and sluices to safe level in terms of dike height and water tightness of sluice gates to prevent river water over-topping and saline water intrusion are urgent issues to be implemented.

(2) Measures: Measures to resolve such issues are to undertake rehabilitation of polder dikes and sluices immediately. However, in order to formulate rehabilitation plan for polder dikes and sluices, it would be required to implement pilot or small scale rehabilitation initially to examine and obtain technical data, construction condition and social environment including design for safety, construction method, construction costs, construction schedule, etc. For this purpose, a pilot project is carried out involving government and private sectors.

3.2 Challenges and Measures on Farming

(1) Challenges: a) As previously stated, lack of farmers' farming technique and MAS technical support services are major issues in the Project Area. Most farmers have been practicing traditional paddy cultivation l farming technique while MAS extension staff has been reduced to a great extent during the recent years. Therefore, it is urgently required to establish an effective support system of MAS to facilitate improvement of farmers' farming technique.

b) Lack of autonomous agricultural supply system in the rural area is also another serious issue. Many supports in various forms (seed, fertilizer, farming machinery, animal power, etc.) were extended after Nargis occurrence by the government, international organizations, NGOs, etc. However, at present, such external urgent supports have been reduced three years after the Cyclone Nargis disaster.

(2) Measures: a) Strengthening of MAS technical support services on farming technique will be effectively planned with the utilization of MAS demo-farms together with advanced farmers on field practice due to the limited number of MAS staffs. Mobilization of advanced farmers who will be tapped to assist MAS in extension works will possible make expansion of agriculture development be more efficient and expansion.

b) Strengthening of agricultural input production: Among agricultural inputs, rice seed will be the most basic and important and it can be produced by farmers. In regard to this, the government issued the Seed Law in January 2011 to enhance the production of high quality seed through the private sector. In line with this, the mechanism and viability of seed production by farmers were studied through the pilot project for rice seed production.

3.3 Challenges and Measures on Livelihood and Income Sources

(1) Challenges: Poverty of landless households, as a target group for the improvement of livelihood and income sources, comes obviously from lack of opportunities for income generation and production means. This limited knowledge/skills and non experiences makes it more difficult for the landless farmers to access to livelihood opportunities and get additional income Thus, the urgent challenge faced by the project is the need to improve livelihood and to generate income sources for landless households.

(2) Measures: The following five activities were initially considered to be possible sources of income generation for landless households in the Project Area. After study as described in Chapter 5.5.2, two activities, i.e. vegetable cultivation and pig raising were determined feasible for the D/P and vegetable cultivation was selected to implement as a pilot project.

a) Vegetable cultivation
b) Fruit tree (banana, mango) plantation
c) Technical improvement of primary processing of small fish and prawn

d) Breeding or fattening of domestic animal (pig raising)
e) Processing of farm produce

3.4 Challenges and Measures on Mangrove Windbreak

(1) Challenges: A large portion of the mangrove trees along the polder dike and embankment were destroyed by Cyclone Nargis. It was assessed that the natural recovery of the mangrove trees that will likely protect the polder dike and embankment from tidal surge and strong storms is very slow and minimal. Thus it would be urgent and important challenge for the project to propose recovery schemes on mangrove windbreak rehabilitation along the dike and embankment areas to accelerate recovery.

(2) Measures: Plantation of mangrove trees will be possible measure to accelerate recovery of mangrove windbreak along polder dike. However, its details shall be carefully studied in terms of mangrove species to be used, plantation procedures, government involvement, village participation, planting costs, implementation arrangement, plantation techniques, etc. For this purpose a pilot project was carried out for the trial plantation involving government sector and village level participation.

Chapter 4 Implementation of Pilot Projects

4.1 Purpose and Scope of Pilot Projects

4.1.1 Purpose of pilot project is to demonstrate and verify the contents of the draft plans and designs of the sub-projects under four components. Results and outcomes from the pilot projects shall be used to finalize the draft D/P.

4.1.2 Basic policy: One among 34 polders in the project area was selected for the implementation of the pilot projects under which various activities were carried out and tested. Period of the pilot project were up to April 2011 according to the study schedule. Results of the pilot project were evaluated together with government officials and farmers/villagers who participated in the pilot project.

4.1.3 Scope of Pilot Projects: The following are the basic framework of four (4) components:

(1) Agricultural and rural infrastructure will focus on the rehabilitations of polder dike and sluice gate, which are the most essential infrastructure for the preservation of farming area.
(2) Farm management will focus on increase of rice production and strengthening of agricultural input support basically on the production of certified rice seed by farmers.
(3) Livelihood and income sources will focus on vegetable cultivation at very small-scale by landless households.
(4) Mangrove windbreak will focus on replanting of mangrove trees along polder dike to protect dike embankment from tidal surge and storm.

4.1.4 Selection of polder: Two polders were initially listed as candidate for the pilot project site, namely Labutta North and Bogalay Daunggyi. The Labutta North Polder was finally selected with following reasons: 1) the most affected area by Nargis, 2) upgraded to the district and being expanded, 3) has better access in terms of the demonstration and exhibition, and 4) priority by the ID.

4.2 Government Laws, Regulations and Institutions related to Pilot Projects

The Land Acquisition Act, enacted in 1894 under the colonial administration, stipulates procedures of land acquisition such as award of land, publication of notice and compensation, which is compiled in the Burma Code Volume X (1958). The Article 39 of the Land Nationalization Act (1953) says that the President or those in authority may consider that any agricultural land as needed and necessary may be used for a specific purpose or method, which means that farmlands can be acquired for the development projects if the President deems beneficial for the State.

According to the Burma Irrigation Manual Volume II, edited in 1948, it describes that a strip of land on each side of dam (tank) embankments shall be allocated with pillar setting by ID staff. Within the demarcated area, no lease or other permission shall be given for cultivation or residential purposes. Since there is no regulation to stipulate the width of the strip of land concerning polder dike construction in the Union, the width to be reserved has been decided by technical officers considering surrounding natural conditions, scale of structures and so on. However, a customarily operated rule does not allow cultivation or putting up of residential structures within 50 feet from toe of polder dike has been applied in the area since 1981.

4.3 Implementation and Result of Pilot Projects

4.3.1 Dike embankment and sluice rehabilitation pilot project

Since earth work for dike embankment can only be done during the dry season, the pilot project was planned to carry out the test embankment during the dry season of year 2009/10 and major embankment during the dry season of 2010/11.

(1) Purpose of pilot project

The purpose of the pilot project is to verify safety (quality), cost and schedule based on construction technology level in Myanmar and to formulate suitable design standard and construction method.

(2) Implementation and result of pilot project

1) Phase-1 for test embankment

Test embankment work was carried out in April 2010 for one km length of existing dike in Labutta North Polder. Six (6) different embankment methods were tested. As a result of test embankment, case-1 (soil improvement by natural drying and dozer compaction) was evaluated the most feasible rehabilitation method to be applied to major embankment work in phase-2. Manual embankment was also selected to be applied where shelters / houses or structures are close to the dike. The total embankment volume was 3,648 sud (= 10,324 m3).

2) Phase-2 for major embankment and sluice rehabilitation

2-1) Dike embankment

Construction method applied was soil improvement by natural drying and dozer compaction method based on test embankment in phase-1. Dike length for the embankment rehabilitation was determined through priority study of dike sections in consideration of expected tidal waves and surge at high tide due to topographic condition of dike in relation to rivers. As a result of the priority study, 39 km out of 56 km of total dike length for Labutta North Polder were evaluated as high priority for the rehabilitation works in Phase-2 Pilot Project.

Table 4.3.1-1 Results of Priority Study on Dike Sections for Rehabilitation

	Dike Length (km)	Embankment Vol. (Sud / m3)	Remarks
High Priority	38.6	161,000 / 456,000	For implementation in Pilot Project Phase-2
Low Priority	17.3	74,000 / 209,000	For future implementation by ID
Total	55.9	235,000 / 665,000	Except for Test Embankment by Pilot Project Phase-1, Road Improvement Project and Others

Two construction arrangements for dike embankment work were employed, namely 1) force account work by ID, and 2) contracted work by private contractors. ID machines and equipment were fully utilized for the force account work. The total embankment volume was 179,192 sud (= 507,113 m3) for actual dike length of 38.6 km.

Phase-2 Pilot Project work was commenced in early December 2010 after selection of the contractor. Ste work was completed at the end of March 2011. Quality control using field density test was made

based on standard D-value 90% (1.40 t/m^3) and lower limited D-value 85% (1.32 t/m^3) in accordance with test embankment conducted in phase-1. Quality control undertaken was very satisfactory with good results, i.e. mean D-value was 94% (1.47 t/m^3) and lowest was 89% (1.39 t/m^3) in the 474 points tested in the whole embankment work site.

2-2) Sluice gates

There are 96 gates (48 flap gates and 48 slide gates) at nine (9) sluices in Labutta North Polder. Among them, 34 flap gates (6 for replacement and 28 for repair) and 34 slide gates (all for replacement) at 6 sluices were rehabilitated in the pilot project.

Table 4.3.1-2 Quantity of Sluice Gate Rehabilitation

Gate Type	Whole Replacement (nos.)	Repair & Replacement (nos.)	Non-Repair (nos.)	Remarks
Flap Gate	6	28 (*)	14	*Repair a part of leaf and replacement of arm, hinge and seal.
Slide Gate	34	-	14	

As to gate material, four kinds of steel materials, namely mild steel, cast iron, aluminum alloy and stainless steel were studied. Of these, stainless steel was selected to be used for both the flap and slide gates that will be replaced. Stainless steel is considered the most resistant material against corrosion as commonly used in many countries.

Rehabilitation work for sluice gates was commenced in early December 2010 and the site work was completed at the end of March 2011. Inspection in the workshop in Yangon was made to confirm work condition to be satisfactory and field test was conducted for gate water sealing function.

(3) Training and study tour

Technology transfer such as compaction method and embankment quality control to ID engineers was carried out under the supervision of JICA study team. A study tour was also carried out from 25 – 27 March 2011 to the Pilot Project work site for dike embankment and sluice gates for 29 officials and engineers of ID, DAP and TPDC from Naypyitaw, Yangon and Pathein.

Table 4.3.1-3 Summary of Study Tour on Dike and Sluice Rehabilitation Pilot Project

Date	25th (Fri.) – 27th (Sun.) March 2011 (site observation and work shop is on 26th)
Place	Labutta North Polder, Labutta Township, Ayeyawady Division
Attendants	ID 23 persons, DAP 2, Agri-Business News 2, General Administration Department 2
Objectives	1) To observe dike and sluice rehabilitation under JICA pilot project. 2) To learn design concept, construction plan, supervision and quality control. 3) To exchange views on the above items.

(4) Evaluation and lessons from pilot project

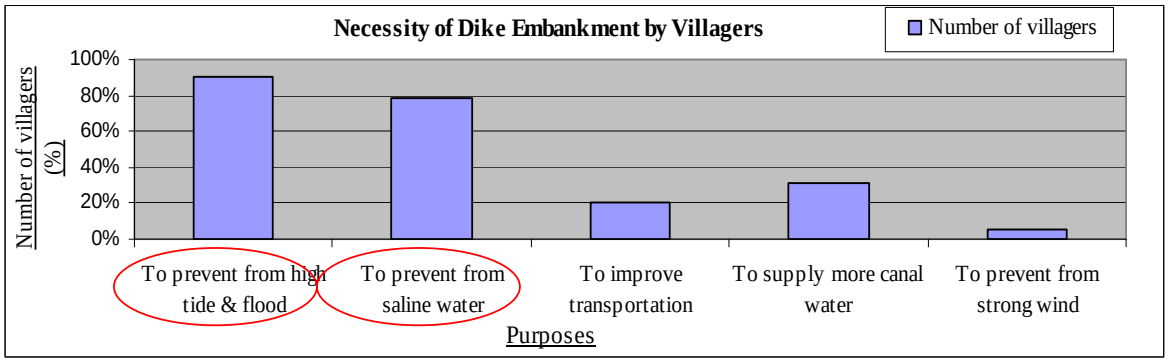
Formulated design concept and construction plan were verified as suitable for safety (quality) of facilities, construction cost and construction schedule on the pilot project and evaluated as possible to be duplicated based on the following reasons.

a) Design standard and quality control method including design dimensions of dike, field density test for embankment, and water sealing and operation of gates were confirmed efficient.
b) Applied filling method based on test embankment was confirmed most economical and viable to attain required work quality and schedule.
c) Resettlement of houses and effect to existing structures were minimized due to application of manual embankment and shifting of dike alignment.
d) It is suggested that proper pre-checking and repair of construction machines are very important to

keep work on schedule.

(5) Villager impact survey

Impact survey on the dike embankment was conducted in November 2010 in the villages where dike rehabilitation took place under the Pilot Project. From the survey, it was confirmed that the villagers understand the necessity of polder dike rehabilitation. About 80% to 90% of responses have recognized the function of the polder dike that is prevention against high tide, flood and saline water.



4.3.2 On-site seed production pilot project

(1) Purpose of pilot project

Purpose of the On-site Seed Production Pilot Project is to verify possibility of expanding high quality paddy seed production by farmers. In addition, the pilot project also aims to strengthen farming technique of participant farmers in the pilot project and MAS extension work.

(2) Implementation and result of pilot project

The pilot project was implemented for 13 months from April 2010 to April 2011 in cooperation with MAS Labutta Township Office.

1) Result of paddy seed quality check and production amount: Two times of seed quality check were conducted. As a result, most farmer participants were requested to execute re-drying of paddy seed they produced. After re-drying, 22 farmers (76%) passed the seed quality check. A total of 2,384 baskets of CS were produced by the 22 farmers.

2) Cropping result (yield and paddy seed production amount): Average yield of the pilot project was 53 baskets/acre for Paw San Yin (local variety), 74 baskets/acre for Manawthukha (HYV) and 77 baskets/acre for Sin Thwe Latt (HYV). These yields are still low in comparison with potential cropping yield of each variety (Paw San Yin: 65-70 baskets, Manawthukha: 100-110 baskets, Sin Thwe Latt: 120-130 baskets). However, the cropping yields are around 30%-50% higher than the non-pilot project areas. Such high yield is possible to be attained with the following combined activities be realized by synergy effect of a) use of adequate amount of fertilizer, b) intensive farming management and c) use of high quality seed.

Table 4.3.2-1 Comparison of Cropping Yield

(Baskets / Acre)

	Potential Cropping Yield *1	Result of the Pilot Project	Non Pilot Project Area *2
Paw San Yin	65-70	53	40
Manawthukha	100-110	74	54
Sin Thwe Latt	120-130	77	49

3) Result of selling paddy seed: In the beginning of the pilot project, many international organizations and NGOs have signified support to buy the paddy seed to be produced by the pilot project. However, such positive response (demand) has not been realized after harvest of the paddy seed. It seemed that these organizations had reduced assistance activity in Nargis affected area in the Ayeyawady Delta. Therefore, participant farmers sold the paddy seed mainly to neighboring farmer and brokers. By the middle of June 2011, 91% of the total paddy seed produced was sold.

4) Profitability: Average net income of paddy seed production in the pilot project was 189,000 Kyats/acre while net income of grain paddy production was estimated at 120,000 - 140,000 Kyats/acre based on the interview of farmers.

(3) Training and workshop

In total, 12 workshops and seminars that include orientation, technical training, evaluation and extension were organized for the pilot project from April 2010 to April 2011. On-site training was frequently undertaken by the JICA project team together with C/Ps and MAS technical officers.

