A Mini - Study of the Potential of Rehabilitation of Canal System in Gravity Irrigation Schemes in the Dry Zone

FINAL REPORT

A Study Conducted by

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ABBREVIATIONS AND ACRONYMS

Abbreviation	Definition
ACC	Agricultural Coordinating Committee
Ac-ft	Acre x feet (Volume measured)
LIFT	Livelihoods and Food Security Trust
TOR	Terms Of Reference
UNOPS	United Nations Office for Project Services
P & D	Planning and Design
ID	Irrigation Department
WUA	Water User Association
RL	Reduced Level
U/S	Upstream
D/S	Downstream
RCC	Reinforced Cement Concrete
RMC	Right Main Canal
LMC	Left Main Canal
Dy	Distributary
O & M	Operation and Maintenance
L.S Cotton	Long Stable Cotton
F.T.L	Full Tank Level
D.W.L	Dead Water Level
F.T.L	Full Tank Capacity
D.L.C	Dead Level Capacity
F.S.L	Full Supply Level
W/C	Water Course
MOAI	Ministry of Agriculture and Irrigation
WUA	Water User's Association
WUG	Water User's Group
WDC	Water Distribution Committee
TPGA	Township General Administrator
DA	Department of Agriculture
SLRD	Settlement and Land Record Department
VAC	Village Administrative Council
TC	Tail Canal
Myaunggaung	Watercourse Leader
MM	Men-month

UNITS AND EQUIVALENTS

Imperial units of measurement, which are in normal use in Burma, have generally been used in this report, except where they would be clearly inappropriate. Burmese units of yield measurement (baskets and viss) have been used when they are most appropriate. A full list of equivalents for these is provided in the Glossary, on the next page.

1	inch	=	2.54	centimetres
1	foot (ft)	=	0.305	metre
1	mile	=	1.609	kilometres
1	acre	=	0.4047	hectare
1	square mile	=	2.59	square kilometres
1	lb/acre	=	1.121	kilometres/hectare
1	pound (lb)	=	0.453	kilogramme (kg)
1	ton (long ton-2240 lbs)	=	1.016	metric tonnes (mt)
1	cubic foot (cu-ft)	=	28.32	litres
1	imperial gallon	=	4.546	litres
1	imperial gallon	=	1.2	US gallons
1	barrel (crude petroleum)	=	42	US gallons
1	metric tonne	=	7.3	barrels (at world average specific gravity)
1	kilowatt (KW)	=	1000	watts (W)
1	megawatt (MW)	=	1000	kilowatts
1	cubic foot per second (cusec)	=	0.028	cubic metre per second
1	acre foot	=	1233	cubic metre (m^3)
1	viss (Burmese measure of weight)	=	3.6	lbs or 1.63 kg
1	Sudrum (sud)	=	100	Cubic feet (ft^3)

GLOSSARY

English Name	Burmese Name	Form	Unit	Equivalent in lb
Paddy	Saba	Dried	Basket	46
Wheat	Gyone	Dried	Basket	72
Blackgram	Matpe	Shelled	Basket	72
Chillies	Ngayokethee	Dried	Viss	3.6
Cotton	Wa	Dried	Viss	3.6
Onion	Kyattyon	Fresh	Viss	3.6

A Mini-Study of the Potential of Rehabilitation of Canal Systems in Gravity Irrigation Schemes in the Dry Zone

1. Introduction

1.1 Background of the Project

The LIFT is presently preparing a new programme that will be implemented from 2013 to 2016. As water related concern are known to have strong bearing on food security and low income thus, LIFT has decided to undertake a rapid review of access to and management of water sources. Its initial analyses have identified rehabilitation of canal systems in gravity irrigation schemes as a potential option for inclusion on the new programme. In order to provide a better basis for assessing the potential of this option a quotation for a mini-study to provide some indicative information on the rational for such an activity was requested to three firms with TOR as prepared by LIFT UNOPS in the contract, NEPS after going through the subject has submitted the quotation which was awarded and has signed the contract agreement on 11th April 2013.

1.2 Objective

The objective of the study is to

(i) Provide an understanding of the extent to which canals are not well maintained and why.

(ii) Explore farmers' perceptions of how irrigation systems should work to be best use to them.

(iii) Explore options for improved management of schemes and in particular better (more sustainable) maintenance of canals.

(iv) Establish if the canal systems have been fully developed.

(v) Tentatively assess the economic rationale for rehabilitating canals in gravity irrigation schemes in the Dry Zone.

1.3 Consultant Service

Selection of A Mini Study Area

As per contract agreement the Consultant shall study two medium size irrigation schemes which should be considered to be in poor condition and the second one which is in a less serious condition. The Consultant on receiving the copy of introduction letter from LIFT-UNOPS to ID, NEPS MD and the Consultant visited ID Planning and Design (P & D) Director on the 29th April and discuss the above subject for the selection of two mini study irrigation schemes in Mandalay Region. Director (P & D) after going through the list of 97 dams and weir of Mandalay Region [See Annex-C and (Annex 1-Map -1)] suggested Thitson Dam and Kyaukse Tank of Pyawbwe Township for the assessment. NEPS prepared necessary desk study and made arrangement for site survey.

The survey teams lead by U Khin Latt and U Than Shwe left Yangon on 2nd May 2013. On the way to project site they call on the Dy Director General of Irrigation Department. He has instructed the Regional Director for the collaboration in the assessment of dam which require urgent rehabilitation. The team proceeds to Meiktila and met the responsible Executive Engineer on behalf of Regional Director. He informed that Thitson Irrigation Scheme which was proposed by Director (P & D) is going to be maintained within this year. Thus, the consulting teams were suggested to survey and assess Chaungmagyi Dam and Kyaukse Tank. The next day 3rd May 2013 the survey team started RMC survey and agro-economic social-economic survey. The teams return to Yangon on 13th May 2013 to assess the raw data and prepare the report.

2. The Irrigation Department

2.1 General

The Irrigation Department (ID) is one of the (11) institutions of the Ministry of Agriculture and Irrigation (MOAT). It is headed by a Director General, head-Quartered in Nay Pyi Taw. The Head-Quarter is made of (6) primary branches and (5) other branches correlated to it. There are (17) maintenance divisions of the respective States and Regions including Nay Pyi Taw territory with three divisions in Shan state and (9) construction divisions stationed in various part of Myanmar as appropriate. There are (4) mechanical divisions each under a Director stationed at Yangon, Mandalay, Taunggu and Magwe. The maintenance divisions are responsible for operation and maintenance of completed Irrigation Schemes. The construction and mechanical divisions are responsible for implementation of new projects. The organization charts of the Ministry and Irrigation Department is as shown in Chart-1 and (Annex – 1 Chart 2, 3, and 4). Irrigation Department is responsible for all the major irrigation works in Myanmar, both for implementation and maintenance together with drainage and flood protection facilities wherever required.

2.2 Assistant Engineer Office, Irrigation Department, Pyawbwe

The present organization chart of Assistant Engineer (AE) Pyawbwe is as shown in Chart -1. Pyawbwe Judiciary is under the charge of Yamethin District. But, concerning with Irrigation Department administration of irrigation works there is one AE office at Yamethin and one at Pyawbwe which are administered by Executive Engineer (EE), Meiktila District.

Pyawbwe AE is responsible for eight irrigation schemes namely Chaungmagyi Dam and Weir, Kyaukse Tank, Yintaw Dam, Yoe Gyi Dam, Yanaung Dam, Thaphanchaung Dam, Minthagyi Dam and Natkar Dam.

All the dams, weir head regulators and main canal head regulator are staffed with care takers. AE supervised the operation and maintenance staff, established water distribution, contact with farmers and to settle farmer's water disputes.

He is assisted by one canal inspector (CI),(to ask AE) assistant canal inspector (ACI), (**to ask AE**) canal revenue surveyors (CRS) and (**to ask AE**) assistant canal revenue surveyors (ACRS). (Duty and function of above personnel see Annex – C4). These CI prior to 2007 do not collect revenue, his responsibility is to check farm irrigation water intake at least twice per irrigation season. The preparation of water tax ticket is the responsibility of land use officer. The officers forward the tax ticket to the department of general administration for collection of revenue. But, at present it is the CI of irrigation department duty to collect water tax and remitted to the bank. (The Irrigation Department does not have the right to use the collected revenue). Furthermore, there are account staffs and other administrative office staffs at AE Pyawbwe office together with a driver and miscellaneous staff **total up to 43**. The staffs mentioned above are responsible for both operation and maintenance works.

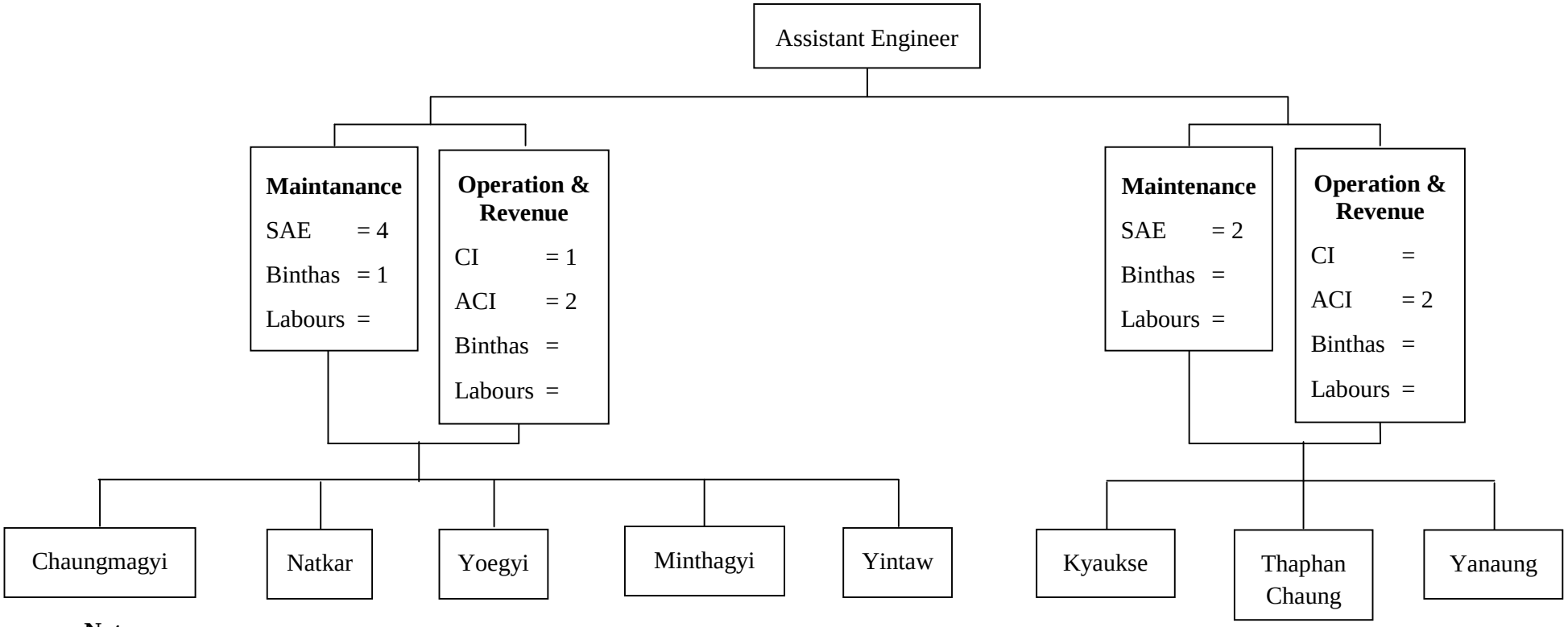
The irrigation season is from 15 July to 15 November, it is a continuous supply system. There are (10) permanent ordinary maintenance labour for Chaungmagyi networks (4) is responsible for RMC and (6) is responsible for LMC. There are (4) Ordinary Maintenance labour for Kyaukse tank. The seasonal maintenance, desilting and special repairs are carried out during the non-irrigation season by hired labour. (If fund is allotted)

The responsibility of ID ends immediately behind the watercourse inlets.

On the other hand, the farmers before the start of irrigation season have to maintain the tertiary canals (water course- WC) without fail.

Chart 1 **Organization Chart of Assistant Engineer**

Irrigation Department, Pyawbwe



Note:

SAE = Sub Assistant Engineer
CI = Canal Inspector
ACI = Assistant Canal Inspector
Binthas = Gate Keeper

3. Rehabilitation Irrigation Schemes

3A. Chaungmagyi Irrigation Scheme

3A.1 History of the Area

Chaungmagyi, a medium size irrigation scheme of Dry Zone is in Pyawbwe township of Mandalay Region, the location is as shown in Chaungmagyi irrigation network map (Map-1). It comprises of two irrigation systems, the Tayankar irrigation areas and Chaungmagyi Tawdwinhla weir irrigation system with 7091 acres of net irrigation area (2013 – ID report). See table - 6. Because this report is concerned only with Tawdwinhla Right Main Canal system. So, we will stress and deal with RMC system in detail. The Chaungmagyi Tawdwinhla weir irrigation itself will be treated in general. The irrigation water is released from Chaungmagyi dam into the old Chaungmagyi river from which some of the water diverted into Tayankar irrigation system and 7 miles below the dam is picked up by Tawdwinhla weir and then this is diverted into the RMC and LMC and regulated by canal head regulators.

The weir is a combination of steel reinforcement and a stone masonry structure. It is one hundred and forty feet wide with 28 nos. of 5 ft x 3 ft automatic falling shutters to raise the water. It has two canal outlets left main canal (LMC) with two numbers of 12 ft x 4.5 ft gates and right main canal with one 12 ft x 4.5 ft gate. The weir do not have any sand ejecting structure. The feeder channel, old Chaungmagyi carry a lot of bed load (sand and silt), all this bed load flows into RMC & LMC together with the water and silted the canals heavily. In this regard, a sand trap or a sand ejector is essential which should be provided without fail.

The Chaungmagyi canal system was designed by Irrigation Department Planning and Design Branch in 1970, original design data are as shown in Table 6 and 6a of Annex A. It was constructed by construction division (2) which was dragged on for years and finally completed in 1981, the salient data of Chaungmagyi Dam is as shown in Table - 5. The capacity of the dam is 40200 ac-ft and the usable water is 33200 ac-ft for the irrigable area of 10423 acre (see Table - 6). The Chaungmagyi dam served Tayankar weir with Irrigable area of 1185 Acres (designed) and Tawdwinhla weir with irrigable area of 9238 Acres (designed), totally 10423 Acres. Firstly, the supplementary irrigation requirement supply for monsoon paddy and other crops. The second crops are planned with the balance of water in the dam (see Table - 4). (The volume measure of water in the reservoir is given in Acre-feet (Ac-ft)). The irrigation ***duty***$^{(1)}$ was 40 acre per cusec equivalent to 0.00175 cumec per ha serving 10423 acre. Chaungmagyi irrigation system comprises of two canal systems right main canal (RMC) serving 2873 acres and left canal system (LMC) serving 6365 acres. According to ID

latest ground survey, RMC served 2128 acres and LMC served 4963 acres. Refer Table - 6. The right system is served by six distributaries (Dy) and RMC a direct turnout and its tail canal. The left system is served by nine distributaries (Dy), two minors and a direct turnout. (See Map 1 and Figure 1 of Annex A1)

Note :(1) The ***duty of water*** refers to the relationship between the quantity of water made available and the area irrigated with it. It is expressed as the number of acres of crop successfully raised with a constant flow of one cusec of water throughout the growth period (base period) or irrigation period.

The initial aim of the project was to uplift the livelihood of the farmers living around Chaungmagyi Dam and in the irrigation systems.

The original cropping pattern was L.S cotton 3000 acres followed by 6923 acres of monsoon paddy with 500 acres of onion. It was implemented and practiced accordantly up to last 10 to 15 years which was mentioned in the discussion between the consultant and farmers.

The agriculture product prior to Chaungmagyi Dam project is as shown in Table - 1 and 2 of Annex - A1. The present agricultural production from the Chaungmagyi cultivated area is summarized in tubular from below. The table indicated the areas planted, lost, harvested, the average yields and production by major crops. It is shown in Table - 3. The cropping practice of the area is as shown in Figure - 1 and 2.

In addition to the gross farm income, farmers also keep a small number of livestock. These livestock normally include a pair of draft cattle plus a variety of pigs and poultry kept around the homestead, as shown in Table - 3 of Annex - A1.

The farmers had enjoyed good crops production up to about year 2001 or so with adequate supply of irrigation water and equity.

Since, then up to present date the irrigable area declined, receiving less and less of irrigation water due to sedimentation and lack of regular maintenance. The yearly maintenance funds could not cope the seasonal maintenance works of canal system desilting, resectioning and maintenance of infrastructures. To what extend is the RMC canal system has being deteriorated is explained in detail in Chapter 3A.3 and as shown in Table - 7.

(a) Description of the Area

There are about 40,000 registered farmers within the Pyawbwe Township, Chaungmagyi RMC irrigable area is also included in it. The average farm size is round about 5 acres (2 hectares) per farmer household.

(b) Population

The project affects 7 village tracts within Pyawbwe Township. These 7 village tracts have a population of 23250 from 4868 families but all these people are not directly benefited from the irrigation scheme. The average family size is 4.8 persons.

(c) Employment

Virtually the entire population within the Chaungmagyi irrigation network area is concerned in one form or another, with agriculture. 90% of families are registered as farmers. Reliable statistics on unemployment and under employment were not available. Field survey conducted in the project areas indicates that previously when the irrigation water supply was adequate without any canal maintenance problem, there were enough farm labour for the areas. At present, many members of farm households are under employed because of scarcity of work due to lack of irrigation water, the village landless labours left the village to work in other place. Therefore, the new demand of labour for rehabilitation will not be available locally but the village administrator of Chaungmagyi said that there is a labour agent who could import the required number of labour. The demography of village tract is as shown in Table - 1.

Table - 1 Demography of Village Tracts under Chaungmagyi Irrigation System Pyawbwe Township, (2012-2013)

Sr. No	Village Tract	House Hold	Family	Under 18 Year		Above 18 Year		Total
				Male	Female	Male	Female	
1	Chaungmagyi	1070	1071	757	809	1609	1870	5045
2	Taw Dwin Hla	742	803	541	554	1321	1538	3955
3	Wet Let	222	222	155	164	309	385	1013
4	Tayankar	1083	1157	871	968	1557	1898	5294
5	Kyi Ni	513	549	493	455	779	926	2653
6	Nyaung Shwe	741	749	531	556	1153	1431	3671
7	Thapya Yoe	317	317	269	166	494	590	1619
	Total	**4688**	**4868**	**3617**	**3672**	**7222**	**8638**	**23250**

(d) Land Area and Use

The gross area of cultivable land under Chaungmagyi dam is about 20605 acres. Out of which the net cultivable area is 15,634 acres. From statistics it is estimated that around 13.67% of the gross area is lost in existing roads, ox-tracts, drains, bunds etc. The actual area available for cropping is 78.53% that is cultivable land plus cultivable waste as shown in Table - 2.

The design irrigable area is 10423 areas including Tayankar which means that 67% of the cultivable area is irrigated. Table - 6 shows the present status of irrigation area with ID latest assessment of the area in which the total irrigable area of the integrated system has decreased from 10423 to 8205 acres i.e, about 21%. In this regard, all calculation concerning agriculture product will be dealt with ID reason assessed data. The irrigable area of RMC as per design is 2873 acres (assessed 2128 acres). At present, agricultural productivity is low due to the poor climate conditions and insufficient water supply from the irrigation system which is deteriorated. Under proper irrigation, the cropping intensity would increase and that crop yields would show substantial rises.

Table - 2 Land Use Status of Chaungmagyi Dam Irrigation Network

Land Use	Acres (ha)	Percentage
(a) Agricultural Land		
(i) Cultivated	15634(6330)	75.87
(ii) Cultivable Waste	548(222)	2.66
(iii) Often wood Land	1607(651)	7.80
Sub Total	**17789 (7202)**	**86.33**
(b) Uncultivable Land (ox-tracts, drains, bunds etc.)	2816(1140)	13.67
Total	**20605 (8342)**	**100.0**

Note: Original land use form of table - 6 is attached as Table - 4 of Annex - A1.

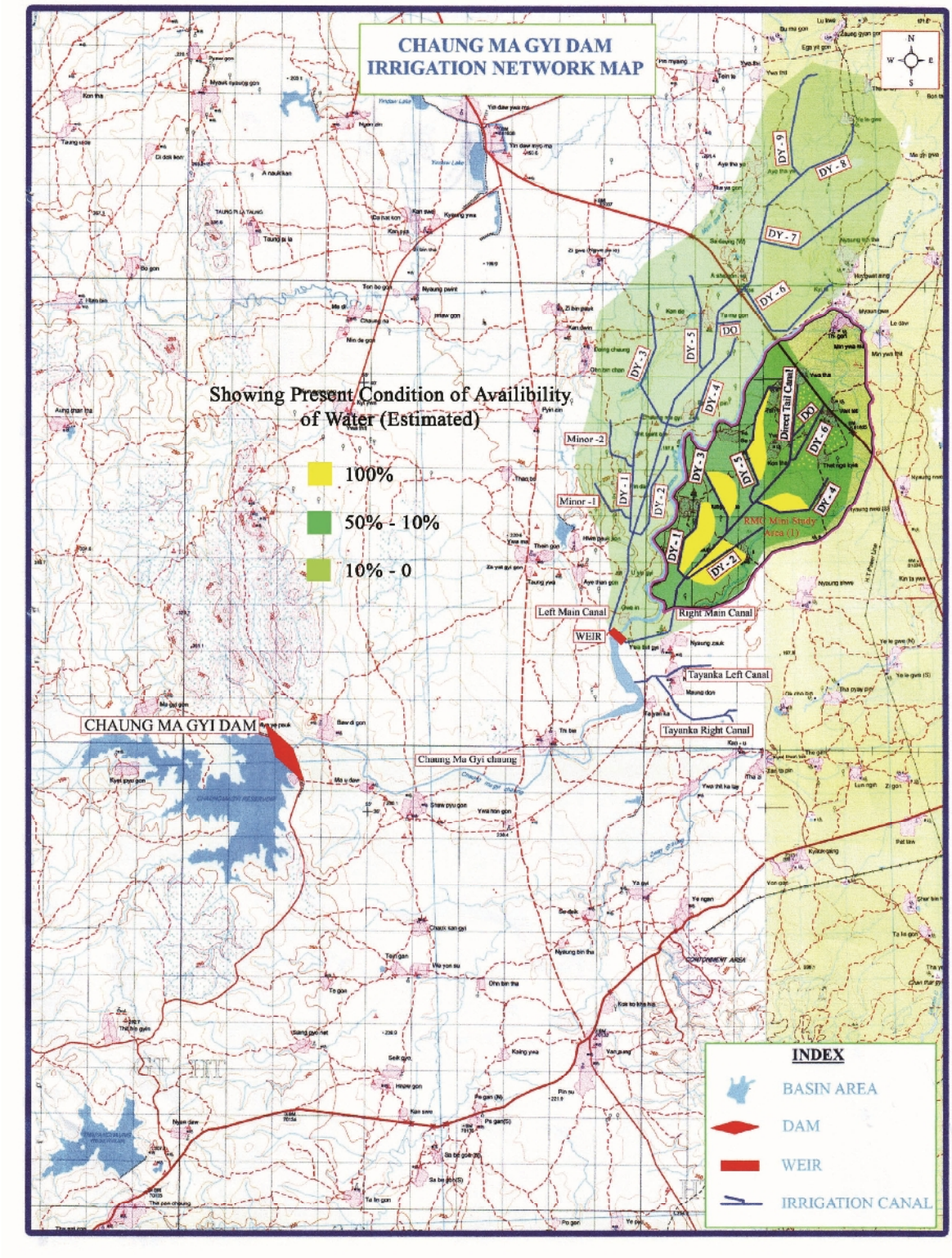
Table - 3 Present Production of Crops under Chaungmagyi Dam Irrigation Scheme

Area Available for RMC Irrigation System = 2873 (as per Design)

Area Available for RMC Irrigation System = 2128 (as per ID Assessed)

Sr. No.	Crop	Area Planted Acres	Acres Lost Acres	Acres Harvested Acres	Average Yield per Acres (Basket or Viss)	Total Production (Basket or Viss)
1	Monsoon Paddy	3930	-	3930	77.67	305243
2	Summer Paddy	617	-	617	88.6	54633
3	Maize	97	-	97	51.2	4966
4	Sorghum	1104	-	1104	12.0	13248
5	Ground nut	31	-	31	36.39	1128
6	Pre-monsoon Sesame	5096	-	5096	5.37	27366
7	Pigeon pea	286	-	286	15.0	4290
8	Green gram	1825	-	1825	12.3	22448
9	Chili	1119	-	1119	250	279750

Map - 1


CHAUNG MA GYI DAM
IRRIGATION NETWORK MAP
Showing Present Condition of Availibility
of Water (Estimated)
100%
50% - 10%
10% - 0
Minor -2
Minor -1
Direct Tail Canal
DO
DY - 1
DY - 2
DY - 3
DY - 4
DY - 5
DY - 6
DY - 7
DY - 8
DY - 9
RMC Mini Study
Area (1)
Left Main Canal
Right Main Canal
WEIR
Tayunka Left Canal
Tayunka Right Canal
CHAUNG MA GYI DAM
Chaung Ma Gyi chaung
INDEX
BASIN AREA
DAM
WEIR
IRRIGATION CANAL

Map 2 Location Map of Chaungmagyi Dam

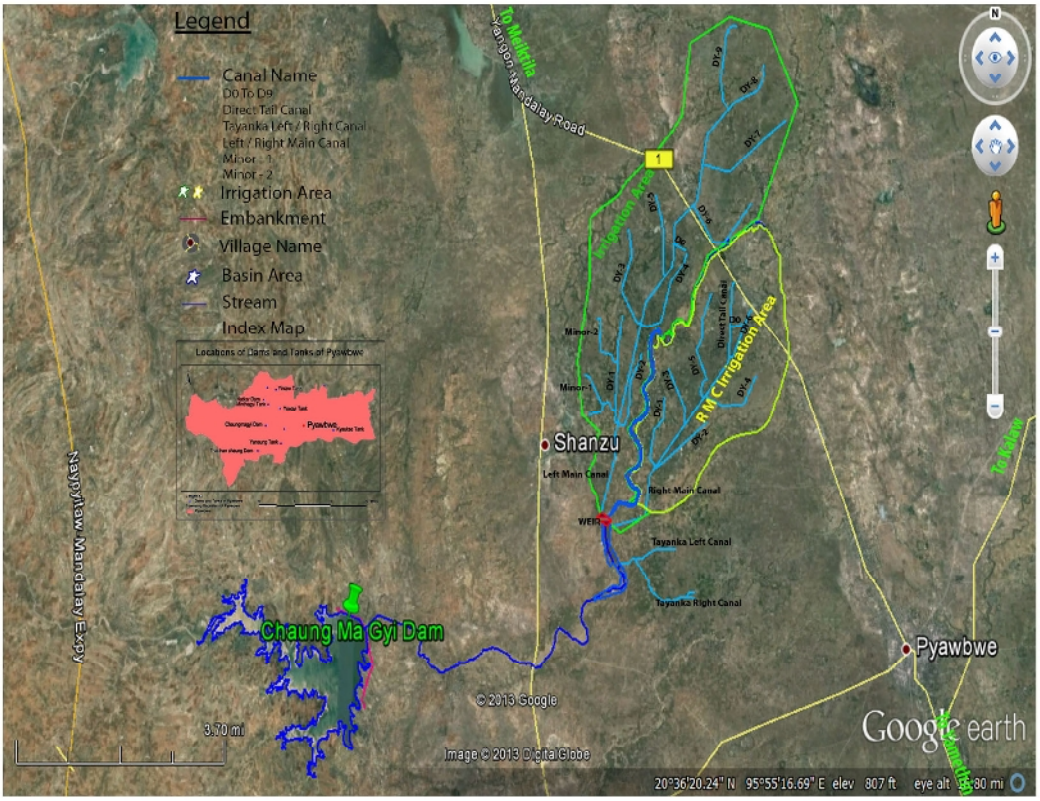


Table - 4 Chaungmagyi Dam Water Balance Status

Sr. No.	Year	Inflow (Ac-ft)	Used (Ac-ft)	Lost (Ac-ft)	Spill (Ac-ft)	Balance (Ac-ft)	Annual Rainfall (inches)
1.	2002	34701	30989	5659	-	28417	30.2
2.	2003	21050	26164	5084	-	18219	20.36
3.	2004	30310	29841	1870	-	16818	34.75
4.	2005	35262	21909	1223	-	28948	52.15
5.	2006	30260	29160	746	-	29302	25.94
6.	2007	45042	37266	1106	-	35972	18.05
7.	2008	25651	39541	-	-	22082	33.72
8.	2009	30924	34638	297	-	18171	33.49
9.	2010	35716	16470	149	-	37213	56.18
10.	2011	29600	30841	620	-	35352	38.19
11.	2012	12325	39055	85	-	8537	(30.11.2012)

Table - 5 Salient Data of Chaungmagyi Dam

1.	Location	-	Near Bawdigone Village, Pyawbwe Township
2.	Map Ref.	-	84° /14-350980
3.	Name of Chaung	-	Chaungmagyi
4.	Catchment Area	-	93 square mile
5.	Type of Dam	-	Earth
6.	Dam Length	-	9150 ft
7.	Dam Crest Level	-	R.L 820.0 ft
8.	Maximum Dam Height	-	96 ft
9.	Crest Width	-	18 ft
10.	F.T.L/Depth	-	R.L 808.8 ft/84.0 ft
11.	D.W.L/Depth	-	R.L 784.5 ft/60.5 ft
12.	Full Tank Surface Area	-	2100 Ac
13.	Full Tank Capacity	-	40200 Ac-ft
14.	Dead Water Capacity	-	7000 Ac-ft
15.	Usable Capacity	-	33200 Ac-ft
16.	Spillway		
	Type	-	Reinforced Concrete
	Number	-	1
	Width	-	100 ft
17.	Conduit Outlet		
	Type	-	Reinforced Concrete
	Number	-	1
	Size	-	5 ft x 3 ft (1) No.
18.	Spillway Length	-	140 ft
	Shutter	-	5 ft x 3 ft (28) Nos.
	LMC Regulator	-	12 ft x 4.5 ft (2) Nos.
	RMC Regulator	-	12 ft x 4.5 ft (1) Nos.
19.	Canals	Nos.	Length
	Main Canal	2	12.85 mile
	Dy + Minor	15	20.57 mile
	Water Course	107	52.57 mile
	Canal Structures	134	-
20.	Irrigable Area	-	10460 Acre (8229 acre)
21.	Date of Construction	-	1969-1970
22.	Date of Completion	-	1980-1981
23.	Project Cost	-	Kyat 22.2 million

Table – 6 Status of Yearly Monsoon Paddy Cultivated by Canal under Chaungmagyi Canal System

Sr. No	Name of Canal	Irrigable Area		Status of Yearly Monsoon Paddy				
		Design Acres	Assessed Acres	2008-09	2009-10	2010-11	2011-12	2012-13
TAWDWINHLA WEIR								
RMC								
1	DY-1	310	281	268	218	-	200	200
2	DY-2	431	218	218	155	-	210	195
3	DY-3	358	328	328	278	-	277	277
4	DY-4	511	365	365	55	-	162	161
5	DY-5	620	445	440	220	-	295	295
6	DY-6	333	311	311	291	-	297	297
7	Dir - RMC	310	180	176	152	-	124	124
Total		**2873**	**2128**	**2106**	**1369**	**-**	**1565**	**1549**
LMC								
1	DY-1 Dir	323	256	256	250	-	264	252
1.1	DY-1 M-1	317	268	268	219	-	258	203
1.2	DY-1 M-2	382	239	239	204	-	215	166
DY-1 Total		**1022**	**763**	**763**	**673**	**-**	**737**	**621**
2	Dy-2	243	166	166	110	-	157	150
3	Dy-3	1013	751	717	514	689	745	661
4	Dy-4	613	530	509	332	494	417	401
5	Dy-5	396	257	255	131	240	269	245
6	Dy-6	773	540	535	509	220	558	470
7	Dy-7	536	382	361	311	-	360	320
8	Dy-8	196	172	196	172	-	102	102
9	Dy-9	1543	1372	1137	506	205	460	330
10	Dir - O/T	30	30	30	14	-	30	30
LMC Total		**6365**	**4963**	**4669**	**3272**	**1848**	**3835**	**3330**
Tawdwinhla Weir Total		**9238**	**7091**	**6775**	**4641**	**1848**	**5400**	**4879**
TAYANKAR WEIR								
11	LMC	553	482	482	302	-	440	440
12	RMC	632	632	632	379	-	216	216
Tayankar Weir Total		**1185**	**1114**	**1114**	**681**	**-**	**656**	**656**
Grand Total		**10423**	**8205**	**7889**	**5322**	**1848**	**6056**	**5535**

3A.2 Institutional Management

All major irrigation schemes are implemented, operated and maintained by Irrigation Department up to secondary system. The tertiary system and farm units are the responsibility of farmers and it is managed by water user association (WUA). Other institution involving in this management are Settlement and Land Record Department (SLRD) for land use and record, land taxation and land acquisition. Department of agriculture is responsible for farms extension services etc.

