Livelihoods and Food Security Trust Fund /UNOPS

Water Resources Utilization Department

Increasing the Efficiency and Effectiveness of Pumped Irrigation Schemes in the Central Dry Zone of Myanmar

FORMULATION REPORT

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Acronyms

ADP	Agriculture Development Programme
ACIAR	Australian Centre for International Agricultural Research
ADRA	Adventist Development and Relief Agency
AED	Agriculture Education Division
AMD	Agriculture Mechanization Department
AMDA	Association of Medical Doctors of Asia
BoQ	Bill of Quantities
CARI	Central Agricultural Research Institute
CARTC	Central Agricultural Research and Development and Training Centre
CBM	Central Bank of Myanmar
CBO	Community-based organization
CDZ	Central Dry Zone
CIRDAP	Centre for Integrated Rural Development for Asia and the Pacific
CWR	Crop Water Requirements
DA	Department of Agriculture
DAP	Department of Agricultural Planning
DAR	Department of Agricultural Research
DYC	Distributary Canal (secondary canal)
DO	Direct Offtake
FAO	Food and Agricultural Organization
FFS	Farmers' Field School
FSATG	Food Security and Agriculture Thematic Group
FSWG	Food Security Working Group
GAD	General Administration Department
GRET	Non Profit Organisation of Professional for Fair Development
GOM	Government of Myanmar
ID	Irrigation Department
INGO	International non-Government organization
IPM	Integrated Pest Management
IR&R	Internal Rules and Regulations (WUOs)
ISF	Irrigation Service Fee
IWM	Integrated Weed Management
JICA	Japan International Cooperation Agency
LC	Lateral Canal (tertiary canal)
LIFT	Livelihoods and Food Security Trust Fund
LUD	Land Use Division (MOAI)
MADB	Myanmar Agriculture Development Bank
MAS	Myanmar Agriculture Service
MC	Main Canal
M&E	Monitoring & Evaluation
MEICA	Mechanical, Electrical, Instrumentation, Control and Automation
MEPE	Myanmar Electric Power Enterprise
MICDE	Myanmar Industrial Crop Development Enterprise
MOAI	Ministry of Agriculture and Irrigation
MOLF	Ministry of Livestock and Fisheries
MOM	Management, Operation and Maintenance
MPBSSMA	Myanmar Pulses, Beans and Sesame Seeds Merchants Association
MRIA	Myanmar Rice Industry Association
NGO	Non-Governmental Organisation
NPC	National Project Coordinator
NSU	National Support Unit
O&M	Operation and Maintenance
OFWM	On-Farm Water Management
Pact	NGO for Sustainable Organizational and Institutional Capacity

PIDM	Participatory Irrigation Development and Management
PIM	Participatory Irrigation Management
PIP	Pumped Irrigation Project
PONREPP	Post-Nargis Recovery and Preparedness Plan
PS	Pump Station
PSC	Project Steering Committee
TGFSA	Thematic Group for Food Security and Agriculture
QC	Quaternary Canal (field channel)
RSU	Regional Support Unit
SLRD	Settlement and Land Records Department
SRI	System for Rice Intensification
UMFCCI	Union of Myanmar Federation of Chambers of Commerce and Industry
UNCT	United Nations Country Team
UNDP	United Nations Development Programme
UNOPS	United Nations Office for Project Services
VDYC	Village Development Committee
WRUD	Water Resources Utilisation Department
WDC	Water Distribution Committee
WFP	World Food Programme
WRUD	Water Resources Utilization Department
WUA	Water Users' Association
WUC	Water Users' Committee
WUG	Water Users' Group
WUO	Water Users' Organisation
YAU	Yezin Agricultural University

Table of Conversions and Local Units

1 hectare	=	2.471 acres
1 kg	=	0.61 vis
1 viss (a measure of weight).	=	1.64 kg
60 tickles	=	1kg
100 tickles	=	1 viss
16 pyi (a measure of volume)	=	1 basket
1 basket (a measure of volume) of:		
Paddy	=	17 kg
Yellow gram (husked)	=	78.18 kg
Yellow gram (unhusked)	=	31.36 kg
Green gram	=	68.40 kg
Unhusked groundnuts	=	25.20 kg
Sesame	=	24.50 kg
Pigeon pea	=	33 kg
Wheat	=	72 kg
Sunflower	=	13.1kg
Red bean	=	72 kgs
Soybean	=	32.65kg

Currency Equivalents

Currency		**Equivalent**
US$ 1.00	=	Kyats 800
Euro 1.00	=	Kyats 950

Length

1 inch (in)	0.0254 m
1 foot (ft)	0.3048 m
1 yard (yd)	0.9144 m
1 mile	1609.344 m
1 metre (m)	39.37 inches (in)
1 metre (m)	3.28 feet (ft)
1 metre (m)	1.094 yards (yd)
1 kilometre (km)	0.62 miles

Area

1 square inch (in^2)	6.4516×10^{-2} m^2
1 square foot (ft^2)	0.0929 m^2
1 square yard (yd^2)	0.8361 m^2
1 acre	4046.86 m^2
1 acre	0.4046 ha
1 square centimetre (cm^2)	0.155 square inches (in^2)
1 square metre (m^2)	10.76 square feet (ft^2)
1 square metre (m^2)	1.196 square yard (yd^2)
1 square metre (m^2)	0.00024 acres
1 hectare (ha)	2.47 acres

Volume

1 cubic inch (in^3)	1.6387×10^{-5} m^3
1 cubic foot (ft^3)	0.0283 m^3
1 cubic yard (yd^3)	0.7646 m^3
1 cubic centimetre (cm^3)	0.061 cubic inches (in^3)
1 cubic metre (m^3)	35.315 cubic feet (ft^3)
1 cubic metre (m^3)	1.308 cubic yards (yd^3)

Power

1 Joule/sec	0.7376 foot pound/sec
1 foot pound/sec	1.3557 watt
1 cheval-vapor	0.9861 hp
1 Kcal/h	0.001162 kW
1 watt (W)	1 Joule/sec = 0.7376 foot pound/sec (ft lbf/s)
1 horsepower (hp)	745.7 watt 550 ft lbf/s
1 horsepower (hp)	1.014 cheval-vapor (ch)
1 kilowatt (kW)	860 Kcal/h = 1.34 horsepower

Capacity

1. imperial gallon	0.0045 m^3
1. US gallon	0.0037 m^3
1. imperial barrel	0.1639 m^3
1. US. barrel	0.1190 m^3
1 pint	0.5681 l
1 US gallon (dry)	0.0044 m^3
1 litre (l)	0.22 imp. gallon
1 litre (l)	0.264 U.S. gallon
1 litre (l)	0.0061 imperial barrel
1 hectolitre (hl)	100 litres = 0.61 imperial barrel = 0.84 US barrel
1 litre (l)	1.760 pints
1 cubic metre of water (m^3)	1000 l = 227 U.S. gallon (dry)
1 imperial barrel	164 litres

Mass

1 ounce	28.3286 g
1 pound	0.4535 kg
1 long ton	1016.05 kg
1 short ton	907.185 kg
1 gram (g)	0.0353 ounces (oz)
1 kilogram (kg)	1000 g = 2.20462 pounds
1 ton	1000 kg = 0.984 long ton = 1.102 short ton

Energy

1 B.t.u.	1055.966 J
1 foot pound-force	1.3559 J
1 B.t.u.	0.25188 Kcalorie
1 B.t.u.	0.0002930 KWh
1 Joule (J)	0.000947 B.t.u.
1 Joule (J)	0.7375 foot pound-force (ftlbf)
1 kilocalorie (Kcal)	4185.5 J = 3.97 B.t.u.
1 kilowatte-hour (kWh)	3600000 J = 3412 B.t.u.