(4) Evaluation and lessons from pilot project

1) Evaluation:

a) All activities of the pilot project were carried out without particular problem. Technical support to farmers and monitoring of the progress were carried out properly as planned.

b) All the participant farmers have sufficient experience of paddy production. However in drying of paddy seed, drying technique was not good enough, thus re-drying was required for several farmers.

c) According to the participant farmers, there are not many casual labors who are familiar with advanced cropping technique such as regular row planting. Therefore, securing the skilled labors is important to continue paddy seed production.

d) For the seed quality test for produced seed, 22 farmers of 29 in total participants (76%) passed the MAS quality test. From this result, it is evaluated that farmers can sufficiently produce high quality paddy seed with technical support.

e) Access to MAS registered seed and MAS seed quality test was insufficient. To disseminate the certified paddy seed production, it is important to expand and strengthen the MAS support system for paddy seed quality test.

f) Selling the paddy seed produced was not very satisfactory. There were some constraints, such as “farmer’s poor understanding on the advantage of high quality seed” and “lack of dissemination for high quality seed”.

2) Lessons:

a) Farm management varies widely by farmer. Some farmers can practice adequate farming management with verbal instruction and explanation. On the other hand, some farmers needed to be coached several times. Therefore, it is important to select seed production farmers in accordance with level of competence on farm management.

b) As to paddy seed storage, some of the participant farmers did not have storage facilities. About 5-6 months storage of paddy seed is required. It is important to consider storage availability in the selection of seed production farmer participants as part of the project component.

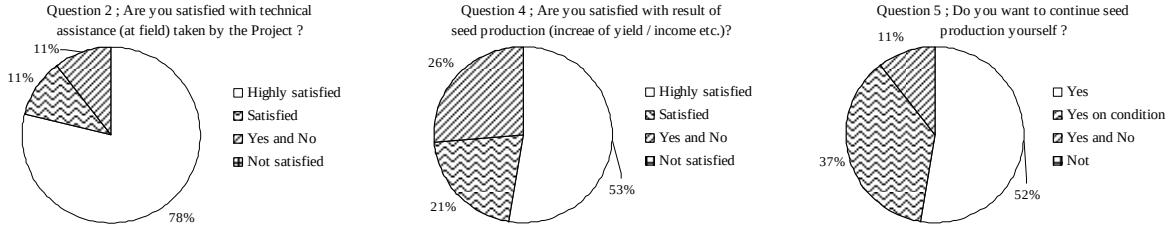
c) A private agricultural company participated in the extension workshop. This company was seeking the possibility of setting up business on high quality seed production on contract farming basis. The contract farming will be one of the ways to minimize problems in budget and storage. It is important to share information about advanced farmers between MAS and private company.

d) Seed renovation is important for improved variety than local variety because of difference of genetic stability. However, local variety still has high demand in the project area therefore, it is

also necessary to increase production of the local variety seed.

(5) Farmer satisfaction survey

During the evaluation workshop held in March 2011, farmer satisfaction survey was conducted. As a result, level of satisfaction of farmer participants with regards to field technical support carried out by the pilot project was nearly 90% while participants who clearly expressed willingness to continue seed production were just 52%. Main reason for this willingness level would be the difficulty in marketing and limited availability and access to paddy seed for production.



4.3.3 Income generation pilot project:

(1) Purpose of pilot project

The pilot project of income generation through vegetable cultivation is aimed at examining the possibility that the participant households would get income from vegetable production. The result of this pilot project will be used to finalize the income generation development plan.

(2) Implementation and result of pilot project

1) Overview of the pilot project implementation

a) JICA project team executed: i) preparation of the framework for landless household to start vegetable production, ii) support to vegetable production and marketing, and iii) establishment of sustainable production framework.

b) Easy growing crops were applied so that beginners will easily get income. Five crops, namely cucumber, okra, water cress, roselle, and yard long bean were chosen for the pilot project.

c) Paddy field after harvest was borrowed from the farmer landowner without payment. Farm size was set at 0.15 acre (607 m2) for each participant.

d) JICA project team and MAS supervised the supporting activity in collaboration with TPDC and VPDC and field work was executed by a subcontracted Myanmar consultant.

2) Selected villages: Two sites were chosen for the pilot project implementation, namely Thet Yat Kone and Pharar Gyi Kone villages in Labutta Loke South village tract and Tet Yat Kone village in Kyauk Hmaw village tract.

Table 4.3.3-1 Summary of Social Condition of Target Villages

Village tract		Labutta Loke South		Kyauk Hmau
Village		Thet Yat Kone	Phayar Gyi Kone	Tha Yet Kone
Population		853	526	641
Households	All households	214	120	142
	Land right holder	39	12	38
	Landless households	175	108	104
	Paddy worker	*145*	*85*	*99*
	Small fishery	*5*	*13*	*5*
	Other casual works	*25*	*10*	*(construction work is important income source)*

3) Implementation process

a) Activity 1 consists of the establishment of implementation body, selection of participants, and confirmation of land for use, preparatory workshop and baseline survey and was done from October to November 2010.

b) Activity 2 consists of technical workshop, distribution of input, cultivation and sale by participants, and on-site training and was executed from December 2010 to March 2011.

c) Activity 3 consists of evaluation workshop, extension workshop, manual making, and satisfaction survey and was done from March to April 2011.

4) Result of pilot project

a) Of 60 selected households, 28 households in Labutta Loke South village–tract (LLS) and 29 in Kyauk Hmaw village-tract (KH) started cultivation, but three households stopped due to illness, other job or movement to other place.

b) More than 80% of the continuing participants got harvest from cucumber, rosele and water cress while successful rate was low in okra and especially yard long bean. Among 54 continuing households, 52 got harvest at for at least one crop.

c) Average gross benefit was 49,300 Kyats per participant and average net return was negative when production cost of 49,401 Kyats was considered. About 30% of participants got positive net return.

Table 4.3.3-2 Result of Vegetables Production in Pilot Project

Item	Unit	Cucumber	long bean	okra	roselle	water-cress	Per HH
Successful participants	HH	44	20	40	49	47	(total 52)
Net return Kyat/participant	Kyat	-7,185	852	1,572	13,056	5,257	-2,790

5) Price fluctuation

a) Almost all participants sold their produce at Labutta Konelay ‘tax free’ market that is open only in the night time. A new market was planned to be constructed in the new district center near the KH site during the 2010-2011 dry season, but it did not materialized.

b) At the markets in Labutta, unit price of all vegetables except roselle tend to decrease from December to March. It means that landless households should start vegetable cultivation as early as possible to get higher profit. However, it is also found that they can not start vegetable cultivation until agriculture labour work is completed.

(3) Training and workshop

Nine workshops were held during the income generation pilot project from November 2010 to April 2011. These workshops included project preparation, crop techniques, technical training, project evaluation and extension.

Table 4.3.3-3 Trainings and Workshops for Income Generation Pilot Project

Workshop	Date	Subject	Attendant
1) Preparation Workshop (at LLS)	24/11/2010	- Explanation of the pilot project - Confirmation of intension of participation - Agreements between participants and JICA study team, participants and land right holders	Participants, MAS, PDC
2) Preparation Workshop (at KH)	25/11/2010		
3) 1st Workshop (Technical training at LLS)	9-10/12/ 2010	- Training on improved cultivation method and book keeping	Participants, MAS
4) 1st Workshop (Technical training at KH)	11-12/12/ 2010		

5) 2nd Workshop (Technical training at LLS)	25/2/2011	- Instruction of proper chemical use	Participants, MAS, PDC
6) 2nd Workshop (Technical training at KH)	26/2/2011		
7) Evaluation Workshop (at KH)	28/3/2011	- Confirmation and sharing of the outputs of the pilot project among stakeholders - SWOT analysis	Participants, MAS, PDC
8) Evaluation Workshop (LLS)	29/3/2011		
9) Extension Seminar	5/4/2011	- Information sharing about the result of the pilot project among participants, government staff, and NGOs	Participants, MAS, NGO, government staff

(4) Evaluation and lessons from pilot project

1) Self-evaluation of participants: Participants evaluated their activities by applying SWOT analysis in the evaluation workshop. Labour force availability, location of cultivation plot, experience, knowledge and technique were regarded important as internal factors. Free land use, work schedule of rice production, and natural (soil, water) condition were found important as external factors.

2) Lessons learned from pilot project for sustainable vegetable cultivation

a) Balance of labour force and cultivation area is an important key for success. 0.1 acre will be suitable for two persons.
b) Distance between cultivation plot and water source shall be less than 100 feet to avoid watering burden.
c) Distance between cultivation plot and house is important to avoid crop injury by cattle and thieves. This is the ideal distance that the participants can watch from their house.
d) Early start of planting vegetable in dry season will bring more profit.
e) Land use must be guaranteed for landless households for sustainable vegetable cultivation.
f) Soil and water condition must be checked before cultivation.

3) Effect on household economy: Net return of sales of five vegetables was positive with 9,363 Kyats/HH in LLS village while it was negative with -7,606 Kyats/HH in KH village.

4.3.4 Mangrove windbreak rehabilitation pilot project

(1) Purpose of pilot project

Objective of the pilot project is to obtain data and information regarding mangrove reforestation to be made along dike embankment. The mangrove windbreak trees are commonly seen along polder dike embankment at river side as natural vegetation, with the function to protect embankment from direct attack of tidal wave and storms. Result of the pilot project is used for the formulation of the D/P for other polders and embankments in the project area in the Ayeyawady Delta.

(2) Implementation and result of pilot project

1) Site selection: The river bank in front of Damin Chaungalay village was selected for the pilot project site. Damin Chaungalay village is located in the North-western part of Labutta North Polder, which faces Thet Ke Thaung River.

2) Planted mangrove species: Three mangrove species, namely Sonneratia apetala (Sa, local name is Kanbala), Nipa fruticans (Nf, local name is Dani) and Avicennia officinalis (Ao, local name is Thame Gyi), were selected for plantation at the pilot project site. Plantation was done for 500 m along existing dike with 100 m in planting width.

3) Procurement of seeds and seedlings and temporary nursery: Seedlings of Sa and Ao were obtained from Thar Kone nursery which is managed by FD. NF seeds were also prepared by FD.

However seedling breeding of Nf was carried out by villagers of Damin Chaungalay. For the seedling breeding of Nf, temporary nursery for Nf was prepared at planting site.

4) Fencing: Bamboo fence was installed around the plantation on river side to protect planted seedlings from river flow as well as to keep animals out of the planted area.

5) Implementing body: Pilot project was implemented by local villagers of Damin Chaungalay village through management of JICA project team together with local consultant. FD Labutta office supported technical aspects regarding planting of mangrove tree species. The Mangrove Windbreak Establishment Committee was established in Damin Chaungalay village for implementing mangrove tree planting. This committee became the core implementing body of the pilot project operation.

6) Result of implementation: The mangrove windbreak with planted area of about 5 ha was established along the polder dike in Damin Chaungalay village through the implementation of the mangrove windbreak rehabilitation pilot project.

Table 4.3.4-1 Implementation Process of Mangrove Windbreak Rehabilitation Pilot Project

Activity	Timing	Contents	Man/day	Material cost (Kyat)
Land survey	April, 2010	・Measurement of boundary ・Location fixing for temporary nursery and fence ・Implementing by local consultants	—	—
Temporary nursery	May, 2010	・Material procurement by project ・Implementing by residents with payment	4.5	29,760
Procurement of Nf seeds	May, 2010	・Procurement of Nf seed from FD nursery by project ・Transportation of Nf seed by boat which prepare by project ・Unloading of Nf seed from boat by residents without payment	—	367,500
Breeding of Nf	May–July, 2010	・Patrol at the nursery ・Implementing by residents without payment	—	—
Fencing	May–June, 2010	・Installing at surround of planting site ・Material procurement by project ・Implementing by residents with payment	215	2,150,700
Marking for planting place	May–June, 2010	・Bamboo stick for marking and support of seedling ・Material procurement by project ・Implementing by residents with payment	131	62,500
Procurement of Ao and Sa seedlings	June, 2010	・Procurement of Ao and Sa seedlings from FD nursery by project ・Transportation of seedlings by boat which prepare by project ・Implementing by residents with payment	22.5	1,175,000
Planting	June–July, 2010	・8000 seedlings of Ao ,5000 seedlings of Sa and 920 seedlings of Nf were planted ・Implementing by residents with payment	163	84,740
Grass weeding	September, 2010	・Grass weeding was conducted along the planted row ・Implementing by residents with payment	—	—
Monitoring	October, 2010	・Implementing by local consultants	—	—
Supplemental planting	October, 2010, January, 2011	・8000 seedlings of Ao ,5000 seedlings of Sa and 920 seedlings of Nf were planted ・Procurement of seedlings from FD nursery by project ・Implementing by residents with payment	—	176,000
		Total	536	4,046,200

7) Cost-benefit analysis of mangrove windbreak pilot project: Villages can get fire wood from Ao, construction material from Sa, roofing materials from Nf. Nf can produce 750 sheets of roof material per ha every year three (3) years after planting. Consequently, annual net profit from the three (3) tree species can be expected at 1,458,000 Kyats/ha after deduction of maintenance cost of mangrove windbreak.

(3) Training and workshop

Several trainings and workshops were conducted during the implementation of the pilot project from April 2010 to March 2011. Picture competition for students by school was held in Damin Chaungalay village for information and educational dissemination purposes. Evaluation workshop was held in the village with participation of villagers, FD and VPDC, and the Mangrove Management Committee was established in the village to maintain planted mangrove windbreak in the pilot project.

(4) Evaluation and lessons from pilot project

1) Evaluation:

a) As to mangrove species, mortality rate of Ao seedling was 17%, Sa was 12% and Nf was 15%. These mortality rates were relatively low compared with other mangrove plantation in Myanmar. Also tree growth was good for the three mangrove species. These results indicate that the three mangrove species planted are suitable for mangrove windbreak rehabilitation in this area.

b) A fence was installed surrounding the planting site. The installation of fence was considered very effective due to the following reasons: (i) it reduces power of strong wave, (ii) it protects the entry of trash and water lily from outside into planting site, and (iii) entry of boat is limited.

c) Implementation plan for the pilot project was considered viable and effective as all activities were carried out smoothly. At the evaluation workshop, the Mangrove Management Committee for the maintenance of mangrove windbreak was established in the village. The committee identified the role of the villagers for the maintenance and utilization of mangrove wind break trees.

2) Lessons:

a) The materials and equipment which the villagers can provide individually are extremely limited. Outside investment/support is essentially required for the materials and equipment.

b) Establishment of mangrove windbreak requires labor force of villagers. Most work shall be done with pay for villagers except some works such as nursery care and cutting grass.

c) Ao and Sa seedlings and Nf seed are available at FD nursery. Nf seed is also available at private nursery. These species are very common and nursery activity is relatively easy. Therefore these three (3) species are suitable for rehabilitation of mangrove windbreak in this area.

d) Although installation of fence would require a lot of labor force, equipment and materials, the function of protection for planting site is very effective.

4.4 Initial Environmental Examination (IEE)

Based on assessment, the activities of four pilot projects would not produce any adverse effect on natural environment as project activities were rehabilitation of existing damaged dikes and mangrove trees, improvement of rice farming and vegetable cultivation. As to air pollution and noise, project activity would only produce temporary effects on small scale during actual construction.

About social-related impact, ROW was a concern since dike rehabilitation was anticipated to produce negative effect in relation to land acquisition and house resettlement. Dike embankment was designed and built at 1:1.5 side slopes to minimize the land acquisition. Manual embankment to reduce the number of affected houses was employed during construction. It was also necessary to consider borrow pit location and transportation measures to minimize disturbance to farmland and houses.