Water User Association and Water Management Organization

RMC irrigation requirement is released from Chaungmagyi dam which is 7 miles U/S of the system. The water released is regulated from Tawdwinhla weir by RMC and LMC regulators in accordance with the irrigation requirement as decided by the water distribution committee (WDC) (see chart - 2). In order to draw the seasonal water distribution schedule must know the available water (volume in ac-ft) in the dam (Table - 4) which is provided by ID.

According to the Burma Irrigation Manual - Canal Act, farmer or water users have full responsibility for the tertiary level canal development and management.

Ministry of Agriculture and Irrigation (MOAI) made policy for irrigation as:

ⅰ) to develop water resources and canal system including on-farm irrigation facilities simultaneously by participation of farmers in construction and maintenance

ⅱ) to establish the water users' association (WUA) in each level of newly developed irrigation system for sustainable development of irrigation

ⅲ) to support the farmers to become the efficient and effective water user in on-farm level

Main irrigation facilities, from water source to secondary irrigation canals, are constructed and managed by Irrigation Department, while O&M of tertiary canal and lower level canals are responsibility of farmers.

For every Township with the Irrigation Scheme or Schemes, the institutional development plan is formulated including formulation of organizations of water management. Different organizations and each responsibility are as follows;

ⅰ） Water Users' Group (WUG): Tertiary canal level water management

ⅱ） Water Users Association (WUA): Secondary canal level WUA consists of leaders of WUG and ID staff (Canal Inspector) as advisor. WUA at system level might be established.

iii） Water Distribution Committee (WDC): WDC is mainly concern for water distribution including detail allocation for each tertiary.

iv） Agricultural Coordinating Committee (ACC): ACC will coordinate with assistant director of Irrigation Department to draw rotational irrigation schedule.

For Chaungmagyi Irrigation Network the water management organization is established as shown Chart - 2. The same ACC organization applies for other irrigation schemes of Pyawbwe Township.

Options for Improvement of the Scheme Sustainability

It is most common for water (water conservation) rather than land to be the upper limit on the potential of Agricultural Development in the Dry Zone irrigation scheme. In order to make the best use of finite supplies, water losses have to be minimized as follows:

a. carefully planning the water allocation

b. tight day to day control of supply to meet the minimum demand

c. correct operation of canals and irrigation/drainage structure

d. providing farmers with advice on efficient field application technique and with training as required

e. by imposing sanctions on users persisting wasteful practices of water

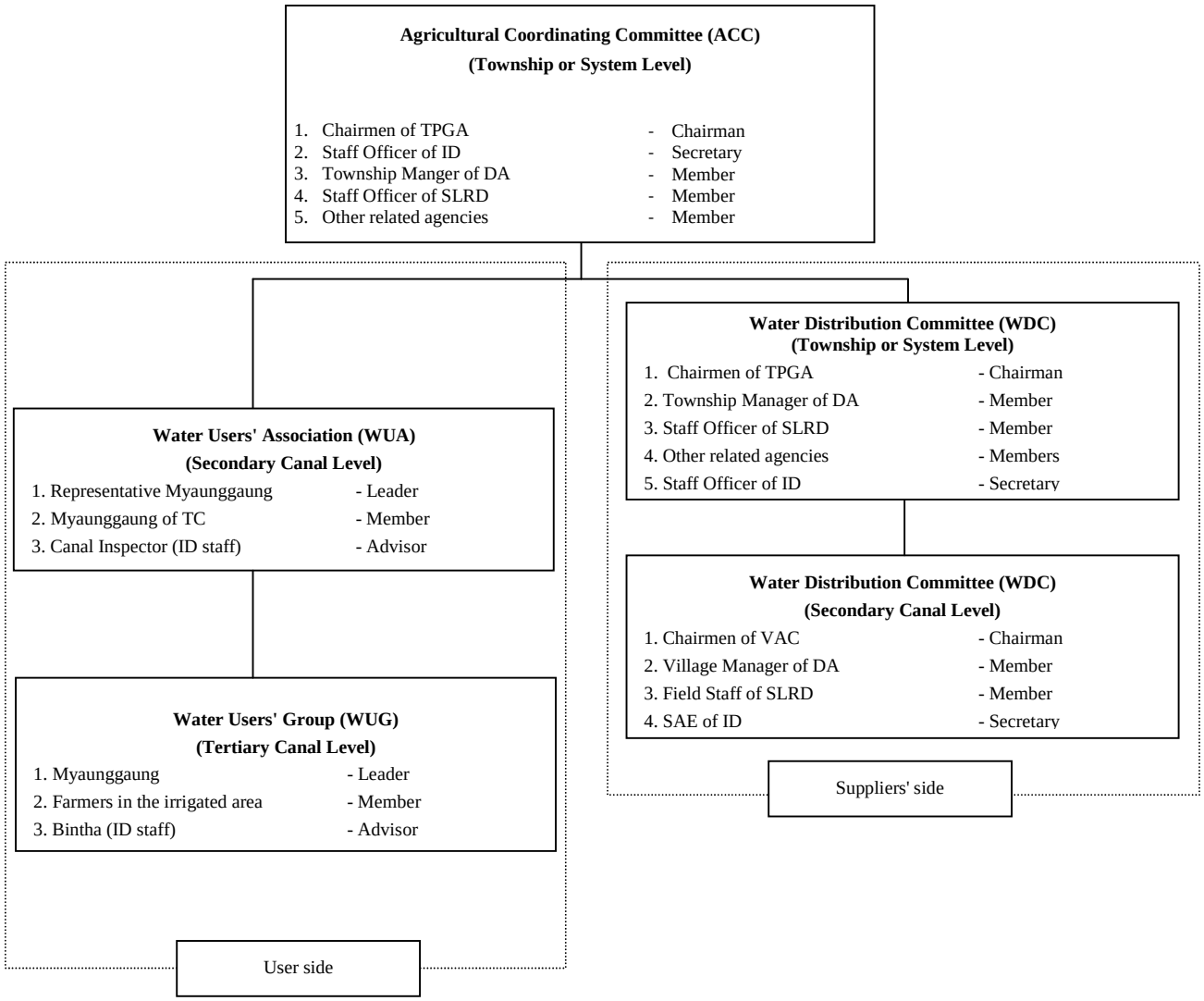
In order to achieve the goal of rehabilitation-*sustainable and better manage scheme* the water management of the canal system must be effective and water supply should be adequate and reliable. Equally drainage water shall be drained and there should not be water poundage and backing up the drain.

For proper system management in drainage and canal operation, irrigation acts, rules and regulations must be applied and exercised.

Finally for sustainable well maintain and operate system. There must be funded with adequate operation and maintenance budget.

The farmers water user association (WUA) must maintain the tertiary unit to farm lever must be well maintained.

Chart - 2


Agricultural Coordinating Committee (ACC)
(Township or System Level)
1. Chairmen of TPGA - Chairman
2. Staff Officer of ID - Secretary
3. Township Manger of DA - Member
4. Staff Officer of SLRD - Member
5. Other related agencies - Member
Water Users' Association (WUA)
(Secondary Canal Level)
1. Representative Myaunggaung - Leader
2. Myaunggaung of TC - Member
3. Canal Inspector (ID staff) - Advisor
Water Users' Group (WUG)
(Tertiary Canal Level)
1. Myaunggaung - Leader
2. Farmers in the irrigated area - Member
3. Bintha (ID staff) - Advisor
User side
Water Distribution Committee (WDC)
(Township or System Level)
1. Chairmen of TPGA - Chairman
2. Township Manager of DA - Member
3. Staff Officer of SLRD - Member
4. Other related agencies - Members
5. Staff Officer of ID - Secretary
Water Distribution Committee (WDC)
(Secondary Canal Level)
1. Chairmen of VAC - Chairman
2. Village Manager of DA - Member
3. Field Staff of SLRD - Member
4. SAE of ID - Secretary
Suppliers' side

3A.3. Description of the infrastructures and current condition

The Chaungmagyi RMC Canal system maintenance condition as inspected and surveyed by consultant team is as shown in Table - 7.

Table -7 Summary of Chaungmagyi RMC Canal System Maintenance Status (Survey and Study on System Facilities)

RMC Design Q = 75.84 Cusec

Sr. No.	Name of		No of Structure in System (No.)	Need to be Rehabilitated				Irrigable Area (Acres) Original ID 2/2013	
	Canal	Structure		100% No.	90-70	70-50	< 50%	Design Acres	Assessed Acres
I	**RMC**								
1	RMC	Fall	13	1/4 ft	9 - 4 ft 2 - 3 ft	-	-		
2	RMC	Regular	6		Dy-2	Dy-1 Dy-3, Dy6			
3	RMC	Bridge	RC=2, T=4	T-4	RC-2	-	-		
4	RMC	Culvert Under RMC	1						
	RMC	**Total**	**23**					**2873**	**2128**
II	**Distributaries**								
1	DY 1	Turn Out	6	6				310	281
		Fall	5			5			
		Bridge	2			2			
2	DY 2	Turn Out	8	8				431	218
		Fall	4			4			
		Bridge	2			2			
3	DY 3	Turn Out	4	4				358	328
		Fall	2			2			
		Bridge	2			2			
4	DY 4	Turn Out	7	7				511	365
		Fall	3			3			
		Bridge	2			2			
5	DY 5	Turn Out	8	8				620	445
		Fall	3			3			
		Bridge	2			2			
6	DY 6	Turn Out	5	5				333	311
		Fall	1			1			
		Bridge	2			2			
7	RMC Tail	Turn Out	3	3				310	180
		Fall	2			2			
		Bridge	2			2			

3A.3-1 The Existing RMC Irrigation System and its extent of deterioration

(a) General

The Right Main Canal System of Chaungmagyi Dam receives it water from Tawdwinhla weir built on the Chaungmagyi Chaung. The weir is without any sand ejector and sand trap. The canal system was opened for irrigation in 1981. The irrigation network is as shown in Map-1. The main canal up to RD 3000 is totally silted to F.S.L in most of the canal even downstream of fall, the canal are either silted or deep scouring depending upon the water velocity. The original design data as provided by ID Assistant Director are canal capacities, irrigable area, length of canals, bed width, water depth and number of structures are presented in schematic drawing in Annex A is as tabulated in Table 6 and 6a.

All the Distributaries (Dys) Head Regulators were constructed partly with brick and partly with reinforced concrete is provided with wooden slide gates, U/S inlet walls, D/S stilling basin and pitching were washed away by over discharge and even retrogression under the main Head Regulator (lack of water management). There are six Head Regulators, Dy-2 Head Regulator is the worst, with D/S side wall totally undermined and collapsed. (See Annex D) The extent to which the system is not well maintained see table - 7.

None of the off takes in the RMC irrigation system is calibrated or has been provided with a discharge measuring device.

All outlets (offtake) to watercourses consist of a simple concrete pipes. But, do not have register which show fixed design R.L and head required for the area serve and most of the pipes are either ruined or removed by breaking the canal embankment.

(b) RMC Dy's and Head Regulators and Measuring Devices

The description of each of the structure was inspected by consultant during the field visit are as described under respective type of structure and to what percentage of each structure are damaged is as shown in Table - 7.

(c) Measurement System

The existing head regulators only allow for a rough estimate of the discharges obtaining them from gauge posts in the main canal and Dy canal which is rather complicated affair for the gate keepers. Although calibration of every structure is possible, this has to be updated regularly and every structure should have a different design table to calculate the discharge. After the inspection of all the RMC regulators, it shows that Chaungmagyi Canal System did not manage the water distribution was obvious. The Dys' inlet stilling basin has been washed away and the canal beds were scoured to round about one foot (See photos of gauge posts in Dys). It is therefore proposed that uniform proper discharge measurement devices be installed at the head reach of each Dy.

(d) RMC Drop Structures

Distributaries and Minor have been constructed perpendicular to the main canal. As the slope of the terrain is rather steep in some places, there are 12 drops in right main canal. These structures reduce the slope of the water level in the canal and keep flow velocities within acceptable limits. The water level within the drops varies from less than a foot to not more than four feet.

The drop structures of the Indian fall type are constructed of brick with RCC slab and stone pitching U/S approach and D/S RCC stilling basin together with D/S stone pitching. Due to the fact that the canal embankment consist of loose material and canal, when the discharge is high, high velocity head from U/S either uplift the D/S slab or remove the loose material and finally the D/S stilling basin collapse, washed away filter material under pitching stone and moved it also. Upstream apron and pitching of fall fail mostly due to water over flowing canal embankment or because of cattle and cart crossing the canal. (See Annex A and Annex D).

(e) RMC Bridges

As per original design there were two RCC bridges and four timber bridges as tabulate in Annex A Table 8. (32) years after the completion of the scheme there are two RCC bridges, one timber bridge and some bridge abutment without deck could be seen. Those, remaining are with cracks on the abutments and RCC bridge is without hand rails. All, these should be replaced.

(f) The Tertiary System and Farm Units

The watercourse (tertiary canal) seems to have been constructed since the opening of the system in 1981. Most of the water courses are long and never developed to the end and also no maintenance. According to existing irrigation manual, the responsibilities of Irrigation Department and farmers are clearly defined. Irrigation Department shall operate and maintain up to distributaries and minor canals beyond this the watercourses (W/C) and dishes are the responsibility of the farmers (REF Irrigation Manual).

The secondary canal system was silted, its embankment settled below authorized bank level, the W/C concrete pipe offtakes were being removed or never installed. In this regard, water supply would be inadequate and there will never be equity water distribution.

On the part of the farmers, the water courses were never repaired, the practice of taking water from plot to plot is most common.

Within the water course unit there are no redistribution structures. The farmers either irrigate the fields direct from the cut in the bund or from one of the many branches of the W/C field irrigation from plot to plot by over land flow via neighbor's field.

3A.4. Proposed repairs, improvement and rehabilitations with estimates

(a) Rehabilitation

Rehabilitation of RMC canal system includes the following component.

- desilting of irrigation canals
- resectioning of canal banks including maintenance of canal embankment and access road
- repairs to structures

It is estimate that the rehabilitation project would take 6 months. The work is to start soon after the irrigation period and planned to finish before the start of the new irrigation season. The summary of estimate calculation is as shown in Table - 8.

(b) RMC and Dys Resectioning

The total length of RMC and distributaries sum up to 63700 feet, length and cross-section per distributary vary depending on length and width. Due to lack of water management the released discharge into Dys may be higher than design intake capacities by 50 to 70%, which create higher velocities causing scouring to earthen canal bed in front of the pitching, forming a pool, below the pitching level, thus the different in level, lead to under mining of the pitching and retrogression started and continued up to the concrete stilling basin and finally causing the failure of Regulator D/S structures.

The scouring of canal bed went on to some extent of the canal and depositing somewhere downstream below W/C outlet in the canal, the silting varies from 1 ft to 2 ft. This is how the Dys with over discharge are being eroded the canal bed at the upper reach and heavy silted at the downstream.

Distributaries (Dys) run perpendicular to contour lines, to keep flow velocities within acceptable limits in every distributary, drop failure of water management and lack of maintenance, sand deposits can be found everywhere, the thickness of the deposits vary from a few inches to two feet and have to be removed to assure proper functioning of the Dys.

Especially, Dy 2 which downstream structure including both side walls which foundation have been eroded and under mined causing collapse of the side walls, blocking the waterway. The broken structure has to be removed immediately and new one build.

(c) Earthwork Requirement

Excavation and backfilling in the RMC and its distributaries have been estimated by comparing the original designed canal section with side slope 1.5, 1.25 and 1 (to vertical) to the existing cross section. The volume of earthwork was calculated by subtracting the existing cross section from the designed cross-section of the implemented designed cross section.

The estimated results are present in Table - 8. The total length of RMC is 26400 feet, the quantity of earthwork to rehabilitation is 13913 Sud (1 Sud = 100 ft^3). The total length of six distributaries is 37300 ft and the quantity of earthwork is 10712 Sud. For detail calculation see Table - 8.

Table - 8 Earthwork Estimate

Item	Particular	Unit	Rate (Kyats)	Quantity	Amount (Kyats in million)
1	RMC	Sud	4500	13912.61	62.607
2	Dys	Sud	4500	10712.14	48.204
Total				**24624.75**	**110.811**

(d) Rehabilitation Cost Estimate

The cost estimate of Chaungmagyi Dam RMC Irrigation Scheme estimation as computed in Annex A is Kyats 615.265 million. The summary of detail estimate calculation is as shown in Table - 9.

Table – 9 RMC Canal System Rehabilitation Estimate

Sr. No	Particular	Size	Quantity	Unit	Rate (Kyats)	Amount (Kyats in Million)	Remarks
1	Survey				for L/S C/S	1.960	For L/S and C/S survey of RMC + Dys
2	Structures					501.264	
	2.1 Head Regulator (RMC)		6	No.	16830000	100.800	Average repair cost for 6 unit cost of each may varies
	2.2 Drop Fall (RMC)	4	10	No.	22307874	178.463	80% Repair cost of new
		3	2	No.	15001067	21.001	70% Repair cost of new
	2.3 Bridges (RCC) (RMC)		2	No.	80000000	160.000	2 new bridges
	2.4 W/C Turn Out (DYs)		41	No.	1000000	41.000	If pipe only with end brickwall will cost 20.5 Million
3	Canal E/W (RMC+DYs)				4500	110.811	Estimated by intensive labour. If by machine will be 73.87 M at K 3000/sud
4	Camp Facilities		L.S		0.2% of cost	1.230	0.2% of Total Cost
	Total					**615.265**	

(e) Construction Method and Proposed Work Schedule

The normal irrigation period is from 15 July until 15 November, after this period it will be possible in principle to execute rehabilitation works. Consequently the construction time is limited to about 7 months. All works to be completed by June so that the irrigation can continue to carry out for next irrigation season.

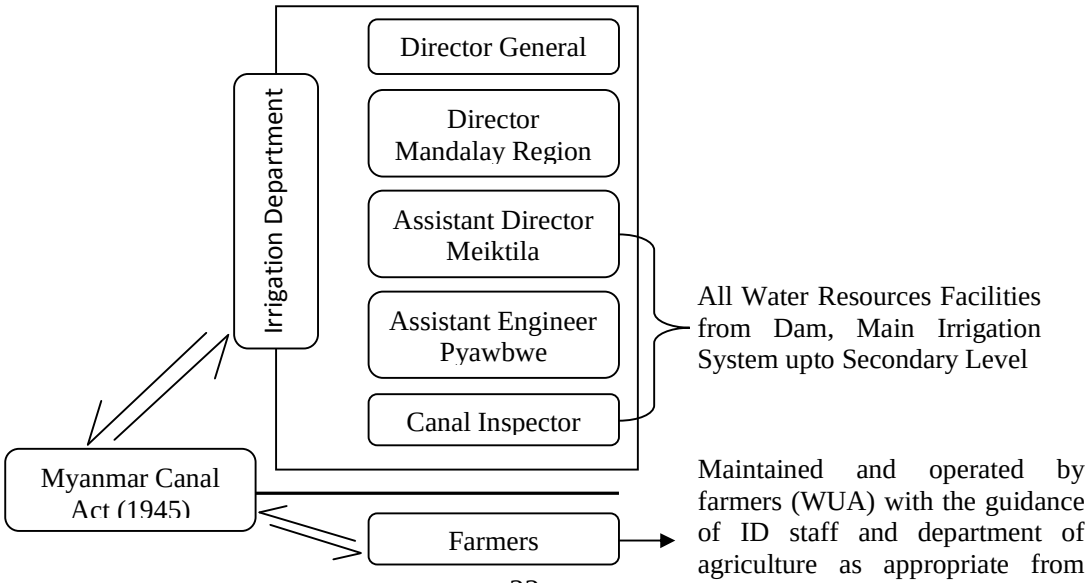
As per the contract agreement, labour intensive method will be used for construction of small structures and rehabilitation of RMC, Dys and minor canals. Therefore, the local labour force is evaluated and the components of the rehabilitation works which could be best carried out by manual labour were defined.

As shown in the summary of the estimate Table - 8. The irrigation period as mention above is from 15 July to 15 November. The construction of rehabilitation could be carried out between November and June, but sometime there is irrigation for dry crop in February. Therefore to be on the safe side, the working plan should be from 15 November to 15 February. In this regard, the estimated canal earthwork is 24624 Sud (2046200 ft^3) will require 479 MM to finish the work in 3 months, so also will require another 500 MM for repairing of old structures and implementation of new structures (see Annex A). But most of the earthwork could be carried out by machine and at a cheaper rate (see table - 9 remarks).

3A.5. Operation and Maintenance Organization

The major irrigation schemes in Myanmar are of dual-managed system, the main system up to the secondary is managed by ID and tertiary system up to farm level is managed by farmers under the strict rules and regulations managed by water user of each W/C group *which were observed up to about 1974 after that it become loose. Finally, no one care to observe it, now it is time to be re-enforced for better water management.*

Chart 3 Operation and Maintenance Organization



(a) Operation

The RMC canal system received water from Tawdwinhla weir. The chaung water level at the weir site can be raised by 5 feet high shutters that will fall down at a predetermined water level. But the shutters have to be raised manually before the water reach the weir or at low water level. RMC water requirement is regulated by the gate keeper of Tawdwinhla .

At present even with the weir water level rise to some extent, because the silt dept in RMC was so high it could divert only some amount of water. But, cannot be able to distribute and managed the system water requirement. Some, outspoken farmers said that all the water just flow down the chaung. In such a case, it is impossible to divert full supply into RMC for delivering sufficient water to courses or prepare water rotation schedule for Dys. In this regard, the weir caretaker (gate keeper) could not operate the Head Regulator without the close supervision of the engineer or canal inspector. So, the unsilting of RMC is the first priority for maintenance for getting irrigation water to the farm.

(b) Organization of assistant engineer operation and maintenance office

The office staffs are concerned with both the operation and the maintenance works. Water distribution and operation management and maintenance staffs of AE office (AE is responsible for all the works under his charge, there are 8 irrigation schemes). Operation staffs have their respective duty concerning with area data collection, checking and compiling, reporting and recording. They are

(a) Assistant Engineer (AE)
(b) Canal Revenue Assistant (CRA)
(c) Canal Inspector (CI)
(d) Assistant Canal Inspector (ACI)
(e) Canal Revenue Surveyor (CRS)

The duty and function of the above staff and personnel are as shown in Annex - C.

The maintenance staffs also have their respective works concerning with daily labour on the dams and canals embankment, inspection of canal system, head regulators, canals gauges, prepare maintenance estimate, etc. They are;

(a) Assistant Engineer (AE)
(b) Sub-Assistant Engineer (SAE)

(c) Maintenance of Secondary and Tertiary Canal System

In spite of the constraint ID staffs manage to keep all irrigation canals open to some extent and farmers are frequently found to unsilt the Dy voluntarily by themselves in case of farmers involvement in maintenance works of the canal system for example last year the farmer of RMC Dy 2 unsilted the canal by using machinery with their own expanse and interest, as told by the Dy 2 farmers and ID water officer. In this regard, Irrigation Department maintenance staff involved for technical supervision only. The participation of farmers in the ID maintenance work was their own decision and depending upon how much they could afford and expected return from their irrigated crops. All the labours are controlled by 10 member villages' irrigators

(*All the villages in the irrigation area have their own (10 member) villages' irrigators group to look after the farm units. All the members must be farmers and the group leader must be a member of the village administration body. The group leaders are also the water course leaders (WUG) from which the representative of the Dy is selected*.)

The farmers want adequate water and equity distribution and to enforce all the existing irrigation water distribution rules and regulations (refer Irrigation Manual) and requested for the total rehabilitation of the scheme and welcome NGO and donor those who could assist. But, one must understand that all government controlled irrigation schemes are dual managed schemes (Dual management schemes have two separate parties, each with their own responsibility, in this case, ID is responsible for O&M up to secondary and lateral canals, tertiary units and field ditches are the duty of farmers.)

The scheme deteriorates because participants do not follow the regulations. The party who is responsible for O&M of the system must do regular un-silting and maintenance works, on the other hand the farmers must maintain the tertiary canals and field ditches. Farmers who take water through illegal off-takes should be punished. Operators (gate keepers) of the main system who break the rules and regulations should also be punished. Such strict disciple was imposed, years ago by 1905 Canal Act, which is still in existing have neither been abolished nor up dated. Some of the specific rules from irrigation manual are 1.Repairs to water courses, 2. Construction of water course crossings, 3.Applications of water, 4.Length of watercourse, 5.Construction of watercourse by Canal Officers, 6.Construction of outlets, 6(a).Borrow-pits and soil-dumps, 6(b) Amalgamation of watercourses, 7.Maintenance of supplies, etc. Please refer meeting and consultation with farmers (Annex C2).

The W/C outlets are all in a rather bad shape (W/C outlet maintenance is the duty of ID). They are all pipes outlet. In most places, the pipes are removed by breaches in the embankment (See Annex D). Introduction of the critical flow flume W/C outlets will

improve the proportional water distribution along the Dy's dramatically. The W/Cs are also not maintained which is the responsibility of farmers. In this regard, the Irrigation Department and farmers must cooperate, ID maintain the system up to secondary and lateral canals (with adequate O&M budget) and farmers maintain their tertiary canals (W/C) and field ditches before irrigation season as per principle.

(d) RMC Irrigation System as Perceived by Farmers

There was sufficient supply of water after the implementation of the Chaungmagyi project and they could grow two crops per year, cotton crop during the pre-monsoon followed by monsoon paddy with some high valued crop like onion and chilli, with full assured available irrigation water supply that increased in crops yield.

However, at present, due to the sediments accumulation at the weir and RMC, water cannot be diverted properly, the RMC main canal is totally filled with sediments. Therefore, water cannot flow well in the canals. So it is necessary to rehabilitate this main canal and also its distributaries as soon as possible and to maintain the system so that the peak discharge could be met and for equity distribution. The farmers on their part will maintain W/C and field ditches and follow the water distribution rules and regulations (refer Annex - C discussion with farmers).

Another reason is that during 1996-97, the upper Tayankar canal was constructed and as a result less water is flowing downstream, the result is that about 80 acres of paddy land cannot be cultivated in RMC.

From the farmer's point of view, irrigation water is very important for them because they knew well that yield responds to water, so, by any mean they would like to rehabilitate the system. They do not mind whoever assist or help. They knew very well that the crops yield (productivity) will increase substantially. The farmer, U Soe Thyn and U Aung Shwe said that L.S cotton without proper irrigation could yield only 200-300 viss/acre but with full irrigation yield will be 500-700 viss/acre, for paddy from 50-60 basket/acre to 80-100 basket/acre and onion from 250 viss/acre to 400 viss/acre. (See Annex-C discussion with farmers).

Many land grow only single rainfed crop, the maturity of crops is uncertain because it all depend on the weather and for the rest of the year, the land is idle.

3A.6. Financial Resource / Management of Operation and Maintenance Budget

The Irrigation Department (ID) budget consists of two parts:

(1) The maintenance budgets (both for operation and maintenance) concerns the fixed items such as salaries, fuel for transport routine, desilting etc.

(2) The "Special Repair Budget" concerns all non-routine items. The proposal for this budget is prepared yearly by Executive Engineer's office together with all the responsible AE concerning their respective works and submitted to ID Head Office through the office of Director Mandalay Region.

(Normally, only part of the required budget is made available. As a consequence maintenance is lacking far behind the actual requirements).

The O & M budget for Chaungmagyi Irrigation Scheme for the last ten years is as shown in Table -10.