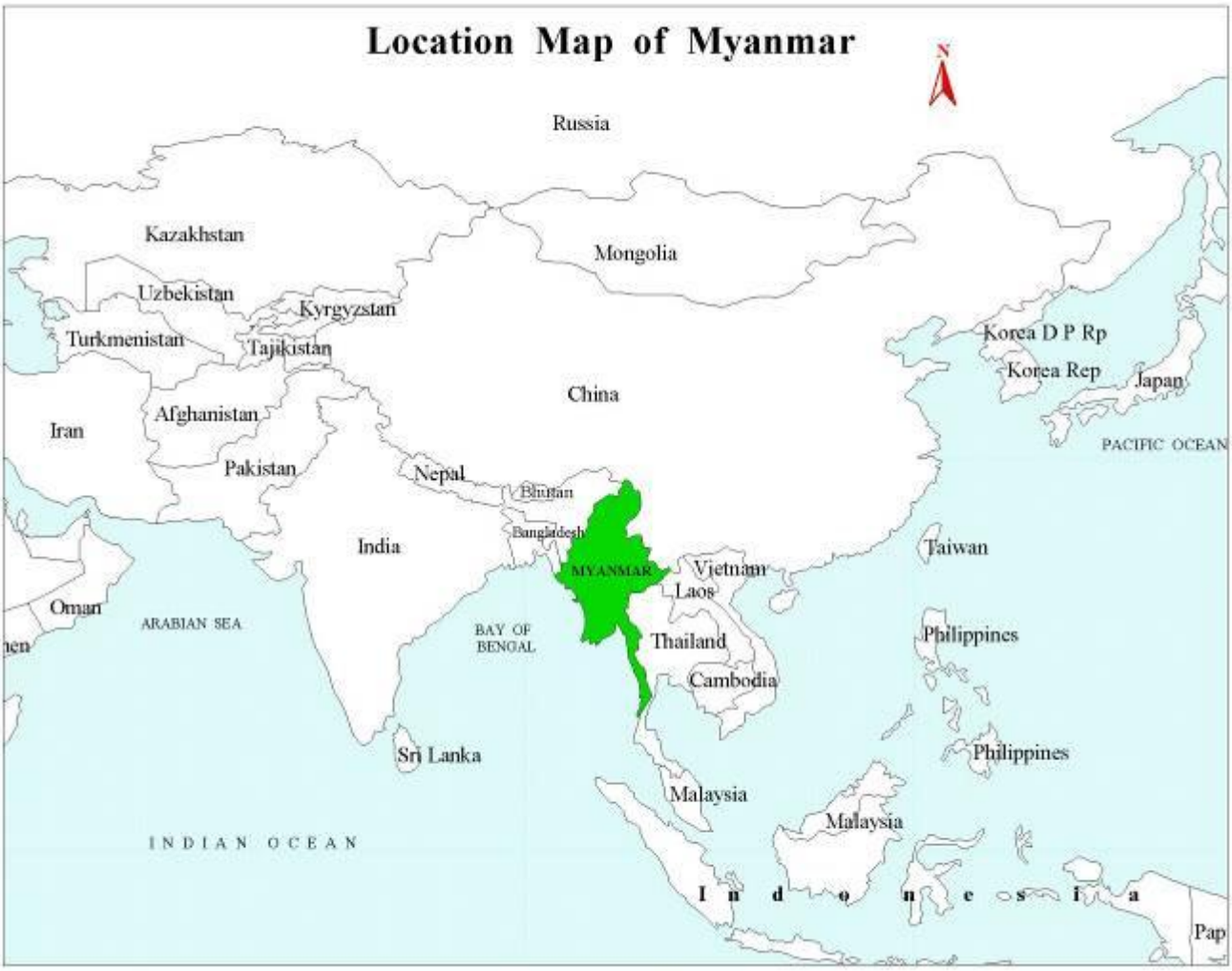
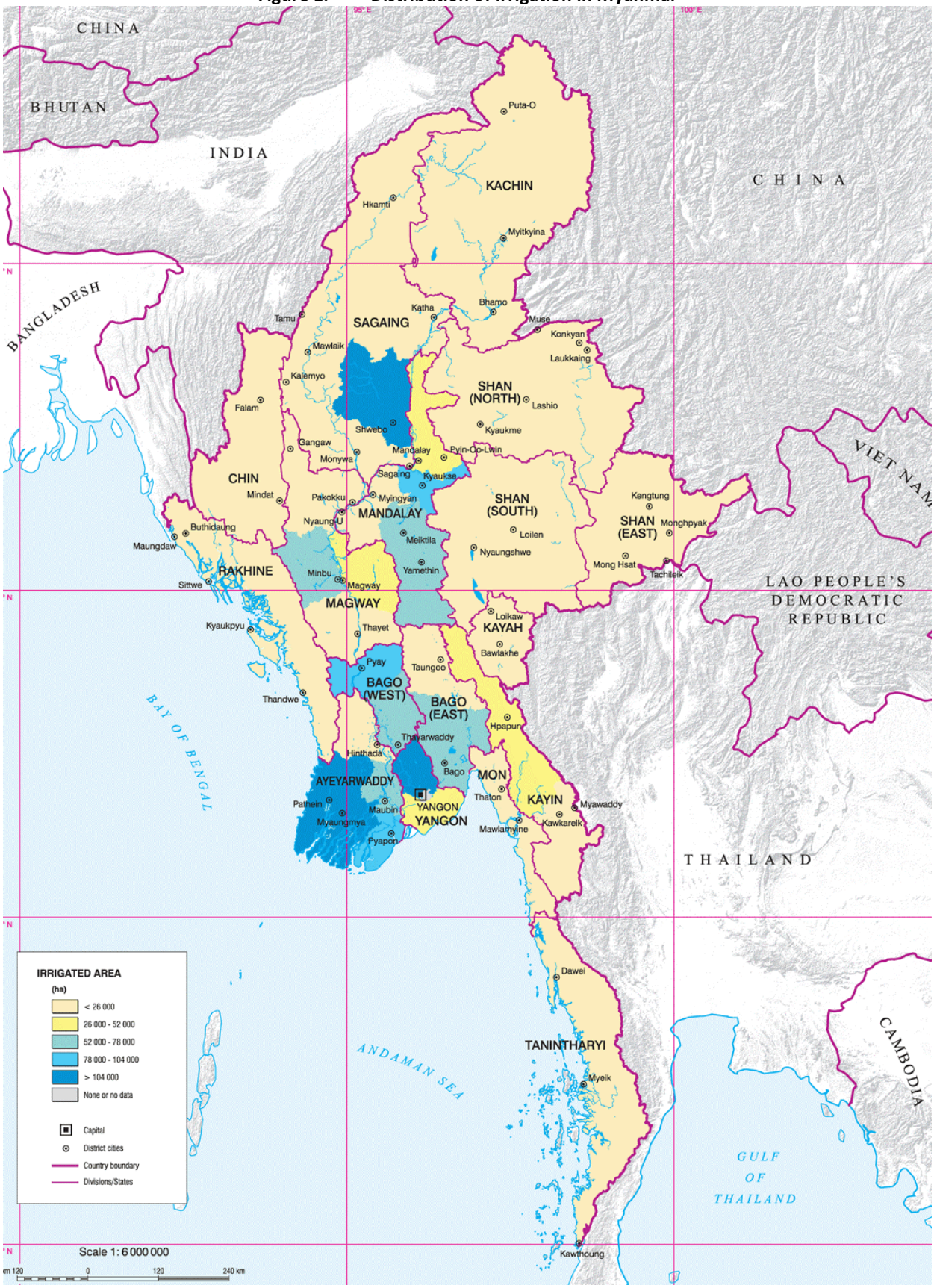