With the rehabilitation of the polder dike embankment farms of 96 farmers and houses of 8 households

were affected encountering some ROW concerns. There were only a few complaints made by affected people even they were not compensated because of their awareness of the necessity of dike rehabilitation for security and public interest according to the farmer survey.

Chapter 5 Development Plan for Preservation of Farming Area

5.1 Basic Policy for Formulation of Development Plan

5.1.1 Basic policy: The objective of the Project is to formulate the "D/P for Preservation of Farming Area for Urgent Rehabilitation of Agricultural Production and Rural Life" in the Ayeyawady Delta. From the discussion made in Chapters 2 and 3, two aspects were prioritized; 1) rehabilitation of polder dikes, embankments and sluices as well as mangrove windbreak for the preservation of farming area, 2) improvement of farming and income generation for rehabilitation of crop production and rural life.

The project area is situated in the coast of the Ayeyawady Delta where severe natural condition has limited the expansion of residential and farming areas over a long period of time. Major severe natural conditions are located in the low-lying polder area surrounded with saline river water and heavy rainfall over 3,000 mm, and when combined with other factor such as big cyclone, it can cause great damage in the area as what actually occurred in May 2008 by Nargis.

As to agriculture, the most essential livelihood in the polder area, there are several urgent issues to be solved as observed clearly after Nargis attack. They are low productivity of rice, lack of farm inputs such as rice seed, insufficient agricultural extension services and low cropping techniques by farmers. Integrated measures such as joint work in cooperation between government extension services and farmer level improvement are strongly required for increase of agricultural production.

From the above, it can be stated that urgent development in the Project Area shall focused on the establishment of firm agricultural infrastructure against severe natural condition as well as on the restoration and increase of agricultural production.

Basic policy for the preservation of farming area shall be set as follows:

1) To preserve farming area through establishment of safe and stable infrastructure: This is essential and urgent for the preservation of farming area in the polders that were seriously damaged by Cyclone Nargis. Farmland in the Project Area can be preserved through physical rehabilitation of related infrastructure particularly polder dikes and sluices as key facility. In addition to that, rehabilitation of mangrove trees, which function as windbreak for the protection of dikes and embankment from erosion caused by tidal surge, are also included as important facility.
2) To restore and increase agricultural production and reconstruct rural life at preserved farming area: Agriculture is the most important subject in this agro-based rural area to rehabilitate and develop and its development shall focus on the improvement of farm management for rice cropping and agriculture-related activities. As to farm improvement, focus is given to the improvement of farm inputs on rice cropping and strengthening of MAS extension services. For agriculture-related activity, on the other hand, income generation plan with focus on vegetables and livestock by landless people shall be formulated in the D/P.

5.1.2 Basic concept and framework of the D/P

a) As to agricultural and rural infrastructure, polder dikes and sluices shall be the major targets for urgent rehabilitation to prevent disaster in the future. Mangroves shall also be proposed to be rehabilitated as they are effective windbreak that will reduce tidal surge and storms and therefore will protect of polder dikes.
b) Agriculture and agriculture-related fields to be promoted in the D/P will be two subjects, namely farm management and income generation. Farm management is the most essential for the increase

of agricultural production and it focuses on quality rice seed production by farmers and MAS extension capacity and services. Income generation through vegetable cultivation, fruit plantation, livestock and fish processing at small scale will be promoted for landless households.

c) Implementation period of the D/P will be set based on the project size and volume to be formulated on component basis.

d) Target area for the D/P will be 34 polders in Ayeyawady Region as stipulated in the Scope of Work (S/W) for the Project.

e) Implementing body will be determined on a project basis. Basically, polder dikes will be handled by ID, mangrove windbreak by local government and villager beneficiaries, farm management by MAS and rice farmers, and income generation by local government and landless households.

f) Implementation method and process will be determined on a project basis. Study and discussion will be made among the stakeholders concerned. Participatory approach and work sharing arrangement with farmer / villager beneficiaries may be employed in implementation process.

g) Procurement of project budget will be made by the government for public infrastructure projects for farming area preservation and disaster prevention like polder dikes, sluices and mangrove trees. On the other hand, rice seed production and income generation will be planned in view of cost sharing under self-help concept.

5.2 Scope of Development Plan

5.2.1 Components of Development Plan;

(1) Agricultural and rural infrastructure, which includes rehabilitation of polder dikes, sluice gates and so on,
(2) Farm management, which includes strengthening of the field extension work and agricultural input support,
(3) Income generation, which includes support of small business for income generation, and
(4) Mangrove windbreak trees, which include rehabilitation / replanting of mangrove trees along polder dike.

5.2.2 Target polders on Development Plan of the D/P is 34 polders, which are scattered in Ayeyawady Region in the Ayeyawady Delta. The total population is about 248,000, the total protected areas is 1,342 km^2 (134,200 ha) and the total dike length is about 940 km.

Table 5.2-1 List of 34 Polders for Development Plan

Township	Sr. No.	Name of polder	Population	Protected area (km^2)	Length of dike (km)
Labutta	1	Alegyun (1) polder	3,947	16.7	21.6
	2	Alegyun (2) polder	6,139	36.1	36.5
	3	Alegyun (3) polder	2,967	36.5	28.4
	4	Magybinmadaukkan	1,601	5.5	5.5
	5	Thingangyi	474	7.0	10.1
	6	Zinywe	633	6.2	9.7
	7	Leikkwin	392	3.8	6.0
	8	Labutta (South)	4,166	28.7	32.5
	9	Labutta (North)	15,547	78.3	61.2
	10	U Gaungpu	205	3.7	8.4
	11	Bitud Island (1)	1,191	19.0	22.6
	12	Bitud Island (2)	7,315	27.8	29.9
	13	Bitud Island (3)	3,743	32.2	45.1
	14	Bitud Island (4)	14,169	76.4	65.3
		Sub-total	**62,489**	**377.8**	**382.8**
Bogalay	15	Daunggyi	15,935	98.9	59.6
	16	Daunggyi (East)	8,433	89.3	54.6
	17	Daunggyi (West)	12,921	69.4	50.9
	18	Daunggyi (Upper)	4,066	13.8	16.9
		Sub-total	**41,355**	**271.4**	**182.0**

Township	Sr. No.	Name of polder	Population	Protected area (km^2)	Length of dike (km)
Phyapon	19	Daw Nyein polder	5,850	12.0	22.5
	20	Myokone polder	4,019	22.8	27.4
	21	Kyetphamwezaung	25,687	125.7	74.1
	22	Banbwezu	9,604	53.3	41.9
	23	Daydalu	4,072	17.2	20.9
	24	Letpanbin	4,195	34.6	32.2
	25	Zinbaung	3,992	26.7	24.2
		Sub-total	**57,419**	**292.3**	**243.2**
Daydaye	26	Myaseinkan	9,866	54.7	21.7
	27	Thandi	1,651	13.9	6.8
	28	Suclubbaluma	4,935	29.5	11.9
	29	Hleseikchaunggyi	2,026	9.1	11.9
	30	Tamatakaw	10,459	53.5	11.3
	31	Kyonsoat	316	2.4	8.1
		Sub-total	**29,253**	**163.0**	**71.7**
Kyaiklatt	32	Maubin Island (North)	27,386	110.0	20.0
	33	Maubin Island (South)	9,248	46.1	7.1
	34	Thonegwakyun	20,851	81.2	35.8
		Sub-total	**57,485**	**237.3**	**62.9**
		Total	**248,001**	**1,341.7**	**942.6**

Source: ID, TPDC, JICA Project Team

5.3 Rehabilitation Plan on Agricultural and Rural Infrastructure

5.3.1 Basic concept for the rehabilitation of agriculture and rural infrastructure is set based on the result of the pilot project as follows:

1) Construction method of "soil improvement by natural drying-up and dozer compaction" will be employed for dike embankment as it is evaluated the most economical and viable. In addition, manual embankment will also be applied where existing houses are close to the dike.
2) In the rehabilitation of sluice, rehabilitation method either be repair or replacement and will be determined based on the result of gate function evaluation in consideration of low cost rehabilitation. For the gate material for new fabrication, stainless steel will be used in consideration of durability.
3) To improve drainage condition of protected farmland, side-borrow area along the dike for embankment will be effectively utilized. Such side-borrow area will also be used as water ponds for domestic use according to village need.

5.3.2 Project contents and volume: The project area covers 34 polders and embankments in Ayeyawady Region with project contents as follows;

- Reconstruction of dike embankment with required crest levels for safety.
- Rehabilitation of sluices with required functions for flap or slide gates.

Project volume is estimated excluding the completed work by ID as of March 2011, as follows:

Table 5.3-1 Project Volume for Rehabilitation of Dike and Sluice

Component of Project	Project Volume	Remarks
1 Dike embankment (sud/m3)	3,381,022 sud (= 9,568,292 m3)	30 polders excluded No. 3,4,9,26 for dike length of 825 km
2 Rehabilitation of sluices	77 sluices	20 polders
2-1 Flap gate (nos.)	332 (67 for replace & 265 for repair)	
2-2 Slide gate (nos.)	339 (159 for replace & 180 for repair)	
Total gates	671 (226 for replace & 445for repair)	

5.3.3 Result of hydrological analysis: Prior to design of polder dikes, hydrological study was made in order to determine the water levels for embankment design. Defining that the high tide level at the delta coastline is the sum of the highest normal tide and the probable storm surge residual of 50 year recurrence, astronomical tides are collected from two stations, Diamond Island and Elephant Point. Flood water levels along the river systems upstream-ward were then estimated, starting from the given magnitude of tidal levels at the river mouths, employing the hydraulically simulated pattern of river water stages during the severe flood of once in 100 years probability that actually occurred in 1974. High water levels so estimated at river mouths and along the river systems were plotted on to generate iso-lines of high water levels.

5.3.4 Design and construction plan

(1) Typical cross section of dike: Definition for determination of the design crest level (hereinafter called as A.C.L) is provided in two ways separately for river dike and coastal dike, where extra height is added to the high water level, as a freeboard, in the following equation.

- Case-1 (for river dike): A.C.L = H.W.L + Freeboard (0.6m to 2.0m)
- Case-2 (for coastal dike): A.C.L = H.W.L + Design wave height + Freeboard (0 to 1.0m)

Here, the freeboard for the case-1 is determined at 1.2m (4.0ft) in accordance with the Japanese Standard, and in consideration of river flow along the dike / embankment to be 2,000 and 5,000 m^3/sec during severe flood in return period of 50 years or more. Actual height of tidal wave is considered to decrease due to coastal vegetation such as mangrove, so that additional freeboard (0 to 1.0m) is not

adapted for the case-2. Dike slope gradient of 1:1.5 is adopted because of the following reasons.

- Dike height is not more than 2-3m (7-10 ft) from the ground elevation on the average, so that risk of slope sliding will be extremely low.
- It is common to see natural mangrove trees along the dike at river side, which protect dike.
- As side slope becomes gentler which require more ROW for embankment work, loss of farmland becomes larger.
- Gentle slope will require more embankment volume with more construction cost.

Furthermore, the crest width is adopted by 3.6m (12 ft) in consideration of traffic condition in future, as presently designed by ID. **Figure 5.3-1** gives typical cross-section and crest level of polder dike.

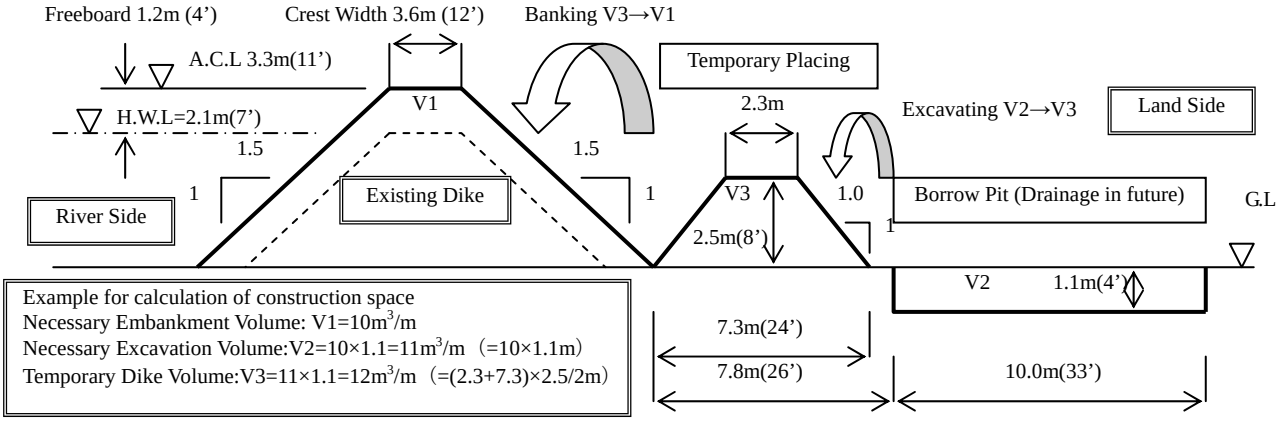


Figure 5.3-1 Proposed Typical Cross Section of Dike

In addition, as shown in the following table, there is different height by 0.0 to 4.0 ft between JPT design ACL and ID design ACL, and reconstruction works of some polder dikes have been already completed by ID. Therefore, it shall consider the other method of additional embankment for raising completed polder dike.

Table 5.3-2 Differences of Design Crest Level and Progress of ID Rehabilitation by Polder

Township	No.	Name of Polder Dike	Dike Length (mile)	Paddy I&II Original CL (ft) (1)	Average Existing ECL (ft) (2)	JPT Design ACL (ft) (3))	ID Design ACL (ft) (4)	Difference ACL height of JPT & ID (ft) (5)=((3)-(4)	Progress (up to end of March 2011)
Labutta	1	Alegyun (1)	13.40	13.5	11.8	13.5	13.5	0	0%
	2	Alegyun (2)	22.70	13.5	10.8	14.0	14.0	0	0%
	3	Alegyum (3)	17.65	13.5	11.4	14.0	14.0	0	100% Completed
	4	Magyibinmadaukan	3.40	13.5	10.5	14.0	14.0	0	100% Completed
	5	Thingangyi	6.30	8.5	3.6	11.5	10.0	1.5	68%
	6	Zinywe	6.00	8.5	5.6	11.5	8.5	3.0	100% Completed
	7	Leikkwin	3.75	8.5	4.8	11.5	8.5	3.0	0%
	8	Labutta (S)	20.20	12.0	5.2	11.0	10.0	1.0	0%
	9	Labutta (N)	38.00	12.0	6.9	11.0	10.0	1.0	High priority only
	10	U Gaungpu	5.20	8.5	1.8	12.0	8.5	3.5	0%
	11	Bitud Island (1)	14.02	10.0	5.5	12.0	10.0	2.0	23%
	12	Bitud Island (2)	18.60	10.0	6.3	12.0	10.0	2.0	7%
	13	Bitud Island (3)	28.00	10.0	4.5	12.0	10.0	2.0	54%
	14	Bitud Island (4)	40.53	10.0	6.8	12.0	10.0	2.0	100% Completed

Bogalay	15	Daunggyi	37.00	7.5	8.0	12.0	8.5	3.5	17%
	16	Daunggyi (East)	33.90	7.5	6.4	12.5	8.5	4.0	368%
	17	Daunggyi (West)	31.60	7.5	6.8	12.0	11.0	1.0	100% Completed
	18	Daunggyi (Upper)	10.50	7.5	6.5	12.0	8.5	3.5	0%
Phyapon	19	Dawnyein	14.00	8.5	6.9	12.5	8.5	4.0	100% Completed
	20	Myokone	17.00	8.5	6.8	12.5	8.5	4.0	100% Completed
	21	Kyetphamwezaung	46.00	8.5	5.7	12.5	9.0	3.5	6%
	22	Banbwezu	26.00	8.5	7.8	12.0	8.5	3.5	0%
	23	Daydalu	13.00	9.0	5.9	12.5	9.0	3.5	100% Completed
	24	Letpanbin	20.00	8.5	7.9	12.5	8.5	4.0	100% Completed
	25	Zinbaung	15.00	8.5	7.8	12.5	8.5	4.0	18%
Daydaye	26	Myaseinkan	13.50	13.0	8.3	13.0	13.0	0	72%
	27	Thandi	4.25	13.0	8.5	13.0	12.0	1.0	100% Completed
	28	Suclubbaluma	7.40	9.0	10.7	13.0	11.0	2.0	100% Completed
	29	Hleseikchaunggyi	7.40	9.5	11.0	13.0	11.0	2.0	0%
	30	Tamatakaw	7.00	12.0	12.7	14.0	12.0	2.0	100% Completed
	31	Kyonsoat	5.00	12.0	11.3	14.0	13.0	1.0	100% Completed
Kyaiklatt	32	Maubin Island (N)	12.40	10.0	8.5	13.5	10.0	3.5	0%
	33	Maubin Island (S)	4.40	10.0	9.3	12.0	10.0	2.0	0%
	34	Thonegwakyun	22.25	12.0	10.3	13.5	12.0	1.5	0%

Note: Average ECL is based on longitudinal survey data by ID and JPT means JICA Project Team and progress is informed by ID.