Table - 10 Chaungmagyi Dam O & M Yearly Budget Allotment
Irrigation Department, Pyawbwe Township

Sr. No.	Year	Chaungmagyi (Kyats)
1	2003 - 2004	1,129,445
2	2004 -2005	1,206,684
3	2005 -2006	1,450,900
4	2006 - 2007	4,044,400
5	2007 - 2008	4,710,500
6	2008 - 2009	1,833,000
7	2009 - 2010	4,448,400
8	2010 - 2011	8,414,710
9	2011 - 2012	8,765,596
10	2012 - 2013	

Source : ID Pyawbwe

Maintenance as observe by consultant

Consultants visited RMC and most of the Dys. Discussed with farmers and ID water officer concerning O & M. It is found that the whole of RMC area has the same low level of maintenance. During the field visit the consultant team made some ground survey of RMC and Dy canals and its structures the quantity of damages are as stated in Table - 7. The yearly maintenance budget falls far short of the requirements and has been for the last twenty years.

The budget allotment of Chaungmagyi Dam for the last (10) years is as shown in Table - 10. ID main office distributed the budget to regional office depending on the yearly financial

allotment, so also the regional authority could not provide the necessary O&M budget instead he has to make priority list for maintenance. The allotted budget is irrespective of water tax collected which is directly remitted to the bank. The ID staffs are never allowed to collect O&M fee un-officially. This same small amount of annual maintenance budget becomes even worst for most of the years, when the same amount of money loose it values because of inflation. In recent year, there is an increase in O&M budget but the amount increased does not cover the inflation compare with the accumulated maintenance works. Some year, the budget allowance was high because the funds for special repair were included. Concerning collection of water tax, it was started in 2006-2007 fiscal year. The status of water tax collection of each crop for the years 2007 to 2013 is as shown in Table - 12.

Another reason for this situation is that the crops water taxes paid by the farmers have never been considered together with the operation and maintenance cost. Refer water tax collection table - 12. According to this ID could collect only fiscal year 2007-2008, the remaining years up to date are all outstanding, the reason why the farmers do not pay is not explained.

Tertiary Canal System

The tertiary system should be simultaneously maintained by repairing the water courses or modifying the system by providing division – boxes in tertiary canal and field ditch for better water management and field water efficiency.

3A.7 Agriculture and Socio-Economic Development (Cultivation)

Chaungmagyi Irrigation Area

There are 7 village tracks in and around the Chaungmagyi Irrigation Scheme. The gross cultivable area is 20605 acres and the net area is 15634 acres. See Table - 2 (Net area = Gross area minus villages, road, cart tract, waste land, pond, drainage canal, forest, cemetery, uncommandable land etc). The net irrigable area of the RMC canal system is 2128 acres (actual) as assessed by ID 2013 survey. But year to year, planned area changes are depending upon the availability of the water balance in the reservoir.

The number of households farming in RMC is about 550 HH and the population is round about 2755 person, the minimum land holding varies from 1.5 acres to 40 acres and the average holding is 4.66 acres.

There are eight to twelve types of crop which occupied the rainfed cultivated area of Pyawbwe Township. See Table - 6 of Annex - 1 and Fig 1. Therefore, the farmers in the irrigable area when short of irrigation water choose the best combination of crops out of the twelve which suit them most. In this regard, most of the farmers from RMC continue to grow pre-monsoon L.S cotton which could stand the drought to some extent, follow by monsoon paddy and some onion or pigeon pea but some farmers who could not afford additional money for ground water development, grow sesame or green-gram instead of cotton follow by monsoon paddy. (See Fig - 1) cropping pattern of Chaungmagyi.

The main vegetables grown in the project areas include onions, chillies, garlic and cabbages. Because of high-price in contrives chillies or onions are normally sown in late monsoon (October) and harvested at the beginning of the dry season chilies are grown throughout the dry season and harvested toward the beginning of the monsoon. Use of fertilizers is quite common.

The chaungmagyi area is one of the best area suited for L.S cotton growing in the country. All the farmers of RMC area want to grow cotton especially where irrigation is available and assured even, this year there is no irrigation water for land preparation and seedling. The farmer try to prepare to land without irrigation water and try to plant with whatever residual ground moisture and those who could afford plant by pumping ground water. Planting occurs during February/March following the monsoon paddy and harvesting takes place in June/July land preparation is done almost by plough drawn by a pair of bullocks, at least 4 pairs is required for preparing an acre of land. There are no tractors on a hire basis from the agricultural mechanization department. Private hand control Chinese ploughing machines are available.

An analysis of crop production of Chaungmagyi RMC irrigation rehabilitation scheme under present rainfed conditions with limited or what so ever available irrigation water and with full irrigation water after rehabilitation was made on 2128 acres in Chaungmagyi RMC scheme of Pyawbwe Township by reviewing the past five years monsoon paddy sown and harvested records for the year 2008-09, 2009-10, 2010-11, 2011-12 and 2012-13 as shown in Table - 11.

Table -11 Status of Yearly Monsoon Paddy Cultivated by Canal under Chaungmagyi RMC Canal System

Sr. No	Name of Canal	Irrigable Area		Status of Yearly Monsoon Paddy				
		Design Acres	Assessed Acres	2008-09	2009-10	2010-11	2011-12	2012-13
RMC								
1	DY-1	310	281	268	218	-	200	200
2	DY-2	431	218	218	155	-	210	195
3	DY-3	358	328	328	278	-	277	277
4	DY-4	511	365	365	55	-	162	161
5	DY-5	620	445	440	220	-	295	295
6	DY-6	333	311	311	291	-	297	297
7	Dir - RMC	310	180	176	152	-	124	124
Total		**2873**	**2128**	**2106**	**1369**	**-**	**1565**	**1549**

Source: ID

Note: (1) ID reported only the planned policy crops like paddy.

(2) Designed acres mean the original irrigation area and assessed area means the recent irrigation area as surveyed by ID.

(3) In 2011-2012, out of the whole Chaungmagyi Irrigation Network only 1848 acres of monsoon paddy from LMC system was harvested and the rest failed or never been planted because there is no water at all.

At present, agricultural productivity is moderately low due to climate conditions and in sufficient water supply. If irrigation water is sufficient and assured, the cropping intensity and productivity would increase simultaneously.

The present cropping calendar of Chaungmagyi irrigation area with pre monsoon crops (ground moisture and with limited supplementary irrigation), monsoon crops with rainfed plus some irrigation and post-monsoon crops with residual ground moisture is as shown in Fig - 1.

Proposed cropping calendar with rehabilitation is as shown in Fig - 2.

Irrigation Scheme

Water Tax

Taxes concerning with Irrigation Department are crops water tax and flood control embankment tax. Prior to 2007, the crop water taxes vary with type of crop such as industrial crop like sugarcane and rubber, the tax was kyats 10. The cereal crops and vegetable taxes vary from kyats 3 to 6 which average about kyats 5. At present, for lowland irrigated crop like paddy the water tax is kyats 1950 and for the upland irrigated crops like sesame and groundnut etc, the water tax is kyats 900 which are presently collected by Irrigation Department. The yearly land tax kyats 5 per year are collected by settlement and land record department (SLRD).Crop water tax of Chaungmagyi area as collected by ID for the year 2007 to 2013 is as shown in table - 12.

Table 1.2 Status for Receipt of Water Tax for Each Crop
Chaungmagyi Irrigation Scheme

Sr. No.	Year	Monsoon Paddy (Tax to be collected)		Received	Balance
		Acre	Amount (Kyat)		
1	2007-2008	7251.39	14,140,210.50	4,999,819.50	9,140,391.00
2	2008-2009	7083.00	13,811,850.00		13,811,850.00
3	2009-2010	4932.22	9,617,829.00		9,617,829.00
4	2010-2011	1609.34	3,138,213.00		3,138,213.00
5	2011-2012	5666.03	11,048,758.50		11,048,758.50
6	2012-2013	5279.87	10,295,746.50		10,295,746.50
	Total	**31821.85**	**62,052,607.50**	**4,999,819.50**	**57,052,788.00**

Sr. No.	Year	Summer Paddy (Tax to be collected)		Received	Balance
		Acre	Amount (Kyat)		
1	2006-2007	-	-	-	-
2	2007-2008	814.89	1,589,035.50	-	1,589,035.50
3	2008-2009	1127.87	2,199,346.50	-	2,199,346.50
4	2009-2010	450.04	877,578.00		877,578.00
5	2010-2011	1266.44	2,469,558.00		2,469,558.00
6	2011-2012	975.08	1,901,406.00		1,901,406.00
7	2012-2013	-	-		
	Total	**4634.32**	**9,036,924.00**	**-**	**9,036,924.00**

Sr. No.	Year	Long Staple Cotton (Tax to be collected)		Received	Balance
		Acre	Amount (Kyat)		
1	2007-2008	3390.34	3,051,306.00	1,139,580.00	1,911,726.00
2	2008-2009	2345.10	2,110,590.00		2,110,590.00
3	2009-2010	2211.05	1,989,945.00		1,989,945.00
4	2010-2011	689.12	620,208.00		620,208.00
5	2011-2012	1678.03	1,510,227.00		1,510,227.00
6	2012-2013	-	-		-
	Total	**10313.64**	**9,282,276.00**	**1,139,580.00**	**8,142,696.00**

3A.8 Financial Analysis

3A.8-1 Crop budgets and model farm

To analyze financial impact of the rehabilitation and their effect upon farmers' livelihood, it is necessary to construct crop budget for RMC rehabilitation irrigation scheme, with present and future with rehabilitation crops production and its rates to use as data in financial analyses. Crop budget based upon present prevalent prices (farm gate price) collected during consultant field survey (as shown in Table -14) for input and product were used to deduce, production cost and produce prices for calculation of proposed project benefit.

Crop budget based upon financial prices for inputs and products of Chaungmagyi irrigation scheme were used in the model farm analysis as a measure of how farmers are affected by the project and to determine from the view of farmer if the cash flow situation is favourable for implementation of rehabilitation.

The crop production have been developed by observing eight to twelve crops of Pyawbwe area under rainfed with limited irrigation and monsoon rainfed with full supplementary irrigation (fully secured) condition and up-land crops with fully assured irrigation condition as viewed by farmers in the RMC area with rehabilitation.

These budget show returns to irrigation cropping as viewed by the farmers during the discussion. RMC farmers prefer the same pre-monsoon L.S cotton followed by monsoon paddy with some cash crops like onion.

3A.8-2 Agricultural Production and Intensity

(a) Cropping Pattern and Cropping Intensity

Cropping pattern and cropping intensity for farm model analysis is based on present cropping pattern obtained from field survey of proposed rehabilitation areas (Pyawbwe Township) and cropping pattern with rehabilitation will be the same cropping pattern, which the farmers are already inpractised as shown in Fig - 1 and 2.

(b) Crop Production

Average yield for the year 2012-2013 of each crop is as shown in Table - 13. The present crop yield data is adopted from Pyawbwe Township 2013 data report both for rainfed and full irrigation (present data with un-assured irrigation water and future data with full irrigation). The cropping pattern with rehabilitation is drawn by assuming that the irrigation water will be 100% assured for double cropping on 2128 acres. Future with rehabilitation yield, were collected from RMC area farmers who received full irrigation and from well to do farmers who used ground water for supplementary irrigation by pumping.

Table - 13 Yield per acres of Each Crop

Sr. No.	Crop	Unit	Present without Rehabilitation	Future with Rehabilitation
1	Monsoon	Basket	53	100
2	Summer	Basket	80	100
3	L.S Cotton	Viss	350	650
4	Onion	Viss	3500	4500
5	Chillies	Viss	300	300

(c) Marketing and Price

Farm gate price of each crop is as shown in Table - 14 below. Farm gate prices are obtained during consultant survey which is checked with Pyawbwe Township 2013 data report.

Table - 14 Farm-gate Price of Crop

Sr. No.	Crop	Unit	Present without Rehabilitation(kyats)	Future with Rehabilitation (kyats)
1	Monsoon Paddy	Basket	3500	3500
2	Summer Paddy	Basket	3500	3500
3	L.S Cotton	Viss	1000	1000
4	Onion	Viss	350	350
5	Chillies	Viss	2500	2500

(d) Product Cost and Net Production Value

Production cost and net value production used for farm model analysis is summarized in table - 15.

Table - 15 Production Cost, Gross Produced Value and Net Production Value

Sr. No.	Crop	Particular	Unit	Present	Future with Rehabilitation
	2128 Acres – R.M.C Canal System				
1	Paddy (Monsoon)	Gross Value of Product	Kyats/	185,500	350,000
		Production Cost	"	180,000	220,000
		Net Value of Product	"	5,500	130,000
2	L.S Cotton	Gross Value of Product	"	350,000	650,000
		Production Cost	"	197,500	197,500
		Net Value of Product	"	152,500	452,500
3	Onion	Gross Value of Product	"	1,225,000	1,575,000
		Production Cost	"	591,000	591,000
		Net Value of Product	"	634,000	984,000

Fig -1 **Chaungmagyi Irrigation Scheme – Present Cropping Pattern (Calendar)**

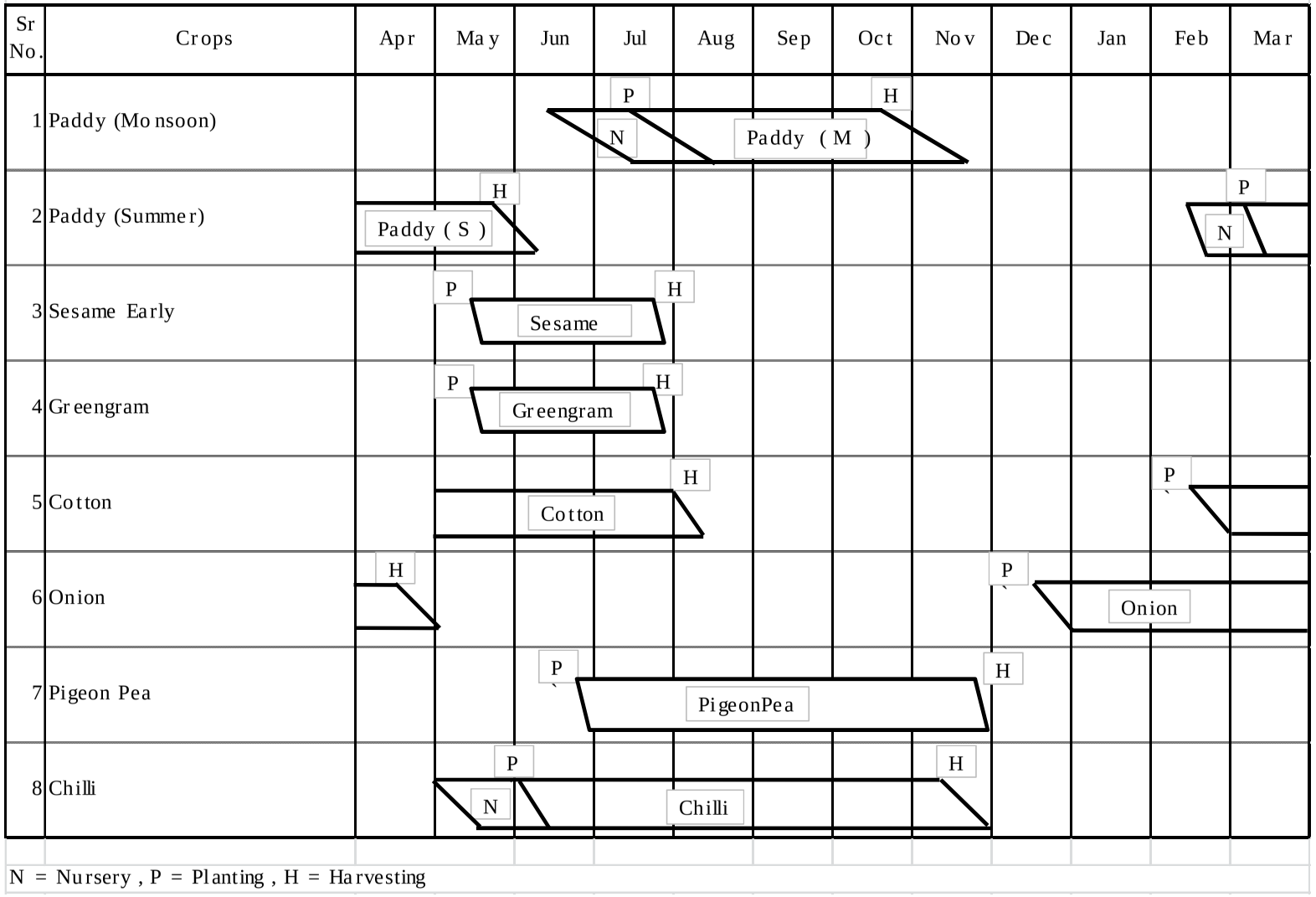


Fig -2 **Chaungmagyi Irrigation Scheme – Present Cropping Pattern (Calendar)**

Sr. No	Name of Crop	Year											
		A	M	J	J	A	S	O	N	D	J	F	M
1	Cotton	Cotton										Cotton	
2	Monsoon Paddy					Monsoon Paddy							
3	Onion 500 Ac								Onion 500 Ac				

3A.8-3 Farm Model (FM) Analysis

Farm model analysis of 4 acres holding is analysed by using the the above crop intensity, crops yield and farm gate prices is as shown in Table - 16. The analysis show that the farm household income with 4 acres holding (without irrigation) cannot cover the household expanse in this case, the head of the family has go away from village to earn the deficit somewhere and the children are looked after by the wife, such is the life of RMC farmers – social impact. But future with rehabilitation, the farm-household income is kyats 2,768,236 and expenditure kyats 1,375,000 could be safe kyats 1,393,236 per year. This could improve the livelihood of the farmer and family could stay together.

Table -16 Farm Model Analysis of the Project

Farm Budget	Ac	Present Situation	Ac	Future with Project	Remark
1. Farming Intensity		106%		189%	
2. Farm Size Holding (ac)		4 ac		4 ac	
3. Crop Farm Income		437,103		2,318,496	Table 25
Paddy monsoon	2.56	9,075	3.64	356,884	Table 25
Long stable cotton	1.32	200,112	3.56	1,607,696	Table 25
Onion	0.36	227,916	0.36	353,916	Table 25
4. Family Labour (kyats/hh/year)		257,560		449,740	Table 25
5. Farm Income (kyats/hh/year)		694,663		2,768,236	
6. Household Expenditure (kyats/hh/year)		1,368,000		1,375,000	
7. Net Farm Income (kyats/hh/year)		-673,337		1,393,236	
8. Net Farm Income (kyats/ac)		-168,334		348,309	

Note: Item 7 and 8 of present situation shows that farmer house hold with (4) acres cannot cover the family expenditure without full irrigation.

Sources:

1. The details calculations see Table 16 and Table - 5 to 9 of Annex - A1. Farm Budgets and income analysis.
2. Proposed Crop Pattern is based on the present farmers' cropping practice.
3. Average farm size holding is estimated based on township settlement and Land Record Department Pyawbwe.
4. Present Situation data (year 2012) is based on baseline survey data.
5. Future with project data is based upon present on ground survey data analysis.
6. Household Expenditure is available from baseline survey.
7. Side income is not considered in this analysis. Therefore, the analysis shows that a family with average 4 acre holding could not survival without side job.
8. Future with rehabilitation with full irrigation, the same farmer with 4 acres holding could safe Kyats 1,393,236 per year

Table - 17 **Gross Profit Comparison on Crops of Chaungmagyi RMC Irrigation System With and Without Rehabilitation Project**

Available Irrigable Area = 2128 Acres USD = 930 Kyats

Sr. No.	Crop	PRESENT							WITH REHABILITATION							INCREMENTAL BENEFIT				
		Acres	Yield per Acres (Basket or Viss)	Total Production (Basket orViss)	Value Per Basket or Viss		Total Value of Project Production (in million		Acres	Yield per Acres (Basket or Viss)	Total Production (Basket or Viss)	Value Per Basket or Viss		Total Value of Project Production (in million)		Acres	Yield per Acres (Basket or Viss)	Total Production (Basket or Viss)	Total Value of Project Production (in million)	
					Kyat	USD	Kyat	USD				Kyat	USD	Kyat	USD				Kyat	USD
1	Monsoon Paddy	1358	53	71974	3500	3.763	251.91	0.271	1928	80	154240	3500	3.763	539.84	0.580	570	27	82266	287.93	0.310
2	L.S Cotton	700	350	245000	1000	1.075	245.00	0.263	1900	650	1235000	1000	1.075	1235.0	1.328	1200	300	990000	990.00	1.065
3	Onion	200	3500	700000	350	0.376	245.00	0.263	200	4500	900000	350	0.376	315.00	0.339	0	1000	200000	70.00	0.075
	TOTAL	**2258**		**Total Gross Income**			**741.91**	**0.798**	**4028**		**Total Gross Income**			**2089.84**	**2.247**	**1770**	**Incremental Income**		**1347.93**	**1.449**

Table - 18 **Chaungmagyi Dam RMC Canal System**

Net Comparison of Production With and Without Rehabilitation Project

Sr. No.	Crop	PRESENT				WITH REHABILITATION				INCREMENTAL BENEFIT			
		Acre	Gross Income by Crop (Kyats in million)	Production of Cost + Water and Land Tax (Kyats in million)	Total Net Value Profit (Kyats in million)	Acre	Gross Income by Crop (Kyats in million)	roduction of Cost + Wate and Land Tax (Kyats in million)	Total Net Value Profit (Kyats in million)	Gain in Gross Income by Crop (Kyats in million)	Gained		Total Net Value Profit (Kyats in million)
											Acre	Percent (%)	
1	Monsoon Paddy	1358	251.91	247.09	**4.81**	1928	539.84	350.81	**189.03**	287.93	570	30	**184.22**
2	L.S Cotton	700	245.00	138.88	**106.12**	1900	1235.00	376.96	**858.04**	990.00	1200	63	**751.92**
3	Onion	200	245.00	118.38	**126.62**	200	315.00	118.38	**196.62**	70.00	-	-	**70.00**
Total		**2258**	**741.91**	**504.35**	**237.55**	**4028**	**2089.84**	**846.15**	**1243.69**	**1347.93**	**1770**	**93**	**1006.14**

COST BENEFIT RATION = 1006 / 615 = 1.64

Assumption

1 Rehabilitation could complete in 6 months time.

2 No change in price between 6 months time.

3A.8-4 Financial Return and Other Benefits

The financial analysis with present cropping system pattern and future with the same cropping pattern and rehabilitation were calculated as shown in table - 17. In this table present condition and future condition with rehabilitation of lands used according to crops on available land (2128 acres) yield of each crops, production of each crops and total product of crops are compared. Finally, the incremental benefit in crop area, yield, production and financial are clearly stated in incremental benefit as shown in table - 17. Therefore, by rehabilitation of Chaungmagyi RMC scheme. The following benefit will be made.

(1) The whole irrigable of 2128 acres could return to full service condition.
(2) There will be increased crops area of 1770 acres.
(3) Monsoon paddy yield could be increased from average of 53 basket/acre to average of 80 basket/acre.
(4) L.S cotton yield could be boost to 650 viss/acre.
(5) The improvement of the RMC canal system by rehabilitation has boosted the production of crops substantially.
(6) Thus, the incremental financial benefit (net value), which is Kyats 1006.14 million per year.
(7) The total investment cost of the rehabilitation of RMC scheme is million kyats 615.265 as shown in Table - 9.
(8) The benefit cost ratio is 1.64. (Benefit 1006 / Cost 615.265).

The quantifiable benefit of irrigation scheme is accrued from incremental of crop production gained from reclamation of irrigable land previously short of irrigation and increase of yield due to assured irrigation.

The rehabilitation of RMC scheme is expected to benefit approximately 550 small scale farm house holds (average holding of 4.66 acres) cultivating a total of 2128 acres in RMC system. Incremental production with rehabilitation will increase 82266 basket of paddy, 990,000 viss of L.S cotton and 200,000 viss of onion per year (for Chaungmagyi RMC).

(Assuming that rehabilitation will implement within 6 months from 15 November that is after irrigation period detailed calculation is as shown in annex A.).

Incremental benefit crop is as shown in Table - 19.

Table – 19 Project Incremental Benefit

Chaungmagyi RMC Canal System					
Sr No.	**Crop**	**Gain in Gross Income by Crop (Kyats in million)**	**Gained**		**Total Net Value Profit (Kyats in million)**
			Acre	**Percent (%)**	
1.	Paddy (Monsoon)	288	570	30	**184**
2.	L.S Cotton	990	1200	63	**751**
3.	Onion	70	-	-	**70**
	Total	**1348**	**1770**	**93**	**1006**

3B. Kyaukse Irrigation Scheme

3B.1 History of the Area

Water Resource

Since Kyaukse tank is situated in the Dry Zone, many of the problems in water resources management revolve in two basis issues, mal distribution in time - the temporal problem and mal distribution in space - the spatial problem. Thus, the availability of water resource over time is subjected to considerable fluctuation and is largely unpredictable. Kyaukse tank is one of the tanks which were constructed on Samon river to resolve the temporal problem. The rainfall varies widely with duration and intensity, there are periods with very high intensity and duration, rain which produce floods, periods of very low flow (drought) and there are periods where the flow varies around the average.

Dam Location

Its location according to 1 inch to a mile reference is 93 D/2 – 640960. The Kyaukse Tank was built across the Samon Chaung to impound the water by Ancient Burmese King many years ago. It is an earthen dam, the length is 14500 feet long, 20 feet high. The purpose of it is to supplement required irrigation water for monsoon paddy and other crops' area of 7537 acres under the reservoir, which could serve only 4306 acres at present (2013 report on Kyaukse Tank). The maximum capacity of the dam is 6250 Ac-ft and it usable capacity is 5726 Ac-ft. When the rainfall is sufficient, the crop yield was good. But the maturity of the paddy depends upon the availability of the water in the tank. Therefore, if there are not enough supplementary irrigation requirements, much of the paddy would fail. The recent assessed irrigable area by ID is 4306 Acres. The dam was rehabilitated in 2002 due to silting in the tank and settlement of the embankment. The dam embankment was re-strengthened in 2007-2008; the salient data concerning Kyaukse Irrigation Scheme is as shown in Table - 23.

The annual inflow, distribution, water balance and rainfall for past ten years are as shown in Table - 22.

The Irrigation Scheme

The Kyaukse Irrigation Scheme is served by three canals. All three have direct outlet from the dam, each controlled by head regulator. Canal No. 1 served 2568 Acres, Canal No. 2 served 956 Acres and Canal No. 3 served 1197 Acres. The Kyaukse Irrigation Scheme location layout map is as shown in Map - 3.

According to ID February 2013 Report, past 5 years average irrigated area was 2385 Acres. The maximum area irrigated was 3649 Acres and the minimum was 983 Acres. When we are talking about irrigation of the dry zone, we must first understand that the irrigation is the supplementary water for wet season crops to assure maturity and good production. If the effective rainfall is uniform, there will be less irrigation frequency and safe more water in the tank and if it is a drought year and no balance of water in the tank for sure, there will be failure of crops.

Irrigation area is planned, depending on the availability of the water balance in the tank. Thus, it varies from year to year. The tank capacity is 6250 acre-feet and useable capacity is 5726 acre-feet as shown in table - 23 and the yearly rainfall and the rainy days for year 2008 to 2012 of Pyawbwe was 32 inches and 56 days respectively but the average rainfall at Kyaukse Tank site at the same period was only 24.8 inches. The rainfall is of temporal and spatial nature. Irrigable area includes sandy soil and saline condition all have to be considered.

Note: Most of the Irrigation schemes in the dry zone were designed for supplementing the water requirement of monsoon paddy and crops to assure the targeted yield and production. Thus, the irrigation period is usually from rainy season through cool season (July to November).

(a) Description of the Area and Population

Kyaukse Tank Irrigation Scheme is situated in Pyawbwe Township, Yamethin district of Mandalay Region. It is located seven mile east of Pyawbwe at the foot of Shan Plateau near Kyaukse village.

(b) Population

Kyaukse Irrigation Scheme area affects 5 village tracts within Pyawbwe Township, Mandalay Regions. These 5 village tracts have a population of 14983 although not all these people would directly benefit from the irrigation works to be supplied. The number of families within the 5 village tracts is 3076. The average family size is 4.9 persons. The demography of the village tracts is shown in Table - 20. Almost all of the population (99%) likely to be affected by the project area are Bamar and followers of the Buddhist faith.

Demography of Village Tracts Under Kyaukse Tank-Irrigation System

Pyawbwe Township

Table - 20 **(2012-2013)**

Sr. No	Village Tract	House	Family	Under 18		Above 18		Total
				Male	Female	Male	Female	
1	Kyaukse	448	456	411	394	667	823	2295
2	Shwenyaungpo	1225	1268	918	991	2067	2182	6158
3	Kone Tha	855	909	769	764	1441	1550	4524
4	Phayarkyi	281	281	212	174	442	530	1358
5	Suchinkone	139	162	101	90	225	232	648
	Total	**2948**	**3076**	**2411**	**2413**	**4842**	**5317**	**14983**

(c) Employment

90% of the families in the project area are working in farming while 9% of the households are occupies in employment and 1% works in trading.

(d) Land Area and Use

Previously, the irrigable area of the Kyaukse Tank is 7977 acres (3230 hectares). At present, only 4306 acres (1743 hectares) receive irrigation for crop production under the scheme.

Agricultural productivity at present is low due to the poor soil and climate conditions and insufficient water supply. Under proper irrigation, the cropping intensity would increase and that crop yields would show substantial rises from statistics. It is estimated that around 10.5 % of the gross area is lost in existing roads, ox-tracts, drains, bunds etc. On this basis the percentage of actual area available for cropping is 81.2%.