Location Map of Myanmar
N
Russia
Kazakhstan
Mongolia
Uzbekistan
Kyrgyzstan
Turkmenistan
Tajikistan
China
Korea D P Rp
Korea Rep
Japan
Afghanistan
Iran
PACIFIC OCEAN
Pakistan
Nepal
Bhutan
India
Bangladesh
MYANMAR
Vietnam
Laos
Taiwan
Oman
ARABIAN SEA
BAY OF BENGAL
Thailand
Philippines
Cambodia
Sri Lanka
Philippines
Malaysia
Malaysia
INDIAN OCEAN
Indonesia
Pap

Figure 1. Distribution of Irrigation in Myanmar



Executive Summary

This Formulation document responds to the request from UNOPS for the preparation of a design document for a potential LIFT project for increasing the efficiency and effectiveness of the pumped irrigation schemes in the Central Dry Zone of Myanmar. There has been a significant period of absence of Donors directly funding development works in Myanmar but with the removal of sanctions and easing of political constraints in early 2012, the way has been opened for the initiation of a new project. The enabling environment is not the easiest to consider for project interventions that purposely selected a shorter than desirable project period of implementation of four years.

The project has been formulated within the overall goal of LIFT to improve the livelihoods of the most vulnerable people in Myanmar. The CDZ with its very variable rainfall during the monsoon season has a significant number of food insecure households. In drier years when these conditions impact very negatively on rainfed production, the poor experience the greatest levels of food insecurity. Access to irrigation is a decisive factor when addressing these problems and the attention that is being paid to improve the efficiency and effectiveness of pumped irrigation projects in CDZ has an important role in addressing food insecurity at household and regional level. If the proposals contained within this document are realised and successful, the livelihoods of some 10,500 people living in 2,130 households in 18 villages in two regions will be able to increase their crop production by two or three fold thereby raising their household incomes from farming on the 4 PIPs to almost US$500 per acre.

There are many uncertainties relating to such projects particularly when the government is not noted for its participatory approach with the farmers. The thrust for rice production on these PIPs irrespective of soils and crop water demand has resulted in the farmers currently achieving negative returns from rice cultivation. By adopting cropping patterns that are directly related to the suitability of the soils and aim at reducing the amount of water delivered for each crop farmers will be able to substantially increase their returns from farming. There are many technical problems with the current irrigation and drainage systems but with suitable experienced professional advice, guidance and training, these can be addressed. However, the current low levels of crop production especially in the monsoon season can only be adequately addressed through the provision of reliable, regular and experienced advice and inputs from agricultural extension services. Within government, these are currently lacking and although they concentrated in the past on rice and certain priority crops, they were not accessible to most ordinary farmers with land on the PIPs.

Agriculture is an important factor contributing to improved food security in the CDZ that is characterized by large crop diversity with more than half of all farming households growing three or more different types of crops (pulses; sesame; rice). Main agricultural constraints for farming households are: (a) dry spells/drought, (b) high cost of agricultural inputs, (c) high costs of labour, (d) Plant diseases, and (e) floods. Although the interventions by the government through WRUD of MOAI could have significant contributions, the lack of suitably designed schemes and insufficient funding for both capital and operational works has meant that their performance has been well below what was anticipated.

Experience elsewhere over the last two or three decades has shown that much of the burden on government can be removed if farmers are closely involved in the management, operation and maintenance of irrigation and drainage schemes and if they are formed into functional water users' organisations. Under the proposed project the existing WUAs will be strengthened and empowered through a series of training and capacity building exercises. This will put the responsibility for water delivery and O&M directly into the hands of the farmers who by working closely together with each other through these WUO groups will be able to significantly increase the efficiency of water supply to the crops. Strengthening of the village communities through the improvement of the WUOs on each PIP and ensuring that they are democratic, effective and fully involved in the project improvements will lead to longer term sustainability.

Training and capacity building is a major thrust in the project and this is essential as many of the training institutions have been effectively isolated in recent years. Irrigation does not appear on the curriculum as a main subject in many of the technical universities and colleges even though 20% of the potential irrigated area of 10.5 million ha of the country is reported to be served by irrigation systems. WRUD who are responsible for the PIPs have no specialists in I & D, agriculture and WUA organisation and this has produced systems that deliver water without considering the land or the end-users.

The LIFT project sets out to address the above issues through a combination of targeted capital investments on for priority PIPs covering a total gross area of almost 7,000 acres (2,800 ha) and technical assistance for the re-design

and upgrading process that will concentrate on learning by doing. National experts are available to provide the agricultural services support needed to realise the potential but they need further guidance and mentoring that will be provided by short-term international technical assistance over the project period of four years. These TA inputs are considered a vital part of the proposed project without which it will be business as usual with the consequences of target driven development.

One of the most challenging aspects of the project proposal has been the identification of the organisation and management of the project. At this stage, direct support to government may not necessarily achieve the desired results. However, without engaging with government, it is unlikely that sustainable results will be achieved. NGOs have shown their strengths in dealing with the communities in the Central Dry Zone especially in the provision of important services and resources to the farming communities and this has been a decisive factor in the resulting organisation. Separate Regional Support Units (RSUs) have been proposed for the two regions of Magwe and Sagaing that have been identified for implementation of the project. By channelling the proposed support services by all the service providers to the PIPs through the RSUs in a coordinated and timely manner, it is expected that the past incomplete, untimely and inadequate service support will not be repeated. An important aspect of this approach is the provision of a separate budget for the RSUs.

The implementation modalities have been determined considering the still unclear future for such development initiatives in the immediate future. Sustainability and support are primary considerations in such rehabilitation and upgrading exercises. Both the formulation mission team and the assessment team fielded in 2011 identified the lack of agricultural and extension support to all farmers with land on the PIPs. In addition to this, the heavy reliance upon headquarter resources for technical and financial issues, has left the WRUD ill-equipped to support the MOM of the PIPs, especially those to be handed over to the regional governments. The proposed RSUs with their teams of subject matter specialists and experienced technical assistance are considered an appropriate means of ensuring that the support that has been requested by the PIP farmers is provided. Although they will be supported by staff from WRUD and DA, the RSUs will be outside the political structure should a reversal of the current improved approaches to development occur. The last thing that is needed in these vulnerable areas is the interruption midstream of interventions aimed at improving the low performing pumped irrigation schemes when the contribution of irrigation to poverty alleviation in the CDZ has been shown to be very significant.

A wide range of services are needed and proposed to improve efficiency and effectiveness of the PIPs in the efforts to improve the livelihoods of the farming communities living within the command area these projects. Many of these services are currently not available within government or if available, are not easily accessed at project level. In addition to this, WRUD has no professionals adequately experienced in irrigation and drainage engineering and support. There are such professionals available in the emerging private sector in Myanmar, but even they do not have the required level of experience needed due to the country's relative technical isolation for a long period. However, with guidance and support from international professionals who would work with them to upscale their practical knowledge, this local support base can be enhanced and ensure a longer term sustainability.

The involvement of NGOs will assist in contributing to the longer term sustainability of the project. It also aims to reduce the risks associated with funding of projects in the public sector. Although it is proposed that after project completion the role of the RSUs will be continued, it is not certain whether this will be realised through further funding to the NGOs or has been suggested, through government taking over responsibility for the RSUs and its activities. The project period of four years is considered too short in the development context but necessary in the immediate political environment. Benefits on such projects are rarely fully realised in less than 8-10 years but the way in which the project has been formulated gives the scope for project extension if the approach adopted is followed by government and they are fully committed to it.