When deciding the additional embankment method, it shall be important to take the following matters into consideration.

- To reduce the quantity of additional embankment volume by considering budget of project.
- To reduce the borrow pit area so as not to reduce the farming land of farmers.
- To undertake actual and suitable method for the construction and site conditions.

The following two (2) methods shall be proposed according to the raising height value.

Case-1 (raising height is more than 2.0 ft)

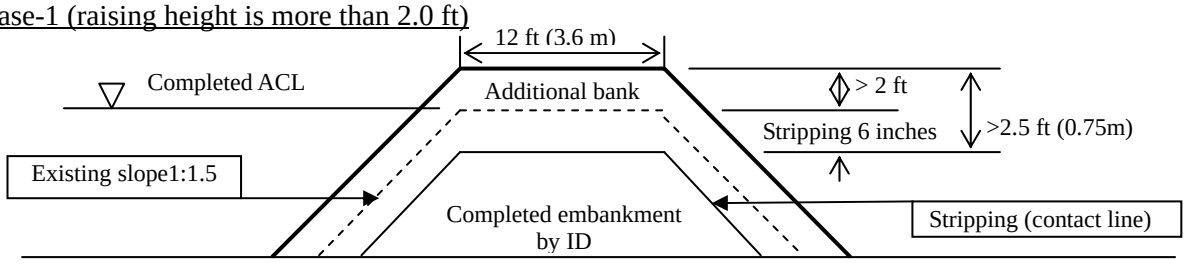


Figure 5.3-2 Additional Embankment Method (Case-1)

Case-2 (raising height is less than 2.0 ft)

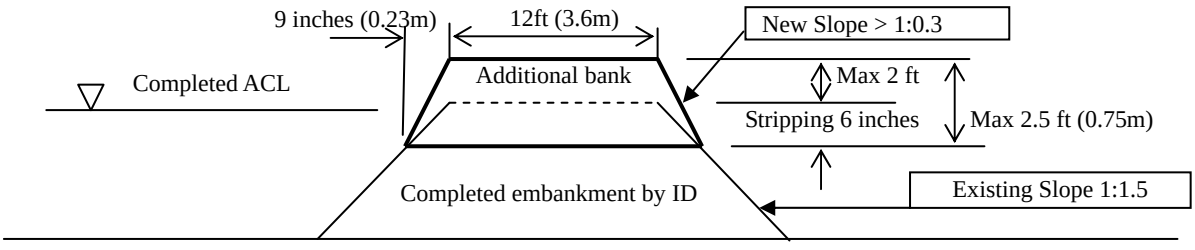


Figure 5.3-3 Additional Embankment Method (Case-2)

Moreover, according to the location of existing borrow pit it shall be necessary to consider whether the river side or land side will be expanded (**Figure 5.3-4 and 5.3-5**).

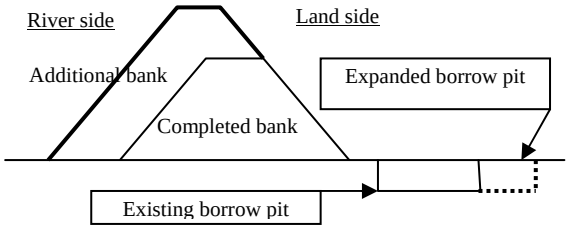


Figure 5.3-4 Case of Bank Expansion to River Side

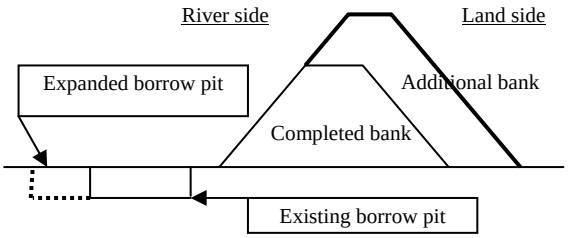


Figure 5.3-5 Case of Bank Expansion to Land Side

(2) Rehabilitation method for sluice gate: Rehabilitation method is classified into 3 types, namely replacement, repair and non-repair, based on the results of the functional survey undertaken for 34 polders and is presented in the table below. However it is suggested that further detailed functional survey should be undertaken when the Development Project takes place in order to have a more detailed evaluation of the polder dikes based on the survey conducted in Labutta North Pilot Project. Presented below is the evaluation method and criteria used for the rehabilitation of the sluice gate.

Table 5.3-3 Point Distribution in Function Evaluation Survey for Sluice Gate

Items / Member	Corrosion			Damage			Function		
	Good	Medium	Bad	Good	Medium	Bad	Good	Medium	Bad
Gate leaf	1	2	3	1	2	3	1	2	3
Gate frame	1	2	3	1	2	3	—	—	—
Hoist	1	2	3	1	2	3	1	2	3

Table 5.3.-4 Selection Criteria of Rehabilitation Method for Sluice Gate

Method	Member of Gate	Total Points	Evaluation Item and Example Point			Remarks (Items*Point)
			Corrosion	Damage	Function	
Replace (by new one)	Leaf & Hoist	More than equal 7	> 2	> 2	> 3	> 2i *2p+1i*3p
	Guide frame	More than equal 5	> 3	> 2	-	> 1i*2p+1i*3p
Repair	Leaf & Hoist	Between 6 and 5	2	2	2	3i*2p or 2i*2p+1i*1p
	Guide frame	4	2	2	-	2i*2p
Non Repair	Leaf & Hoist	Less than equal 4	< 2	1	1	< 2i*1p+2i*1p
	Guide frame	Less than equal 3	< 2	1	-	< 1i*2p+1i*1p

Table 5.3-5 Result of Function Survey for Sluice Gates at 34 Polders

	Nos. of Sluice	Flap Gate				Slide Gate			
		Nos.	Replace	Repair	Non-repair	Nos.	Replace	Repair	Non-repair
Grand Total	86	500	73	293	134	428	193	180	55
Grand Total (Except Labutta North)	77	452	67	265	120	380	159	180	41

In addition, stainless steel is proposed to be used for the replacement of gates based on the pilot project study.

(3) Construction plan: In order to secure required volume of embankment soil, borrow pit at the paddy field adjacent to the existing polder dike an area of 10 m in width and 1.2 m depth is required. In addition, a temporary space of about 10 m. wide for embankment materials for natural drying will be needed. However, exact width shall be determined on polder basis in consideration of each polder condition. For embankment quality control, standard compression density of soil material is set with target density of 90% D-value and lower limited density of 85% D-value.

5.3.5 Implementation method and implementing body: The rehabilitation work for polder dike / embankment and sluices including concrete work shall be basically carried out by private contractors on contract basis in consideration of the general trend toward privatization. For the implementing body, a Steering Committee is proposed to be organized with membership of DAP, ID and SLRD. Under the Steering Committee, Project Management Unit (PMU) will be established with ID as mainly responsible for overall design and supervision. Consultants will be hired to carry out assistance to PMU in design and construction supervision.

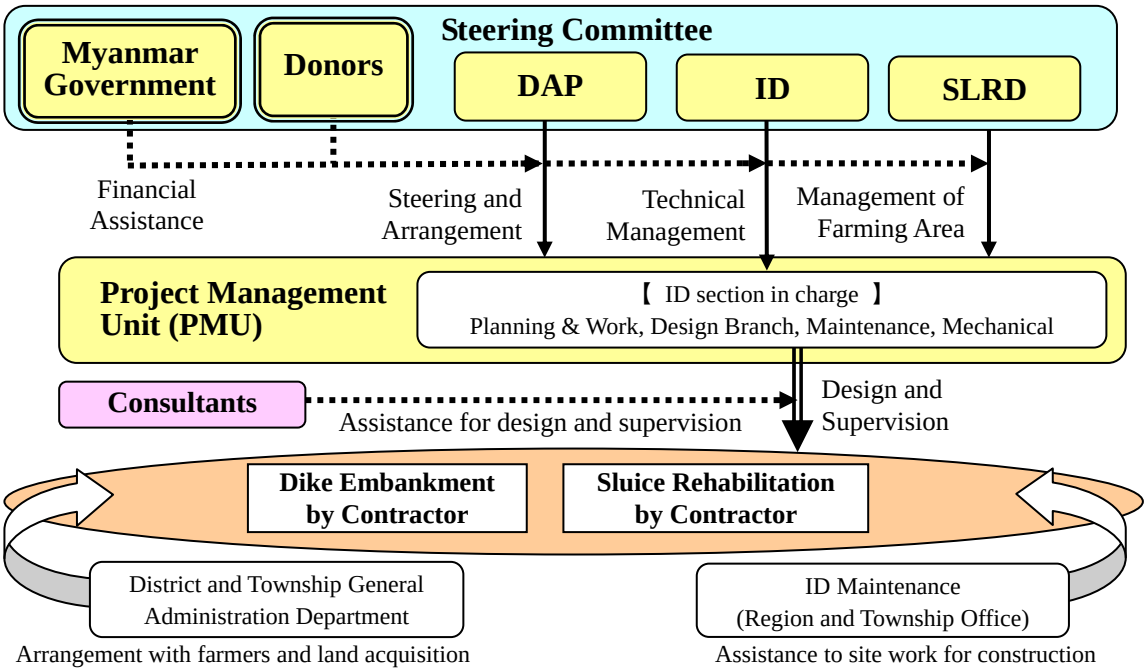


Figure 5.3-6 Implementation Structure on Rehabilitation of Polder Dike and Sluice

5.3.6 Operation and maintenance: Operation and maintenance of the facilities rehabilitated under the D/P, i.e. polder dikes / embankments and sluice gates, shall be carried out by ID as mandated by the government.

Stock management is the technical system and management method to extend life span as well as to reduce the life-cycle cost of the facility, through execution of preventive maintenance measures based on facility function evaluation. Judgment on shifting from daily examination to function evaluation is very important in preventive maintenance measures.

5.4 Improvement Plan on Farming

5.4.1 Basic concept: Purpose of the D/P for the improvement of farming is "recovery and improvement of agriculture in 34 polders in Ayeyawady Region.

1) Strengthening of production and demand of high quality paddy seed: Importance of dissemination of high quality seed is recognized by many governmental agencies such as MAS.

However farmers' understanding is not sufficient. In fact, selling paddy seed in the pilot project was not easy due to price fluctuation and unclear demand. Therefore, the program aims to strengthen both production and demand to disseminate use of high quality seed.

2) Reflection of local demand: In the project area, demand of the local variety is still high. On the other hand, availability of high quality seed for the local variety is relatively low as compared with the improved variety. Therefore, the variety for the high quality paddy seed production should be selected carefully in accordance with demand in the project area.
3) Use of local resources for provision of extension work: Lack of farming technique is common to many farmers in the project area. Extension work provided by MAS is important to improve farming technique of farmers. However, number of MAS staff was drastically decreased in recent years. Therefore, effective use of local resources such as village demonstration farms in cooperation with advanced farmers shall be considered.
4) Consideration and contribution to the government policy: The Government of Myanmar established the Seed Law in January 2011. One of the important contents of the Law is "encouragement of participation of private sector in high quality seed production". Development of advanced farmers will be important to encourage the participation of the private sector through contract farming. However, excessive official support to farmers (e.g inputs support) will decrease fairness in the market and discourages private sector's motivation. Therefore, official support shall be limited to technical aspects.

5.4.2 Project contents and volume: The project consists of following three sub-projects.

1) Development and strengthening of high quality paddy seed production farmers
2) Strengthening of MAS's supporting system for high quality paddy seed production
3) Strengthening of MAS's extension work on high quality paddy seed and advanced farming technique

Target of the project are farmers in 34 polders in Ayeyawady Region with approximately 227,195 acres of paddy cropping area. Duration of the project will be five years for each polder.

Target area for dissemination of high quality seed shall be whole paddy cropping area. Area for high quality seed production is calculated at 1,407 acres based on assumption that farmers renovate every four years. Target area of direct extension work which intends development of high quality seed demand and improvement of farming technique shall be 113,597 acres, 50% of total target area for dissemination of high quality seed. Nevertheless, all farmers will have opportunity to receive extension work indirectly from the demonstration farm.