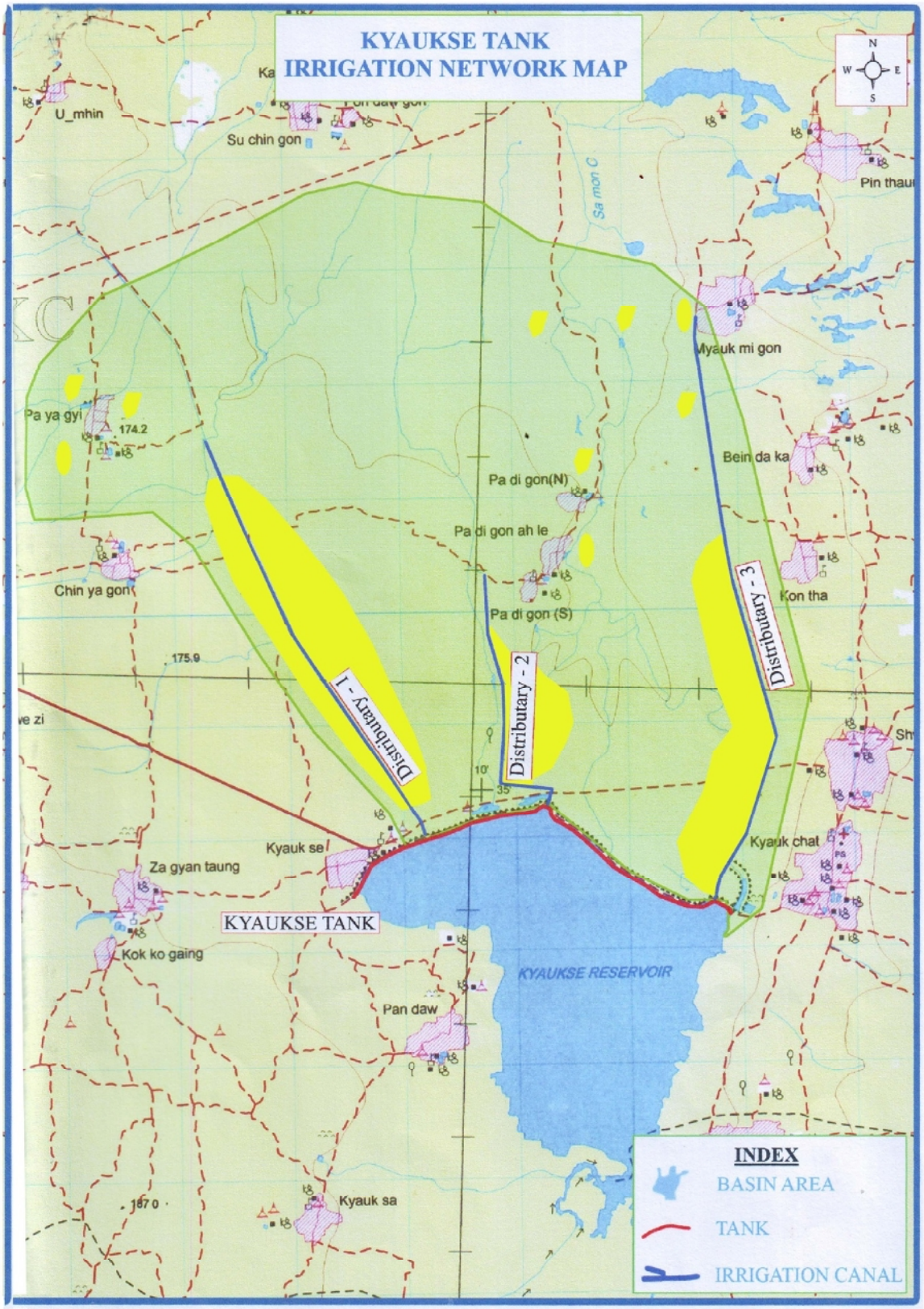
Table - 21

Land Area and Use

Land Use	Area (ha)	Percentage
a) Agricultural Land		
i) Cultivated	22030(8919)	80.8
ii) Cultural Waste	91.39(37)	0.4
iii) Reserved Forest	2272.4(920)	8.3
Sub-Total	**24393.72(9876)**	**89.5**
b) Uncultivable Land (ox-tracts, drains, bunds etc.)	2860(1158)	10.5
Total	**27254(11034)**	**100.0**

Note: Original land use form of table - 21 is attached as Table - 1 of Annex - B1 .

Map -3


KYAUKSE TANK
IRRIGATION NETWORK MAP
N
W
E
S
U_mhin
Su chin gon
Sa mon C
Pin thau
Myauk mi gon
Pa ya gyi
174.2
Bein da ka
Pa di gon(N)
Pa di gon ah le
Chin ya gon
Pa di gon (S)
Kon tha
175.9
Distributary - 1
Distributary - 2
Distributary - 3
Kyauk se
Kyauk chat
Za gyan taung
KYAUKSE TANK
Kok ko gaing
KYAUKSE RESERVOIR
Pan daw
Kyauk sa
INDEX
BASIN AREA
TANK
IRRIGATION CANAL

Map – 4 Location of Kyaukse Dam

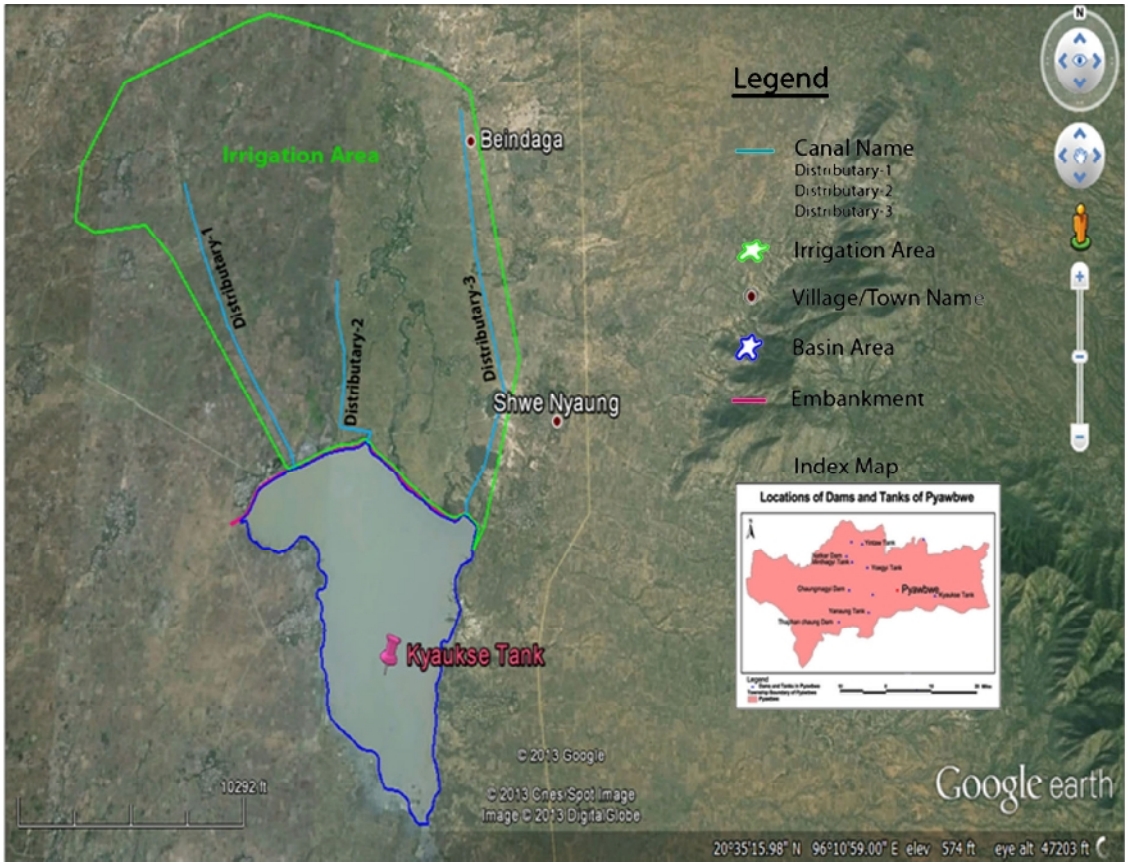


Table - 22 Kyaukse Tank Water Balance Status

Sr. No.	Year	Inflow (Ac-ft)	Used (Ac-ft)	Lost (Ac-ft)	Spill (Ac-ft)	Balance (Ac-ft)	Annual Rainfall (inches)
1.	2002	17179	7040	2354	8491	3551	21.23
2.	2003	6282	5784	1539	-	2269	10.35
3.	2004	4844	4072	956	-	2089	21.54
4.	2005	7407	5736	425	-	3331	25.83
5.	2006	6882	6172	316	-	3725	16.35
6.	2007	9091	8770	715	-	3331	12.14
7.	2008	7234	6956	162	-	3609	26.30
8.	2009	2740	4457	267	-	1355	20.70
9.	2010	5674	1546	1643	-	3840	28.03
10.	2011	7236	7942	231	-	2903	26.33
11.	2012	1502	4128	277	-	-	(30.11.2012)

Table - 23 Salient Data of Kyaukse Tank

1.	Location	-	Near Kyaukse Village, Pyawbwe Township
2.	Map Reference	-	92° /2-653952
3.	Name of Chaung	-	Samon
4.	Catchment Area	-	187 square mile
5.	Type of Embankment	-	Earth
6.	Embankment Length	-	14500 ft
7.	Embankment Height	-	20 ft
8.	Crest Width	-	12 ft
9.	Crest Level	-	R.L 585.0 ft
10.	F.T.L/Depth	-	R.L 580.0/13.3 ft
11.	D.W.L/Depth	-	R.L 586.7 ft/2.0 ft
12.	F.T.C	-	6250 Ac-ft
13.	D.L.C	-	524 Ac-ft
14.	Usable Capacity	-	5726 Ac-ft
15.	Water Spread Area	-	1691 Acre
16.	Spillway		
	Type	-	Broad Crest Weir
	Number	-	1
	Width	-	200 ft
17.	Conduit	-	1
18.	Benefit Area	-	7537 Acre (Assessed 4306 Acres)
19.	Date of Construction	-	Myanmar King

3B.2 Institutional Management - Irrigation System Management

Water User Association and Water Management Organization

In Kyaukse Tank Irrigation Scheme, the method of supply from the source of water to the irrigation area is quite different from Chaungmagyi RMC. In Kyaukse Irrigation system, there are three main canals which distribute irrigation water to the field. These (3) canals water are directly released from the tank controlled by its respective head regulators. But the irrigation water requirement of each canal is decided by the water distribution committee (WDC). The Irrigation Department in charge of the canal head regulator (HR) released the required discharge and controlled from the respective HR.

Concerning with water management organization, the same Pyawbwe Township institutional management applied for Kyaukse Irrigation Scheme. The scheme has its own Water User Association (WUA). The same irrigation rules and regulations applied also for Kyaukse Tank Irrigation Scheme.

3B.3 Description of the infrastructures and current condition

The canal system as inspected and survey by consultant team on 3rd May 2013 to 13th May 2013

Kyaukse Tank is totally dry because of low inflow. Upstream pitching work of the Dam is in progress.

Canal No. 1 The canal embankment settlement is about one foot, there are about 20 acres of sandy lands and 464 uncommandable acres because the level is about 1ft above full supply level. Many portion need unsilting about 6 inches to 9 inches although the irrigation water carry very little silt, silting is due to erosion of sandy banks. It is 22,704 ft long.

Canal No. 2 There are about 467 acres are uncommandable because the level is about 1ft above full supply level and the canal need unsilting. It is 11,600 ft long.

Canal No. 3 D/S of the canal intake head regulator basin, the concrete slab and pitching are eroded and the drainage crossing structure has collapsed, have to repair urgently. Most of the lands around Canal No. 3 are highly saline due to lack of drainage and may be over irrigation (no water management). The area is about 120 Acres. It is 20,000 ft long.

All the three canals are the same size (3ft bed width) irrespective of irrigation area of dam, the design has to be reviewed from the point of water efficiency and water distribution and management.

3B.4 Proposed repairs, improvement and rehabilitations with estimates

(a) Earthwork for Unsilting and Resectioning of Kyaukse Irrigation Scheme

The general spot check survey of Kyaukse Tank, structures and canal were carried out during the consultant field visit and the typical cross section of canal for unsilting and resectioning earthwork are as shown in Annex B Fig -3. The earthwork estimate for each canals and cost are as shown in Table - 24.

Table - 24 Rehabilitation Earthwork Estimate

Sr. No.	Particular	Quantity	Unit	Rate (Kyats)	Amount (Kyats)
1	Canal - 1	11246.77	Sud	4500	50,610,465.00
2	Canal - 2	6085.85	Sud	4500	27,386,325.00
3	Canal - 3	9478.00	Sud	4500	42,651,000.00
Total		**26810.62**	**Sud**	**4500**	**120,647,790.00**

(c) Rehabilitation Cost Estimate

There are about 27,150 ft of canal length, need to be repaired, the cost is estimated about Kyat 121 million and about Kyat 17 million for repairing structures. The total estimated rehabilitation cost of Kyaukse Tank including survey and supervision is about Kyat 140 million is shown in Table - 25.

Table – 25 Kyaukse Tank System Rehabilitation Estimate

Sr. No	Particular	Size	Quantity	Unit	Rate (Kyats)	Amount (Kyats in Million)	Remarks
1	Survey					1.556	For L/S and C/S survey of kyauk Se Canal
	1.1 C.S		56	No.	1850	0.104	
	1.2 L.S		10.3	Mile	141000	1.452	
2	Structures					17.029	
	2.1 Head Regulator (Canal 1 & 2)		2	No.	1013880	2.028	Average repair cost for 2 unit cost of each may varies
	2.2 Drop Fall (Canal 1 & 2)	4	2	No.	15001067	15.001	50% Repair cost of new
3	Canal E/W (Canal 1+2+3)		26810.6	Sud	4500	120.648	Estimated by intensive labour. If by machine will be 80.43 M at K 3000/sud
4	Camp Facilities		L.S		0.2% of cost	0.278	0.2% of Total Cost
	Total					**139.511**	

3B.5 Operation and Maintenance Organization

Main Irrigation System (Canal 1,2, 3 and its structure)

The secondary system is operated and maintained by ID and tertiary system by farmers (WUA).

The irrigation system maintenance up to offtake of watercourse is the responsibility of ID which comprises of canal 1, 2, 3 and its structures. Kyaukse Tank system schematic layout drawing is as shown in Figure 1 of Annex - B.

During the consultant field visit some of Kyaukse Tank Irrigation Canal System was inspected. The canals and its infrastructures seem to be a little better than Chaungmagyi RMC canal system but there are some silting, bank settlement and erosion which need to be maintained. Some survey records were made.

Concerning with infrastructures, some of the structures like falls and head regulators offtake need some minor repairs mostly the stilling basin and pitching (revetment) which need argent repair.

Kyaukse Irrigation Scheme yearly O & M budget for year 2003 to year 2013 is as shown in Table - 26. The status of water tax collection of each crop for the years 2007 to 2013 is as shown in Table - 27.

Operation

The Kyaukse Tank Irrigation Scheme is different from Chaungmagyi RMC system. In the RMC case, the water is from Chaungmagyi Dam which is (7) miles from the irrigation network diverted into the system by Tawdwinhla weir. For Kyaukse irrigation scheme, the irrigation water is directly distributed from the tank into the canals by (3) canals each controlled by a head regulator. The irrigation water management is same as Chaungmagyi RMC irrigation scheme.

Water Course (W/C)

It is the duty of farmers to maintain W/C and field ditches. There are no proper watercourse offtake structures, only pipe outlet is provided. Although there are some W/C (tertiary) start from the offtake which were not properly maintained. But mostly the field irrigation practice of Kyaukse irrigation is governed by plot to plot irrigation method.

3B.6 Financial Resource / Management of Operation and Maintenance Budget

The O & M budget for Kyaukse tank irrigation scheme for year 2003 to 2013 is as shown in table - 26. The budget received for year 2010 to 2013 was more because it include the budget for rehabilitation of tank embankment**.**

Table - 26 Kyaukse Tank O & M Yearly Budget Allotment
Irrigation Department, Pyawbwe Township

Sr. No	Year	Kyaukse (Kyats)
1	2003-2004	309777
2	2004-2005	533307
3	2005-2006	710644
4	2006-2007	1764600
5	2007-2008	1911500
6	2008-2009	856450
7	2009-2010	1204900
8	2010-2011	2493400
9	2011-2012	2740740
10	2012-2013	

Source : ID Pyawbwe

Water tax

Water tax collected from year 2007-2008 to 2012-2013 is as shown in table - 27. The outstanding in tax collection are not explained.

Table - 27 Status for Receipt of Water Tax for Each Crop

Kyaukse Tank Irrigation scheme

Sr. No.	Year	Monsoon Paddy (Tax to be collected)		Received	Balance
		Acre	Amount (Kyat)		
1	2007-2008	4334.94	8,453,033.00	234,019.50	8,219,013.50
2	2008-2009	3649.00	7,115,550.00		7,115,550.00
3	2009-2010	-	-		-
4	2010-2011	551.18	1,074,801.00		1,074,801.00
5	2011-2012	3545.41	6,913,549.50		6,913,549.50
6	2012-2013	306.12	596,934.00		596,934.00
	Total	**12386.65**	**24,153,867.50**	**234,019.50**	**23,919,848.00**

Sr. No.	Year	Summer Paddy (Tax to be collected)		Received	Balance
		Acre	Amount (Kyat)		
1	2007-2008	343.59	670,000.50		670,000.50
2	2008-2009	362.13	706,153.50		706,153.50
3	2009-2010	-	-		-
4	2010-2011	422.21	823,309.50		823,309.50
5	2011-2012	501.13	977,203.50		977,203.50
6	2012-2013	-	-		-
	Total	**1629.06**	**3,176,667.00**	**-**	**3,176,667.00**

Sr. No.	Year	Long Staple Cotton (Tax to be collected)		Received	Balance
		Acre	Amount (Kyat)		
1	2007-2008	441.98	97,782.00	261,270.00	136,512.00
2	2008-2009	681.17	613,053.00		613,053.00
3	2009-2010	206.05	185,445.00		185,445.00
4	2010-2011	-	-		
5	2011-2012	-	-		
6	2012-2013	-	-		-
	Total	**1329.20**	**1,196,280.00**	**261,270.00**	**935,010.00**

3B.7 Agriculture and Socio - Economic Development (Cultivation)

Kyaukse Irrigation Area

The present agricultural production from the Kyaukse Tank cultivated area is summarized in tubular as shown below. The table indicated the areas planted, lost, harvested, the average yields and production by major crop is shown in Table - 28. The cropping calendar as as practiced in the area is as shown in Figure - 3 and 4.

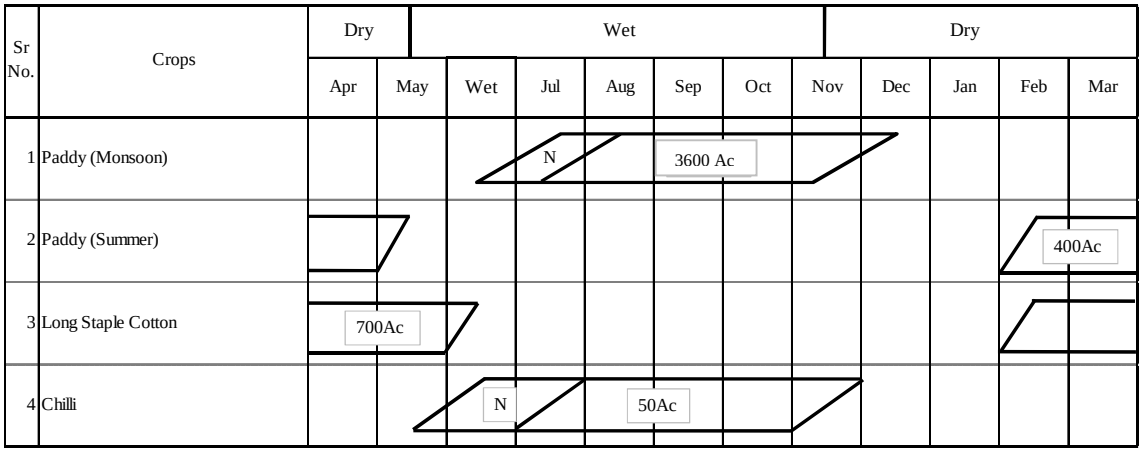
In addition to the gross value from crops, farmers also keep a small number of livestock. These livestock normally include a pair of draft working cattle plus a variety of pigs and poultry kept around the homestead as shown in Table - 2 of Annex - B1.

Table - 28 Present Production of Crops Under Kyaukse Tank Irrigation Scheme (2011-2012)

Sr. No.	Crop Name	Area Planted (acre)	Area Lost (acre)	Area Harvested (acre)	Average Yield (basket/ac)	Production (basket)
1	Paddy (M)	3251	-	3251	73.67	239,501
2	Paddy (S)	501	-	501	93.68	46,934
3	Maize	516	-	516	50.50	26,058
4	Sorghum	1310	-	1310	12.1	15,851
5	Groundnut	-	-	-	-	-
6	Premonsoon Sesame	2361	-	2361	5.18	12,230
7	Pigeon Pea	565	-	565	14.2	8,023
8	Green gram	3320	-	3320	12.3	40,836
9	Chili	-	-	-	-	-

Fig 3 **KYAUKSE TANK Crops Calender Present**

Avialable Irrigable Area 4721

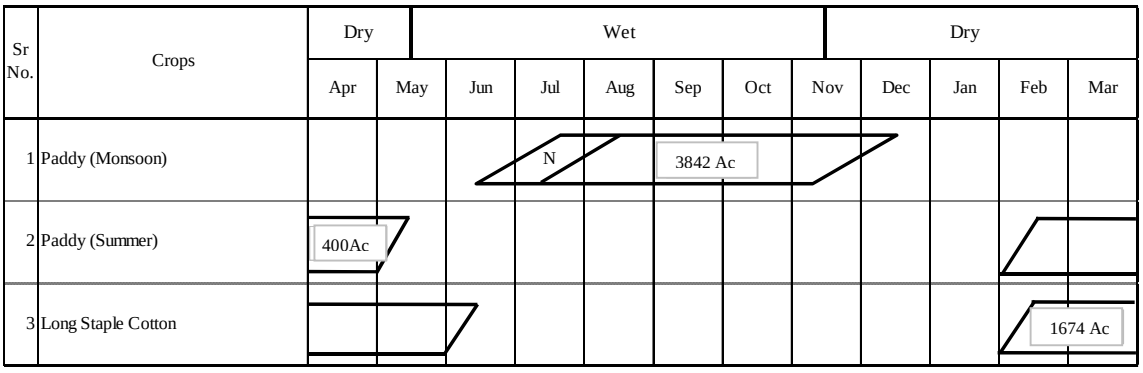


N = Nursery , P = Planting , H = Harvesting

Crop intensity = 121%

Fig 4 **KYAUKSE TANK Crops Calender Proposed**

Avialable Irrigable Area 4721



N = Nursery , P = Planting , H = Harvesting

Crop intensity = 153%

3B.8 Financial Analysis

3B.8-1 Crop Budget and Model Farm

For the purpose of the farm budget analysis with and without rehabilitation project situation, the financial prices, production data, land tax, crop water tax, etc., as delineated in chapter 3B.7 are used.

To analyze economic impacts of the project and their effects upon the well-being of farmers, it is necessary to construct crop budgets for each of the present and with rehabilitation and to use these as tools in financial analysis. Crop budgets based upon financial prices for imputes and products were used to calculate rehabilitation benefits and its cost to determine in a traditional financial terms i.e., the incremental benefit and benefit-cost ratio. Crop budgets based upon financial prices as obtained from farmers during the field survey and checked with Pyawbwe Township Agriculture office prevalence prices. These inputs and products' prices were used in the model farm analysis as a measure of how farmers are affected by the rehabilitation and to determine if their cash flow situation is favorable and improve their livelihood. Crop production budgets have been developed for two case A and B and compared.

A. Without the Rehabilitation – Present Condition

Production of 3 to 4 crops under rainfed with some limited irrigation using present prevalence financial prices. These crop budgets reflect current condition as viewed by farmers in Kyaukse tank irrigation scheme.

B. With the Rehabilitation

Production of the same 3 crops (with full irrigation made possible by rehabilitation project) using the same financial prices as case A. These condition show returns to full irrigated cropping as viewed by the farmers. The comparison of present and with rehabilitation is as shown in table - 33 and 34.

Production Input

In Myanmar all land within the country are controlled by the state. The farmers have the right to cultivate and inherit the land which they occupied and pay annual land tax per acre to the government.

Present average land tax + Irrigation water tax for the rehabilitation area is Kyats 1955. (K5+1950).

3B.8-2 Agricultural Production and Intensity

(a) Cropping Pattern and Cropping Intensity

Cropping pattern and cropping intensity for farm model analysis is based on present cropping pattern obtained from field survey of proposed rehabilitation areas and cropping pattern after rehabilitation will be the same cropping pattern, which the farmers have already accepted and practised. See Figure 3 and 4.

(b) Crop Production

Yield of each crop is as shown in Table - 29.

Table - 29 Yield per acre of Each Crop

Sr. No.	Crop	Unit	Present	Future with Rehabilitation
1	Monsoon Paddy	Basket	53	100
2	Summer Paddy	Basket	80	100
3	L.S Cotton	Viss	350	650
4	Onion	Viss	3500	4500
5	Chillies	Viss	300	300

Note. The crop yield data is adopted from Pyawbwe Township 2013 data report (present data with un-assured irrigation water and future data with full irrigation).

(c) Marketing and Price

Farm gate price of each crop is as shown in Table - 30 below.

Table -30 Farm-gate Price of Crop

Sr. No.	Crop	Unit	Present kyats	Future with Rehabilitation
1	Monsoon Paddy	Basket	3500	3500
2	Summer Paddy	Basket	3500	3500
3	L.S Cotton	Viss	1000	1000
4	Onion	Viss	350	350
5	Chillies	Viss	2500	2500

Note:

Farm gate prices are obtained during consultant survey which is check with Pyawbwe Township 2013 data report.

(d) Product Cost and Net Production Value

Production cost and net value production used for farm model analysis is summarized in table - 31.

Table -31 Production Cost, Gross Produced Value and Net Production Value

Sr. No.	Crop	Particular	Unit	Present	Future with Rehabilitation
	3892 Acres – Kyaukse Tank				
1	Paddy (Monsoon)	Gross Value of Product	Kyats/Acres	185,500	280,000
		Production Cost	"	180,000	220,000
		Net Value of Product	"	5,500	60,000
2	Paddy (Summer)	Gross Value of Product	"	280,000	350,000
		Production Cost	"	220,000	220,000
		Net Value of Product	"	60,000	130,000
3	L.S Cotton	Gross Value of Product	"	350,000	650,000
		Production Cost	"	197,500	197,500
		Net Value of Product	"	152,500	452,500
4	Chilli	Gross Value of Product	"	750,000	750,000
		Production Cost	"	275,800	275,800
		Net Value of Product	"	474,200	474,200

3B.8-3 Farm Model (FM) Analysis

The farm model analysis was developed using a farmer family with an average holding of 4 acres to compare their living condition with present condition and the condition with rehabilitation. The results of the analysis are as shown in table - 32. Item 7 and 8 of present situation (rainfed and little or no supplementary irrigation condition) show that a farmer family could not live with farming alone.

Table -32 Farm Model Analysis of the Project

Farm Budget	Ac	Present Situation	Ac	Future with Project	Remark
1. Farming Intensity		121%		153%	
2. Farm Size Holding		4 ac		4 ac	
3. Crop Farm Income		164,348		1,235,160	Table 52
Paddy monsoon	3.68	13,046	3.96	388,258	Table 52
Paddy summer	0.4	23,218	0.40	51,218	Table 52
Long staple cotton	0.72	109,152	1.72	776,752	Table 52
Chilli	0.04	18932	0.04	18,932	Table 52
4. Family Labour (ks/hh/year)		264,680		339,660	Table 52
5. Farm Income (ks/hh/year)		429,028		1,574,820	
6. Household Expenditure (ks/hh/year)		1,368,000		1,375,000	
7. Net Farm Income (ks/hh/year)		-938,972		199,820	
8. Net Farm Income (ks/ac)		-234,743		49,955	

Sources:

1. The details calculations see Table 32 and Table 3 to 7 of Annex – B1. Farm Budgets and income analysis.
2. Proposed Crop Pattern is based on the present farmers' cropping practice.
3. Average farm size holding is estimated based on township settlement and Land Record Department Pyawbwe.
4. Present Situation data (year 2012) is based on baseline survey data.
5. Future with project data are based upon present on ground survey data analysis.
6. Household Expenditure is available from baseline survey.
7. Side income are not considered in this analysis. Therefore, the analysis shows that a family with average 4 acre holding could not survival without side job.
8. Future with rehabilitation with full irrigation, the same farmer with 4 acres holding could safe Kyats 199,820 per year.

Table -33

Kyaukse Tank Irrigation scheme
Net Profit Comparison on Crops With and Without Rehabilitation Project

Available Irrigable Area = 3892 Acres less 414 Acres of sandy, saline and uncommandable

USD = 930 Kyats

Sr. No.	Crop	PRESENT							WITH REHABILITATION							INCREMENTAL BENEFIT				
		Acres	Yield per Acres (Basket or Viss)	Total Production (Basket or Viss)	Value Per Basket or Viss		Total Value of Project Production (in million)		Acre	Yield per Acres (Basket or Viss)	Total Production (Basket or Viss)	Value Per Basket or Viss		Total Value of Project Production (in million)		Acre	Yield per Acres (Basket or Viss)	Total Production (Basket or Viss)	Total Value of Project Production (in million)	
					Kyat	USD	Kyat	USD				Kyat	USD	Kyat	USD				Kyat	USD
1	Monsoon Paddy	3600	53	190800	3500	3.763	667.80	0.718	3842	80	307360	3500	3.763	1075.76	1.157	242	27	116560	407.96	0.439
2	Summer Paddy	400	80	32000	3500	3.763	112.00	0.120	400	100	40000	3500	3.763	140.00	0.151	-	20	8000	28.00	0.030
3	L.S Cotton	700	350	245000	1000	1.075	245.00	0.263	1674	650	1088100	1000	1.075	1088.10	1.170	974	300	843100	843.10	0.907
4	Chilli	50	300	15000	2500	2.688	37.50	0.040	50	300	15000	2500	2.688	37.50	0.040	-	-	-	-	-
	TOTAL	**4750**		**Total Gross Income**			**1062.30**	**1.142**	**5966**		**Total Gross Income**			**2341.36**	**2.518**	**1216**			**1279.06**	**1.375**

Table -34 **Kyaukse Tank Irrigation Scheme**

Comparison of Production With and Without Rehabilitation Project

Sr. No.	Crop	PRESENT				WITH REHABILITATION				INCREMENTAL BENEFIT			
		Acre	Gross Income by Crop (Kyats in million)	Production of Cost + Water and Land Tax (Kyats in million)	Total Net Value Profit (Kyats in million)	Acre	Gross Income by Crop (Kyats in million)	Production of Cost + Water and Land Tax (Kyats in million)	Total Net Value Profit (Kyats in million)	Gain in Gross Income by Crop (Kyats in million)	Gained		Total Net Value Profit (Kyats in million)
											Acre	Percent (%)	
1	Monsoon Paddy	3600	667.80	655.04	**12.76**	3842	1075.76	699.07	**376.69**	407.96	242	6	**363.93**
2	Summer Paddy	400	112.00	88.78	**23.22**	400	140.00	88.78	**51.22**	28.00	-	-	**28.00**
3	L.S Cotton	700	245.00	138.88	**106.12**	1674	1088.10	332.12	**755.98**	843.10	974	58	**649.86**
4	Chili	50	37.50	13.84	**23.67**	50	37.50	13.84	**23.67**	-	-	-	-
Total		**4750**	**1062.30**	**896.54**	**165.77**	**5966**	**2341.36**	**1133.81**	**1207.55**	**1279.06**	**1216**	**64**	**1041.79**

COST BENEFIT RATION = 1042 / 140 = 7.44

Assumption

1 Rehabilitation could complete in 6 months time.

2 No change in price between 6 months time.

3B.8-4 Financial Return

The quantifiable benefit of irrigation scheme is accrued from incremental of crop production gained from reclamation of irrigable land previously short of irrigation and increase of yield due to assured irrigation.