The 4 projects that have been identified for support provide good examples of various situations found on the PIPs that need improvement. They will be used as training grounds for the communities, the government and NGOs and have been identified as having the greatest potential in this respect. Although additional projects could also be undertaken in Mandalay region, the support would require an additional RSU and this would increase the funds needed beyond the originally envisaged project budgets. However, if additional funds are made available and the approach is considered suitable, then these additional projects can be easily added to the programme.

The formulation report starts with describing in Chapter 1 the situation prevailing in Myanmar regarding food security and how the proposed project fits well into the LIFT country programme. In Chapter 2, the approach to the project formulation mission is discussed together with how it was carried out and how the information on

which the programme is based was collected. In Chapter 3, the setting for the project is discussed along with the prevailing conditions in each sector and recommendations on how the different aspects could be improved. In Chapter 4, the project components are discussed in detail and summarised in the accompanying log frame. The financial and economic analyses that were undertaken to justify the project are discussed in Chapter 5 along with the results of the cost benefit and sensitivity analyses. Chapter 6 discusses the implementation and institutional arrangements for the projects considering the uncertainty that still exists in the development sector. The proposal for project implementation is presented together with activities that could be undertaken prior to project start-up and aspects that need to be considered after project implementation. In the final chapter, the project risks and sustainability are discussed and possible mitigation measures included. The report relies heavily upon the detailed Working Papers that have been prepared in support of the technical decisions that have been made. The Working Papers have been prepared as stand alone documents to support the main formulation report.

1. STRATEGIC CONTEXT AND RATIONALE FOR LIFT INVOLVEMENT

1.1. Rural Development Context

Myanmar's climate is tropical monsoonal. Rainfall is highly seasonal, being concentrated in the hot humid months of the southwest monsoon (May-October) and with significant regional variations associated with the intensity of the rains. Mean annual rainfall is estimated at 2,341 mm but in the Central Dry Zone (CDZ), it declines to 500 - 1,000 mm with a pronounced dip in the middle of the rainy season around July. River flows are directly influenced by the main monsoon season and rise in June and decline from September onwards. Monthly values of effective rainfall can still be considered reasonable but the pronounced variations within the months and the start of the monsoon season can create very uncertain conditions for rainfed cultivation.

The Ayeyarwaddy-Chindwin River basin provides a good source of irrigation water but as it is incised in its river course, access to water supplies for irrigation can only be achieved by gravity from its tributaries or through pumping from the main river course. The monthly distribution of river flows closely follows the pattern of rainfall, with about 80% occurring during the monsoon season (May-October) and 20% in the dry season (November-April). This wide variability in discharge over the year and the occurrence of sandstone within the catchment, results in sedimentation and river meandering that predominate in its middle and lower reaches.

The dry zone represents an unusual part of Myanmar that experiences fully the effects of poor monsoons and any climate change. Variability in rainfall is not new to the area, but the pronounced periods with reduced or no rainfall during the monsoon season that in dry years has impacted very negatively on rainfed production and the livelihoods of people living within the area.

1.2. Food security in the Central Dry Zone

Agriculture still dominates the Myanmar's economy in spite of the recent expansion of the oil and gas sector. Two thirds of the rural population is either directly or indirectly engaged in the agricultural sector with rice being the most important crop and more consumed per capita than anywhere else in the world[1]. In 2009-10 rice comprised 35% of the sown area of agriculture in the country, followed some way behind by pulses (19%) and oilseeds (16%). Other important crops include cotton, fruit trees and vegetables. Since the reforms of 1988, the government has pursued market-oriented economic policies with major objectives of self-sufficiency and edible oil price control. Although this required the selection of *Policy* and *Priority* crops (rice, edible oils), with support and incentives provided for their production, with the new government formed in 2011, the demands relating to these crops have been considerably relaxed. The choice of crops has now been left to the producers although in practice this has yet to reach field level and to be incorporated in Township plans. If farmers have reliable irrigation water they are given no choice but to grow rice in both the summer and monsoon seasons.

After the devastating effect of Cyclone Nargis on the Delta region in 2008, the Government was highly focused on the Central Dry Zone (CDZ) producing crops to assist with national food security. The first priority was rice cultivation and that remains in place in the CDZ today even though rice production is now at a comfortable level nationally (Working Paper 5). Approximately 5% of the 13.6 million ha dedicated to rice production in 2009-10 was on sandy soil[2]. The rainfall and hydrological pattern of the country means that irrigation and drainage play an important part in Myanmar's agriculture production. The need for irrigation is highest in the CDZ.

The Central Dry Zone (CDZ) covers large parts of Magwe, Mandalay and lower Sagaing Regions and represents one of the most food insecure areas in the country. It covers about 13% of the country with about 1/3 of the country's total population. The area is prone to erratic rainfall and prolonged dry spells that are a regular threat to rural livelihoods. The CDZ is characterized by clay and sandy soils with a high risk of water and wind erosion leading to land degradation and declining agricultural production. Agriculture is an important factor contributing to improved food security in the CDZ that is characterized by large crop diversity with more than half of all farming households growing three or more different types of crops (pulses; sesame; rice). Access to irrigation is a decisive factor contributing to food security. Main agricultural constraints for farming households are: (a) dry spells/drought, (b) high cost of agricultural inputs, (c) high costs of labour, (d) Plant diseases, and (e) floods.

Generally, farming households are amongst the most food secure as they are able to benefit from any improved

[1] MOAI-MAS August 2011 (Rice Almanac 3rd Ed)

[2] In some cases, Thaphanzeik PIP, due to the high crop water requirement of these permeable soils, irrigation is having to be carried out every 2 days or up to 70 times per season to produce rice.

crop conditions and increased marketing opportunities. Food insecurity levels remain high among households where there is poor access to land and physical access to markets. Households relying on casual labour as well as female headed households and those with children under-5 are more vulnerable to food insecurity compared to other groups. About half of the households are regularly affected by dry spells or drought that has a negative impact on their food security status and create high debts. These are thus amongst the most food insecure groups within the CDZ[3].

A number of risks factors repeatedly affect the food security: (a) untimely and irregular rainfall, (b) increasing food prices that put pressure on vulnerable groups relying heavily on food markets, and (c) seasonal water scarcity during the dry season that poses a serious health risk in some areas. There are also longer-term factors to be addressed including continuous land degradation through poor agricultural practices and gender inequality despite the fact that women are contributing largely to the household income.

1.3. Irrigation in Myanmar

Myanmar has a long history of irrigation that extends back to the former kings. The functioning of irrigation in modern times was started when the irrigation Branch was established in the public works department in 1917. After independence in 1948, the irrigation branch continued maintenance of existing irrigation networks for agricultural development as well as embarking on new projects in various parts of the country. In 1972 the Irrigation Department was formed to coordinate the development and management of water resources for irrigation. With the increasing concern for food security in the Central Dry Zone of Myanmar, resulting from the unpredictable and variable rainfall and the extremely limited options the gravity irrigation, the water resources utilisation Department was established in 1995[4]. Since then it has been responsible for *inter alia* pumped irrigation projects that now represent approximately 10% of the land equipped with irrigation facilities in the country[5]. Developments have achieved an increase in reported equipped area[6], but the result in terms of land that is successfully irrigated has not kept pace with the physical works.