Table 5.4-1 Project Volume (Target Area) for Improvement Plan on Farming

Polder		Estimated Paddy Area (Acres)	Target Extension Area of High Quality Paddy Seed and Advance Farming Technique (Acre)	Area for High Quality Paddy Seed Production (Acres)	Area for Direct Extension Work High Quality Paddy Seed and Advance Farming Technique (Acres)
1	Alegun (1)	1,753.2	1,753.2	10.9	876.9
2	Alegun (2)	4,036.8	4,036.8	25.0	2,018.0
3	Alegun (3)	5,196.0	5,196.0	32.2	2,598.6
4	Magyibinmadaukkan	337.9	337.9	2.1	168.7
5	Thingangyi	779.4	779.4	4.8	390.0
6	Zinywe	29.2	29.2	0.2	15.4
7	Leikkwin	11.4	11.4	0.1	6.5
8	Labutta (South)	2,453.2	2,453.2	15.2	1,226.6
9	Labutta (North)	9,826.7	9,826.7	60.8	4,913.5
10	U Gaungpu	106.6	106.6	0.7	53.4
11	Bitud Island (1)	662.4	662.4	4.1	331.2
12	Bitud Island (2)	4,572.5	4,572.5	28.3	2,286.9

Polder		Estimated Paddy Area (Acres)	Target Extension Area of High Quality Paddy Seed and Advance Farming Technique (Acre)	Area for High Quality Paddy Seed Production (Acres)	Area for Direct Extension Work High Quality Paddy Seed and Advance Farming Technique (Acres)
13	Bitud Island (3)	3,881.3	3,881.3	24.0	1,940.3
14	Bitud Island (4)	10,179.5	10,179.5	63.0	5,089.7
15	Daunggyi Island	12,997.7	12,997.7	80.5	6,498.7
16	Daunggyi (East)	18,809.7	18,809.7	116.5	9,404.9
17	Daunggyi (West)	15,145.4	15,145.4	93.8	7,572.7
18	Daunggyi (Upper)	2,859.2	2,859.2	17.7	1,430.1
19	Daw Nyein	990.2	990.2	6.1	495.1
20	Myokone	3,082.3	3,082.3	19.1	1,540.7
21	Kyetphamwezaung	26,028.7	26,028.7	161.2	13,014.5
22	Banbwezu	9,898.5	9,898.5	61.3	4,949.1
23	Daydalu	2,165.5	2,165.5	13.4	1,082.9
24	Letpanbin	6,671.3	6,671.3	41.3	3,335.9
25	Zinbaung	5,437.7	5,437.7	33.7	2,718.7
26	Myaseinkan	9,532.1	9,532.1	59.0	4,765.7
27	Thandi	2,617.1	2,617.1	16.2	1,309.0
28	Suclubbaluma	5,879.8	5,879.8	36.4	2,940.1
29	Hleseikchaunggyi	1,742.8	1,742.8	10.8	872.1
30	Tamatakaw	10,084.8	10,084.8	62.4	5,042.9
31	Kyonsoat	403.4	403.4	2.5	201.9
32	Maubin Island (North)	22,681.5	22,681.5	140.4	11,340.4
33	Maubin Island (South)	10,575.9	10,575.9	65.5	5,287.5
34	Thonegwakyun	15,765.1	15,765.1	97.6	7,882.7
Total		227,194.6	227,194.6	1,406.8	113,601.1

5.4.3 Implementation method and implementing body of the project is summarized as follows.

1) Strengthening of supporting system of high quality seed production
2) Implementation of seed quality / demand survey

Table 5.4-2 Selection Criteria of Farmers for Seed Production

Criteria / Consideration		Detailed Explanation
1	Cultivation Method (experience in advance Cultural practices	Advance cultivation method is required for high quality paddy seed production. Farmer's presently practicing advance management systems and practices maybe more easy to convince and participate.. Therefore, it is recommended to select the farmers who have experience of advance cultural practices as much as possible.
2	Grade of reliance on debt	Harvested seed usually should be stored 5-6 months until that the seed demand is increased for next growing season. On the other hand, most of farmers prefer to sell paddy immediately after harvest to re-repay agricultural loan. Therefore, it is recommended to select the farmers who do not strongly depend on loan as much as possible.
3	Availability, capacity and condition of the storage	As abovementioned, seed should be stored 5-6 months. Therefore, storage is indispensable for seed production. It is recommended to select the farmers who have own a storage that is clean and with sufficient capacity.
4	Location and condition of farm land	Condition of farm land such as drainage, fertility should be good for seed production. Also, farming land should be isolated from cropping area of other variety. Therefore, it is recommended to select the farmers who have farm land in good condition as mentioned above.

3) Technical support for high quality paddy seed production farmers

Table 5.4-3 Program of Technical Seminar on High Quality Paddy Seed Production

Title	Program
Orientation and Seed Production Technique 1	- Explanation on Importance and Advantage of High Quality Paddy Seed - Explanation of Official High Quality Seed (Certified Seed) Production Procedure - Seed Production Technique 1 (Land Preparation, Seed Selection, Nursery Preparation) - Preparation of Production Plan (Production Amount, Variety, Cropping Schedule,

	Sales Method etc.)
Seed Production Technique 2	- Confirmation of Progress and Discussion on encountered difficulties - Seed Production Technique 2 (Transplanting, Fertilization, Weed Control, Rouging, Pest and Disaster Control)
Seed Production Technique 3	- Confirmation of Progress and Discussion on encountered difficulties - Seed Production Technique 3 (Harvesting and Post Harvesting)

4) Extension work on high quality seed and advance cropping technique
5) Implementation of demonstration activity on high quality seed and advanced cropping techniques

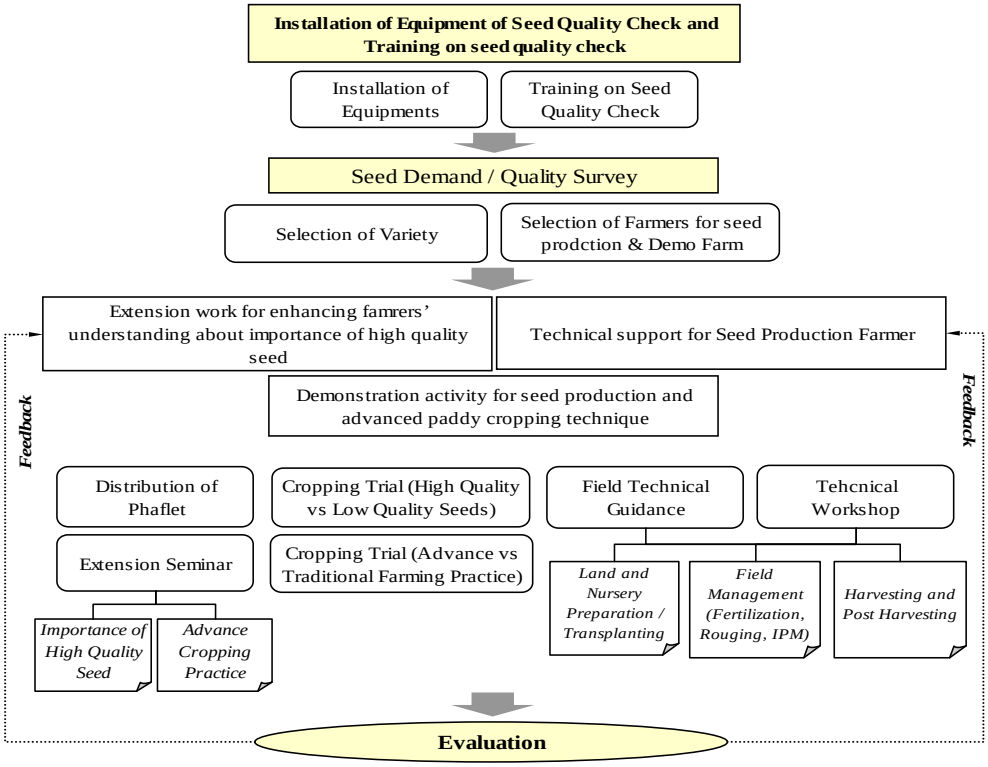


Figure 5.4-1 Implementing Flow for Improvement Plan on Farming

MAS Region Office in Pathein shall be core organization for implementation and management of the project. And MAS district and township offices are responsible agency for field activities. Participation of private sector will be a key factor to maintain reality and sustainability of high quality paddy seed production. In addition, collaboration between government and private sector can realize smooth implementation of the project (e.g technical support by MAS and inputs and sales support by private sector).

Table 5.4-4 Implementation Schedule for Improvement Plan on Farming

Activities		Year																			
		1				2				3				4				5			
1	Strengthening of Supporting System of High Quality Seed Production																				
2	Seed Quality and Demand Survey																				
3	Technical support for High Quality Paddy Seed Production Farmer																				
4	Extension work on high quality seed and advance cropping technique																				
5	Implementation of demonstrative activity on high quality seed and advance cropping technique																				

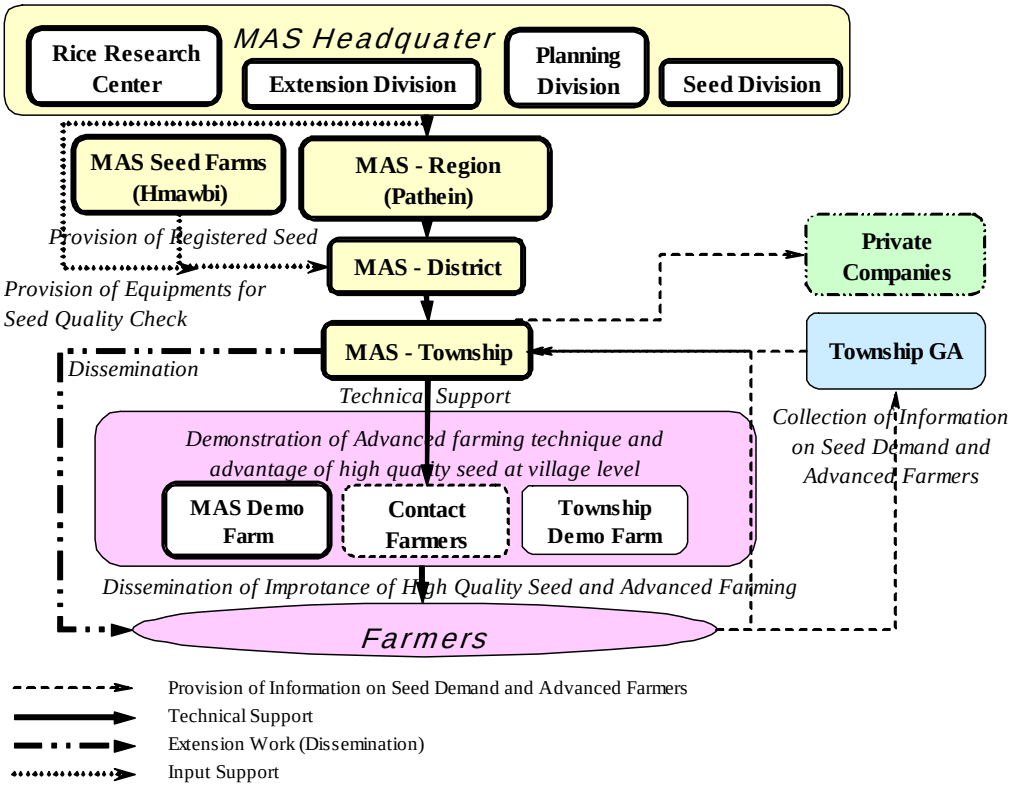


Figure 5.4-2 Implementation Structure for Improvement Plan on Farming

5.5 Income Generation Plan

5.5.1 Basic concept

1) The goal of the D/P is to increase income generation opportunities for landless people and thereby to obtain supplementary income through self-help efforts as well as to improve their rural life at 34 target polders.
2) Income generation activities must:
   - require small amount of initial investment so that the people with low or minimal income will be able to afford,
   - use of simple technique so that the people with limited skills/ knowledge and experience can easily apply,
   - be small in scale with minimal risk to encourage people to participate without hesitation,
   - require short time gestation period –the return/income is realized within a short period of time,
   - present basic infrastructure such as transportation means and local market to sell product.
3) To meet these requirements, activities that inhabitants have already experienced are proposed.
4) Commencement of such activities requires support from outside.

5.5.2 Project contents and volume

(1) Scope of income generation activities

1) Target area and people: Landless households at 34 polders in the project area in Ayeyawady Delta are the target people in this D/P. They have neither means of production except their labour force nor opportunity of getting cash income from stable and regular sources.

2) Activities: After polder dikes/embankments and sluice gates are rehabilitated, quality of canal water inside the polder will improve. To obtain maximum benefit from project, activities in agriculture

are considered as appropriate. Also, land used for agriculture-related activities must be arranged and guaranteed by administrative organisations.

(2) Selection of target activities

Five activities were initially considered for income generation activities for landless households in the project area. After examination of five activities, two were considered feasible for implementation in the framework of this D/P.

1) Activity-1, vegetable cultivation: Vegetable cultivation brings supplementary cash income in a few month and MAS has human resources to support. Thus it is judge as appropriate for income generation activity.

2) Activity-2, breeding or fattening of domestic animal (pig): Raising pigs brings supplementary cash income to the implementer and LBVD has human resources and experience to support them. Though the profit is generated one year after starting and it is not a quickly responding activity, people keep pigs regarding it as a kind of saving. Thus it is judged as feasible for income generation activity.

(3) Vegetable cultivation sub-project

1) Target area and target people: 10% of landless households in all 34 polders.

2) Components the project: Implementers cultivate 4 vegetables (yard long bean, okra, roselle and watercress) in 0.025 acre each (total 0.1 acre) borrowing paddy field after harvest without payment. Staff of MAS township office shall provide support activities to implementers for 2 years in collaboration with local government (region, district, township and village tract).

3) Key points in implementation: Generally landless implementers borrow paddy field from land right holders during dry season. To assure cultivation place, local authorities (township, village tract) guarantee the land use. Training must be given on basic technique in a week course, using easy words and explanation. MAS show good practice to the implementers in the form of demonstration farm.

4) Project period: The project of each polder will start one year after the rehabilitation of embankment and sluices in the polder. Project period will be 2 years at each polder and will take 7 years to cover 34 polders.

5) Project volume: Number of target polders shall be 34 polders, number of target households is 4,023 households (10% of landless households) and number of townships concerned is 5 townships.

6) Project costs: The total project costs for 2 years are estimated at 249,097,750 Kyats (= 61,918 Kyats/HH).

Table 5.5-1 Project Volume of Vegetable Cultivation Sub-project

No.	Item	Volume setting	Total quantity	unit	unit price Kyat	total Kyat
V1	Extension workshop to implementers	1 time/ HH	4	times	4,996	20,100,000
V2	Technical workshop for implementers	4 time/ HH	16,092	times	4,996	80,400,000
V3	Print of manual for implementers	1 HH	4,023	copies	2,500	10,057,500
V4	Technical training for MAS staff	3 time/ township	15	times	300,000	4,500,000
V5	Management of demonstration farm (2 years)	1 Polder	34	farms	1,500,000	51,000,000
V6	Onsite consultation (2 years)	1.5 day/ HH	6,035	days	10,000	60,345,000
Sub-total						226,452,500
Physical contingency (10% of sub-total)						22,645,250
Total (2 years)						249,097,750
Total per household (2years)						61,918

7) Crop budget and effect on income generation: It is estimated that a household can earn 29,343 Kyats as net income in one dry season cultivation. It means that annual income of landless households will increase by 2.1% compared with current average annual income of 1,422 thousand Kyats.

Table 5.5-2 Crop Budget for Vegetables Cultivation Sub-project

Items	Long yard bean	Okra	Roselle	Watercress	4 vegetables/1.0 acre (household)
Cost for 0.025 acre cultivation (Kyat)					
Seed	788	1,125	30	150	2,093
Fertilizer	2,240	2,435	2,123	1,798	8,596
Agrochemicals	2,700	750	113	113	3,675
Transportation	125	333	373	334	1,165
Sub-Total	5,852	4,643	2,639	2,394	15,529
Physical Contingency (5%)	293	232	132	120	776
Total cost (Kyat)	6,145	4,875	2,771	2,514	16,305
Return from 0.025 acre cultivation					
Yield kg/ 0.025 acre each	50	98	50	50	
Losses	0.9	0.9	0.9	0.9	
Net Yield (kg/ 0.025 acre)	45	88	45	45	
Farm gate price (Kyat/ kg)	496	128	143	128	
Gross return (Kyat)	22,302	11,188	6,419	5,739	45,648
Net return (Kyat)	16,157	6,313	3,648	3,225	29,343

Table 5.5-3 Effect on Income Generation Unit: Kyat/HH/year

Township	2009 Household income Kyat	Net profit from vegetable cultivation Kyat	Incremental rate (2009 income = 100)
Labutta	1,231,685	29,343	1.024
Bogaley	655,000	29,343	1.045
Phyarpon	1,512,333	29,343	1.019
Daydaye	2,333,214	29,343	1.013
Kyaiklatt	1,354,333	29,343	1.022
All townships	1,422,448	29,343	1.021

(4) Pig raising sub-project

1) Target area and target people: 5% of landless households in all 34 polders.

2) Components of the project: Implementers organize units of 16 household. 6 households breed pigs of a 4-year-cycle and the remaining 10 households fatten pigs of a 1-year-cycle. LBVD supports in the enhancement of implementer's technical knowledge. Also, they do onsite consultation including health matters and vaccination.

3) Key points in implementation: LBVD shall collect basic information on capacity and problem of implementers as much as possible in the beginning months and give training and do on-site consultation to respond to specific problems.