The projects are expected to benefit approximately 960 small scale farm house holds (average holding of 4.9 acres) cultivating a total of 4306 acres in and Kyaukse Tank irrigation area. Incremental production at full development is estimated to include for Kyaukse Tank are 116,560 basket of monsoon paddy, 8,000 basket of summer paddy and 843,100 viss of L.S cotton.

The benefits to be derived from the rehabilitation of Kyaukse Tank have been compared with the investment costs of the projects is as shown in Table 35.

The net incremental benefit of Kyaukse tank irrigation scheme is Kyats 1042 million, increase in crop area is 1216 acre and the cost benefit ratio is 7.44 (assuming cropping condition same as RMC canal system) only if there is enough rain and supplementary water for monsoon paddy and full irrigation water for summer crop.

Incremental benefit crop is as shown in Table- 35.

Table - 35 Project Incremental Benefit

Kyaukse Tank Irrigation Scheme					
Sr No.	**Crop**	**Gain in Gross Income by Crop (Kyats in million)**	**Gained**		**Total Net Value Profit (Kyats in million)**
			Acre	**Percent (%)**	
1.	Paddy (Monsoon)	408	242	6	**364**
2.	Paddy (Summer)	28	-	-	**28**
3.	L.S Cotton	843	974	58	**650**
4.	Onion	-	-	-	-
	Total	**1279**	**1216**	**64**	**1042**

(But in reality the irrigation water capacity 5726 (ac-ft) of the tank is much smaller than the irrigation water requirement of actual irrigable area 7977 acres. Water management devices and its management should be considered for efficient water use etc., for financial viability. In this case, time will be required for detail study anyhow, consultants have collected all available data and have discussed all options possible. The above financial return will be true if and only the water availability is assured.)

4. Benefit Comparison of the two Irrigation Scheme

Financial Return of Chaungmagyi Irrigation Scheme

According to farm model the project is expected to benefit small scale farmers (average land holding of 4 acres) cultivating a total irrigable area of 2128 acres of Chaungmagyi RMC and the incremental production at full development is estimated that it will increased in 3.64 ac x 80 basket of monsoon paddy/ac, 3.56 ac x 650 viss of cotton/ac plus cash crop quantity of onion which yield over 4000 viss/ac, i.e, 0.36 ac x 4500 viss of onion/ac. Incremental net farm income under the rehabilitation project (for farmers with 4 acres to 40 acres)is expected to be substantial ranging from Kyat (1,393,236) (USD 1498.1) to Kyats 13,932,360 (USD 14981) per household. See Table 16 and Table 5 to 9 of Annex - A1. The increased in cropping area will be 1770 acres which is 83% of the land area.

Financial Return of Kyaukse Tank Irrigation Scheme

For 4306 acres of Kyaukse Tank Irrigation system, the incremental production are 3.96 ac x 80 basket of monsoon per ac, 0.4ac x 100 basket of summer paddy per ac, 1.72ac x 650 of cotton per viss, plus cash crop 0.04ac x 300 chill per viss. Incremental net farm income under the rehabilitation project is expected to be substantial ranging from Kyats 199820 (USD 214.86) to Kyats 1998200 (USD 2148.60) per household depending on the size and type of farm holding. This kyaukse financial analysis was carried out assuming that there will be enough rain and supplementary irrigation and for monsoon paddy and full irrigation for summer crop. But in reality that may not be the case. See Table - 32 and Table 3 to 7 of Annex - B1. The increased in cropping area will be 1216 acres which is 31% of the land area.

The quantifiable benefit of irrigation scheme is accrued from incremental of crop production gained from reclamation of irrigable land previously short of irrigation and increase of yield due to assured irrigation (see table 17 and 33).

The projects are expected to benefit approximately 550 small scale farm households of Chaungmagyi RMC areas and 960 small scale farm house holds of Kyaukse Tank area (average holding of 4.66 acres) cultivating a total of 6020 acres, 2128 acres in RMC system and 3892 acres plus 414 acres in Kyaukse Tank. Incremental production at full development is estimated that it will increased 82,266 basket of paddy, 990,000 viss of L.S cotton and 200,000 viss of onion (for Chaungmagyi RMC) and 116,560 basket of monsoon paddy, 8,000 basket of summer paddy and 843,100 viss of L.S cotton for Kyaukse Tank.

The benefits to be derived from the rehabilitation of RMC and Kyaukse Tank have been compare separately with each of the respective total investment costs of the projects as shown in Table - 36 and Table - 42 which also show other aspect.

The net incremental benefit of Chaungmagyi Dam RMC canal system is million Kyats 1006, increase in crop area is 1770 Acre that is 83% of land area and the benefit cost ratio is 1.64 (Benefit 1006 / Cost 615.265). (Assuming that rehabilitation will implemented within 6 months from December that is after irrigation period).

The net incremental benefit of Kyaukse tank irrigation scheme is Kyats 1042 million, increase in crop area is 1216 acre that is 31% of land area and the benefit cost ratio is 7.44 (Benefit 1042 / Cost 139.51) (assuming cropping condition same as RMC canal system) only if there is enough and assured water in the reservoir. The benefit cost ratio is high because of less repair works for larger irrigable area. But if the irrigation water is not assured the benefit will be dropped.

The 10 years average rain fall of Kyaukse area is only 26.15 inches which means that paddy crop water requirement will be always lucking and need a lot of supplementary water from the tank. In this regard, the water balance will be low. The cropping pattern should be reviewed in coordination with farmer's outlook.

Table -36 Comparison of Project Incremental Benefit

Chaungmagyi RMC Canal System						**Kyaukse Tank Irrigation Scheme**			
Sr No.	**Crop**	**Gain in Gross Income by Crop (Kyats in million)**	**Gained**		**Total Net Value Profit (Kyats in million)**	**Gain in Gross Income by Crop (Kyats in million)**	**Gained**		**Total Net Value Profit (Kyats in million)**
			Acre	**Percent (%)**			**Acre**	**Percent (%)**	
1.	Paddy (Monsoon)	288	570	30	**184**	408	242	6	**364**
2.	Paddy (Summer)	-	-	-	**-**	28	-	-	**28**
3.	L.S Cotton	990	1200	63	**751**	843	974	58	**650**
4.	Onion	70	-	-	**70**	-	-	-	-
	Total	**1348**	**1770**	**93**	**1006**	**1279**	**1216**	**64**	**1042**

Comparison of Cost Estimate

The rehabilitation project is to be construction in (6) months during the recess of irrigation period that is from December to May. The cost is about Kyats 615.265 million for Chaungmagyi RMC canal system and about Kyats 139.511 million for Kyaukse Tank irrigation scheme.

Table -37 Cost of estimate for rehabilitation of Chaungmagyi RMC canal system and Kyaukse tank irrigation scheme

Sr. No.	Item	Amount in million Kyats	
		Chaungmagyi RMC	Kyaukse Tank Irrigation Scheme
1.	Survey	1.960	1.556
2.	Earthwork	110.811	120.648
3.	Structures	501.264	17.029
4.	Camp Facilities	1.230	0.278
		615.265	**139.511**

Chaungmagyi Irrigation Scheme (RMC and LMC)

Table – 38 Comparison of available with crop water requirement

Year	Rainfall	Water balance	Dead value	Useable water	Irrigation Water Requirement
					Grown Crop W-Rqed
2009-2010	33.49 in (2.8 ft)	18171	7000	11171 ac-ft	L.S.C 2236 ac x 3.33 ft = 7446 ac-ft S.P 490 ac x 8.33 ft = 4082 ac-ft
2010-2011	56.18 in (4.7 ft)	37213	7000	30213 ac-ft	L.S.C 728 ac x 3.33 ft = 2424 ac-ft S.P 1292 ac x 8.33 ft = 10762 ac-ft
2011-2012	38.19 in (3.2 ft)	35352	7000	28352 ac-ft	L.S.C 1703 ac x 3.33 ft = 5671 ac-ft S.P 1000 ac x 8.33 ft = 8330 ac-ft

L.S Cotton (L.S.C) – Crop water requirement – 500 mm to 1000 mm (20" to 40")

Summer Paddy (S.P) – Crop water requirement – 1200 mm to 2500 mm (48" to 100")

Original Registered Irrigable area (RMC plus LMC) = 9238 acre

Latest ID Assessed Registered Irrigable area (RMC plus LMC) = 7091 acre (see table - 9)

Table - 39 Yearly Crop Sown in Chaungmagyi Irrigation Network

Sr No.	Fiscal Year	Wet Season		Dry Season		Total
		Monsoon Paddy	Other	Summer Paddy	L.S cotton	
1	2009-2010	4987	-	490	2236	7713
2	2010-2011	1643	-	1292	728	3663
3	2011-2012	5721	-	1000	1703	8424

Chaungmagyi Irrigation System

Cropping intensity of Chaungmagyi irrigation system from ID 2013 report of Chaungmagyi irrigation networks show that the irrigation crop intensity for both wet season plus dry season for year 2010-2011 was 109% for year 2010-2011 was only 52% and year 2011-2012 was 119% which mean that there are a lot of land and water if the system is well maintained.

Kyaukse Tank Irrigation Scheme

Table - 40 Comparison of available with crop water requirement

Year	Rainfall	Water balance	Dead value	Useable water	Irrigation Water Requirement	
					Grown	Crop W-Rqed
2009-2010	20.7 in (1.7 ft)	1355	524	831 ac-ft	L.S.C 206 ac = 686 ac-ft	x 3.33 ft
2010-2011	28.03 in (2.3 ft)	3840	524	3316 ac-ft	S.P 422 ac = 3515 ac-ft	x 8.33 ft
2011-2012	26.33 in (2.2 ft)	2903	524	2379 ac-ft	S.P 501 ac = 4173 ac-ft	x 8.33 ft

L.S Cotton (L.S.C) – Crop water requirement – 500 mm to 1000 mm (20" to 40")

Summer Paddy (S.P) – Crop water requirement – 1200 mm to 2500 mm (48" to 100")

Original Registered Irrigable area = 7537 acre
Latest ID Assessed Registered Irrigable area = 4306 acre

Table - 41 Yearly Crop Sown in Kyaukse Tank Irrigation Network

Sr No.	Fiscal Year	Wet Season		Dry Season		Total
		Monsoon Paddy	Other	Summer Paddy	L.S cotton	
1	2009-2010	1003	-	-	206	1209
2	2010-2011	2841	-	422		3263
3	2011-2012	3546	-	501		4047

Kyaukse Tank Irrigation Scheme

Cropping intensity of Kyaukse Irrigation Scheme from ID 2013 report of Kyaukse irrigation network show that the irrigation crop intensity for both wet season plus dry season for year 2009-2010 was just 28% for year 2010-2011 was 76% and year 2011-2012 was 94%. The percentage for 3 years average 66% only that mean the whole irrigable area could not be fully irrigated for a crop even with the supplementary water from Kyaukse tank.

The reason why it was not fully irrigated is complicated because it may be due to soil feature and land layout, limited water resource in appropriate canals' design (size and capacity in accordance with irrigable area). The above farm model study reflect the present low income farmers with good soil with insufficient water will benefit future with rehabilitation and assured water which is a question.

Table - 42 **Comparison of Chaungmagyi RMC Area with Kyaukse Tank Area**

Sr. No.	Subject	Chaungmagyi RMC	Kyaukse Tank	Remark
1	Location	Within 7 miles Northwest of Pyawbwe Town	Within 9 miles East of Pyawbwe Town	**Kyaukse area has limited water resource and rainfall is the primary obstacle to boost crop intensity. Mainly to increase cotton. This may be the reason that some of the farmer is not interested to grow cotton.**
2	Irrigable area	2128 acres	3892 acres	
3	Reservoir useable Maximum Capacity	33200 ac-ft	5726 ac-ft	
4	Rainfall (10 years average)	39.8 inches	26.15 inches	
5	Source of Water	Chaungmagyi Dam	Kyaukse Tank	
6	Main and Secondary Canal System	RMC, Dy 1 to Dy6	Canal 1,2 and 3	
7	Canal Earthwork	24625 Sudrum	26811 Sudrum	
8	Tertiary system	41nos of pipe outlet with some defined W/C	48 nos. of pipe outlet (without W/C) irrigated plot to plot	
9	Canal Infrastructure	RMC (fall=13, HR=6, Bridge=1, Culvert=1)	Canal 1 (Fall=2, HR=1)	
		DY + RMC Tail (Turnoff=41, Fall=20, Bridge=14)	Canal 2 (Fall=2, HR=1)	
10	Estimated Rehabilitation Cost in Million Kyats	Million Kyats 615.265	Million Kyats 139.511	
11	Operation and Maintenance	Very Bad	Reasonable	
12	Financial Sources/ Management O&M budget	minimum = 1,129,445 Kyats	minimum = 309,777 Kyats	
	(Average of 9 years)	maximum = 8,765,596 Kyats	maximum = 2,740,740 Kyats	
		average = 4,000,404 Kyats	average = 1,391,702 Kyats	
13	Agriculture and Socio-Economic Condition	Low	Low	
14	Financial Analysis			
	(a) Farm Budget per Acres			
	(i) Farm Gate Price	Monsoon paddy = 3500 bkt/acre, L.S cotton = 1000 viss/acre	Monsoon paddy =3500 bkt/acre, L.S cotton =1000viss/acre	
		Onion = 350 viss/acre	Chilli = 2500 viss/acre, Summer paddy = 3500 bkt/acre	
	(ii) Production Cost	Monsoon Paddy=kyat 180,000/220,000, Summer Paddy= kyat 220,000, L.S Cotton=kyat 197,500, Onion=kyat 591,000, Chilli=kyat 275,800 (see Table - 20,21,22,48,49 and 50)		
	(b) Yield of Crops	Wet season Paddy=100bkt/ac with full irrigation, 53 bkt/ac with some or no irrigation, L.S cotton=650viss/ac with full irrigation and 350viss/ac with some irrigation, Onion=3500viss/ac with full irrigation and 4500viss/ac with some irrigation, Chilli=300viss/ac with full irrigation		
	(c) Present cropping pattern	L.S Cotton 700 Ac, Onion 200 Ac, Monsoon Paddy 1358	L.S Cotton 700 Ac, Monsoon Paddy 3600, Summer Paddy 400 Ac	
	- Present farm intensity and income	106% , 673337 kyat/hh/yr	121% , 938972 kyat/hh/yr	
	(d) With rehabilitation cropping pattern	L.S Cotton 1900 Ac, Onion 200 Ac, Monsoon Paddy 1928 Ac	L.S Cotton 1674 Ac, Monsoon Paddy 3842 Ac, Summer Paddy 400 Ac	
	- With rehabilitation farm intensity and income	189% , 13932360 kyat/hh/yr (Project)	153% , 1998200 kyat/hh/yr (Project)	
		1393236 kyat/hh/yr (Model)	199820 kyat/hh/yr (Model)	
	(e) Benefit/Cost	1.64	7.47 (high ratio because less investment on less area but return per acre is not assured)	
	(f) Incremental Production Benefit	1006 (Kyats in Million)	1042 (Kyats in Million)	
	(g) Physical and Social Incremental Benefit	Land - 570 Acre, Crops - 1770 Acre	Land - 242 Acre, Crop - 1216 Acre	
		More farm job opportunity.	More farm job opportunity	
		Farm labour who left the village will return	Farm labour who left the village will return	

5. Finding, Recommendation and Conclusions

(i) Finding – Output of the Objections

A. Chaungmagyi RMC Irrigation Scheme

- Chaungmagyi irrigation networks with RMC and LMC system was implemented since 1981 was operated and well maintained upto 1998 or so and since then lacking in regular maintenance and operation started which lead to the present stage that no party could managed the water distribution. (Party responsible for O&M of the main system and party-farmers who are responsible for tertiary system)
- Chaungmagyi chaung carry a lot of silt but no silt ejector. Therefore, when the water is diverted into RMC and LMC, the silt also flows into the canal together with water. Right main canal head reach about 3000ft is total silted and side bank with heavy erosion from design point of view RMC is no more irrigable (see Annex D – Photo) – need urgent unsilting and resectioning. But ID has tried to divert some water into the RMC by increasing the original shutters by one foot.
- The magnitude of repair to canal varies as it moves downstream from about 70% to 50%, The nature of damage were also different along the same canal, type of damages were silting, bank settlement, deep cut and erosion. Most of the canal embankment has settlement up to 1 foot and above.
- The extent to which the structure and Dys are damaged is as explained in Chapter 3A.3.(see Table -7)
- All these deterioration may be be due to

  (1) Inadequate O & M funds for years

  (2) Lack of regular maintenance

  (3) Lack of experience of field irrigation engineers and water inspectors

  (4) Lack of proper water management
- Chaungmagyi area according to Dam site rain gauge average rainfall is 39.8 inches.
- Although there are some sandy soils, but most of the soil are light soils good for paddy and cotton.

B. Kyaukse Tank Irrigation Scheme

Concerning with Kyaukse tank it is quite different from Chaungmagyi irrigation scheme. It is an old ancient dam built by Myanmar King which had been rehabilitated many times.

- Original designed irrigable area is 7537 acres.
- Present irrigable area as per ID survey is 4306 acres.
- Canal 1,2 and 3 were all silted but not heavy just about 6 inches to 1 foot. There were settlement of some canal embankment which varies from a feet to 2 feet.
- There were no heavy damage in structure but there were some damages in downstream protection of the structures (stilling basin and stone pitching).
- Kyaukse Tank irrigation canal is less silted than Chaungmagyi canal system because the irrigation water is directly regulated from the Dam which is free of silt. The silt in canal is due to bank erosion.
- The canal No.3 crossed Samon Chaung by a syphon. Around this area, some of the land is water logged and the salinity is high (need to review soil property to what extent of the area has been contaminated.)
- The canal No.1 is long and the water hardly reaches the tail (need to review water efficiency and canal losses.)
- In this area, paddy (rice) water requirement varies from 4 feet (1200 mm) to 8 feet (2500 mm) and the average rainfall at Kyaukse Tank for last ten years is 26.15 and for the last 5 years is only 24.8 inches.
- The maximum useable capacity of Kyaukse tank is 5726 Ac-ft.

(ii) The perceptions of the farmers (mostly tail and high ground irrigable area). They said that, they wanted the whole system to be rehabilitated. Dy Head regulators should be properly controlled by ID and managed for equitable water distribution. To provide cross-check in Dy at watercourses (W/C) turnout, for assured water requirement. To repair all the farm access bridges crossing RMC and Dy canals. They also said that they are willing to follow the canal rules and regulation like in the olden days after the rehabilitation.

In this regard, ID should cooperate with farmers, give them the necessary technical support during the primary system rehabilitation. Then, the farmers' organization carried out the maintenance, realignment and modernization of the tertiary system simultaneously.

(iii) Output of Objective - Improvement in Management of Scheme

For the improved management of scheme and in particular better (more sustainable) maintenance of canal the options to be adopted are;

(a) Operation and Distribution of Water

Distribution of water must follow the operating rules as per designed and built which are laid down for the conveyance system. In order to minimize operation losses of water and make effective use of rainfall, the following points are to be considered.

(a) A rapid and accurate system changes must be carried out in water distribution according to crop requirement.
(b) An effective system of communication
(c) A rapid and accurate system of changing canal flow, operating reservoir, and regulating weir outflow.

(b) Irrigation Planning

By the start of an irrigation season, as soon as the available supply can be determined, system operations are to be planned. With the proposed cropping pattern, planting dates are collected from the farmers through the WUA. After that, the water distribution committee has to calculate the crop irrigation requirement according to crop growth stages of the proposed cropping pattern, starting from land preparation. With this calculated water requirement information, a seasonal plan of water deliveries has to be planned. Then, WUA meeting shall be called for discussion and confirmation of the seasonal water deliveries. Thereafter, the water distribution schedule shall be announced and the water distribution authority act accordingly.

(c) Water Conservation

It is most common for water rather than land to be the upper limit on the potential of Agricultural Development. In order to make the best use of finite supplies, water losses have to be minimized for water conservation as follows:

Secondary System

a. carefully planning the water allocation
b. tight day to day control of supply to meet the minimum demand
c. correct operation of canals and irrigation/drainage structure

Tertiary System

d. providing farmers with advice on efficient field application technique and with training as required
e. by imposing sanctions on users persisting wasteful practices of water

In order to achieve the goal of any rehabilitation the water management of the canal system must be effective and water supply should be adequate and reliable. Equally drainage water shall be drained and there should not be water backing up the drain and forming pondage.

For proper system management in drainage and canal operation of both secondary and tertiary system, all irrigation acts, rules and regulations must be applied and exercised.

Tertiary System

It is important that farmers in the planning of rehabilitation project for the maintenance of existing system with improvement to structure to some extent of modernization have a different setting.

In this regard, farmers are well aware of the short comings in the existing structures and its management. This point has been clearly seen and noticed during the consultant field visit discussion with farmers and they said that Dy head regulators should be properly controlled by ID and managed for equitable water distribution. To provide cross-check in Dy at watercourses (W/C) turnout, for assured water requirement. To repair all the farm access bridges crossing RMC and Dy canals. So, farmers' participation is most essential for the effectiveness of the project. Farmer participation in the day to day management of the system is (as per definition) located in the water course system (tertiary unit) and not within the main system, See Chart 2. The main system is solely the task of the professional's staff, following the guideline of the "Highest Authority". They should not rely on unpaid labour by farmers for maintenance or on farmers' participations in their operational matters. There must be sufficient O&M staff and budget.

Farmers' participation is clearly shown in Chart 2. They are only responsible for tertiary system and on-farm water distribution and maintenance.

Law and Order – Canal Act

Irrigation systems fail when the participants do not follow the regulations. Farmers who steel water through illegal offtakes should be punished. Operators (gate keepers) of the main system who do not supply the agreed water volume (discharge) to the tertiary units should also be punished. Such a strict discipline should be imposed.

(iv) Output of the objective - Whether the irrigation scheme is established

A. Chaungmagyi RMC Irrigation Scheme

RMC have been fully developed and established since 1981 with required secondary system and tertiary system which both of the system are deteriorated. As, one of the farmer stated that RMC system has no problem up to last ten years (refer Annex C2). They had the experience in paddy farming without irrigation the yield were low (See crop production in 1973 to 1979 without irrigation) refer (Table 1 and 2 of Annex - A1) and there were time that they had enjoyed good crop production with full irrigation but at that time all were planned crops and they were not free to sell. Now, they are free to grow and sell, they have learnt that crop yield response to water but the canal system has deteriorated and hard to get required irrigation water and they are trying to get all available water, by pumping ground water, dug well and from drainage etc., with enough water the yield of cotton is over 600 viss/Ac and the price is Kyats 1000/viss. The yield of paddy with same irrigation is about 50 basket/acre and with full irrigation is over 100 basket/acre is Kyat 3500 to 4500 per basket.

B. Kyaukse Tank Irrigation Scheme

Concerning with Kyaukse tank it is quite different from Chaungmagyi irrigation scheme. It is an old ancient dam built by Myanmar King which had been rehabilitated many times. The irrigation area is irrigated by three separate canals, 1, 2 and 3, directly release from the reservoir and controlled by its respective Head Regulator from the dam but there are no tertiary unit, the farms irrigation method is taken water from the outlet to plot by plot.

All the canals were designed and built with the same canal cross-section irrespective of irrigable area. The canal is designed to carry maximum water for paddy irrigation therefore no problems for any other crops. But, for proper equity irrigation and distribution water management the system must be reviewed. But, at present some unsilting, resectioning and minor repairs to structures are only required. Canal no. 1 is provided with 22 W/C, canal no.2 with 8 W/C and canal no.3 with 18 W/C. But, there are no drainage canals.

O & M staffs are lacking in experiences and training for water distributions and operation. Field engineers are also not sufficient. No day to day inspection by canal inspector and field engineer for desilting, replacing displaced stone pitching and so on, which accumulated and lead to beyond normal maintenance works and finally causing total failure. There are no fix operation regulation for the Dy Regulators, therefore the cause of downstream slab and pitching erosion due to the release of over discharge.

(v) Output of the objective - Tentative assessment of the economic rationale for rehabilitation of gravity irrigation scheme the Dry Zone.

There are 97 Irrigation Schemes in Mandalay Region. Most of them need rehabilitation. The canals were silted with heavy sedimentation, the canal bank has been settled, and they could hardly convey 40 to 50 % of the design capacity. In some cases the canal efficiency is about 10 to 15% depending upon the water sources could be expected.

Rationale

The reduction in canal capacity was due to lack of proper water management and regular maintenance works. The main basic cause is that the responsible institute did not have sufficient O & M budget for years. Most of the irrigated area downstream of the tank or weir are paddy (rice) growing area and rice crop irrigation requirement varies from 48 inches (1200 mm) to 100 inches (2500 mm) of water per season depends upon evapotranspiration water availability for irrigation purpose is a function of the seasonal variation of surface water flow and rainfall pattern. And therefore it is very important that the available storage water being delivered to a well rehabilitated canal system operated and managed for high efficiently and water conservation.

We shall see that there can be considerable variations in detail according to local circumstance wherever development is contemplated, and this is not surprising in view of the great physical and institutional variety of the deteriorated irrigation schemes (not unmanaged scheme or developed scheme without any follow up). But, differences in the precise role allocated to agriculture an amount only to differences in the emphasis placed on various items which, together, which constitute the fullest role that can be played by agriculture in any attempt to remedy on unsatisfactory socio/economic situation are of numerous agricultural development aims, out of which to increase total output and the variety of output both agricultural and industrial crops from existing cultivated land, so that better diets livelihood can be provided for both the farmer and non-farmers populations and at the same maintaining and due regard for conservation practices by rehabilitation improvement and modernization at the same time for sustainability.

Once, the lost cultivable and irrigation areas are reclaimed farm labours who left their home will return. At the moment farm labour and casual labour are scared in the area. Only if their home land is assured that there is a lot of job opportunity in irrigation agricultural farming they will return.

The increase production of either food (paddy and onion) or industrial crop (cotton) for which RMC system has the best advantage, so that cash income can be attained for farm population and a contribution made to general economic development by the provision of basic material if not for export but at least for the development of local industries.

Limited water supplies will be primary obstacle to increased food production in the few decides. As population expands irrigated land will be expected to produce more food. The share of agriculture production of the scheme at township level its agricultural output (paddy and onion) is significant. The L.S cotton production also supports the regional cotton facilities. Pyawbwe Township is not self-sufficient in rid, it has to import rice from other region. The additional rice output will be absorbed by the township which would reduce the import. Additional output of rice is about 1689 tons (82266 basket see table - 17) which will be absorbed by the township need.

Justification

The majority of the irrigation schemes in the dry zone if properly selected for rehabilitation shall definitely contribute to fulfill the requirement for distribution of water to the paddy field from tank for wet season supplementary water, bridging long dry spell and irrigation of second crops. The project will lead to sustainability of environment, yield improvement of crops, the lost cultivable and irrigable will be reclaimed, cropping intensity will be increased substantially so do the crop production, localize self-sufficient of food, income improvement of rural people and upgrading the livelihood of rural people. The primary beneficiaries are the farmers of the rehabilitation areas who will be able to eat more food and general income from production of crops. The farm labours who left the villages and work outside will return if the farm land is fully developed. (see Table - 42)

Recommendation

Key things that can be controlled to improve water delivery & productivity.

Maintenance

Maintenance or rehabilitate the canal system in accordance with the original design requirement and ID simultaneously organized farmer for remodeling and realignment of watercourses for better water on-farm management and efficiency.

Operation

(1) ID declared the availability of water from the weir headwork regulator to the township irrigation committee. With the availability of water, draw necessary water distribution schedule according to Dys.

(2) The township committee meets with the representative of farmers for each Dy and declared the quantity of water (discharge of each Dy) and the date of distributions.

(3) ID Dy head regulators keeper release the require discharge as officially announce and to keep all the gates under lock and key.

(4) Then, the canal inspector and assistant canal inspector, duty is to check all the W/C turnout (outlet) whether each outlet taking their requirement of water as specified or taken more. (conventional method)

To issue and execute the above order by Irrigation Department or by ACC. The department or ACC has to be vested with the required power to take action accordantly which is spelled out in the irrigation manual under the canal act (with necessary amendments to some of the rules and regulations as required).

These canal rules and regulations which were spelled out in Burma irrigation manual volume 1 (with the necessary up to date amendment) which cover all government controlled irrigation works. It should be declared to all the farmers in the irrigation areas. The law must be re-enforced. To do this the authorities must have the political will, if not, no need to have rehabilitation.

Water User Association

It is very important to provide a strong program for the formation of water user's groups at the watercourses (W/C) level and trained them to assure that the available water is distributed to the entire command area of each W/C equitably and each W/C is properly maintained.