Initially, the staffs involved in the pumped irrigation projects were drawn from those who had been involved in the development of surface irrigation and were well experience with I & D developments. This experience has been gradually lost with time not only within the WRUD but also in the Irrigation Department who are responsible for gravity (surface) irrigation. Technical developments need to be well prepared and based on reliable and comprehensive data but the quality and sustainability of interventions has been compromised by the national thrust to move forward with irrigation developments as quickly as possible. Designs have been dominated by the need to pump water from the Ayeyarwaddy River into the main canal and distributary systems, with insufficient attention to farm level delivery and cost effective technical designs. The situation has been further exacerbated by a lack of adequate funding for both construction and Management and operation and maintenance. Quality of construction has been significantly affected and funds for maintenance of the built works have been totally inadequate. In many cases, the distribution systems that have been provided are not complete; they do not extend down to field level and are unable to deliver adequate water to all parts of the designated command area.

Initially, WRUD only concentrated on small-scale pumped irrigation facilities for increasing productivity and areas under I & D throughout the country. Since the 1999-2000 fiscal year, WRUD has changed its emphasis towards the construction and management of larger pumped irrigation projects (command areas > 1,000 acres (~400 ha). More recently, it has been proposed that projects with command areas less than 2000 acres (809 ha) will be transferred to the regions for MOM.

1.4. The LIFT Country Programme

In 2008, a group of international donors were considering how best to support poor and disadvantaged people in Myanmar when Cyclone Nargis struck. It was the worst natural disaster in the country's history. However, it made the plan to strengthen external assistance all the more timely and within a year, the Livelihoods and Food Security

[3] WFP. February 2012.
[4] See Working Paper 4, Management Operation and Maintenance and Water User Organisations, section 1.3.1 Water Resources Utilisation Department for a description of its responsibilities and activities.
[5] About 10% of the equipped area is under pumped irrigation of which 70% is in the three central dry zone states of Magwe, Mandalay and Sagaing. It is estimated that WRUD has installed 327 pumping stations since its formation in 1995 with a total irrigable area of 496,905 acres (201,095 ha).
[6] By 2010, about 20% of potential irrigated area of 10.5 million ha, was reported to be served by irrigation systems (Table 1).

Trust Fund (LIFT) was formed. Funds provided by eight Donors[7] are pooled to support projects that aim to alleviate hardship among the poorest members of the communities. The United Nations Office for Project Services (UNOPS) was appointed as the fund manager to administer the funds and provide monitoring and oversight for LIFT.

(a) Vision, goal and purpose

Vision: LIFT's vision is to be an effective mechanism for channelling aid through partners, to achieve its goal of improving the food and livelihood security of the poor and vulnerable in Myanmar. Working with partners, LIFT aims to be a collective and influential voice promoting programme coherence, innovation and learning and providing a platform for enhanced policy engagement on agriculture, food security and rural development.

Goal: To improve the food and livelihood security of poor and vulnerable people in Myanmar.

Purpose: To sustainably increase food availability and incomes of 2 million target beneficiaries.

(b) Efficiency and Effectiveness of Pumped Irrigation Schemes in CDZ

One of the eight outputs of LIFT is increased agricultural production and incomes supported through improved production and post-harvest technologies, improved access to inputs and markets. The CDZ is one of the most vulnerable parts of the country and although there are a number of pumped irrigation projects that should contribute to poverty alleviation, their past performance is not enabled significant inroads to be made. The objective of the current formulation mission is to design a LIFT project for addressing the identified issues and improving the efficiency and effectiveness of PIPs.

2. PROJECT FORMULATION

The formulation team has been formed from the same Consultants[8] who undertook the assessment mission of June/July 2011. They are therefore familiar with the issues identified in that assignment and the overall objectives approaches of LIFT. This will ensure that the proposed project is consistent with the LIFT mandate and their previous knowledge of the country and WRUD will assist in ensuring that the project is realistic, workable and will contribute to poverty alleviation in the CDZ.

2.1. Rural poverty

The overall objective of LIFT is to contribute resources to a livelihoods and food security programme with the aim of making progress towards the achievement of Millennium Development Goal 1[9] (the eradication of extreme poverty and hunger) in Myanmar. Working through a trust fund modality, LIFT's purpose is to sustainably increase food availability and incomes of 2 million target beneficiaries.

2.2. Sustaining LIFT's benefits

A key Component of LIFT's approach has been the involvement of local partner organisations, primarily local and international NGOs. Some of these are already involved in the CDZ under LIFT's project support to help poor communities boost and diversify income is as well as manage water, soil and other natural resources. For the proposed project, several NGOs were involved in contributing data for the formulation mission and providing experts to join the formulation team. This will increase the capacity of these organisations and to strengthen them to support livelihoods and food security initiatives. Such approaches are essential in ensuring the longer term sustainability of supported projects and that immediate benefits are not lost once the direct assistance ceases.

2.3. The Target Group

The farming households with land located on the existing PIPs are the target group for the proposed LIFT project. This will not include all farmland within the gross command area of the PIPs, but the land that is considered good and could be economically irrigated within the gross command area. In the four projects, it is estimated that the total beneficiaries are about 10,500 people living in 2,130 households in 18 villages in 4 PIPs. Although initially all three regions within the Central Dry Zone were included in the proposals, the proposed project at the moment is limited to 2 regions, Magwe and Sagaing. Although this represents less than 1% of the people living in the CDZ, the potential for reaching far greater numbers is great so long as interventions are successfully implemented.

[7] Australia, Denmark, the European Union (EU), the Netherlands, New Zealand, Sweden, Switzerland and the United Kingdom.
[8] Anderson irrigation and engineering services Ltd, Ashford, Kent, UK.
[9] Reduce by half the proportion of people living on less than a dollar a day; achieve full and productive employment and decent work for all, including women and young people; reduce by half the proportion of people who suffer from hunger.

2.4. Geographic Coverage of the Project

PIPs represent about 10% of the irrigation projects in the country and about 0.5 million acres (200,000 ha).The proposed project is located solely within the Central Dry Zone of Myanmar. The projects envisaged for the first interventions comprise Kanni and Myinkun in Magwe Region and Pyawt Ywa and Satpagone in lower Sagaing Region. All of the projects are irrigated by the Ayeyarwaddy River or one of its primary tributaries. The locations of the 10 pumped irrigation projects considered during the formulation mission are shown in Table 1 and Figure 2.

2.5. Project Formulation Approach

The first stage of the Project formulation was started in May 2012 with a short mission by the team leader to identify more clearly projects for inclusion in the mission and to identify the levels of data that should be made available at the start of the mission, due to start in mid June. This concluded with LIFT/UNOPS contracting three NGOs to collect data on social, economic and institutional issues prior to arrival of the full Project formulation team. These data and information request were outlined in a checklist prepared for them by the team leader that also identified information requested from WRUD. The results of these data collection exercises were presented by the three NGOs at a meeting held shortly after the arrival of the consultants in Myanmar[10].

Data were also presented to the team during the initial discussions in WRUD Naypyidaw prior to the start of fieldwork but the lack of contact with the main departments of MOAI responsible for agriculture and agricultural services limited the amount of information that could be obtained. Following the confirmation of the plan for field trips by WRUD[11], the team proceeded on the 27th June 2012 to Nuang U in Magwe region to start their field examinations of the 10 identified and shortlisted pumped irrigation projects (Table 3). Throughout the mission, the team met with local and regional officials, representatives from WRUD and the regional agricultural offices and farmers involved in each PIP. The Director-General of WRUD joined the mission for its duration in the field.