4) Project period: The year of commencement is one year after the rehabilitation of each polder. Project period is 4 years at each polder and will take 9 years to support all polders.

5) Project volume: Number of target polder shall be 34 polders, number of target households 2,080 households (5% of landless households), number of pig raising unit (16 HH) will be 130 units, and number of townships to be involved will be five.

6) Project cost: The total project cost is estimated at 79,640,000 Kyats for four-year support for 34 polders. Support cost per target unit is 612,615 Kyats (= 38,288 Kyats per household for 4 years).

Table 5.5-4 Project volume and project cost of pig raising sub-project

No.	Item	Volume setting	Total quantity	unit	unit price Kyat	total Kyat
P1	Extension workshop (breeding)	1 time/ polder	34	times	100,000	3,400,000
P2	Extension workshop (fattening)	1 time/ polder	34	times	100,000	3,400,000
P3	Printing of manual for implementers	2080 HH	2,080	copies	2,500	5,200,000
P4	Technical workshop (breeding)	2 time/ polder	68	times	100,000	6,800,000
P5	Technical workshop (fattening)	1 time/ polder	34	times	100,000	3,400,000
P6	Technical training for LBVD staff	2 time/ township	20	times	300,000	6,000,000
P7	Onsite consultation on breeding (4 years)	4 day/ HH	3,120	days	10,000	31,200,000
P8	Onsite consultation on fattening (1 year)	1 day/ HH	1,300	days	10,000	13,000,000
Sub-total						72,400,000
Physical contingency (10% of sub-total)						7,240,000
Total (4 years)						79,640,000
Total per household (4 years)						38,288

7) Pig raising budget and effect on income generation: It is estimated that a household can earn net income of 741,155 Kyats from the pig breeding for a 4-year-cycle and 361,976 Kyats from the pig fattening for the same period. It means that annual income of landless households will increase by 15% to 25% from breeding and 7% from the fattening activity.

Table 5.5-5 Cost and Benefit of Pig Raising per Household Unit: Kyat

Activity	Item	1st Year	2nd Year	3rd Year	4th Year	4-year-cycle
Breeding	Breeding cost					
	Breeding cost	113,508	204,275	232,175	134,656	684,615
	Physical Contingency (5%)	5,675	10,214	11,609	6,733	34,231
	Total Cost	119,184	214,489	243,784	141,389	718,845
	Income from breeding					
	Sale of piglets	0	106,667	133,333	200,000	440,000
	Sale of medium pigs	0	320,000	400,000	200,000	920,000
	Sale of parent pigs	0	0	0	100,000	100,000
	Gross Income	0	426,667	533,333	500,000	1,460,000
	Net income	-119,184	212,178	289,550	358,611	741,155
Fattening	Fattening cost					
	Fattening cost	107,744	77,744	77,744	77,744	340,975
	Physical Contingency (5%)	5,387	3,887	3,887	3,887	17,049
	Total Cost	113,131	81,631	81,631	81,631	358,024
	Gross Income	180,000	180,000	180,000	180,000	720,000
	Net Income	66,869	98,369	98,369	98,369	361,976

Table 5.5-6 Effect on Income Generation unit: kyat

Item	Labutta	Bogaley	Phyarpon	Daydaye	Kyaiklatt	All townships
Income 2009 Kyat	1,231,685	655,000	1,512,333	2,333,214	1,354,333	1,422,448
Breeding						
Breeding 1st year	-119,184	-119,184	-119,184	-119,184	-119,184	-119,184
Incremental rate	0.903	0.818	0.921	0.949	0.912	0.916
Breeding 2nd year	212,178	212,178	212,178	212,178	212,178	212,178

Incremental rate	1.172	1.324	1.140	1.091	1.157	1.149
Breeding 3rd year	289,550	289,550	289,550	289,550	289,550	289,550
Incremental rate	1.235	1.442	1.191	1.124	1.214	1.204
Breeding 4th year	358,611	358,611	358,611	358,611	358,611	358,611
Incremental rate	1.291	1.547	1.237	1.154	1.265	1.252
Fattening						
Fattening 1st year	66,869	66,869	66,869	66,869	66,869	66,869
Incremental rate	1.054	1.102	1.044	1.029	1.049	1.047
Fattening 2nd year	98,369	98,369	98,369	98,369	98,369	98,369
Incremental rate	1.080	1.150	1.065	1.042	1.073	1.069

5.5.3 Implementation method and implementing body

Administration system of local governments is actually in transition and work demarcation between the central government and the regional government and that of departments within a local government is not clearly defined at the study period. However, it is said that the regional government will have financial and administrational responsibility of rural development.

(1) Vegetable cultivation sub-project

The D/P proposes the implementation method of vegetable cultivation sub-project as follows: landless households do cultivation; regional government takes initiative of project implementation such as assuring land use guarantees, budget allocation and other administration matters; and MAS will provide technical support.

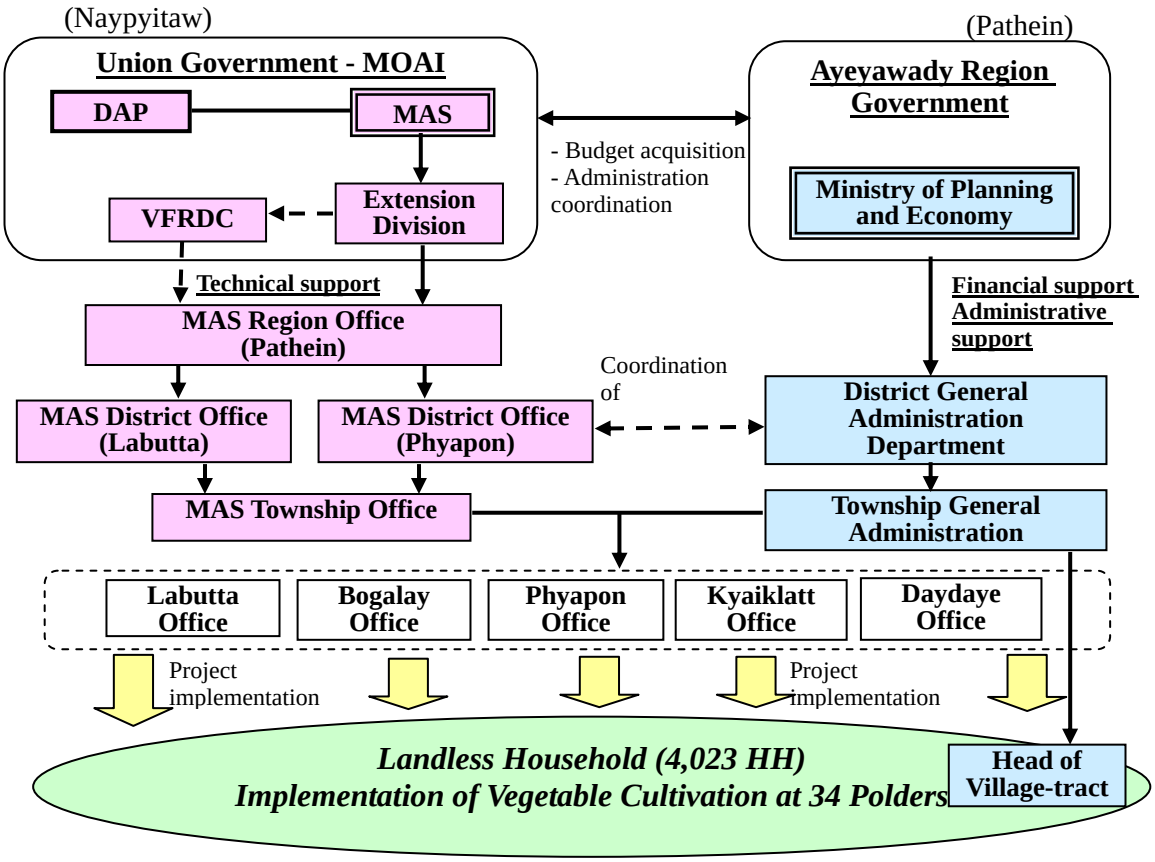


Figure 5.5-1 Implementation Structure for Vegetable Cultivation Sub-project

(2) Pig raising sub-project

The method of implementation is that 16 landless households organize one unit and of this, six will undertake breeding and 10 households will be involved in fattening. The number of the unit depends on the number of landless household in each polder but every polder will at least have one unit.

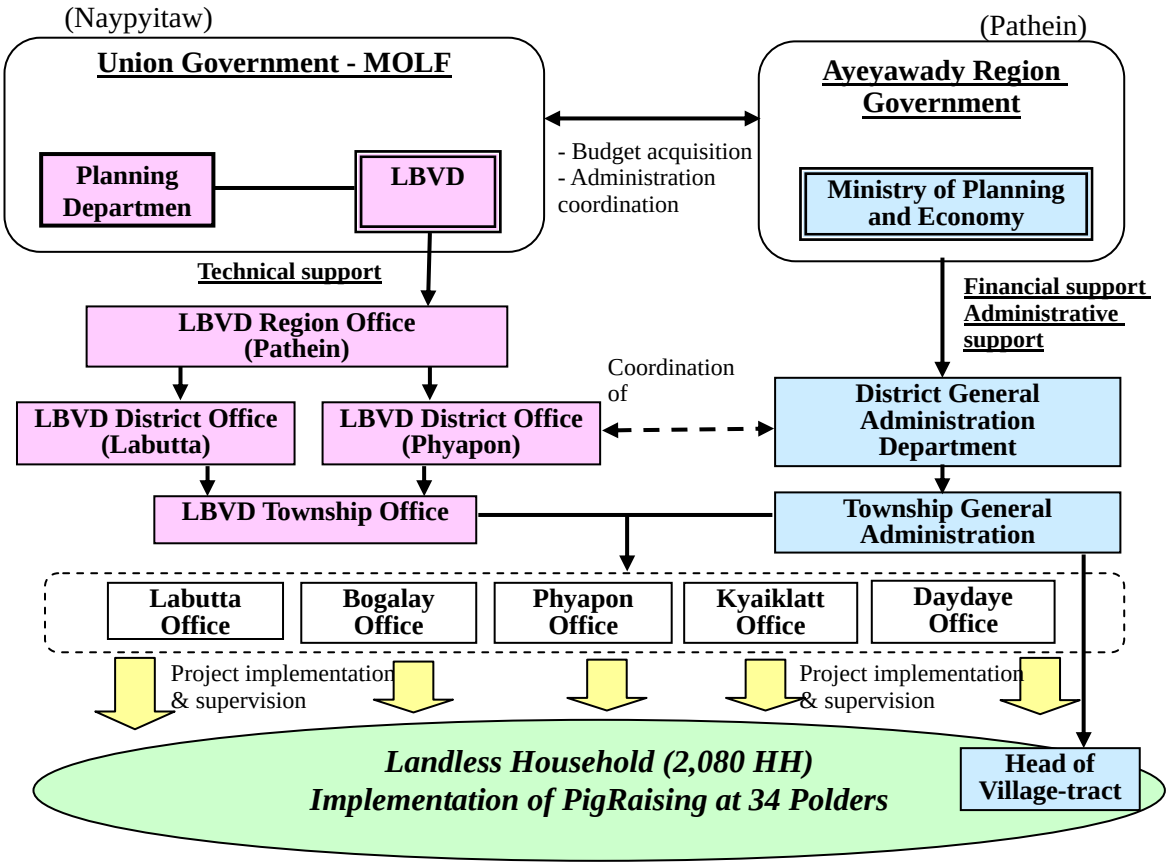


Figure 5.5-2 Implementation Structure for Pig Raising Sub-project

5.6 Rehabilitation Plan on Mangrove Windbreak

5.6.1 Basic concept: Objective of the rehabilitation of mangrove windbreak is to rehabilitate mangrove area to protect the polder dikes. Mangrove windbreak trees will be planted along the dike to protect the dike from direct attack of tidal surge and storm. Basic concept for the rehabilitation of mangrove windbreak in the D/P is explained below:

1) To plant mangrove trees in areas damaged by Cyclone Nargis located along the polder dike and embankment for the protection of the dikes and embankment from further any similar disaster.
2) To select suitable mangrove species in consideration of local demand, maintenance and utilization by village community.
3) To involve village community in plantation and maintenance of mangrove windbreak in view of sustainability since mangrove management activities along the polder dike and embankment is not under management of the FD nor the ID. To facilitate this concept a village committee shall be established for the operation and maintenance of mangrove windbreak.

5.6.2 Project contents and volume

(1) Scope of project

The project will rehabilitate the mangrove windbreak along the bank and embankment at 34 polders in the Ayeyawady Delta. The JICA project team investigated current situation of the mangrove windbreak damaged by Cyclone Nargis in March 2011. Based on the result of investigation, the rehabilitation volume in terms of dike length where mangrove windbreak was destroyed by Nargis was determined. It was determined that 22 polders/embankments out of 34 polders in the project area will need rehabilitation through plantation of mangrove. The total required length of dike/embankment for mangrove windbreak will be about 207 km for the 22 polders that is about 22% of the total length of 34 polder dikes and embankments.

(2) Planning and design

1) Planting mangrove species: Mangrove tree species shall be selected in consideration of natural condition of plantation site, seedling supply, local demand, biodiversity, etc. For the D/P, three mangrove species, namely Sonneratia apetala (Sa, local name is Kanbala), Nypa fruticans (Nf, local name is Dani) and Avicennia officinalis (Ao, local name is Thame Gyi) are recommended from the experience of the pilot project.

2) Planting design and quantity: Sa will be planted in the most river ward zone, Nf in the middle portion and Avicennia officinalis in the land side. Width of Sa and Nf are 15m each, width of Ao is 20m, with total width is 50m. Planting length is dependent on the required length of windbreak rehabilitation along the dike. Planting spacing of each three species are 2m x 2m. Quantity required will be 3,750 seedlings for Sa and Nf, and 5,000 seedlings for Ao for one kilometer length of dike.

3) Procurement of seeds and seedlings: Seedlings of Sa and Ao can be obtained from the Thar Kone and Kwakwakalay nurseries which are under the management of FD. NF seeds can also be prepared by FD or local farmers who have Nf plantation farms. For the seedling breeding of Nf, temporary nursery will be required at planting site.

4) Fencing: In the Ayeyawady Delta, at the onset of the monsoon season, waves become high and rough. Rough waves affect negatively growth of planted mangrove trees. To avoid this, bamboo fence will be installed around the planted are. The bamboo fence will also prevent entry of animals.

5) Temporary nursery: For the nursery activity of Nf seeds, temporary nursery will be installed in the planting site. The temporary nursery is made of bamboo sticks and Nypa leaves. Bamboo sticks are used to support the roof. A small fence is made around the nursery for the protection of seedlings from tidal waves. Nypa leaves are used for shade.

6) Work schedule and process: As suitable mangrove planting season starts from middle of May, Ao and Sa seedling will be prepared according to this planting season at the FD nursery. Although suitable season for collection of Nf seeds is from middle of March to middle of May, seed of Nf is available through the year. As mentioned above, a temporary nursery will be established at the planting site to breed Nf seedling. Working process will be implemented as follows; (i) Land survey for planting site, (ii) Establishment of temporary nursery, (iii) Breeding of Nf seedling, (iv) Installing of fence, (v) Planting of Sa, Ao seedling, (vi) Planting of Nf seedling, (vii) Maintenance, (viii) Monitoring for supplemental planting, (ix) Supplemental planting.