To assure that ID distributed the required water of each W/C equitably, thus control structures have to be constructed on every W/C outlets direct outlets to regulate the supplies for which past ID authority was hesitant to put these into operation due to the possibility of these being damaged by farmers. But, it is time that ID talk with farmer-WUS and installed such structures and put into operation for better water management. The farmers should be trained for crop water application, better water management and water law concerning irrigation water distribution. Then, enforced the require law and order as per canal act which is in the Burma Irrigation Manual (1948). (Translated into Myanmar by U Hla Khaing (Retired ID Director) December 1974).

Food for Thought

Type of Irrigation system and water management

(1) ID should discuss with farmers and other organization

(2) To what extent do ID like to reform the irrigation system which size (small, medium and large)

(2.1) Dual management, all government controlled system in Myanmar are dual system – big and small

(2.2) Small – farmer community? Below 500 acres (200 hectares)

(2.3) Medium – by company? 500 acres to 5000 acres (200 to 2000 hectares)

(2.4) Public – always large above 5000 acres (2000 hectares)

System Rehabilitation

1. System Rehabilitation

1.1 Repairs to RMC canal system of Chaungmagyi irrigation network and Kyaukse Tank irrigation scheme structures

1.2 Repair, strengthen and gravel pavement to inspection path

1.3 Remodeling of main, distributary and minor canals with appropriate design

2. System Modernization

2.1 Construction of a sediment (silt) ejector and silt trap cross regulators

2.2 Construction of outlets with measuring devices at the heads of Dys, minors and W/C

2.3 Provision of side and tail escape in the main canal

2.4 Installation of measuring devices at Dy intakes

2.5 Construction of inspection roads and tracks

2.6 Provision of telephone communications for Chaungmagyi RMC canal system and Kyaukse Tank irrigation scheme to communicate with command office.

On-farm Development

Remodeling and realignment of W/C

Provision of division box for all field dishes form W/C

Equipment

Provision of light and fast moving maintenance equipment for day to day maintenance. For example like small dozer and back-hoe which could be carried by (8) tons truck or dump truck.

6. Conclusions

Potentiality of Irrigation Scheme Rehabilitation Project

Chaungmagyi RMC Irrigation System

The Chaungmagyi RMC irrigation which is selected for investigation and assessing in term of requirement for maintenance and rehabilitation, the consultants have studied the irrigation scheme from the 3 impact areas that is Irrigation System, the engineering side, the agriculture and the financial side.

The outcome of the studies is as follows:

- From engineering point of view, the RMC system need urgent repair. If any delay in unsilting and resectioning works of RMC, the water distribution could be totally crippled.
- According to consultant initial cost estimate of RMC system as shown in Annex A of the report the estimated investment cost is million Kyat 615.265. The rehabilitation scheme is schedule to implement during the irrigation recess period November to February.
- Agricultural and cropping practice

Premonsoon long staple cotton or summer paddy, monsoon paddy and onion which is in practice (present cropping pattern). The intensity is 106% on land area of 2128 Acres.

With rehabilitation the same cropping pattern will be adopting which the farmer viewed as most beneficial for them. The intensity will be 189% that means an increased in intensity by 83%.

- The incremental production benefit will be 1006 million kyats. The other physical and social benefit is as shown in Table 42. Such financial return could not be achieved from any other agriculture development project in so short time.
- Chaungmagyi RMC system will be rehabilitated within 6 months and the system will be fully restored.
- More works opportunities for RMC farmers and farm labours of surrounding village tracts.
- RMC after completion of unsilting and resectioning will convey its full capacity of irrigation water for 2128 acres via Dy1, Dy2, Dy3, Dy4, Dy5, Dy6 and by RMC to its tail canals.
- The newly installed W/C turnout will distribute adequate water to respective farm block and field.
- The adequate and assured water distribution will increase crops production, in turn the farmer income will increase and improve their livelihood.
- Improve food security for the township and the surrounding neighboring villages.

- The L.S cotton production also supports the regional cotton facilities.
- The least land holding farmer category (1-10 acres) is about 80% to 90% which account for about 550 households. They will have enough diet with better livelihood and free of debt.

  The above outcome of the studies clearly support the LIFT initial analyses which identified rehabilitation of canal systems in gravity irrigation schemes as a potential option for inclusion on the new program. The reason is that this project is directly related to food security of the area and the livelihood of the farmer. It is already explained in Chapter - 4 under 4A.1 and 4A.7 that these will be substantially increased in incremental production of either food (paddy and onion) or industrial crop (cotton). In this regard, RMC system had the best advantage so that the cash income can be attained for farmers and contribution made to economic development by the provision of basic materials if not for export, but at least for the development of local industries.

Kyaukse Tank Irrigation Scheme

Kyaukse irrigation scheme, present agricultural productivity is low due to the poor soil and climate conditions and insufficient water supply but all this need to be reviewed and surveyed. We must be aware that these irrigation schemes are in the Dry Zone and we must not forget that each scheme is governed by its own temporal and spatial type of erratic rainfall pattern and the supplementary irrigation water for the small tank is never assured, one year may be full of water and next year may be dry or drought. Under sufficient water and proper irrigation, the cropping intensity would increase in accordance with soil fertility thus the crop yield (see Table - 40 and 41). Accepting that the present agricultural production of Kyaukse Tank area is low due to lack of water, without consider other factors, the future yield will increase substantially as shown in the model farm with assured water. But, in reality the production may be lower than what is expected. The sample model farm means any assumed household having an average land holding of 4 acres whose is growing with the selected cropping pattern for present and future with rehabilitated situation. It is analysed as shown in table - 32.

Note that present yield data are received from field discussion with farmers (see Annex – C).

There is no drainage system in canal no. 3 area some of the land are already water logged with high salinity See Annex C.

Present Kyaukse irrigation system compare to Chaungmagyi system is better only in maintenance works because the source of water do not carry silt load like Chaungmagyi chaung. Kyaukse canals received clear water from the reservoir. Although Chaungmagyi system received from the reservoir, the feeder channel is the natural Chaungmagyi chaung

which is 7 miles long and carry a lot of silt load. But Chaungmagyi dam capacity (volume of water) and rainfall are much more than Kyaukse tank for crop production (see Table - 38,39,40 and 41).

Other factors like the land area, soil type, hydrology, reservoir available capacity, system compare to Chaungmagyi, all these have to be carefully reviewed and redesigned which would require time. And in addition from the point of water management, financial and economic, Kyaukse tank irrigation is less favourable than Chaungmagyi irrigation scheme.

From the above points of view, Chaungmagyi RMC canal system could be more favourable as a high potential scheme for food security generation compare to Kyaukse (which still need to be investigated in many aspects) for the consideration of including in the new programme of LIFT.

Sustainability of Rehabilitated Irrigation Scheme

For the sustainability of the rehabilitated system ID and farmers WUA have to coordinate and train farmers for the awareness of their responsibility and to make them to understanding that the irrigation system is a dual controlled system. The secondary system is controlled by ID, who is solely responsible for O&M and for equitable distribution of water to tertiary system. On the other hand farmers are totally responsible for the maintenance of tertiary system and on farm management.

The Benefit of Rehabilitated Irrigation Scheme

Rehabilitation of irrigation scheme compare to any other agriculture development project have great advantages in term of investment cost, rate of return, length of recovery period, project period, restoration of primary system and tertiary system facilities could be brought back the lost irrigation area to effective irrigation command. This will be also brought back the farmer to better livelihood with more food security.

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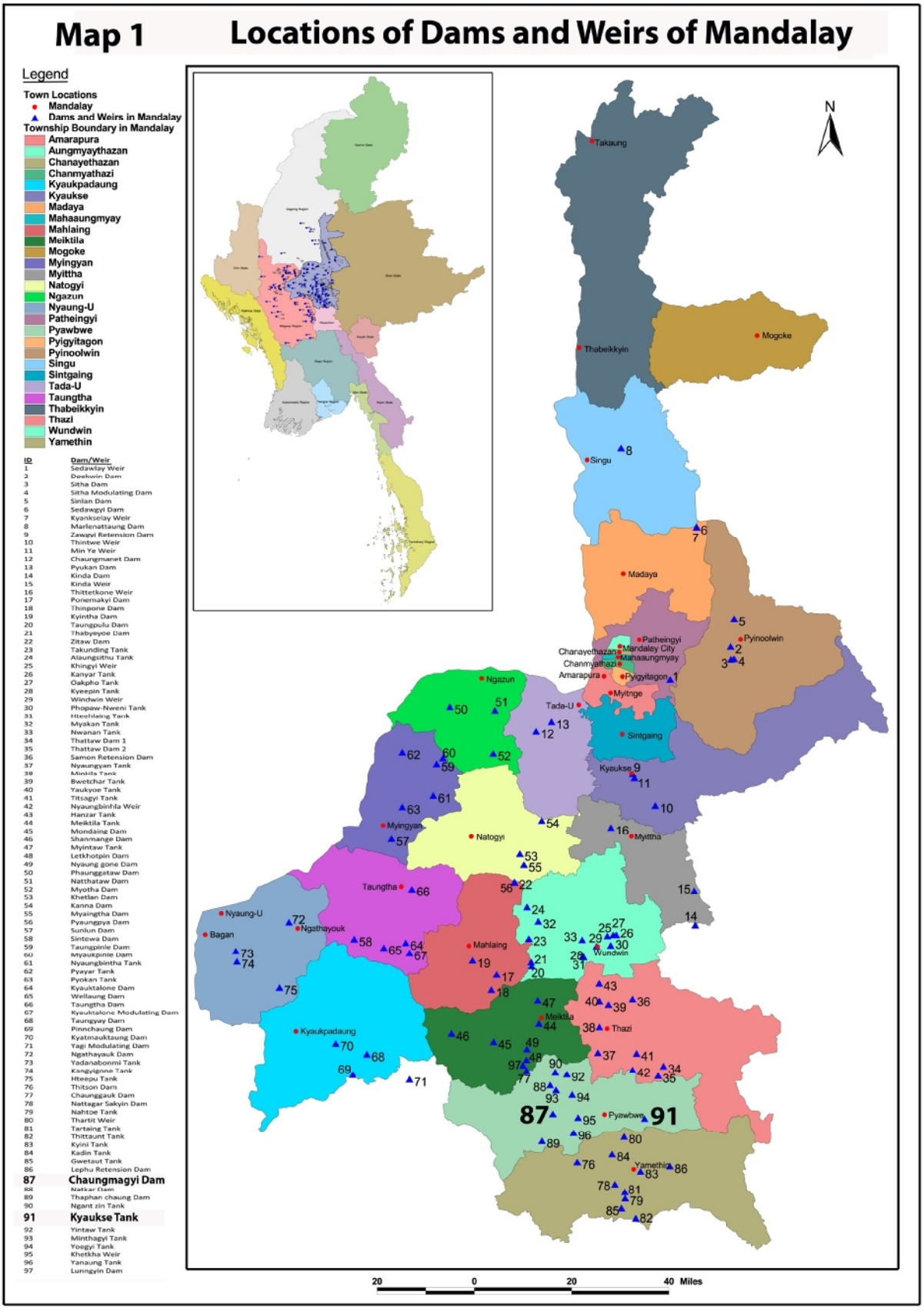
1. Presentation of the Area (Pyawbwe Township)

1.1 The Project Area and its Administration Structures and Irrigation Scheme

The two selected irrigation schemes for assessment of rehabilitation are in Pyawbwe Township. There are eight government controlled major irrigation schemes of which the above (2) are included (see Map - 2) and (69) small to very small village irrigation schemes varying in size from a hundred acres to a few acres, as reported in Pyawbwe Township 2013 Report.

The eight government irrigation schemes are managed by the Office of Irrigation Assistant Engineer - Pyawbwe under the control of Assistant Director of Irrigation Department, Meiktila District, Mandalay Region. According to general administration system, Pyawbwe Township is in Yamethin District under Mandalay Region. The region administration system flow chart up to township level is as shown in Chart 1.

Map 1 Locations of Dams and Weirs of Mandalay



Map 2 **Locations of Dams and Tanks of Pyawbwe**

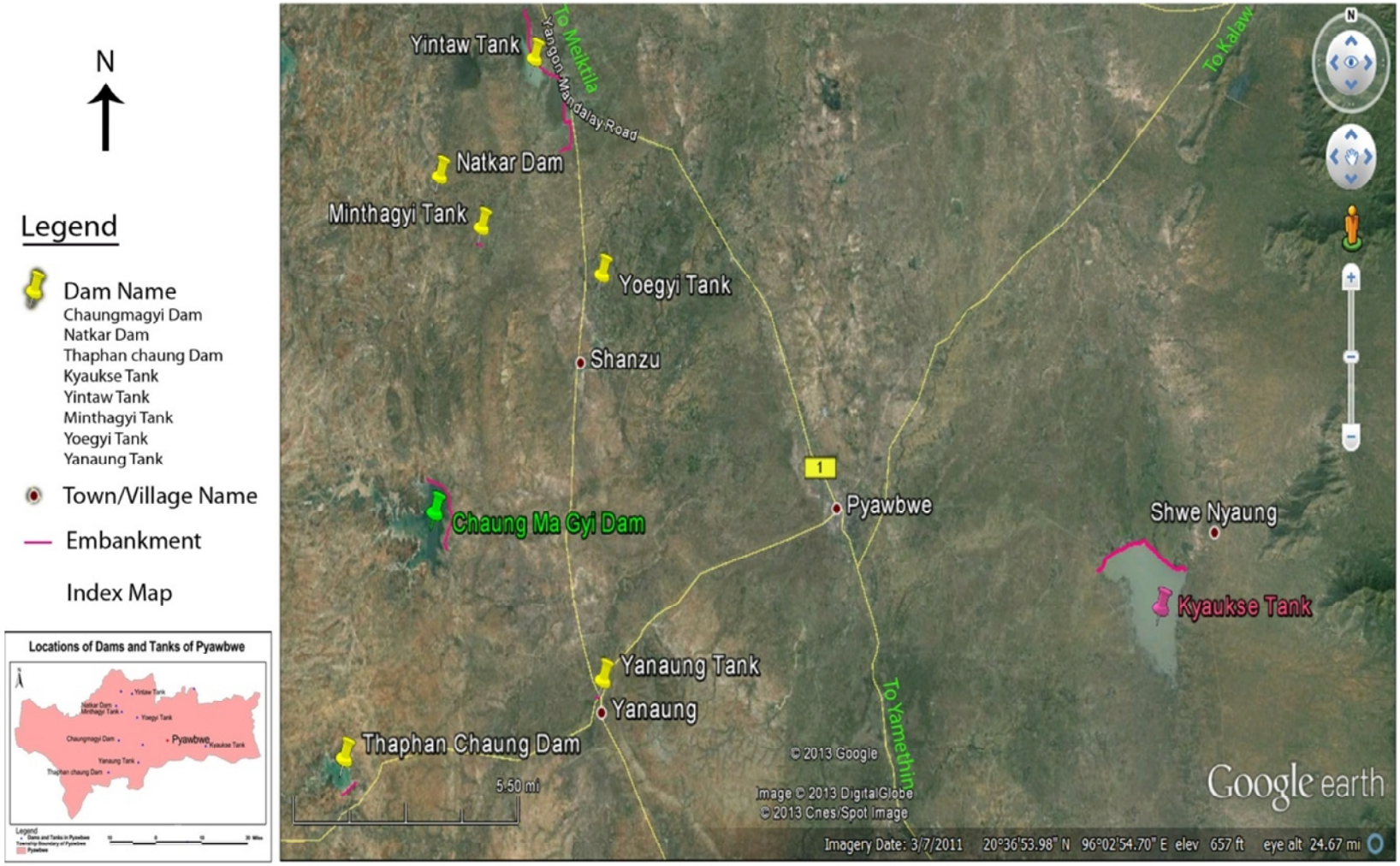
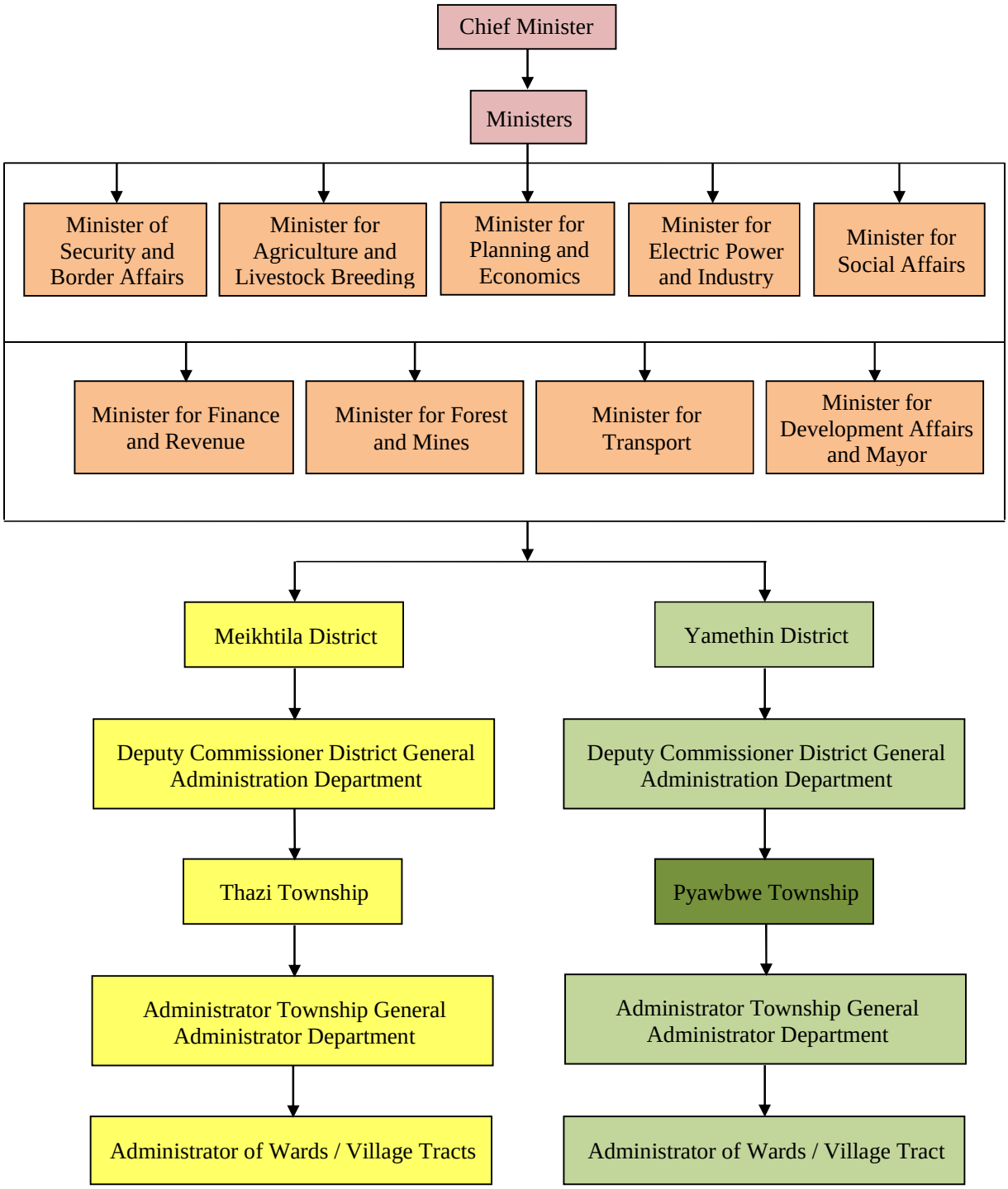


Chart 1 **MANDALAY REGION**

REGIONAL HLUTTAW

1. Region Hluttaw Speaker
2. Dy Region Hluttaw Speaker
3. Region Hluttaw Minister
4. Region Hluttaw Representatives

REGIONAL GOVERNMENT



1.2 Geography and Climate

Geographically Pyawbwe Township is at the southern edge of Dry Zone, lying between the Shan plateaus in the east with the northern end of the Bago range on the west. All streams and rivers of Pyawbwe flow into Samon. It is (312) miles from Yangon and (126) miles to Mandalay. Its border to the south is Yamethin and to the north is Meiktila (see Map - 2).

The study of mini rehabilitation areas are in the dry zone, the climate is predominately determined by monsoon and influenced by the two air masses, i.e. southwesterly wind during the rainy season and the North-East wind during the winter. The rainy season or the monsoon is characterized by temporal and spatial nature is from mid-May to end of October, the heaviest rain normally falls in the months August to October but erratic, the average rainfall is about (32) inches.

In November rainfall diminishes rapidly and temperature begins to drop as much as 7 to 10 at night. This cool and dry season lasts through to February-March. During this season Myanmar is under the influence of the North-East monsoon, the North-South arrangement of the mountain ranges causes this dry, cool wind to blow almost from the North. The hot and also dry, season starts in March and lasts till the end of May. The maximum that you could experience is 40.6 °C to 43.6 °C. The change to the South-West monsoon is characterized by a period of thunderstorms, about 80 to 90 % of the total annual rainfall occurs during the period May to October. In the cool season, the temperature drop to 10c to 7c. Pyawbwe Township annual rainfalls, maximum and minimum temperature of last five years are as shown in Table - 1. Characteristic meteorological data of Yamethin station have been presented in (Table 2).

Pyawbwe area with low total average annual rainfall characterized by temporal and spatial wet season with an erratic rainfall pattern and/or other factors such as insects and disease combined, lead to the total crop failure on an average of 10 to 15% of the area planted. The annual average for (5) years period of temperature and rainfall is as shown in Table - 1.

Table - 1 Pyawbwe Rainfall and Temperature

Sr. No.	Year	Rainfall		Temperature	
		Rainey Day (No.)	Annual Rainfall in inches	Summer	Winter
				Maximum °C	Minimum °C
1	2008	57	36.12	41.3	7.0
2	2009	44	20.76	40.6	8.4
3	2010	57	34.81	43.6	9.5
4	2011	71	41.20	40.4	10.0
5	2012	53	24.95	41.4	10.0
Average		56	31.57	41.5	9

Table 2 Meteorological Data of Yamethin

Latitude 20.25 N **Longitude** 96.10E **Altitude** 199 **Agriculture Region** 9 **Code** 11

	Unit	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	RC	YRS
P	1	2.0	6.0	9.0	48.0	141.0	121.0	100.0	150.0	180.0	150.0	54.0	9.0	970.0	1.0	10.0
T-MEAN	2	21.5	24.0	28.5	31.3	30.6	28.5	28.0	27.8	28.2	27.3	25.2	21.7	26.9	1.0	10.0
T-MAX	2	27.8	31.1	36.1	38.3	36.7	33.9	33.9	33.3	32.8	31.7	29.4	26.7	32.6	3.0	0.0
T-MIN	2	12.8	15.0	18.9	25.0	26.1	25.6	25.6	25.0	24.4	22.8	18.9	13.9	21.1	3.0	0.0
T-DAY	2	23.0	26.0	30.6	34.0	33.2	31.2	31.2	30.6	30.1	28.9	26.1	22.6	29.0	3.0	0.0
T-NIGHT	2	18.0	20.4	24.4	29.0	29.2	28.0	28.0	27.5	27.0	25.7	22.5	18.4	24.8	3.0	0.0
ED	3	13.6	13.5	15.9	19.5	24.0	26.1	25.8	26.1	26.8	25.8	21.2	16.0	21.2	1.0	10.0
RH-MEAN	4	53.0	45.3	40.8	42.7	54.7	67.0	68.3	69.8	70.0	71.0	66.1	61.7	59.2	2.0	10.0
RH-MAX	4	91.9	79.4	72.7	61.5	71.0	79.5	78.6	82.3	87.7	92.9	97.0	100.0	82.9	2.0	10.0
RH-MIN	4	36.4	29.9	26.6	28.9	38.8	49.3	48.8	51.0	53.9	55.1	51.7	45.6	43.0	2.0	10.0
U	5	0.6	0.8	1.1	1.6	1.9	2.6	2.8	2.2	1.5	0.7	0.6	0.6	1.4	1.0	10.0
U-DAY	5	0.8	1.1	1.5	2.1	2.5	3.5	3.7	2.9	2.0	0.9	0.8	0.8	1.9	2.0	10.0
N	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CL 8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
N-N	4	86.0	84.0	86.0	74.0	50.0	29.0	19.0	18.0	29.0	50.0	66.0	80.0	56.0	2.0	10.0
RG	6	446.9	500.1	576.5	570.3	481.0	382.4	332.0	318.9	344.4	391.2	395.1	408.0	428.9	2.0	10.0
ET-PENMAN	1	88.8	111.3	173.8	193.1	199.6	165.7	160.9	142.5	128.1	116.8	97.6	80.0	1658.1	4.0	0.0
ET-BLANEY	1	110.5	118.5	163.0	195.6	171.3	163.4	166.3	116.4	91.4	81.4	88.5	98.7	1565.1	2.0	0.0
ET-RADIATION	1	130.5	138.2	188.6	218.6	187.7	124.1	109.4	104.4	84.7	99.5	105.1	106.5	1597.1	2.0	0.0
ET-CORR. PENMAN	1	130.3	147.2	217.7	227.0	220.9	162.3	156.7	138.9	131.7	134.2	119.6	112.9	1899.6	2.0	0.0
CORRECTION FACTOR		1.10	1.07	0.99	1.04	0.94	0.94	0.94	0.98	1.06	1.06	1.06				
PRECIPITATION		2	6	9	49	141	122	100	151	180	150	55	9	975	10	

1.3 Geology

The study area occupies three geological formations. They are the Pegu series, the Irrawadian series and the alluvium. The Pegu series consist of soft thin bedded sandstones and silty clay shales of Miocene age. They are generally with highly siliceous, ferruginous and rarely or slightly calcareous, cements.

The Irrawadian series sedimentary terrestrial rocks of pliocene or more recent age are soft yellowish or grayish argillaceous sandstones with thin clay beds and pebble beds in places. Much of the material exposed is weathered or unconsoli dated rock. This series occupies most of the land around Yamethin.

The alluvium includes all the deposits more recent then the Irrawadian series, and in general occupies the lower land. It is difficult to distinguish it from the Irrawadian series from which much of the alluvial deposits are derived. Along the Chaungmagyi chaung, there are extensive areas of alluvium.

1.4 Soils Classification

There are three distinguished soil types in the study area. They are vertisoils, luvisoils and regosoils.

Vertisoils: These soils occur in the dry zone in the level plans of Mandalay Region. They are very dank gray, almost black, clay soils with wide and deep cracks and slickensides in the subsoil. The humus content of these soils is also very poor so care should be taken for saline and alkali problems. These soils are alkaline and having pH ranging from 7 to 9 so they are strongly calcareous. All of these soils are paddy land and yields are evidently good. With irrigation and fertilizers sustained high yield of double cropped paddy can be obtained. If water is abundance, it is also suitable for cotton in the premonsoon and late monsoon.

Luvisoils: These soils are mostly found in the undulating relief low uplands. These soils are sandy in the topsoil and sandy clay loam in the subsoil. The soil reaction is about neutral in the top soil and slightly alkaline in the subsoil. The soil contains a certain amount of lime and is rich in calcium and magnesium. The soils are low in other nutrients except potassium. These soils are used for a variety of crops including hand irrigated vegetables. They are suitable for irrigated agriculture but attention must be given to maintaining and improving the drainage and fertilizers applications are necessary.

Regosoils: These soils occur on low upland plains in the dry zone area. The lands are dry and sandy so can be utilized for dry cropping on uplands. Being the important soils for the variety of cash crops they should be treated with green manure and organic matter together with nitrogen and phosphate fertilizer.

1.5 The socio - economic description of Pyawbwe Township

1.5.1. Location

The Pyawbwe Township is located in Yamethin District, Mandalay Region. It is situated between North latitude 20°-21' to 20°-47' and East longitude 95°-34' to 96°-20'. The area of the township covers approximately 408,605 acres or 638.6 square miles and it extends 40 miles east to West and 27 miles South to North. Refer 2013 Pyawbwe Township Data Report.

1.5.2. Population

There are 8 quarters and 75 village tracts within the Pyawbwe Township. The population is approximately 261,136 people, living in the quarters and village tracts. The number of families within the township is 53,606. The average family size is 4.9 persons. The population of Pyawbwe Township is shown in Table - 3 below. The growth rate is 1.01%

Table - 3 Population of Age Group and Sex (2012) Pyawbwe Township

Sr. No.	Particular	House	Family	Under 18 Year		Above 18 Year		Total
				Male	Female	Male	Female	
1	Quarters	5,660	5,950	4,582	4,438	9,239	11,769	30,028
2	Village Tracts	45,916	47,656	36,359	35,480	73,377	85,892	231,108
	Total	**51,576**	**53,606**	**40,941**	**39,918**	**82,616**	**97,661**	**261,136**

Almost all of the population (99.9%) is Bamar and followers of the Buddhist faith.

1.5.3. Employment

Most of the people and engaged in farming virtually the entire population within the township is concerned, in one form or another, with agriculture. Some local village industries are present in the township. There are limited job opportunities available in Pyawbwe government offices and factories. It is likely that any job vacancies in Pyawbwe government offices and factories, it would be filled by the residents.

1.5.4. Land Area and Use

The gross area of Pyawbwe Township is 408,605 acres out of which the net cultivated area is 229,717 acres, cultivable waste land is 10,440 acres, wood land is 114,596 acres and uncultivable land is 53,852 acres.

From statistics it is estimated that around 13.2% of the gross cultivable area is lost to existing town and villages' area, roads, cart tracts, drains, bunds, tank, pond etc. On this basis the actual area available for cropping is 58.8% as shown in Table - 4.

The land holding categories are as shown in table – 5. In this table, the cultivable area also includes 10143 acres of uncultivable land occupied by farmers' household and domestic use. The actual cultivable area is same as mentioned above.

Table -4 Land Classification

Land Use	**Acres**	**Percentage**
(a) Agricultural Land		
(i) Cultivated	229,717	56.2
(ii) Cultivable Waste	10,440	2.6
(iii) Wood Land	114,596	28.0
Sub-Total	**354,753**	**86.8**
(b) Uncultivable Land (roads, drains, bunds etc.)	53,852	13.2
Total	**408,605**	**100.0**

Type of cultivable area and holding according to its categories

There are 40522 registered farmers within the Pyawbwe Townships. The farmers of Pyawbwe occupied 250300 acres (101336 hectares), with the average farm size being 6.18 acres (2.50 hectares) per farming household. The distribution of the farming population within a range of farm size is presented in Table – 5 below.