Table 1. Details of Shortlisted Projects Examined During Formulation

PIP		Command Area		Cropped Area						Region	Water Source	Township	District
				Monsoon		Summer		TOTAL					
		Acres	Ha	Acres	Ha	Acres	Ha	Acres	Ha				
1	Lat Pan Che Baw	1,500	607	917	371	394	159	1311	531	Mandalay	Ayeyarwaddy River-left bank	Nyaung U	Nyaung U
2	Law Ka Nandar	11,000	4,452	2243	908	760	308	3003	1,215	Mandalay	Ayeyarwaddy River-left bank	Nyaung U	Nyaung U
3	Hnone Poe	8,000	3,238	3238	1,310		0	3238	1,310	Magwe	Ayeyarwaddy River-right bank	Pakokko	Pakokko
4	Myinkun	550	223	270	109	50	20	320	130	Magwe	Ayeyarwaddy River - East bank	Magwe	Magwe
5	Thaphanzeik	7,200	2,914	500	202	1080	437	1580	639	Magwe	Ayeyarwaddy River-left bank	Magwe	Magwe
6	Kanni	590	239	375	152	50	20	425	172	Magwe	Ayeyarwaddy River - West Bank	Minbu	Magwe
7	Pyawt Ywa	5,000	2,023	700	283	626	253	1326	537	Sagaing	Mo River-right bank	Myinmu	Sagaing
8	Kyawe Yaik	500	202	109	44	40	16	149	60	Sagaing	Ayeyarwaddy Right Bank	Myinmu	Sagaing
9	Satpagone	750	304	90	36	140	57	230	93	Sagaing	Ayeyarwaddy River - right bank	Myinmu	Sagaing
10	Shwe Hlan Bo	3,500	1,416	3,500	1,416	2,000	809	5,500	2,226	Mandalay	Dokhtawady River - Left bank	Sint Kiang	Kyauk Se
	Total	**38,590**	**15,617**	**11,942**	**4,832**	**5,140**	**2,080**	**17,082**	**6,913**				

Note. *The location of the PIPs is shown in Figure 2.*

From 28 June until 8 July inclusive, the team systematically examined in much more detail the long list of PIP sites to be visited and on each site, the team split into four groups:

Group 1:	I & D systems
Group 2:	Mechanical engineering
Group 3:	Agriculture and economics
Group 4:	Management, operation and maintenance (MOM) & water users' Organization (WUOs)

The formulation team returned to the capital Naypyidaw on 9 July to clarify outstanding issues and to prepare

[10] The data collected and presented by ADRA was very useful over the course of the mission. However the data from NAG and Proximity NGOs was not well collected or collated and provided less useful assistance to the mission.
[11] The organisation responsible for pumped irrigation within Myanmar.

their draft ideas on the project. On 10 July, a courtesy call was paid by the LIFT fund director and the Consultants' team to the Honourable Minister of Agriculture and Irrigation (MOAI) [12]. A debriefing meeting and technical seminar with WRUD[13] and key staff was held with the formulation team on Friday, 13 July. Representatives from YAU, DA and DAR also attended. The main conclusions from each site and the basic recommendations for the way forward for addressing the issues under the proposed LIFT project were presented to WRUD by the various mission team members and discussed with the invited participants during a brief question and answer session.

2.5.1. In-Field Discussions

Discussions that were held in the main WRUD PIP site office, usually by pump station One, were followed by visits to different areas and soil types within the scheme command areas and other sites supplied by a number of distributary canals (DYCs) and lateral canals (LCs). The aim of these visits was to inspect crops under cultivation, talk more with farmers about topical problems in the field and see firsthand the agronomic practices being employed. This enabled the group to further assess the actual growing and soil conditions for the farmer, the availability of water and other aspects that would affect the crops grown and levels of yields obtained and to obtain an overview indicative of the broader command area.

During the time spent on each site, approximately one day for each, a series of group based farmer interviews were conducted at each PIP with a subset of farmers representing different parts of the command area. On the larger PIPs, 2 group interviews were carried out. The groups interviewed were made up of representative farmers, WRUD staff and other interested officials, with the data being obtained through interactive discussions. It was considered important that the group(s) were made up of farmers representing different parts of the PIP command area so that PIP-specific data for each part of the system as well as the system as a whole could be collected. Other important information that was discussed and obtained included data related to the existing situation on each PIP scheme and to gain feedback from the participants on the way forward.

Table 2. I & D Rankings for Prioritisation of PIPs

PIP Scheme	Command Area (Acres)[B.]	Ranking				
		MEICA[A.]	I & D System	Water users organisation	Agriculture	Overall
Lat Pan Che Baw	1,500	7	8	5	3	**5**
Law Ka Nandar	11,000	6	3	8	7	
Hnone Poe	8,000	8	7	7	9	
Myinkun	500	4	4	2	5	**4**
Thaphanzeik	7,200	9	9	9	8	
Kanni	1,078	3	1	4	6	**1**
Pyawt ywa	5,000	5	5	1	1	**2**
Kywe Yike	500	1	2	6	4	
Satpagon	750	2	6	3	2	**3**

[A.] MEICA – Mechanical, Electrical, Instrumentation, Control and Automation, used to avoid confusion with M&E which most funding agencies interpret as Monitoring & Evaluation.
[B.] The gross irrigable area considered in the implementation of the project by WRUD and commanded by the built pumping network.

The detailed field examinations of the shortlisted pumped irrigation projects identified those with considerable investments and technical problems as well as those that could be improved in a relatively easy way. To have the greatest impact, schemes that are easier to rehabilitate and upgrade and that can be implemented early on in the project will have the greatest impact and provide examples for other schemes. Such sites to be considered for rehabilitation and upgrading should be utilised as training sites for all technical staff both that the design and the operational level. After all PIPs were examined in the field, a matrix was therefore created to summarise the findings from each of the 9 PIPs. All aspects of the schemes were considered to ascertain the limiting factors and advantages of each (Table 2). Each formulation team member produced a matrix for their sectors with separate priority rankings. This was conducted independently and combined to produce the final priority list across sectors

[12] The Minister was joined by selected senior representatives from the MOAI.
[13] The Director-General and senior staff.

for inclusion in the proposed LIFT project (Table 3) that comprises four PIPs, 2 in Magwe Region and 2 in Sagaing Region. Heavy weighting was placed on soil type and suitability to irrigation as this has a large bearing on water use efficiency, frequency of irrigation, crop water requirements and overall potential yield.