Table 5.6-1 Typical Schedule for Mangrove Windbreak Rehabilitation Work

Work contents	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Land survey for planting site	—											
Establish temporary nursery		—										
Breeding of Nf seedling			—	—								
Fencing			—									
Procurement of Ao & Sa seedlings				—								
Planting				—								
Maintenance					—	—						
Monitoring							☆					
Supplemental planting									—			

(3) Project volume

The total target length of the mangrove windbreak rehabilitation at the 22 polders and embankments is estimates at 207 km with planting area of 1,035 ha. The total length of the fence required will be 413.8 km. Number of seedlings required will be 775,875 for Nf and Sa, and 1,034,500 for Ao. Total number of the temporary nursery required will be 217 nurseries.

Table 5.6-2 Unit Quantity required for Mangrove Windbreak Rehabilitation

Length of fence (m)	Number of Sa seedling	Number of Nf seedling	Number of Ao seedling	Number of temporary nursery	Number of marking stick
2,000	3,750	3,750	5,000	1	12,500

Table 5.6-3 Project Volume by Polder for Mangrove Windbreak Rehabilitation

Sr. no.	Polder name	Target of rehabilitation (km)	Planting area (ha)	Length of fence (m)	No. of Sa seedling	No. of Nf seedling	No. of Ao seedling	No. of temporary nursery
1	Alegyun (1) polder	0.2	1	400	750	750	1,000	1
2	Alegyun (2) polder	4	20	8,000	15,000	15,000	20,000	4
3	Alegyun (3) polder	16	80	32,000	60,000	60,000	80,000	16
4	Magybinmadaukkan	2.2	11	4,400	8,250	8,250	11,000	3
5	Thingangyi	0	0	0	0	0	0	0
6	Zinywe	0	0	0	0	0	0	0
7	Leikkwin	0	0	0	0	0	0	0
8	Labutta (South)	1.2	6	2,400	4,500	4,500	6,000	2
9	Labutta (North)	2.4	12	4,800	9,000	9,000	12,000	3
10	U Gaungpu	0	0	0	0	0	0	0
11	Bitud Island (1)	4.8	24	9,600	18,000	18,000	24,000	5
12	Bitud Island (2)	12.8	64	25,600	48,000	48,000	64,000	13
13	Bitud Island (3)	16	80	32,000	60,000	60,000	80,000	16
14	Bitud Island (4)	40.8	204	81,600	153,000	153,000	204,000	41
15	Daunggyi	11.2	56	22,400	42,000	42,000	56,000	12
16	Daunggyi (East)	0	0	0	0	0	0	0
17	Daunggyi (West)	0	0	0	0	0	0	0
18	Daunggyi (Upper)	0.3	1.5	600	1,125	1,125	1,500	1
19	Daw Nyein polder	0	0	0	0	0	0	0
20	Myokone polder	0	0	0	0	0	0	0
21	Kyetphamwezaung	27.2	136	54,400	102,000	102,000	136,000	28
22	Banbwezu	0	0	0	0	0	0	0
23	Daydalu	0	0	0	0	0	0	0
24	Letpanbin	0	0	0	0	0	0	0
25	Zinbaung	0	0	0	0	0	0	0
26	Myaseinkan	2.4	12	4,800	9,000	9,000	12,000	3
27	Thandi	2.4	12	4,800	9,000	9,000	12,000	3
28	Suclubbaluma	1.6	8	3,200	6,000	6,000	8,000	2
29	Hleseik chaunggyi	4.8	24	9,600	18,000	18,000	24,000	5
30	Tamatakaw	11.2	56	22,400	42,000	42,000	56,000	12
31	Kyonsoat	3.8	19	7,600	14,250	14,250	19,000	4
32	Maubin Island (North)	16	80	32,000	60,000	60,000	80,000	16
33	Maubin Island (South)	6.4	32	12,800	24,000	24,000	32,000	7
34	Thonegwakyun	19.2	96	38,400	72,000	72,000	96,000	20
	Total	**207**	**1,035**	**413,800**	**775,875**	**775,875**	**1,034,500**	**217**

5.6.3 Implementation method and implementing body

(1) Implementing body

Local government: Initiatives of the mangrove windbreak rehabilitation project shall be undertaken by the local administration even if it does not have technical capacity in mangrove windbreak rehabilitation. The local administrations shall be assisted by an NGO or local consultant in project management and FD in technical matter.

NGOs and local consultants: The NGOs and consultants under work contract with the local government will operate the project. A mangrove windbreak establishment committee will be established within the village community at each project site. The NGOs and consultants will receive project budget to be allocated by the local administrations for required materials and equipment.

Mangrove Windbreak Establishment Committee: The mangrove windbreak establishment committee will be composed of villagers who will be selected from among the residents through selection process. The committee shall receive training and guidance from the NGOs and consultants. Villagers shall participate in the project activities under the management and coordination of the committee.

Forest Department (FD): FD shall provide technical support for the mangrove windbreak rehabilitation project. The seedlings required in the planting will be procured from the FD nursery.

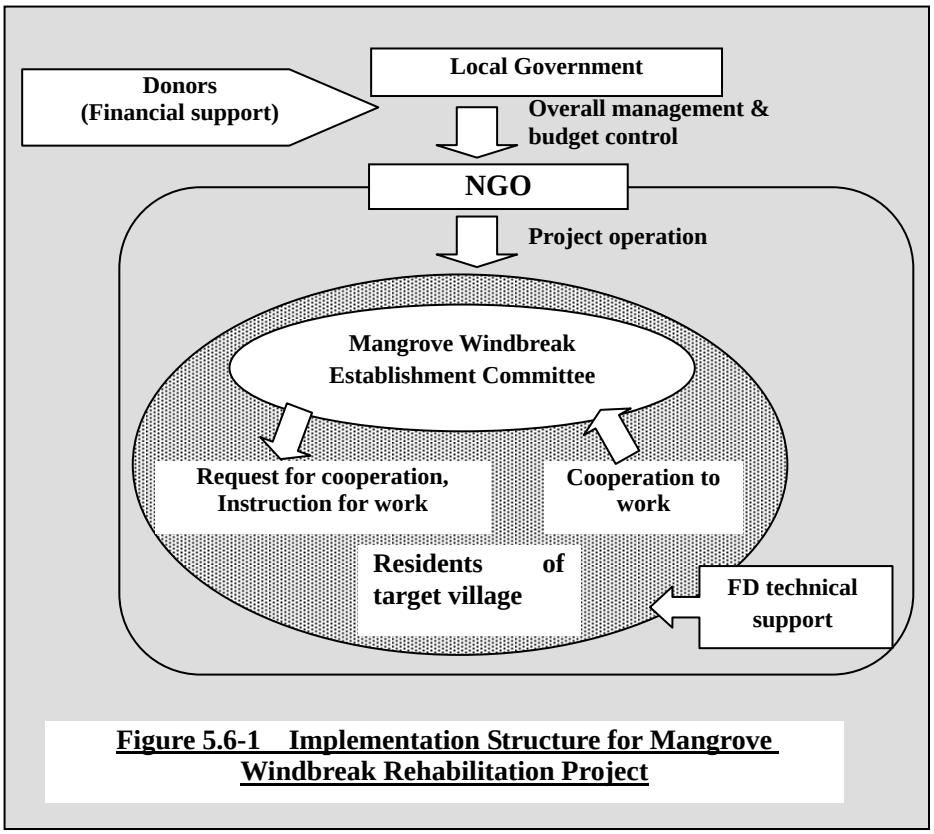


Figure 5.6-1 Implementation Structure for Mangrove Windbreak Rehabilitation Project

(2) Implementing method

It is important to operate the project at step by step together with village community under management of local administrations and NGOs s or consultants to be hired for the project and with technical support of FD. Field activities and workshops / trainings shall be conducted in consonance with planting schedule as well as social environmental condition.

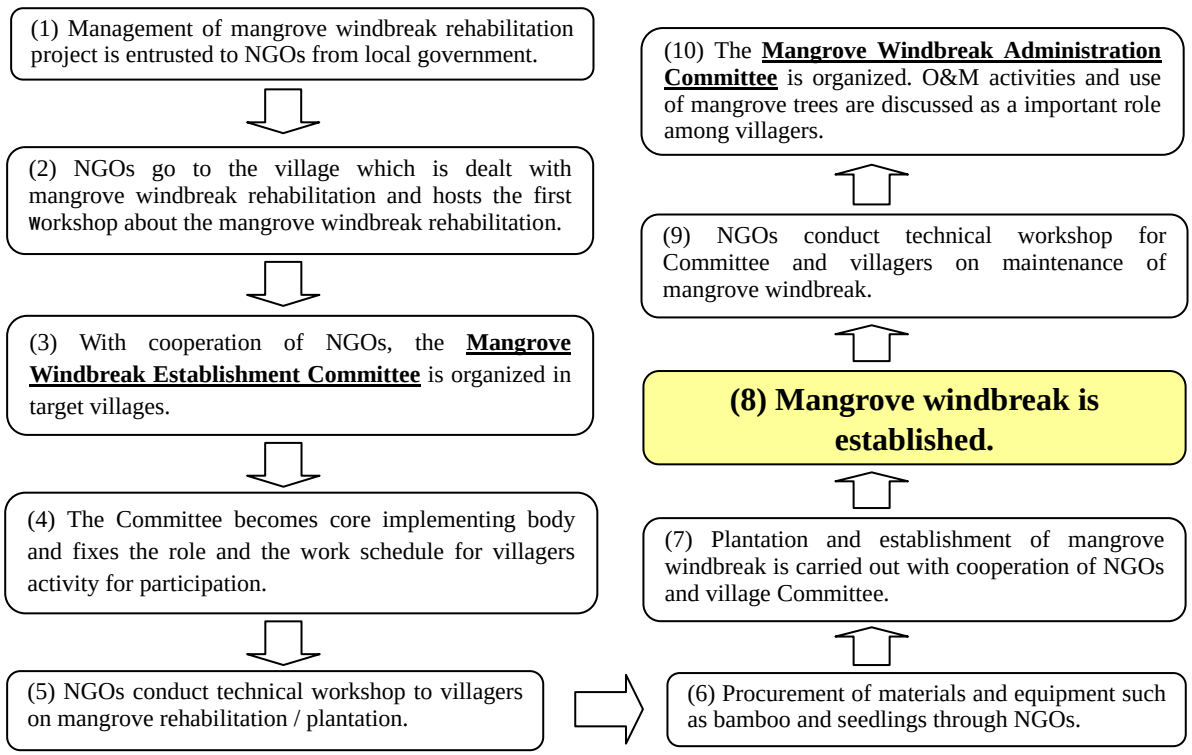


Figure 5.6-2 Implementation Process of Mangrove Windbreak Rehabilitation

5.7 Environmental Study

5.7.1 Guideline on environmental impact assessment: The NCEA under the MOF is responsible for environmental issues within the forest reserve area only. Currently the Union of Myanmar has no formal system for the EIA. The ID has some experiences to assess environmental effects caused by irrigation facility constructions, however, there is no stipulated guideline or manuals describing specified procedures to assess effects and mitigate negative impacts so far. Given these situations, the proponent is to comply with "JICA Guidelines for Environmental and Social Considerations" as stipulated in M/M on S/W signed between GoJ and GoUM.

5.7.2 Initial environmental examination (IEE): The D/P includes 4 major components the same as that of the pilot project. Considering that the main activities are rehabilitation of existing facilities or promotion / improvement of current activities and forest reserves are not included in the project area, damage to natural environment can be very minimal.

However, land acquisition can not be avoided in dike embankment work due to unavoidable ROW expansion. In this connection, appropriate construction method shall be employed in order to minimize land acquisition of existing farmland as well as resettlement of houses. Several measures executed in the pilot project such as side slope of dike embankment, use of manpower construction, arrangement of borrow area, soil transportation measure, and so on shall be carefully applied.

5.8 Implementation Plan and Schedule

5.8.1 Overall implementation plan: The D/P which covers 34 polders in the Ayeyawady Region will require considerable period to implement its component projects. The project for the rehabilitation of polder dike and sluice as a component for agricultural and rural infrastructure will be set as a principal indicator for overall implementation schedule since it is the basic and dominant component. Other three components, namely farm management, income generation and mangrove windbreak, will

follow the schedule of rehabilitation of polder dike and sluice.

Step-1	Contents of Study
Grouping of 34 polders	- Available yearly embankment volume - Geographical conditions

⇩

Step-2	Contents of Study
Study on priority ranking 1 Emergency (Risk) evaluation 2 Effective disaster prevention	Among each group and each polder 1 Difference between planed height and existing height 2 Economic benefit with implementation of development

⇩

Step-3	Contents of Study
Implementation schedule	- Overall construction period - Schedule plan considering priority of polder group

5.8.2 Selection of priority polders and embankments: 34 polders are classified into 10 groups with viewpoint of possible annual work volume and geographical situation. Then priority ranking by polder and by group is made in consideration of emergency risk analysis and effective disaster prevention value. 10 groups are prioritized based on the polder-wide priority ranking.

(1) Evaluation of Emergency Risk

Criteria for evaluation of each polder are shown in the table and evaluation method for each polder group is estimated by weighted average on each polder point in the group as follows;

- Evaluation point of group = (ΣV×P) / (ΣV)
  Where, V: embankment volume on each polder
  P: evaluation point on each polder

Criteria of Emergency Risk	
ACL – ECL (ft)	Evaluation Points
> 6.0ft (1.8m)	3 (High)
6.0~3.0ft (1.8～0.9m)	2 (Mean)
< 3.0ft (0.9m)	1 (Low)

(2) Evaluation of Disaster Prevention Effects

Disaster prevention effect on each polder has been ranked in terms of ratio of annual prevention value to embankment volume according to the evaluation criteria as shown in table.

- Evaluation point of group = (ΣA×P) / (ΣA)
  Where, A: annual prevention value on each polder,
  P: evaluation point on each polder

Criteria of Disaster Prevention Effects	
Annual prevention value/embankment volume	Evaluation Points
＞4.0	3 (High)
1.5 – 4.0	2 (Mean)
＜1.5	1 (Low)

(3) Selection of Priority Polder Groups

As for overall evaluation, the sum up points for emergency evaluation and points for disaster prevention effects shall be added to determine the priority ranking of polders and group. As shown in the following table, priority ranking of polder groups in Labutta & Bogalay Township was evaluated higher than others.

Table 5.8-1 Priority Ranking of Polder Groups

Township	Gr. No	Polder No.	Name of polder	Evaluation of Emergency		Evaluation of Disaster Prevention Effects		Overall Evaluation		Priority Ranking	Remarks
				Each Polder (1)	Each Group (2)	Each Polder (3)	Each Group (4)	Each Polder (1)+(3)	Each Group (2)+(4)	Group Basis	Progress by ID's Work (%)
Labutta	1	1	Alegyun (1)	1		3		4			0
		2	Alegyun (2)	2		2		4			0
		8	Labutta (South)	2	1.9	2	2.3	4	4.2	4	0

	-	3	Alegyun (3)	1		3		4			100
	-	4	Magybinmadaukkan	2		2		4			100
	-	9	Labutta (North)	2		3		5			70
	2	5	Thingangyi	3		1		4			68
		6	Zinywe	2		1		3			100
		7	Leikkwin	3		1		4			0
		10	U Gaungpu	3	2.8	1	1.0	4	3.8	8	0
	3	11	Bitud Island (1)	3		1		4			23
		12	Bitud Island (2)	2	2.5	2	1.7	4	4.2	4	7
	4	13	Bitud Island (3)	3		1		4			54
		14	Bitud Island (4)	2	2.8	2	1.5	4	4.3	3	100
Bogalay	5	16	Daunggyi (East)	3	3.0	2	2.0	5	5.0	1	36
	6	15	Daunggyi	2		3		5			17
		17	Daunggyi (West)	2		3		5			100
		18	Daunggyi (Upper)	2	2.0	2	2.9	4	4.9	2	0
Phyapon	7	19	Daw Nyein	2		1		3			100
		20	Myokone	2		1		3			100
		22	Banbwezu	2	2.0	1	1.0	3	3.0	10	0
	8	21	Kyetphamwezaung	3	3.0	1	1.0	4	4.0	7	6
	9	23	Daydalu	3		1		4			100
		24	Letpanbin	2		1		3			100
		25	Zinbaung	2	2.3	1	1.0	3	3.3	9	18
Daydaye	-	26	Myaseinkan	2		2		4			72
	10	27	Thandi	2		2		4			100
		28	Suclubbaluma	1		3		4			100
		29	Hleseikchaunggyi	1		2		3			0
		30	Tamatakaw	1		3		4			100
		31	Kyonsoat	1		1		2			100
Kyaiklatt		32	Maubin Island (N)	2		2		4			0
		33	Maubin Island (S)	1		3		4			0
		34	Thonegwakyun	2	1.8	1	2.3	3	4.1	6	0

5.8.3 Implementation schedule: Project period for the D/P was determined based on the rehabilitation work for polder dike which is the most critical and dominant work in the D/P. Total project period for the rehabilitation of agricultural and rural infrastructure is proposed to be five years in consideration of embankment volume and project urgency.