Table -5 Mandalay Region - Pyawbwe Township

(2012 - 2013) Nos. of Farmers and Present Size of Land Holding

Sr. No.	Land Size	Previous			Present		
		House hold	Area	Average	House hold	Area	Average
1	**Paddy**	**5979**	**29951**	**5.01**	**5979**	**29951**	**5.01**
	Below 5 Acre	2823	5700	2.1	2823	5700	2.1
	5 to 10 Acre	2938	21154	7.2	2938	21154	7.2
	Below 10 Acre	5761	26854	4.66	5761	26854	4.66
	10 to 19.99 Acre	193	2531	13.11	193	2531	13.11
	20 to 49.99 Acre	25	566	22.64	25	566	22.64
	50 to 99.99 Acre	-	-	-	-	-	-
	Above 100 Acre	-	-	-	-	-	-
2	**Upland**	**8300**	**43807**	**5.28**	**8300**	**43807**	**5.28**
	Below 10 Acre	7767	34502	4.45	7767	34502	4.45
	10 to 19.99 Acre	388	5257	13.55	388	5257	13.55
	20 to 49.99 Acre	144	3918	27.21	144	3918	27.21
	50 to 99.99 Acre	-	-	-	-	-	-
	Above 100 Acre	1	130	130	1	130	130
3	**Paddy and Upland**	**26062**	**175545**	**6.74**	**26062**	**175545**	**6.74**
	Below 10 Acre	21365	101451	4.74	21365	101451	4.74
	10 to 19.99 Acre	3960	53826	13.59	3960	53826	13.59
	20 to 49.99 Acre	722	18976	26.29	722	18976	26.29
	50 to 99.99 Acre	12	707	58.92	12	707	58.92
	Above 100 Acre	3	585	195	3	585	195
	20 to 49.99 Acre	144	3918	27.21	144	3918	27.21
	50 to 99.99 Acre	-	-	-	-	-	-
	Above 100 Acre	1	130	130	1	130	130
4	**Garden and Paddy**	**133**	**667**	**15.43**	**133**	**667**	**15.43**
	Below 10 Acre	131	646	4.93	131	646	4.93
	10 to 19.99 Acre	2	21	10.5	2	21	10.5
	20 to 49.99 Acre	-	-	-	-	-	-
	50 to 99.99 Acre	-	-	-	-	-	-
	Above 100 Acre	-	-	-	-	-	-
5	**Others**	**48**	**330**	**6.87**	**48**	**330**	**6.87**
		45	296	6.58	45	296	6.58
	10 to 19.99 Acre	3	34	11.33	3	34	11.33
	Total	**40522**	**250300**	**6.18**	**40522**	**250300**	**6.18**

Source: Pyawbwe, Land Records Department

1.5.5. Present Agricultural Production

The present agricultural production from the Pyawbwe Township is summarized in the following table - 6. The table indicates the areas provisional, planted, harvested, the average yields and production by major crop. But the crop yield depends upon the rainfall and climate and availability of irrigation water in 2012/13, out of 3074 acres of onion sown only 473 are harvested.

Table - 6 Present Production of Crops in the Pyawbwe Township (2012 -2013)

Sr. No.	Crops	Planted Area (Ac)	Harvested Area (Ac)	Unit	Average yield basket/viss/Ac	Production Basket/viss
1	Paddy (monsoon)	30612	30612	basket	52.80	1616210
2	Groundnut (monsoon)	1690	1690	viss	34.52	58339
3	Groundnut (winter)	2690	2690	viss	40.46	108837
4	Sesame (monsoon)	79609	79609	viss	5.14	409190
5	Sesame (winter)	578	578	viss	6.55	3786
6	Sun flower (monsoon)	4440	4440	viss	25.22	111977
7	Sun flower (winter)	8839	8839	viss	26.48	234057
8	Green gram (monsoon)	26239	26239	viss	11.83	310407
9	Green gram (winter)	982	982	viss	11.42	11214
10	Pigeon pea	13781	13781	viss	13.76	189627
11	Cotton	33040	33040	viss	467.25	15437940
12	Onion	3074	473	viss	3571.25	1689201

In addition, farmers also keep a small number of livestock. Their livestock normally include a pair of draft working cattle plus a variety of pigs and poultry kept around the homestead. Mainly, animals are fed with crop by-products.

1.5.6. Social Services and Infrastructure

(a) Communications

The Pyawbwe Township is situated some 312 miles from Yangon and 118 miles from Mandalay by tarred road. The railway from Yangon to Mandalay runs through the area. From Pyawbwe, it is accessible to Natmauk (Magwe Region) and Taunggyi (Shan State) by a tarred road. However, internal roads within Pyawbwe Township are generally poor. 2.36% of population in Pyawbwe Township use phone for telecommunications.

(b) Electricity

There is electrical supply from Lawpitha Hydro-Power Station via a 66 KV branch distribution station line. This supply is insufficient for the township because they received only 2500 KW. Therefore the people utilize the power from private small-scale diesel turbine. However, the Government has plans for a Rural Electrification Programme to be extended to the villages as soon as possible in the near future.

(c) Education

The Government of the Union of Myanmar places considerable emphasis on basic education, with compulsory student-attendance for the first four primary grades. Upon completion of primary education, successful students attend middle or high schools which are located in the major villages or towns.

There are 9 High Schools, 5 middle schools and 197 primary schools within the township. The teacher: student ratio is 1:28 in high school, 1:42 in middle school and 1:32 in primary school. Pyawbwe Township has only one pre - primary school (nursery) and seventeen monastery education centers.

(d) Rural Health

The Government plans for the development of health facilities in the country. Present health facilities within the township are: one Township Hospital at Pyawbwe and two Station Hospitals in two major villages. There are five Rural Health Centers and twenty eight sub-rural Health Centers. In private sector, twelve private clinics are serviceable in the township.

Chart 2

Organization Chart
Of
The Ministry of Agriculture and Irrigation

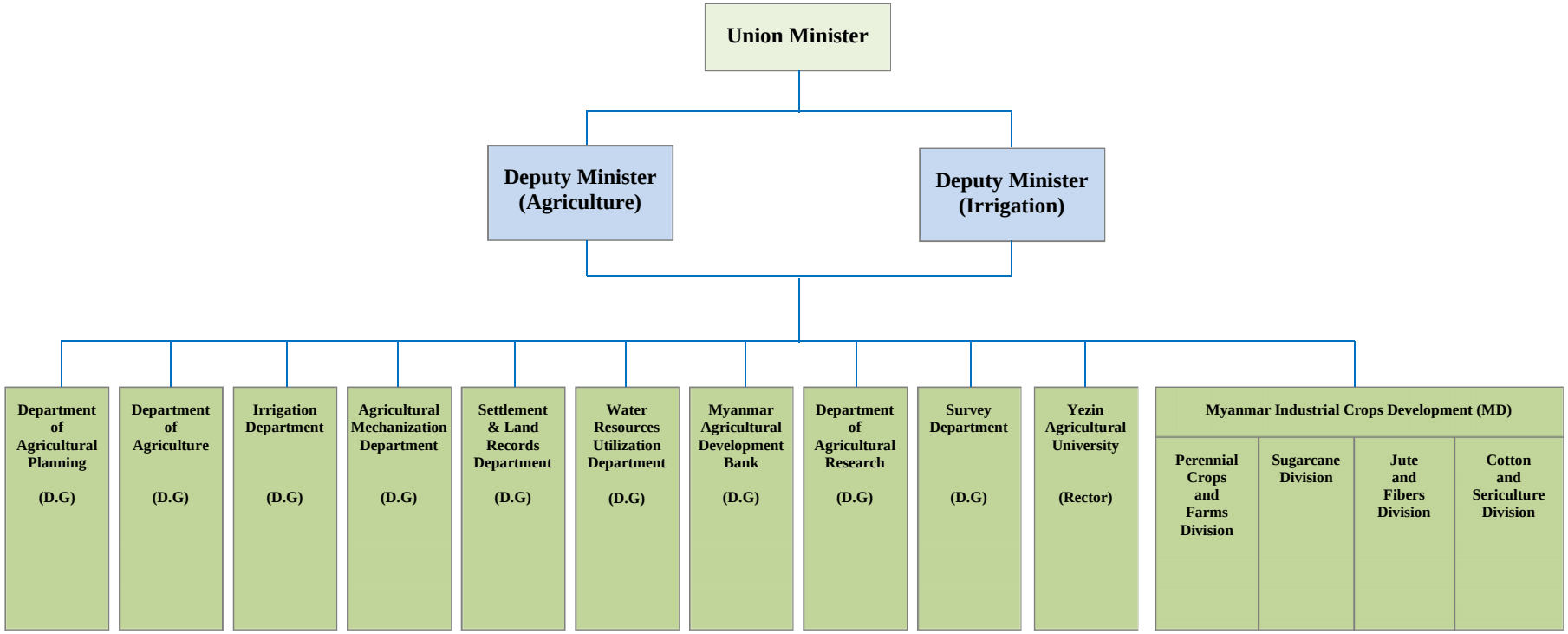
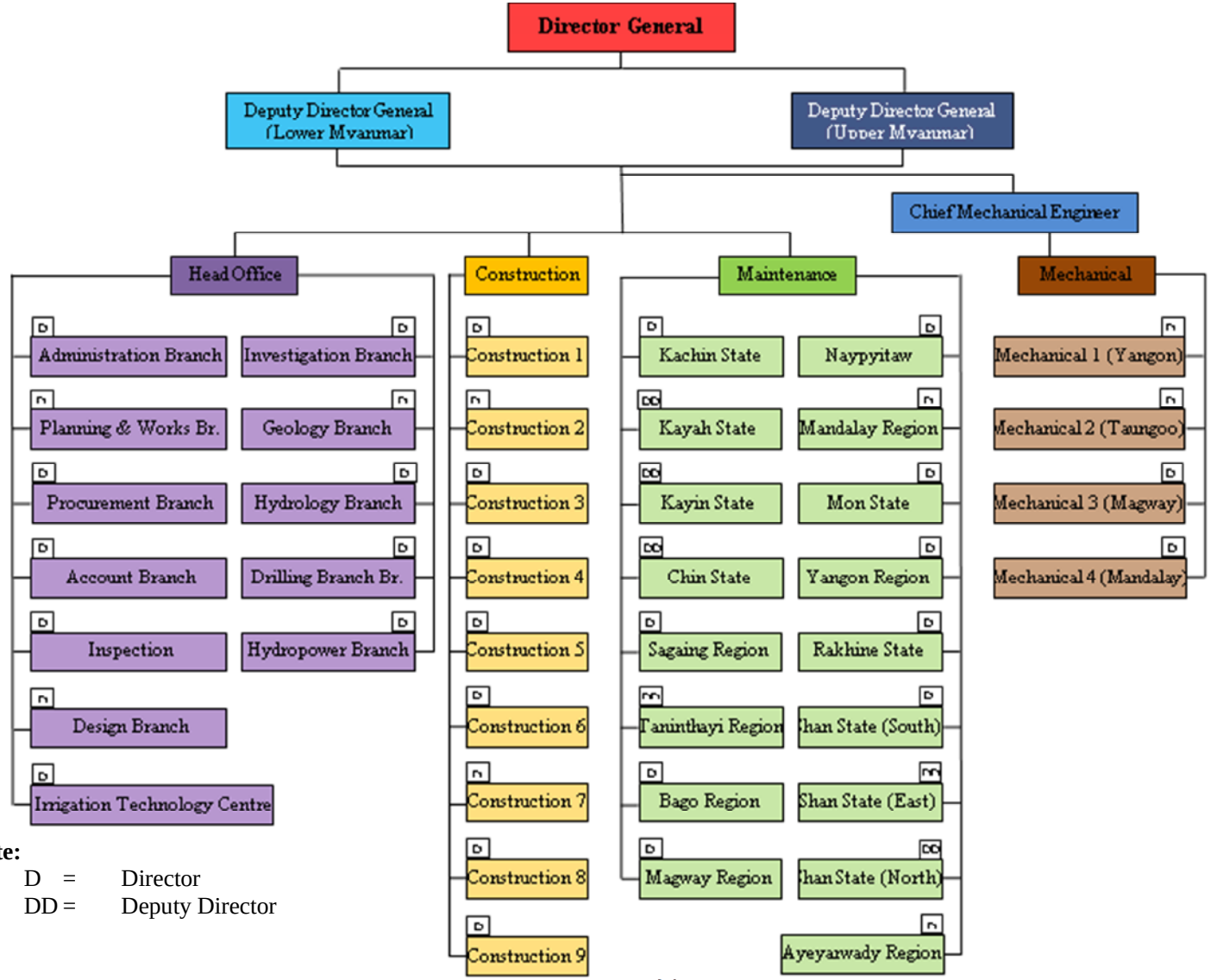


Chart 3 **Organization Chart of the Irrigation Department**

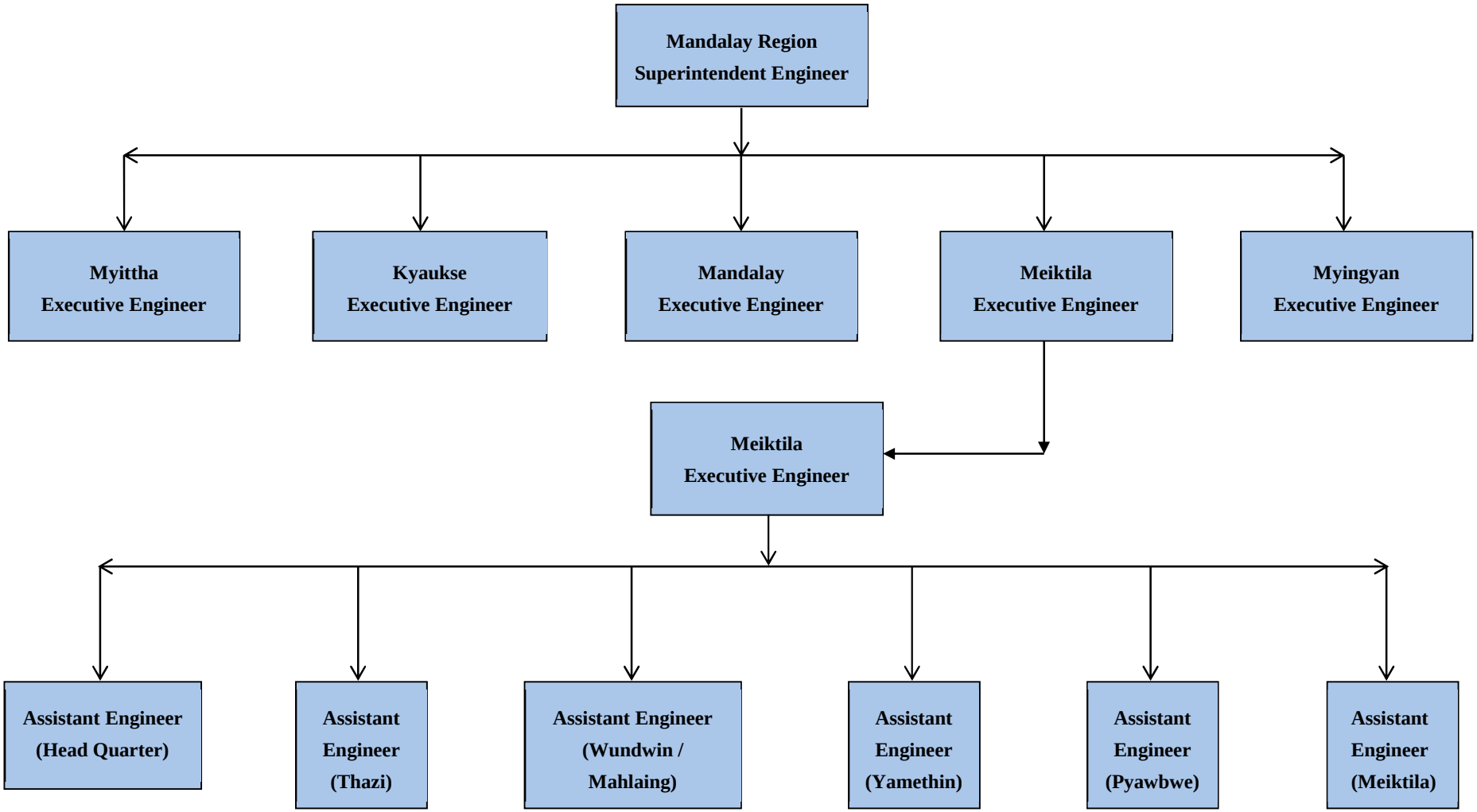


Note:

D = Director

DD = Deputy Director

Chart 4 **Organization Chart of the Irrigation Department**



Social Services and Infrastructure

(i) Communication

Chaungmagyi Right Main Canal is located from 10 km from Pyawbwe Town. Access to the Chaungmagyi weir is about 9 km from Yangon Mandalay old highway road. Internal roads are generally poor although there is a road to weir is uses main canal bank.

At present telecommunication are restricted because there are few cell phones utilized by villagers. There are plans to increase cell phones in rural area.

(ii) Electricity

There is few electricity supply in the study area although Pyawbwe is linked to the National grid. The Government has a Rural Electrification Programme it is unlikely that this would extend to the study area in the foreseeable future.

(iii) Education

The village of Nyaungbinde State Middle School and some villages have primary school in the study area. The Government places considerable emphasis on basic education, with attendance during the first four primary grades being compulsory. On competing primary education, successful students attend middle or high schools which are located in the major villages or towns.

(i) Rural Health

The Government plans for the development of health facilities on rural area of the country. At present the existing health facilities are regarded as being inadequate by most villagers. There is a sub-rural health center in the Nyaungbinde village. As a consequence diseases and other illnesses may not be treated at the earliest opportunity.

Table -1

Annual Planting in Chaungmagyi Project Area
List of Plant, Harvest, Rate and Yield

Sr No.	Crop	1973-1974					1974-1975					1975-1976					Unit
		Pre Monsoon	Monsoon	Winter	Mature	Yield	Pre Monsoon	Monsoon	Winter	Mature	Yield	Pre Monsoon	Monsoon	Winter	Mature	Yield	
1	Long Staple Cotton												38		30	150	Viss
2	Wagyi (Cotton)		85		85	70		74		74	70		100		100	70	Viss
3	Mahlaing (Cotton)																
4	Paddy		1450		1400	30		1539		1500	32		1908		1891	30	Basket
5	Short Term Sesame	1859			1800	4	2430			2380	4	535			2500	4	Basket
6	Long Term Sesame			52	45	2			45	40	2			30	28	2	Basket
7	Sunflower																
8	Niger																
9	Monsoon Ground nut		533		500	8		853		803	8		750		739	8	Basket
10	Winter Ground nut			253	250	5			289	280	5			382	380	2	Basket
11	Laplap			150	145	7			150	147	7			245	241	7	Basket
12	Pigeon Pea		750		750	4			700	700	4		766		760	4	Basket
13	Cow Pea																
14	Black grain		56		56	2		60		60	2		45		41	2	Basket
15	Soy Bean																
16	Chick Pea			1200	1150	8			1300	1270	8			1355	1320	7	Basket
17	Tomato			25	20	300			55	50	300			33	30	310	Viss
18	Chilli	779			779	70	965			965	70	1347			1330	70	Viss
19	Onion			590	590	1500			760	760	1500			895	895	1500	Viss
20	Potato																
21	Vegetables																
22	Corn		50		50	5		60		60	5		75		75	5	Viss
23	Maize		725		725	8		740		740	8		1200		1200	8	Viss
	Total	**2638**	**3649**	**2270**	**8345**	**2023**	**3395**	**3326**	**3299**	**9829**	**2025**	**1882**	**4882**	**2940**	**11560**	**2179**	

Note

Paddy	1 Basket	=	46 Lb	Laplap	1 Basket	=	69 Lb
Cotton	1 Viss	=	3.6 Lb	Chick Pea	1 Basket	=	69 Lb
Sesame	1 Basket	=	54 Lb	Chilli	1 Basket	=	72 Lb
Ground Nut	1 Basket	=	25 (In Shell)				

Table -2

Annual Planting in Chaungmagyi Project Area
List of Plant, Harvest, Rate and Yield

Sr No.	Crop	1976-1977					1977-1978					1978-1979					Unit
		Pre Monsoon	Monsoon	Winter	Mature	Yield	Pre Monsoon	Monsoon	Winter	Mature	Yield	Pre Monsoon	Monsoon	Winter	Mature	Yield	
1	Long Staple Cotton		78		60	150		115		100	150		480		470	150	Viss
2	Wagyi (Cotton)		90		90	70		50		50	70		50		50	70	Viss
3	Mahlaing (Cotton)																
4	Paddy		1600		1540	32		1661		1650			1684		1670	30	Basket
5	Short Term Sesame	3241			3200	4	2870			2750	4	3183			2900	3	Basket
6	Long Term Sesame			45	73	2			54	50	2			30	28	2	Basket
7	Sunflower										10			192	190		Basket
8	Niger																
9	Monsoon Ground nut		752		712	8		472		462	8		487		480	8	Basket
10	Winter Ground nut			321	320	5			204	200	5			346	346	5	Basket
11	Laplap			225	215	7			175	170	7			125	120	6	Basket
12	Pigeon Pea		1050		1050	4		900		900	4		500		500	4	Basket
13	Cow Pea																
14	Black grain		75		75	2		55		55	2		48		48	2	Basket
15	Soy Bean																
16	Chick Pea			1185	1355	8			1000	1000	8			650	645	8	Basket
17	Tomato			50	45	300			60	55	300			20	20	300	Viss
18	Chilli	1347			1340	70	1515			1515	70	1042			1042	70	Viss
19	Onion			950	950	1500			750	750	1500			550	550	1500	Viss
20	Potato																
21	Vegetables																
22	Corn		50		50	5		35		35	5		30		30	5	Viss
23	Maize		896		896	8		825		825	8		774		774	8	Viss
	Total	**4588**	**4591**	**2776**	**11971**	**2175**	**4385**	**4113**	**2243**	**10567**	**2153**	**4225**	**4053**	**1913**	**9863**	**2171**	

Note

Paddy	1 Basket	=	46 Lb	Laplap	1 Basket	=	69 Lb
Cotton	1 Viss	=	3.6 Lb	Chick Pea	1 Basket	=	69 Lb
Sesame	1 Basket	=	54 Lb	Chilli	1 Basket	=	72 Lb
Ground Nut	1 Basket	=	25 (In Shell)				

Table - 3 Animal, Livestock and Poultry

Breeding Status of Villages Under Chaungmagyi Dam

Sr. No.	Name of Village	Bullock / Cow	Buffalo	House	Sheep / Goat	Pig	Chicken	Duck
1	**Nyaung Shwe Village Track**							
	1-1 Nyaung Shwe	720	-	-	372	70	6016	-
	1-2 Nyaung Nwet (S)	874	-	-	595	67	10360	-
	1-3 Nyaung Nwet (N)	175	-	-	151	41	3208	-
	1-4 Kintar	121	-	-	85	83	6250	-
	1-5 Yalegwa (N)	128	-	-	129	-	3607	-
	Total	**2018**			**1332**	**261**	**29441**	
2	**Watlet Village Track**							
	2-1 Watlet	121	-	-	130	44	2329	-
	2-2 Thet Nge Chaung	166	-	-	130	89	3943	-
	2-3 Ywatan	279	-	-	125	104	608	-
	2-4 Ywathar	264	-	-	88	30	1065	-
	Total	**830**			**473**	**267**	**7945**	
3	**Chaungmagyi Village Track**							
	3-1 Chaungmagyi	144	-	-	-	-	250	-
	3-2 Thit Seinnpin	209	-	-	-	-	350	-
	3-3 Pandaukpin	180	-	-	-	-	300	-
	3-4 Konthar	160	-	-	-	-	282	-
	3-5 Seywa	327	-	-	-	-	381	-
	3-6 Dine Kyaung	335	-	-	-	-	320	-
	3-7 Ohnpin Chan	120	-	-	-	-	253	-
	3-8 Htantapin	310	-	-	-	-	370	-
	3-9 Nyaung Pin Te	460	-	-	-	-	400	-
	Total	**2245**					**2906**	
4	**Tawdwin Hla Village Track**							
	4-1 Tawdwin Hla (S)	260	-	-	-	6	543	-
	4-2 Tawdwin Hla (N)	173	-	-	95	28	567	-
	4-3 Chaungkangyi	351	-	-	143	-	494	-
	4-4 Nyaung Sauk	233	-	-	-	36	744	-
	4-5 Ywa Thit Gyi	518	-	-	-	48	757	-
	4-6 Ayeyan Kone	534	-	-	148	35	1001	-
	Total	**2069**			**386**	**153**	**4106**	
5	**Thapyay Yoe Village Track**							
	5-1 Thapyay Yoe	450	-	-	130	-	235	-
	5-2 Min Ywa Thit	530	-	-	13	16	307	-
	5-3 Min Ywa Ma	34	-	-	-	-	37	-
	5-4 Letaw	55	-	-	-	-	69	-
	5-5 Myaung Kga	20	-	-	-	7	46	
	Total	**1089**			**143**	**23**	**694**	
6	**Kyini Village Track**							
	6-1 Kyini	308	-	-	50	19	809	-
	6-2 Thee Kone	291	-	-	43	13	607	-
	6-3 Nyaung Pin Tha	301	-	-	73	22	813	-
	Total	**900**			**166**	**54**	**2229**	
7	**Tayankar Village Track**							
	7-1 Tayankar	166	-	-	442	6	350	-
	7-2 Shwe Pantaw	164	-	-	-	-	353	-
	7-3 Tharsi	289	-	-	-	-	378	-
	7-4 Kan Oo	108	-	-	320	-	239	-
	7-5 Kyat Thon Khinn	53	-	-	-	102	88	-
	7-6 Nan Chon	147	-	-	31	-	481	-
	7-7 Oate Cho Pin	255	-	-	21	54	372	-
	7-8 Maung Tone	92	-	-	98	-	159	-
	7-9 Htanta Pin	137	-	-	15	120	559	-
	7-10 Ywa Thit Gale	383	-	-	290	66	1032	-
	7-11 Thee Pin	608	-	-	417	-	1182	-
	Total	**2402**			**1634**	**348**	**5193**	
	Total	**11553**			**4134**	**1106**	**52514**	

Table - 4 **Chaungmagyi Irrigation Scheme Land Use Status**

(2011 – 2012)

Sr. No	Village Track	Cultivable Area					Cultivable Waste Land	Reserved Forest	Wood land	Uncultivable Land	Total
		Lowland	Upland	Orchard	Farm	Total					
1	Tawdwinhla	476	1616	-	-	2092	-	-	-	466	2558
2	Wettlat	87	1027	-	-	1114	-	-	-	236	1350
3	Tayankar	1731	1332	-	-	3063	44	-	-	606	3713
4	Nyaungshwe	924	2055	-	-	2979	66	-	1017	282	4344
5	Chaungmagyi	2208	934	-	-	3142	-	-	-	643	3785
6	Kye Oo	352	231	-	-	583	-	-	-	206	789
7	Thapyayine	1221	1440	-	-	2661	438	-	590	377	4066
Total		**6999**	**8635**			**15634**	**548**		**1607**	**2816**	**20605**

Table -5 **Cost of Cultivation Per Acre**
Year 2012 - 2013

Crop Name - Monsoon Paddy

Sr. No	Name of Process	Unit	Rate	Labour Charges				Total	Material Cost		Total Cost Kyats
				Family		Hired			Qty	Rate	
				Day	Kyat	Day	Kyat				
1	**Nursery**				**13000**		**15000**	**28000**			**28000**
	Ploughing	Pair	5000	1	5000	1	5000	10000			10000
	Harrowing	Pair	5000	1	5000	2	10000	15000			15000
	Seeding	No	1500	1	1500			1500			1500
	Farmyard manure	No	1500	1	1500			1500			1500
2	**Preparation of plantation**				**18000**			**18000**			**18000**
	Ploughing	Pair	5000	1	5000			5000			5000
	Harrowing	No	5000	2	10000			10000			10000
	Farmyard manure	No	1500	2	3000			3000			3000
3	**Planting and Management**				**16500**		**25500**	**42000**			**42000**
	Up-rooting	No	1500	2	3000	3	4500	7500			7500
	Transplanting	No	1500	2	3000	12	18000	21000			21000
	Irrigation and drainage	No	1500	2	3000			3000			3000
	Fertilizer application	No	1500	2	3000			3000			3000
	Inter-cultivation	No	1500	2	3000			3000			3000
	Replacement of plant	No	1500	1	1500	2	3000	4500			4500
4	**Harvesting**				**3000**		**16500**	**19500**			**19500**
	Harvesting	No	1500	1	1500	9	13500	15000			15000
	Bundling	No	1500	1	1500	2	3000	4500			4500
5	**Threshing**				**3000**		**25000**	**28000**			**28000**
	Hiring machine	Basket	250				25000	25000			25000
	Stacking	No	1500	2	3000			3000			3000
6	**Input Version 1**									**84500**	**84500**
	Seed	Pyi	6000						1	6000	6000
	Urea	Bag	20000						1	20000	20000
	Compound	Bag	30000						1	30000	30000
	Insecticide	Liter	5000						5	25000	25000
	Farmyard manure	Cart	3500						1	3500	3500
	Version 1 Total				**53500**		**82000**	**135500**		**84500**	**220000**
7	**Input Version 2**									**44500**	**44500**
	Seed	Pyi	6000						1	6000	6000
	Urea	Bag	20000						0.5	10000	10000
	Compound	Bag	30000						0.5	15000	15000
	Insecticide	Liter	5000						2	10000	10000
	Farmyard manure	Cart	3500						1	3500	3500
	Version 2 Total				**53500**		**82000**	**135500**		**44500**	**180000**

Note
In actual condition the above cost does not apply to all farmers. There is two version of input well to do farmers applied version 1 and poor farmers applied version 2 if they received enough loan credit, they also applied version 1.