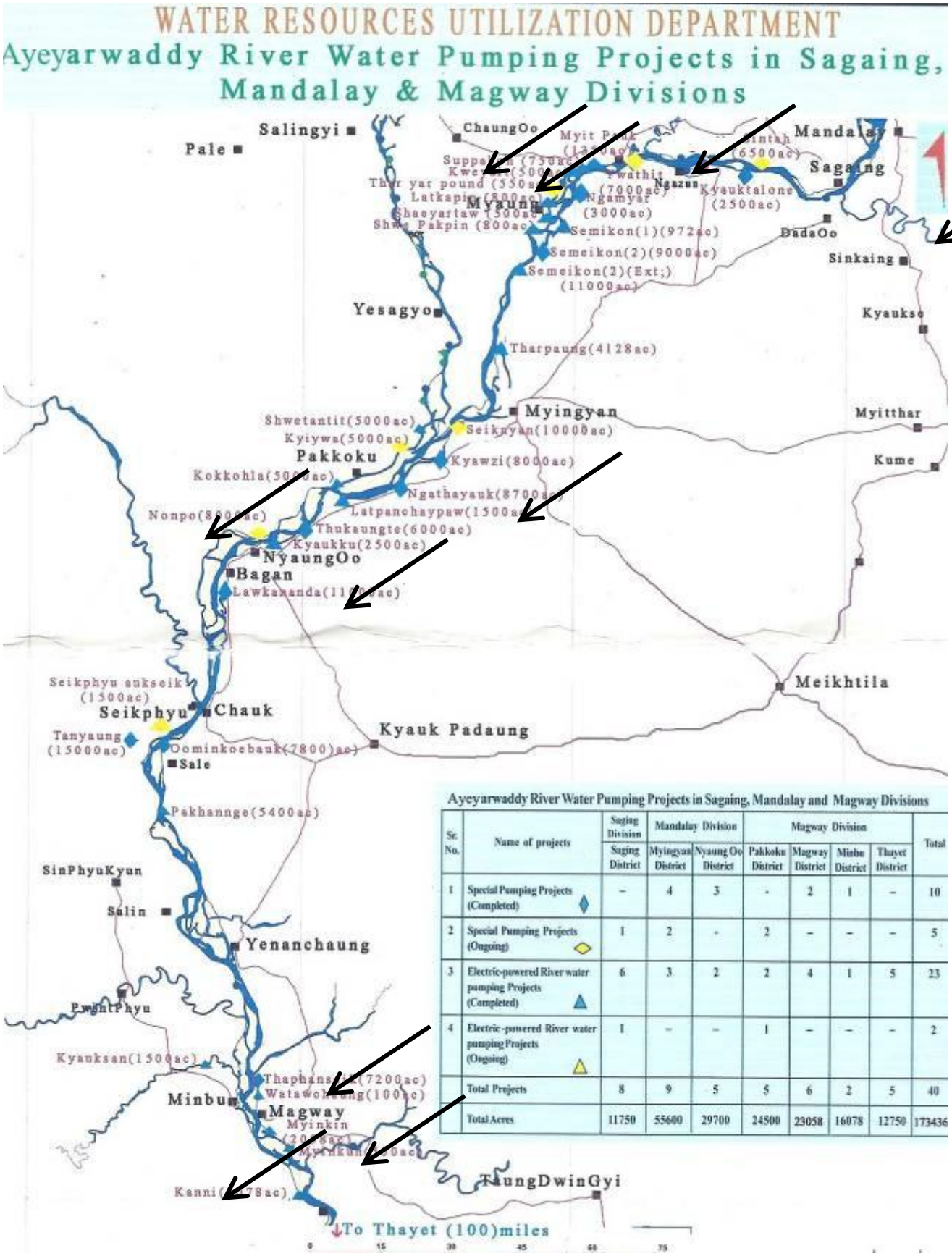
The identified 4 priority sites comprise those with better agricultural soil types and topography well very suited to irrigation. The heaviest soils are in Sagaing Region with good open flat topography, however Kanni has a good area of suitable irrigation soils and Myinkun has lighter soils but with some degree of clay and reasonable fertility.

Table 3. Details of Priority PIPs Resulting from the Selection Process

Pumped Irrigation Project (PIP)		Command Area		Cropped Area						Region	Water Source	Township
				Monsoon		Summer		TOTAL				
		Acres	Ha	Acres	Ha	Acres	Ha	Acres	Ha			
1	Myinkun	550	223	270	109	280	113	550	223	Magwe	Ayeyarwaddy River - East bank	Magwe
2	Kanni	590	239	375	152	50	20	425	172	Magwe	Ayeyarwaddy River - West Bank	Kanni Village, Minbu
3	Pyawt Ywa	5,000	2,023	700	283	626	253	1326	537	Sagaing	Mo River-right bank	Myinmu
4	Satpagone	750	304	90	36	140	57	230	93	Sagaing	Ayeyarwaddy River - right bank	Myinmu
	Total	6,890	2,788	1,435	581	1,096	444	2,531	1,024			

Note: See Working Paper 3 for further discussion on cropping patterns and cropped areas.

Figure 2. Location of 10 Short Listed PIP sites in CDZ



Ayeyarwaddy River Water Pumping Projects in Sagaing, Mandalay and Magway Divisions

Sr. No.	Name of projects	Sagaing Division	Mandalay Division		Magway Division				Total
		Sagaing District	Myingyan District	Nyaung Oo District	Pakkoku District	Magway District	Minbu District	Thayet District	
1	Special Pumping Projects (Completed) ◆	–	4	3	-	2	1	–	10
2	Special Pumping Projects (Ongoing) ◇	1	2	-	2	–	–	–	5
3	Electric-powered River water pumping Projects (Completed) ▲	6	3	2	2	4	1	5	23
4	Electric-powered River water pumping Projects (Ongoing) △	1	–	–	1	–	–	–	2
	Total Projects	8	9	5	5	6	2	5	40
	Total Acres	11750	55600	29700	24800	23058	16078	12750	173436

3. PROJECT DESCRIPTION

3.1. Selection of model projects for the LIFT project

The data obtained from the site visits and focus group interviews have been utilised to identify potential "model sites" for the proposed LIFT project. A wide range of issues are affecting the effectiveness and efficiency of the pumped irrigation schemes exist and are described in the Working Papers. From these data, a multi-criterion matrix was developed to prioritise the 10 shortlisted projects. Included in the selection criteria were the chance of success with the interventions proposed, whether they will provide good training grounds for the remodelling of PIPs with WRUD staff (and others) through learning by doing and whether there is adequate scope to implement rehabilitation and upgrading proposals. Whereas all PIPs offer some potential for improvement, the nature of the soils, the constraints experience during construction and many other aspects (see sections below) mean that interventions on some sites will be very costly and returns to the farmers will be lower than anticipated. The results of the rankings are shown in Table 2 above. Depending on available funds, it is anticipated that at this stage, 4 PIPs will be considered for inclusion in the proposed LIFT project.

The "pipeline" process of selection and identification of the schemes needs to be developed further to ensure that should any project fail at any hurdle during the planning and development of the rehabilitation process, additional projects could be initiated whilst the selected priority sites overcome constraints. In addition to this, should more funds become available during implementation, additional projects can be included in the work plans of the RSUs. The final list of identified PIPs should not be regarded as rigid however the inclination to bypass the initial screening processes should be avoided as this approach has been shown to be relevant and provides valid mechanism for identifying suitable projects for the way forward. Although some schemes have been excluded due to poor soils, the absence of any detailed soil information means that at this stage it is not been possible to identify the parts of the PIP command areas that could be considered for inclusion.

The issues that were being raised at many of the PIP sites are already being addressed at Shwe Hlan Bo PIP and as these works are underway, it is considered that resources available under the proposed LIFT project would be best allocated to other PIPs that have not yet been included in the rehabilitation and upgrading process.

The proposals prepared by the current formulation mission provide a comprehensive rationale and program for assisting government to not only improve upon the physical aspects of existing pumped irrigation developments, but through the interaction of international and national experts working together on a few "model" projects, knowledge and experience can be greatly enhanced through the learning by doing process. These priority PIPs are called "model" projects as they will provide sites for improving design and implementation by involving both technical staff (from WRUD, DA, NGOs and others) and farmers in a practical learning-by-doing situation. The strengthening of water users' organisations is an essential and linked part of the process of involving farmers with the designers and planners.

3.2. Irrigation and Drainage

The current issues identified on the priority PIPs are discussed in detail in Working Paper 1 & 2. Many of the problems and issues identified both by WRUD staff as well as those details noted by the formulation mission applied across many schemes. These are discussed below and more detail can be obtained from the relevant Working Papers.

Pumping Stations

Many of the problems and issues identified by the local staff relate directly to problems that are occurring on site and highlight the limitations of the existing design process as many issues could be "designed out", instead they tend to be retained and repeated in subsequent schemes. These relate to availability of spares and workshop facilities, unreliable power supply, water hammer effect when the pumps trip (due to power failure), the design and access ability of riser pipes connecting the pump stations to the irrigation commenced network, high sand content in the pump water, inadequate funds for O&M, absence of facilities for comprehensive maintenance, poor cable management, and insufficient site records to accurately monitor problems and maintenance completed.