Table 5.8-2 Implementation Schedule for Rehabilitation on Agricultural and Rural Infrastructure

Group	Polder Name	Nos. of Polders	1st year	2nd year	3rd year	4th year	5th year
No. 1	Alegyun (1)~(2), Labutta (S)	3		▬			
No. 2	Thingangyi, Zinywe, Leikkwin, UGaungpu	4				▬	
No. 3	Bitud Island (1)~(2)	2			▬		
No. 4	Bitud Island (3)~(4)	2		▬			
No. 5	Daunggyi (East)	1	▬				
No. 6	Daunggyi, Daunggyi (West, Upper)	3	▬				
No. 7	Dawnyein, Myokone, Banbwezu	3					▬
No. 8	Kyetphamwezaun	1				▬	
No. 9	Daydalu, Lepanbin, Zinbaung	3					▬
No. 10	Thandi, Suclubbaluma, Hleseikchaunggyi, Tamatakaw, Kyonsoat, Maubin Island (N)&(S), Thonegwakyun	8			▬		

On the other hand, implementation of the projects for the improvement of farming and income generation will be for nine (9) years while the rehabilitation of mangrove windbreak will be for five (5) years.

5.9 Cost Estimates

The total project costs are estimated at 41,292 million Kyats (equivalent to 47.5 million US Dollar).

Table 5.9-1 Summary of Total Project Costs

Component	Project Costs (1000 Ks)	Remark
1. Rehabilitation of agricultural & rural infrastructure	39,661,713	To cover 30 polders for embankment & 20 polders for sluice, for 5 years
2. Improvement of farming	231,509	To cover 34 polders for 9 years
3. Income generation	328,738	To cover 34 polders for 9 years
4. Rehabilitation of mangrove windbreak	1,070,583	To cover 22 polders for 5 years
Total	**41,292,543**	
(In US Dollar)	(47,517,311)	

Table 5.9-2 Summary of Project Costs by Polder and by Component

Unit: 1,000 Ks

Sr. No	Polder name	Rehabilitation of agricultural & rural infrastructure	Improvement of farming	Income generation	Rehabilitation of mangrove windbreak	Total
		(1)	(2)	(3)	(4)	(5)=(1)+(2)+(3)+(4)
1	Alegyun (1)	533,278	1,788	5,869	1,035	541,970
2	Alegyun (2)	1,576,725	4,112	9,385	20,698	1,610,920
3	Alegyun (3)	121,300	5,296	4,940	82,790	214,326
4	Magybinmadaukkan	0	345	2,346	11,384	14,075
5	Thingangyi	498,179	795	1,294	0	500,268
6	Zinywe	449,420	32	1,356	0	450,808
7	Leikkwin	512,721	13	1,046	0	513,780
8	Labutta (South)	2,214,215	2,500	6,055	6,209	2,228,979
9	Labutta (North)	0	10,014	21,681	12,419	44,114
10	U Gaungpu	1,179,204	109	860	0	1,180,173
11	Bitud Island (1)	1,546,136	675	2,161	24,837	1,573,809
12	Bitud Island (2)	2,028,182	4,660	10,562	66,232	2,109,636
13	Bitud Island (3)	2,929,946	3,955	5,683	82,790	3,022,374
14	Bitud Island (4)	913,821	10,372	17,663	211,116	1,152,972
15	Daunggyi	2,190,115	13,244	18,901	57,953	2,280,213
16	Daunggyi (East)	3,868,073	19,166	9,385	0	3,896,624
17	Daunggyi (West)	446,918	15,431	25,940	0	488,289
18	Daunggyi (Upper)	1,190,735	2,915	4,383	1,552	1,199,585
19	Daw Nyein	1,143,024	1,008	7,596	0	1,151,628
20	Myokone	1,462,690	3,140	5,498	0	1,471,328
21	Kyetphamwezaung	5,542,112	26,521	29,215	140,744	5,738,592
22	Banbwezu	2,338,090	10,086	12,722	0	2,360,898
23	Daydalu	1,064,921	2,208	5,064	0	1,072,193
24	Letpanbin	1,551,158	6,798	4,940	0	1,562,896
25	Zinbaung	1,367,744	5,541	5,126	0	1,378,411
26	Myaseinkan	0	9,711	14,821	12,419	36,951
27	Thandi	45,504	2,667	2,408	12,419	62,998
28	Suclubbaluma	127,751	5,992	7,658	8,279	149,680
29	Hleseikchaunggyi	233,074	1,777	2,966	24,837	262,654
30	Tamatakaw	87,926	10,276	15,997	57,953	172,152
31	Kyonsoat	48,858	412	984	19,663	69,917
32	Maubin Island (North)	690,606	23,110	30,199	82,790	826,705
33	Maubin Island (South)	93,451	10,776	10,314	33,116	147,657
34	Thonegwakyun	1,665,836	16,064	23,718	99,348	1,804,966
	Total	39,661,713	231,509	328,738	1,070,583	41,292,543
	(In US Dollar)	(45,640,636)	(266,409)	(378,295)	(1,231,971)	(47,517,311)

Table 5.9-3 Disbursement Schedule of Project Costs

Unit: 1,000 Ks

	Component-1	Component-2	Component-3	Component-4	
	Rehabilitation of Agricultural & Rural Infrastructure	Improvement of Farming	Income Generation	Rehabilitation of Mangrove Windbreak	Total Amount
1st Year	7,695,841	23,146	26,847	178,517	7,924,351
2nd Year	8,167,985	22,284	50,627	321,848	8,562,744
3rd Year	6,567,324	42,546	48,152	429,474	7,087,496
4th Year	8,302,936	42,901	83,239	140,744	8,569,820
5th Year	8,927,627	41,631	59,157	-	9,028,415
6th Year	-	28,337	40,120	-	68,457
7th Year	-	19,070	17,494	-	36,564
8th Year	-	8,510	2,046	-	10,556
9th Year	-	3,083	1,056	-	4,139
Total	39,661,713	231,509	328,738	1,070,583	41,292,543
(In US$)	(45,640,636)	(266,409)	(378,295)	(1,231,971)	(47,517,311)

Note: The 4th year cost of component-1 includes the costs of Alegyun (3) that require only sluice rehabilitation.

5.10 Project Justification

5.10.1 Technical evaluation: Under the D/P, appropriateness of embankment design standards, effective utilization of machine and manual construction, transfer of technology for MAS, LBVD and FD, and fostering awareness about quality control for seed and vegetable production will be ensured with technical justification.

5.10.2 Financial and economic evaluation: Results of financial and economic evaluation for four projects are summarized below. Nevertheless, two projects for improvement of farming and income generation have been evaluated in terms of financial analysis only due to their project nature characterized as a self-reliance project.

Table 5.10-1 Financial and Economic Analysis for Agricultural and Rural Infrastructure Rehabilitation

Project	Financial analysis			Economic analysis		
	NPV (1,000 Kyats)	B/C ratio	FIRR (%)	NPV (1,000 Kyats)	B/C ratio	EIRR (%)
1) Rehabilitation of agricultural and rural infrastructure	24,813,932	1.87	15.3	36,940,367	2.33	28.1
2) Windbreak mangrove rehabilitation	4,508,920	6.14	26.8	4,633,205	6.38	27.7

Table 5.10-2 Farm Budget Analysis for Improvement of Farming

Item	Local variety	Improved variety
Incremental income (Kyat / 2 acres / HH)	125,096	194,052
Proportion of loan repayment to incremental income (%)	15	11

Table 5.10-3 Farm Budget Analysis for Income Generation

Item	Vegetables production				Livestock production	
	Yard long bean	Okra	Roselle	Water cress	Pig breeding	Pig fattening
Incremental income (Kyat / 0.025 acre / HH)	16,157	6,313	3,648	3,225	-	-
Incremental income (Kyat / HH)	-	-	-	-	185,288	87,869
Proportion of loan repayment to incremental income (%)	3	7	6	7	16	18

As a result of the evaluation, two projects for rehabilitation of agricultural and rural infrastructure and mangrove windbreak rehabilitation were considered as financially and economically viable, with even results of sensitivity analyses on financial and economic viability indicators, while other two projects are financially viable and highly profitable.

5.10.3 Social and natural environmental evaluation

From the social environment point of view, resettlement will be avoided or minimized to extent possible at the embankment planning and design stages, and generation of employment and income opportunities will be highly significant for the poor and very poor groups, thereby leading to high poverty alleviation. In natural environment, on the other hand, no significant post-project negative impact will be expected in terms of natural environment and pollution. As a result, four projects are of great importance from socio-economic and natural environmental viewpoints by providing a catalyst both for assurance of the security of life and property (including agricultural land conservation) in the polder areas, and for alleviation of rural poverty.

Chapter 6 Technology Transfer

6.1 Introduction

Technology transfer for the counterparts personnel of the DAP, ID, MAS as well as farmers and landless households was extended during the entire project period from December 2009 to May 2011 through on-the-job training in various activities in both field and office work.

6.2 Result of Technology Transfer

The target personnel of technology transfer were categorized into three groups, namely: 1) central level officers including C/Ps, DAP, ID and MAS, 2) site level officers of ID, MAS and local government, and 3) site level farmers involved in the pilot projects.

The number of participants in the workshops /seminars /field trainings/ study tours held in relation to the pilot projects was 1113 in total (256 officers and 857 farmers/ landless/ villagers).

6.3 Evaluation of Technology Transfer

It is concluded that technology transfer was highly relevant to its process and methodology. Technical and management capacities of the target groups at all levels related to the pilot projects were strengthened for the preservation of farming area.

Chapter 7 Conclusion and Recommendations

1. Relevance of D/P on preservation of farming area

It is concluded that the D/P on preservation of farming area would be technically applicable to Nargis affected-area, socially acceptable for rehabilitation of agricultural production and rural life, financially viable to the government of Myanmar and environmentally sound for the country. Thus, all components of the D/P could be implemented without much difficulty except income generation component which involves landless villagers under the self-help concept. Assessment shows that income generation projects would be technically and institutionally viable and sustainable only if full government support is effectively extended.

2. Realization of preservation of farming area for rehabilitation of agricultural production and rural life through implementation of D/P

Upon implementation of the projects in the D/P, preservation of farming area shall be attained, agricultural production be restored then increased, and rural life be rehabilitated at 34 polders and embankments. More details are clearly explained below;

1) Polder dikes and embankments as the most essential structures proposed for farmland preservation and disaster prevention shall become safer from big cyclone with height and size. Sluice gates shall become more functional as it will drain excess water outside and will also prevent salt water intrusion from the river. Thus, farmland inside the polder shall be preserved, hence agriculture, the first important sustenance, will be developed.
2) Mangrove windbreak shall be planted along polder dikes and embankments to as protection from tidal surge and storms. Mangrove trees will be maintained by the village community and used for community's income generation activities.
3) With efficient technical support of MAS on farming improvement, production of quality rice seeds will be increased and widely disseminated in the area that will result to increase in their farm incomes. Other farmers who use such quality rice seed will also get increased farm income with increased production. MAS extension work will become active and efficient as the project is carried out at demo-farms with involvement of advanced farmers.
4) With efficient support of MAS, LBVD, local government and NGOs, small income generation activities, i.e. vegetable cultivation and pig breeding shall be practiced by landless. Moreover through self-expansion of the project, such activities will be expanded to other landless people. It is then ultimately expected rural life in the polder area to become active and be developed.

3. Acceleration of rehabilitation for polder dike and sluice gates

It is highly expected that rehabilitation of polder dikes and sluice gates would be accelerated as the D/P has been formulated based on the pilot project experience. Technical standards, construction method, implementation process and so on stated in the D/P shall be fully utilized as essential guide.

There are two ways of implementation for public civil works in the country, i.e. force account work by government and contracted work by contractors. As reconstruction of Nargis-affected area is urgent challenge, it will be practical to carry out the rehabilitation with force account work by ID using the ID-owned construction equipment from the viewpoint of quick and low cost implementation as compared with contracted work that usually takes long time. Only it will be required to maintain and repair of ID construction equipment as they are already very old, or to procure new equipment for the project.

4. Observation of mitigation measures on resettlement due to dike embankment rehabilitation

It is suggested that mitigation measures on resettlement and land acquisition as well as monitoring plans as recommended in the D/P in relation to dike embankment work shall be earnestly followed.

5. Village community involvement in rehabilitation of mangrove windbreak

The key to sustain the mangrove windbreak after plantation through government support will be how mangrove windbreak trees can be operated and maintained. The village community shall be involved in the project implementation and mangrove trees shall be maintained by them. For this purpose, a Mangrove Windbreak Administration Committee will be established by village people.

6. Expected wide spread of quality rice seed in Ayeyawady Delta

The D/P programme for quality rice seed production focuses on rice seed, the most basic and important farming material to be used every year. It would require neither much financial investment nor particular farming technology for farmers. On the contrary, it could benefit not only farmer participants of the seed producers program but other farmers in the Ayeyawady Delta. Moreover, it is expected to increase efficacy of the Seed Law which was newly issued in January 2011.

7. Support required in income generation projects

Expected supports to be rendered by the government / NGOs / international organizations to the landless people who will participate in the income generation projects are;

1) Financial assistance to procure initial inputs such as seed, fertilizer, pesticide, watering can, piglet, vaccination and so on.
2) Provision of pre-implementation guidance as to role sharing, work responsibility, expected technical and management support, and budget involved.
3) Provision of technical training on vegetable cropping and pig culture through timely field visit.
4) Provision of market information for harvest control and preparation of transport and selling.

8. Way of initiatives between beneficiaries and government on self-help project under D/P

Among the projects in the D/P, the projects for quality rice seed production and income generation are self-help concept activities from which individual participant either farmers or landless people will be benefitted. In such self-help-natured projects, initiatives and responsibilities shall be basically taken by beneficiary (participant). However, for the success of the project in view of public interest, as participants are on very weak base in terms of technique, finance and marketing, the government from the union and/or region involved shall take initiatives in the promotion of the project particularly at the initial arrangement and orientation period.

9. Funds Procurement for the D/P

The total development costs for the rehabilitation of agricultural and rural infrastructure under the D/P are estimated at 39,662 million Kyats (equivalent to 45.6 million US Dollar), which the government of Myanmar needs to prepare. Therefore, the government of Myanmar shall make serious efforts to procure the development funds from possible financial sources such as government fund, donor countries, international development organizations, financial lending institutions, etc.