Table -6 **Cost of Cultivation Per Acre**

Year 2012 - 2013

Crop Name -Long Staple Cotton

Sr. No.	Name of Process	Unit	Cost of (1) Acre		Total Cost	Remark
			Quantity	Cost (Kyat)		
1	Seed	Viss	3	3000	3000	
	Fertilizer				**37000**	
	Urea	Bag	1	21500		
	Compound fertilizer	Bag	1	15500		
	Insecticide				**27500**	
	Dust (Aldrin)	Pack	1	2500		
	Spray	Pack	3	5000		
	Spray	Liter	3	20000		
2	**Service charges for hire**				**130000**	
1	Draft animal	Pair	10	40000		
2	Tractor	Pair				
3	Pumping and Irrigation charges	Pair				
4	Labour charges	No	30	45000		
5	Taxes	No				
6	Reduce cost	No				
7	Others	No	30	45000		
	Total			**197500**	**197500**	

Gross income per Ac = 350 Viss x 1000 = 350000 (yield 1000 viss per acres)

Cost of cultivation 1 Ac = 197500

Net Farm Income = 152500

Table – 7 **Cost of Cultivation Per Acre**
Crop Name - Onion

Sr. No	Name of Process	Unit	Rate	Labour Charges				Total	Material Cost		Total Cost (Kyats)
				Family		Hired			Qty.	Rate	
				Day	Kyat	Day	Kyat				
1	**Land Preparation**				**17500**		**45000**	**62500**			**62500**
	Ploughing	Pair	5000	1	5000	2	10000	15000			15000
	Harrowing	Pair	5000	1	5000	1	5000	10000			10000
	Grass Cleaning	No	1500	1	1500	3	4500	6000			6000
	Cleaning watercourses	No	1500	1	1500	3	4500	6000			6000
	Repair of bunds	No	1500	1	1500	7	10500	12000			12000
	Drainage	No	1500	1	1500	6	9000	10500			10500
	Farmyard manure application	No	1500	1	1500	1	1500	3000			3000
2	**Cost of Nursery**				**64500**		**7500**	**72000**			**72000**
	Watering	No	1500	40	60000			60000			60000
	Land preparation	No	1500	1	1500	2	3000	4500			4500
	Weeding	No	1500	1	1500	1	1500	3000			3000
	Uprooting	No	1500	1	1500	2	3000	4500			4500
3	**Transplanting**				**3000**		**45000**	**48000**			**48000**
	Planting Labour	No	1500	2	3000	24	36000	39000			39000
	Lining	No	1500			6	9000	9000			9000
4	**Nursery**				**21000**		**112500**	**133500**			**133500**
	Inter-Weeding Between Row	No	1500	3	4500	10	15000	19500			19500
	Weeding under cost	No	1500	1	1500	24	36000	37500			37500
	Irrigation cost	No	1500	1	1500	32	48000	49500			49500
	Fertilizer application	No	1500	4	6000	4	6000	12000			12000
	Spray Pesticide	No	1500	5	7500	5	7500	15000			15000
5	**Harvesting**				**9000**		**72000**	**81000**			**81000**
	Uprooting	No	1500	2	3000	14	21000	24000			24000
	Transportation	No	1500			10	15000	15000			15000
	Cutting Stem	No	1500	2	3000	16	24000	27000			27000
	Sorting	No	1500	2	3000	8	12000	15000			15000
6	**Input**									**194000**	**194000**
	Seed	Pyi	20000						4	80000	80000
	Urea	Bag	20000						1.5	30000	30000
	Compound fertilizer	Bag	30000						1	30000	30000
	Farmyard manure	Cart	5000						8	40000	40000
	Pesticides	Liter	7000						2	14000	14000
	Total				**115000**		**282000**	**397000**		**194000**	**591000**

Gross income per Ac = 350 Viss x 3500 = 1225000 (yield 3500 viss per Acres)

Cost of cultivation = 591000

Net Farm Income = 634000

Table -8 Farm gate Price of each Crop

Sr. No.	Crop	Present	Remark
1	Paddy (monsoon)	3500	**MAY 2013 PYAWBWE**
2	Paddy (summer)	3500	**MAY 2013 PYAWBWE**
3	Long Staple Cotton	1000	**MAY 2013 PYAWBWE**

Cost and benefit of each crop(present)

Sr. No.	Crop	Income (kyat)	Cost (kyat)	Benefit (kyat)
1	Paddy (monsoon)	185,500	181,955	3,545
2	Paddy (summer)	280,000	221,955	58,045
3	Long Staple Cotton	350,000	198,400	151,600

Cost and benefit of each crop(Future with Rehabilitation)

Sr. No.	Crop	Income (kyat)	Cost (kyat)	Benefit (kyat)
1	Paddy (monsoon)	280,000	181,955	98,045
2	Paddy (summer)	350,000	221,955	128,045
3	Long Staple Cotton	650,000	198,400	451,600

Table -9 Net Income for each Crop (Present)

Sr. No.	Crop	Acre	Per Ac (Ks)	Net Income Present (Ks)
1	Paddy monsoon	2.56	3,545	9,075
2	Long staple cotton	1.32	151,600	200,112
3	Onion	0.36	633,100	227,916
Total				**437,103**

Net income for each crop (Future with Rehabilitation)

Sr. No	Crop	Acre	Per Ac (Ks)	Future with Rehabilitation (Ks)
1	Paddy monsoon	3.64	98,045	356,884
2	Long staple cotton	3.56	451,600	1,607,696
3	Onion	0.36	983,100	353,916
Total				**2,318,496**

Contribution of Farm Labor by Family

Sr. No	Crop	Acre		Family Labor Per Ac (Ks)	Present (Labor contribution of FM) (Ks)	Future with Rehabilitation (Ks)
		Present	Future with Rehabilitation			
1	Paddy monsoon	2.56	3.64	53,500	136,960	194,740
2	Long staple cotton	1.32	3.56	60,000	79,200	213,600
3	Onion	0.36	0.36	115,000	41,400	41,400
Total					**257,560**	**449,740**

Source

Cost of farm Labour (Ks/ hh/ year) is available from cost of cultivation for each crop of Agriculture Department, Pyawbwe Township.

Financial Analysis

For justification of the rehabilitation project, the financial study was made for the viability of the projects. The financial study, the formulation and calculation for RMC scheme have been carried out by the consultants are as shown in Table - 10 to 15.

Table – 10 Comparison of Crop Production With and Without Rehabilitation
Chaungmagyi Dam RMC System
RMC available area = 2128 acres

Sr. No.	Name of Crop	Crop Area in Acre		Yield (Basket/Acre)		Rate in Kyat	Gross Income in Million Kyats	
		Present	With Project	Present	With Project		Present	With Project
1	Monsoon Paddy (Basket)	1,358	1,928	53	80	3,500	71,974	154,240
2	Long Staple Cotton (Viss)	700	1,900	350	650	1,000	245,000	1,235,000
3	Onion (Viss)	200	200	3,500	4,500	350	700,000	900,000
Crop Intensity		**106%**	**189%**	**Gross Increased Income**				**1,347.93**

At present, under RMC canal system, out of 2128 acres of available irrigable area only 1358 acres of (average of 2012 and 2013) of monsoon paddy could be grown as shown in Table 6 (of main report) followed by onion and pre monsoon L.S cotton for RMC area although some farmers prefer other pulses in and around the Chaungmagyi irrigation network. With rehabilitation and assured water in the same cropping pattern is the best for the farmers is concerned as viewed by them.

Table -11 Chaungmagyi Dam RMC Canal System

Calculation of "PRESENT" Crop Production and Value

in Myanmar Unit

Net Area Available for Cropping = 2128 Acres

1USD = K 930

Sr. No.	Crop	Percent of Net Cropped	Acres Planted	Acres Harvested	Yield per Acres (Basket or Viss)	Total Production (Basket or Viss)	Value Per Basket or Viss		Total Value of Project Production (in million)	
							Kyat	USD	Kyat	USD
1	Monsoon Paddy	64	1358	1358	53	71974	3500	3.763	251.91	0.271
2	L.S Cotton	33	700	700	350	245000	1000	1.075	245.00	0.263
3	Onion	9	200	200	3500	700000	350	0.376	245.00	0.263
	TOTAL	**106**	**2258**	**2258**					**741.91**	**0.798**

Percent of Net Cropped = Crop Intensity = 106%

Assumed Prevailing Exchange Rate (APE), 1 USD = 930 kyats

Note

1 Ha = 2.471 Acres
1 Viss = 3.6 lb
1 Basket of Paddy = 46 lb
1 Ton = 2240 lb

Table -12 Calculation of "WITH REHABILITATION" Crop Production

and Value in Myanmar Unit

Net Area Available for Cropping = 2128 Acres

1USD = K 930

Sr. No.	Crop	Percent of Net Cropped	Acres Planted	Acres Harvested	Yield per Acres (Basket or Viss)	Total Production (Basket or Viss)	Value Per Basket or Viss		Total Value of Project Production (in million)	
							Kyat	USD	Kyat	USD
1	Monsoon Paddy	91	1928	1928	80	154240	3500	3.763	539.84	0.580
2	L.S Cotton	89	1900	1900	650	1235000	1000	1.075	1235.00	1.328
3	Onion	9	200	200	4500	900000	350	0.376	315.00	0.339
	TOTAL	**189**	**4028**	**4028**					**2089.84**	**2.247**

Percent of Net Cropped = Crop Intensity = 189%

Assumed Prevailing Exchange Rate (APE), 1 USD = 930 Kyats

Note

1 Ha = 2.471 Acres
1 Viss = 3.6 lb
1 Basket of Paddy = 46 lb
1 Ton = 2240 lb

Table -13 Chaungmagyi Dam RMC Canal System

Production Cost and Tax by Crop per Acre

(Present Without Rehabilitation)

Sr. No.	Name of Crop	Monsoon Paddy	L.S Cotton	Onion
		1358 Ac	**700 Ac**	**200 Ac**
1	Cost of Crop Production per Acre (Kyat)	180000	197500	591000
2	Water + Land Tax per Year per Acre (Kyat)	1955	900	900
Total Cost per Acre (Kyat)		**181955**	**198400**	**591900**

Source: DA Paddy Production Cost K 220000 with Full Input

Farmer Paddy Production Cost K 180000 with Limit Input

Net Profit from Chaungmagyi RMC Irrigation Scheme without Rehabilitation

Net Area available for Cropping = 2128 Ac

	Name of Crop	Monsoon Paddy	L.S Cotton	Onion
	Crop Acres	1358	700	200
	Yield per Acre (basket/viss)	53	350	3500
	Farm Gate Price (kyat per basket/viss)	3500	1000	350
Sr. No.	**Particular by Crop**	**Monsoon Paddy Value kyats in million**	**L.S Cotton Value kyats in million**	**Onion Value kyats in million**
1	Gross Income by Crop	251.91	245.00	245.00
2	Production of Cost + Water and Land Tax	247.09	138.88	118.38
	Total Net Profit	**4.81**	**106.12**	**126.62**

Table -14 Chaungmagyi Dam RMC Canal System

Production Cost and Tax by Crop per Acre

(With Rehabilitation)

Sr. No.	Name of Crop	Monsoon Paddy	L.S Cotton	Onion
		1928 Ac	**1900 Ac**	**200 Ac**
1	Cost of Crop Production per Acre (Kyat)	180000	197500	591000
2	Water + Land Tax per Year per Acre (Kyat)	1955	900	900
Total Cost per Acre (Kyat)		**181955**	**198400**	**591900**

Source DA Paddy Production Cost K 220000 with Full Input

Farmer Paddy Production Cost K 180000 with Limit Input

Note: - Land tax is levied per year base and crops tax is based on per crop base.

Net Profit from Chaungmagyi RMC Irrigation Scheme with Rehabilitation

Net Area available for Cropping = 2128 Ac

	Name of Crop	Monsoon Paddy	L.S Cotton	Onion
	Crop Acres	1928	1900	200
	Yield per Acre (basket/viss)	80	650	4500
	Farm Gate Price (kyat per basket/viss)	3500	1000	350
Sr. No.	**Particular by Crop**	**Monsoon Paddy Value kyats in million**	**L.S Cotton Value kyats in million**	**Onion Value kyats in million**
1	Gross Income by Crop	539.84	1235.00	315.00
2	Production of Cost + Water and Land Tax	350.81	376.96	118.38
	Total Net Profit	**189.03**	**858.04**	**196.62**

Table -15 **Chaungmagyi Dam RMC Canal System**
Comparison of Production Cost and Tax by Crop per Acre

Sr. No.	Crop	PRESENT			WITH REHABILITATION		
		Cost of Crop Production per Acre (Kyat)	Water + Land Tax per Year (Kyat)	Total Cost per Acre (Kyat)	Cost of Crop Production per Acre (Kyat)	Water + Land Tax per Year (Kyat)	Total Cost per Acre (Kyat)
1	Monsoon Paddy	180000	1955	**181955**	180000	1955	**181955**
2	L.S Cotton	197500	900	**198400**	197500	900	**198400**
3	Onion	591000	900	**591900**	591000	900	**591900**

Social Services and Infrastructure

(i) Communication

Pyawbwe Town is situated 500 km from Yangon City. Access to the Kyaukse tank is about 20 km from Yangon-Mandalay high way road. Internal roads are generally poor although there is a road to Kyaukse tank which has been constructed with stones to some extent of its length without any pavement.

At present telecommunications is low intensity in the study area because there are few cell phones utilized by villagers

(ii) Electricity

There is no electricity supply in the study area although Pyawbwe is linked to the National grid. Although the government has a rural electrification programme it is unlikely that this would extend to the study area in the foreseeable future.

(iii) Education

The government places considerable emphasis on basic education, with attendance during the first four primary grades being compulsory. On competing primary education, successful students attend middle or high schools which are located in the major villages or towns.

(iv) Rural Health

The government plans for the development of health facilities on rural area of the country. Present health facilities within the study area are limited. Only one station hospital in Shwe Nyaung Po village and one sub-rural health centre in Kyaukse village.

Table - 1 **Kyaukse Irrigation Scheme Land Use Status**

Sr. No	Village Track	Cultivable Area (Ac)					Cultivable Waste Land	Reserved Forest	Wood land	Uncultivable Land	Total (Ac)
		Lowland	Upland	Orchard	Farm	Total					
1	Kyaukse	4491	203	-	-	4694	-	-	-	500	5194
2	Shwe Nyaung Po	1464	4105	-	-	5569	-	2133	-	820	8522
3	Suuchinkone	1715	176	-	-	1891	-	-	-	116	2007
4	Payagyi	2263	335	-	-	2598	-	-	-	255	2853
5	Konetha	3006	4272	-	-	7278	92	140	-	1170	8680
Total		**12939**	**9091**			**22030**	**92**	**2273**		**2861**	**27256**

(2011 – 2012)

Table - 2 Livestock

Pyawbye Township

Under Kyaukse Tank Irrigable Area (2010 - 2012)

Sr No.	Village Track	Cow	Buffalo	Horse	Sheep	Goat	Pig	Fowl	Duck
1	**Suchingone Group**								
	Suchingone	673	21	-	-	-	65	1509	-
	Potawgone	90	-	-	-	-	58	314	-
		763	**21**				**123**	**1823**	
2	**Konethar Group**								
	Konethar	1106	-	-	421	-	-	2641	-
	Peinnaka	503	-	-	278	-	-	1381	-
	Megone (North)	658	-	-	289	-	690	2507	-
	Minthaung	739	-	-	397	-	-	2106	-
	Themon	293	-	-	90	-	-	1604	-
		3299			**1475**		**690**	**10239**	
3	**Kyaukse Group**								
	Kyaukse	455	153	-	-	-	-	3042	-
	Padeekone (South)	193	46	-	193	-	132	2004	-
	Padeekone (South)	334	207	-	70	-	189	2997	-
	Padeekone (North)	123	18	-	55	-	31	2110	-
		1105	**424**		**318**		**352**	**10153**	
4	**Shwenyaungpoo Group**								
	Shwenyaungpoo	1422	185	-	246	-	561	4095	289
		1932	137	-	162	-	816	3331	288
		3354	322		408		1377	7426	577
5	**Pavargyi Group**								
	Pavargyi	502	-	-	117	-	61	1922	-
	Chinyargone	482	-	-	165	-	-	2092	-
	Yargyi	563	-	-	15	-	-	1975	-
	Kumin	343	-	-	59	-	14	1872	-
		1890			356		75	7861	577

Table – 3 **Cost of Cultivation Per Acre**

Year 2102 - 2013

Crop Name - Monsoon Paddy

Sr. No	Name of Process	Unit	Rate	Labour Charges				Total	Material Cost		Total Cost
				Family		Hired			Qty	Rate	
				Day	Kyat	Day	Kyat				Kyats
1	**Nursery**				**13000**		**15000**	**28000**			**28000**
	Ploughing	Pair	5000	1	5000	1	5000	10000			10000
	Harrowing	Pair	5000	1	5000	2	10000	15000			15000
	Seeding	No	1500	1	1500			1500			1500
	Farmyard manure	No	1500	1	1500			1500			1500
2	**Preparation of plantation**				**18000**			**18000**			**18000**
	Ploughing	Pair	5000	1	5000			5000			5000
	Harrowing	No	5000	2	10000			10000			10000
	Farmyard manure	No	1500	2	3000			3000			3000
3	**Planting and Management**				**16500**		**25500**	**42000**			**42000**
	Up-rooting	No	1500	2	3000	3	4500	7500			7500
	Transplanting	No	1500	2	3000	12	18000	21000			21000
	Irrigation and drainage	No	1500	2	3000			3000			3000
	Fertilizer application	No	1500	2	3000			3000			3000
	Inter-cultivation	No	1500	2	3000			3000			3000
	Replacement of plant	No	1500	1	1500	2	3000	4500			4500
4	**Harvesting**				**3000**		**16500**	**19500**			**19500**
	Harvesting	No	1500	1	1500	9	13500	15000			15000
	Bundling	No	1500	1	1500	2	3000	4500			4500
5	**Threshing**				**3000**		**25000**	**28000**			**28000**
	Hiring machine	Basket	250				25000	25000			25000
	Stacking	No	1500	2	3000			3000			3000
6	**Input**									**44500**	**44500**
	Seed	Pyi	6000						1	6000	6000
	Urea	Bag	20000						0.5	10000	10000
	Compound	Bag	30000						0.5	15000	15000
	Insecticide	Liter	5000						2	10000	10000
	Farmyard manure	Cart	3500						1	3500	3500
	Total				**53500**		**82000**	**135500**		**44500**	**180000**

Gross income per Ac = 53 basket x 3500	=	185500	(yield 3500 basket per acres)
Cost of cultivation (Without Family Labour)	=	180000	
Net Benefit	=	5500	

Table - 4 **Cost of Cultivation Per Acre**
Year 2102 - 2013

Crop Name - Summer Paddy

Sr. No.	Name of Process	Unit	Rate	Labour Charges				Total	Material Cost		Total Cost
				Family		Hired			Qty	Rate	
				Day	Kyat	Day	Kyat				Kyats
1	**Nursery**				**13000**		**15000**	**28000**			**28000**
	Ploughing	Pair	5000	1	5000	1	5000	10000			10000
	Harrowing	Pair	5000	1	5000	2	10000	15000			15000
	Seeding	No	1500	1	1500			1500			1500
	Farmyard manure	No	1500	1	1500			1500			1500
2	**Preparation of plantation**				**18000**			**18000**			**18000**
	Ploughing	Pair	5000	1	5000			5000			5000
	Harrowing	No	5000	2	10000			10000			10000
	Farmyard manure	No	1500	2	3000			3000			3000
3	**Planting and Management**				**16500**		**25500**	**42000**			**42000**
	Up-rooting	No	1500	2	3000	3	4500	7500			7500
	Transplanting	No	1500	2	3000	12	18000	21000			21000
	Irrigation and drainage	No	1500	2	3000			3000			3000
	Fertilizer application	No	1500	2	3000			3000			3000
	Inter-cultivation	No	1500	2	3000			3000			3000
	Replacement of plant	No	1500	1	1500	2	3000	4500			4500
4	**Harvesting**				**3000**		**16500**	**19500**			**19500**
	Harvesting	No	1500	1	1500	9	13500	15000			15000
	Bundling	No	1500	1	1500	2	3000	4500			4500
5	**Threshing**				**3000**		**25000**	**28000**			**28000**
	Hiring machine	Basket	250				25000	25000			25000
	Stacking	No	1500	2	3000			3000			3000
6	**Input**									**84500**	**84500**
	Seed	Pyi	6000						1	6000	6000
	Urea	Bag	20000						1	20000	20000
	Compound	Bag	30000						1	30000	30000
	Insecticide	Liter	5000						5	25000	25000
	Farmyard manure	Cart	3500						1	3500	3500
	Total				**53500**		**82000**	**135500**		**84500**	**220000**

Gross income per Ac = 80 Basket x 3500 = 280000 (yield 3500 basket per acres)

Cost of cultivation = 220000

Net Benefit = 60000

Table - 5 Cost of Cultivation Per Acre

Year 2102 - 2013

Crop Name -Long Staple Cotton

Sr No.	Name of Process	Unit	Cost of (1) Acre		Total Cost	Remark
			Quantity	Cost (Kyat)		
1	Seed	Viss	3	3000	3000	
	Fertilizer				**37000**	
	Urea	Bag	1	21500		
	Compound fertilizer	Bag	1	15500		
	Insecticide				**27500**	
	Dust (Aldrin)	Pack	1	2500		
	Spray	Pack	3	5000		
	Spray	Liter	3	20000		
2	**Service charges**					
	For Hire				**130000**	
1	Draft animal	Pair	10	40000		
2	Tractor	Pair				
3	Pumping and Irrigation charges	Pair				
4	Labour charges	No	30	45000		
5	Taxes	No				
6	Reduce cost	No				
7	Others	No	30	45000		
	Total			**197500**	**197500**	

Gross income per Ac= 350 Viss x 1000	=	350000	(yield 1000 viss per acres)
Cost of cultivation 1 Ac	=	197500	
Net Farm Income	=	152500	

Table – 6 Farm gate Price of each crop

Sr. No.	Crop	Present	Remark
1	Paddy monsoon	3500	**MAY 2013 PYAWBWE**
2	Paddy summer	3500	**MAY 2013 PYAWBWE**
3	Long staple cotton	1000	**MAY 2013 PYAWBWE**

Cost and benefit of each crop (Present)

Sr. No.	Crop	Income (kyat)	Cost (kyat)	Benefit (kyat)
1	Paddy monsoon	185500	181,955	3,545
2	Paddy summer	280000	221,955	58,045
3	Long staple cotton	350000	198,400	151,600

Cost and benefit of each crop (Future with Rehabilitation)

Sr. No.	Crop	Income(kyat)	Cost(kyat)	Benefit(kyat)
1	Paddy monsoon	280000	181,955	98,045
2	Paddy summer	359000	221,955	128,045
3	Long staple cotton	650000	198,400	451,600

Table – 7 Net income for each Crop (Present)

Sr. No	Crop	Acre	Per Ac (Ks)	Net Income Present (Ks)
1	Paddy monsoon	3.68	3,545	13,046
2	Paddy summer	0.4	58,045	23,218
3	Long staple cotton	0.72	151,600	109,152
4	Chilli	0.04	473,300	18932
Total				**164,348**

Net income for each crop (Future with Rehabilitation)

Sr. No.	Crop	Acre	Per Ac (Ks)	Future with Rehabilitation (Ks)
1	Paddy monsoon	3.96	98,045	388,258
2	Paddy summer	0.4	128,045	51,218
3	Long staple cotton	1.72	451,600	776,752
4	Chilli	0.04	473,300	18,932
Total				**1,235,160**

Contribution of Farm Labor by Family

Sr. No.	Crop	Acre		Family Labor Per Ac (Ks)	Present (Labor contribution of FM) (Ks)	Future with Rehabilitation (Ks)
		Present	Future with Rehabilitation			
1	Paddy monsoon	3.68	3.96	53,500	196,880	211,860
2	Paddy summer	0.4	0.4	53,500	21,400	21400
3	Long staple cotton	0.72	1.72	60,000	43,200	103200
4	Chilli	0.04	0.04	80,000	3,200	3200
Total					**264680**	**339660**

Source

From Labour (Kyats/ hh/ year) are available from cost of cultivation for each crop at Agriculture Department, Pyawbwe Township.

Table – 8 **Kyaukse Tank Irrigation Scheme**

Calculation of "PRESENT" Crop Production and Value

In Myanmar Unit

Net Area Available for Cropping = 3892 Acres less 414 Acres of sandy, saline and uncommandable

1USD = K 930

Sr. No.	Crop	Percent of Net Cropped	Acres Planted	Acres Harvested	Yield per Acres (Basket or Viss)	Total Production (Basket or Viss)	Value Per Basket or Viss		Total Value of Project Production (in million)	
							Kyat	USD	Kyat	USD
1	Monsoon Paddy	92	3,600	3,600	53	190,800	3,500	3.763	667.80	0.718
2	Summer Paddy	10	400	400	80	32,000	3,500	3.763	112.00	0.120
3	L.S Cotton	18	700	700	350	245,000	1,000	1.075	245.00	0.263
4	Chili	1	50	50	300	15,000	2,500	2.688	37.50	0.040
	TOTAL	**121**	**4,750**	**4,750**					**1062.30**	**1.142**

Percent of Net Cropped = Crop Intensity = 121%

Assumed Prevailing Exchange Rate (APE), 1 USD = 930 kyats

Note

1 Ha = 2.471 Acres

1 Viss = 3.6 lb

1 Basket of Paddy = 46 lb

1 Ton = 2240 lb

Table - 9 **Kyaukse Tank Irrigation Scheme**

Calculation of "WITH REHABILITATION" Crop Production and Value

In Myanmar Unit

Net Area Available for Cropping = 3892 Acres less 414 Acres of sandy, saline and uncommandable

1USD = K 930

Sr. No.	Crop	Percent of Net Cropped	Acres Planted	Acres Harvested	Yield per Acres (Basket or Viss)	Total Production (Basket or Viss)	Value Per Basket or Viss		Total Value of Project Production (in million)	
							Kyat	USD	Kyat	USD
1	Monsoon Paddy	99	3842	3842	80	307,360	3500	3.763	1075.76	1.157
2	Summer Paddy	10	400	400	100	40,000	3500	3.763	140.00	0.151
3	L.S Cotton	43	1674	1674	650	1,088,100	1000	1.075	1088.10	1.170
4	Chili	1	50	50	300	15,000	2,500	2.688	37.50	0.040
	TOTAL	**153**	**5966**	**5966**					**2341.36**	**2.518**

Percent of Net Cropped = Crop Intensity = 153%

Assumed Prevailing Exchange Rate (APE), 1 USD = 930 kyats

Note

1 Ha = 2.471 Acres

1 Viss = 3.6 lb

1 Basket of Paddy = 46 lb

1 Ton = 2240 lb

Note

20 Acres of Canal No.1 area is sandy soil.

170 Acres of Canal No.2 area is high salinity.

467 Acres of Canal No.2 area is at present 1 feet above full supply level, out of which 243 Acres could be reclaimed after modification of Canal.

Therefore, the irrigable area with rehabilitation will be 3892 Acres.

Table - 10 Kyaukse Tank Irrigation Scheme

Production Cost and Tax by Crop per Acre

(Present Without Rehabilitation)

Sr. No.	Name of Crop	Monsoon Paddy	Summer Paddy	L.S Cotton	Chilli
		3600 Ac	**400 Ac**	**700 Ac**	**50 Ac**
1	Cost of Crop Production per Acre (Kyat)	180,000	220,000	197,500	275,800
2	Water + Land Tax per Year per Acre (Kyat)	1,955	1,955	900	900
Total Cost per Acre (Kyat)		**181,955**	**221,955**	**198,400**	**276,700**

Source
DA Paddy Production Cost K 220,000 with Full Input
Farmer Paddy Production Cost K 180,000 with Limit Input

Net Profit from Kyaukse Tank Irrigation Scheme without Rehabilitation

Net Area available for Cropping = 3892 Ac

	Name of Crop	Monsoon Paddy	Summer Paddy	L.S Cotton	Chilli
	Crop Acres	3600	400	700	50
	Yield per Acre (basket/viss)	53	80	350	300
	Farm Gate Price (kyat per basket/viss)	3500	3500	1000	2500
Sr. No.	**Particular by Crop**	**Monsoon Paddy Value kyats in million**	**Summer Paddy Value kyats in million**	**L.S Cotton Value kyats in million**	**Chilli Value kyats in million**
1	Gross Income by Crop	667.800	112.000	245.000	37.500
2	Production of Cost + Water and Land Tax	655.038	88.782	138.880	13.835
	Total Net Profit	**12.762**	**23.218**	**106.120**	**23.665**

Table -11 Kyaukse Tank Irrigation Scheme

Production Cost and Tax by Crop per Acre

(With Rehabilitation)

Sr. No.	Name of Crop	Monsoon Paddy	Summer Paddy	L.S Cotton	Chilli
		3842 Ac	**400 Ac**	**1674 Ac**	**50 Ac**
1	Cost of Crop Production per Acre (Kyat)	180000	220000	197500	275800
2	Water + Land Tax per Year per Acre (Kyat)	1955	1955	900	900
Total Cost per Acre (Kyat)		**181955**	**221955**	**198400**	**276700**

Source
DA Paddy Production Cost K 220,000 with Full Input
Farmer Paddy Production Cost K 180,000 with Limit Input

Net Profit from Kyaukse Tank Irrigation Scheme with Rehabilitation

Net Area available for Cropping = 3892 Ac

	Name of Crop	Monsoon Paddy	Summer Paddy	L.S Cotton	Chilli
	Crop Acres	3842	400	1674	50
	Yield per Acre (basket/viss)	80	100	650	300
	Farm Gate Price (kyat per basket/viss)	3500	3500	1000	2500
Sr. No.	**Particular by Crop**	**Monsoon Paddy Value kyats in million**	**Summer Paddy Value kyats in million**	**L.S Cotton Value kyats in million**	**Chilli Value kyats in million**
1	Gross Income by Crop	1075.760	140.000	1088.100	37.500
2	Production of Cost + Water and Land Tax	699.071	88.782	332.122	13.835
	Total Net Profit	**376.689**	**51.218**	**755.978**	**23.665**

Table - 12 **Kyaukse Tank Irrigation Scheme**

Comparison of Production Cost and Tax by Crop per Acre

Sr. No.	Crop	PRESENT			WITH REHABILITATION		
		Cost of Crop Production per Acre (Kyat)	Water + Land Tax per Year (Kyat)	Total Cost per Acre (Kyat)	Cost of Crop Production per Acre (Kyat)	Water + Land Tax per Year (Kyat)	Total Cost per Acre (Kyat)
1	Monsoon Paddy	180000	1955	**181955**	180000	1955	**181955**
2	Summer Paddy	220000	1955	**221955**	220000	1955	**221955**
3	L.S Cotton	197500	900	**198400**	197500	900	**198400**
4	Chili	275800	900	**276700**	275800	900	**276700**