Many pumps and ancillary equipment have been taken off-the-shelf or locally fabricated rather than meeting the requirements set out in the design documents. As a result capacities do not match those of canals and in some cases head losses through the pumping equipment are excessive and increase the energy requirements substantially. The way in which the pumping sites are maintained and the pump stations operated, contribute to the serviceability of the pump stations. In addition to this the lack of appropriate operating equipment, specialised

support services and technical requirements such as a lack of suitable foot valves, inadequate machine foundations, poor machine alignment causing excessive vibration and premature bearing failure and the lack of correct adjustment of the shaft glands, that contributes to excessive wear on shaft sleeves and reduces the efficiency of the pumps.

Many of these issues relate to the lack of a thorough design that leaves many details ignored or to be resolved on site by the construction team. With good guidance and well experienced professional technical assistance, many of the problems would be relatively simple to solve. Some of the problems such as water hammer effect require more investigation and more details on the high and low operating water levels of the Ayeyarwaddy River at the particular PIP site need to be obtained. The condition and current performance of the existing pumps and their suitability for the I & D system had been estimated during the formulation mission but need to be confirmed through the fitting of pressure and flow monitoring equipment in order to establish the of the pumps. As the Ayeyarwaddy River contains high quantities of sand and transported corrosive material, this is an essential consideration when sourcing of new pumps[14] or rehabilitating existing pumps.

Interfaces with the civil design, particularly with respect to pump foundations and pipe supports, need to be managed to ensure that civil design is suitable for the needs of the mechanical equipment. Access to pumping stations, particularly the pontoons needs to be addressed both for personnel access as well as to facilitate maintenance and removal/replacement of equipment on and off the pontoons.

Training of the operations staff is needed to ensure that they understand how to effectively operate the equipment and carry out basic maintenance. Local suppliers capable of more advanced repairs should be identified and developed and the WRUD staff supported in terms of managing and supervising the use of external "contractors". Basic asset management should be implemented to monitor equipment usage, maintenance and breakdowns to provide a better understanding of equipment performance.

Whilst the unreliability of the power supply is to a large extent outside the direct control of WRUD as a major power consumer they should have some sway over the power suppliers. Agreement should be made with them to agree to a proper scheduling of power outages in order to be able to schedule the water supply to the farmers and to avoid water loss, excessive energy demands and equipment damaged that currently results.

Irrigation and Drainage Systems

The designs for the conveyance and water distribution systems in most cases do not agree with those determined for the pump stations. In many cases this has been the result of non-availability of suitable pumps combined with inadequate understanding of crop water demands. The speed at which the systems have been implemented together with the lack of adequate data on which the designs were based has resulted in the need for investments to overcome a construction deficiencies, deferred maintenance and inappropriate designs. In addition to the modifications recommended for the pumping and ancillary equipment (Working Paper 2), many of the systems need to be checked and redesigned so that they meet more closely the water demands of the farming systems and include improvements such as better control structures, the provision of flow measurement at key locations down the systems, provision of suitable durable gates and other adjustments and design supports to facilitate the improved management, operation and delivery of the water to the farmers systems.

In some PIPs, adjustments are needed primarily to address deferred maintenance or changes in capacity. However, in some PIP systems, due to significant construction problems or oversights in design, major investments are required for the necessary full rehabilitation and upgrading of the systems to more appropriately deliver the required amounts of water. The level of these investments is likely to adversely influence the viability of those schemes. In all systems there are places where delayed or untimely maintenance has resulted in further investments needed to overcome damage to structures, canals and other infrastructure. In some systems such as Kanni PIP in Magwe, the systems have been designed for a variety of crops and therefore lend themselves more easily to rehabilitation and upgrading. In other systems such as Pyawt Ywa, the construction has not been well executed, but the existing canal systems would be suitable with improvement for the irrigation of the soils as they are some of the most suitable for irrigation in the CDZ.

Because most of the systems are designed to grow rice under flood conditions, little attention has been given to

[14] There are many established international standards, e.g. ISO, BS, ASME, and API for pumps that manufacturers refer to when designing their pumps and many standards have numerous options to allow pumps to be tailored to the specific application.

drainage. This is constraining crop cultivation due to periodic inundation during the monsoon season but the lack of proper drainage systems needs to be addressed particularly if alternative crops are to be grown. In addition to this, some PIP schemes located along the Ayeyarwaddy River and its tributaries require flood protection works and improved river training to protect both the irrigated land and the first reaches of main canal and pump stations.

Almost all of the design staff of WRUD has only been trained in civil, mechanical and electrical engineering. Few have experience of I & D and in particular the design requirements for such schemes. Under the present philosophy, schemes are designed to deliver water to the farmers who "appear" at the end of the lateral canals. Very little consideration is given to how the farmers deal with the water that is delivered to them and how it is distributed amongst them. With the rice-based system, few quaternary canals or associated structures are provided with water being delivered to the top irrigation plots and then passing through the upper plots to the lower plots. For alternative cropping patterns, this is not adequate and a network of supporting quaternary and watercourses and division structures is required. Some of the design problems that have been identified include:

1. Designs should reflect the prevailing conditions in the PIP project areas and reflect the actual availability of electricity (assume a maximum of 12 hours per day).
2. Estimates of water conveyance loss and the time taken to fill the canals have not been considered. This has resulted in a disproportionate balance between conveyance and application of the water.
3. Engineering designs are too inflexible and not adjusted to anticipated crop and hence water demands.
4. Gates provided are difficult to operate, poorly manufactured and often overdesigned leading to significant operational inefficiency and a failure to meet all farmers' expectations.
5. No accurate flow measurement for determining water quantities delivered has been provided with quantities being estimated from pump rating curves. There is therefore no way in which the PIP management or farmers know how much water is actually being delivered and where the inefficiencies occur.
6. Water pumping rate in relation to crop water demand needs to be known in order to reduce the significant conveyance and distribution losses and reduce the energy need per ha and her crop.
7. No comprehensive detailed and complete design calculations, maps and criteria are available to support the complete PIP designs.

Many of the reported irrigable lands include excessive amounts of sandy soils that can only be irrigated by overhead and drip irrigation methods and some soils have insufficient water holding capacity even for these methods. The areas considered for PIPs are located in the areas along the Ayeyarwaddy River that are dominated by Aeolian deposits[15] of sandy soils. These should not be considered as irrigable. In addition to this, pumping and conveyance systems with very high pumping heads have been built to supply many of these non-irrigable soils. Work by the FAO investment centres among others has shown that total pumping heads in excess of 60 m result in unviable investments for all but very high-value crops.

Construction problems identified include poorly built and compacted embankments constructed from unsuitable soils, poorly reconstructed and insufficient canal lining with no construction joints, poor transitions between pumping stations and canal structures, lack of sufficient gates and measurement and control structures, the disconnect between the primary and secondary conveyance system and the on-farm networks, no division structures for quaternary and watercourse canals and a failure to adapt canal alignments and outlets to farm topography.

Although some WRUD staffs have tried adapting designs to field conditions, they do not have the experience, time or budgets to do this effectively throughout the PIPs. In most cases, the systems can be adapted to local conditions as well as alternative crops and irrigation methods, there is very little knowledge within WRUD on how to approach this and how to provide a conveyance and distribution system that can deliver water for flood irrigation during the monsoon season and for furrow irrigation during the summer season. This lack of understanding and suitable design experience is exacerbated by insufficient and untimely construction budgets that have prevented on-site adjustments and completion of all the required works in time. Poor construction quality and completeness has resulted meaning that the limited O&M budgets have been utilised in part to overcome these problems and this has led to a significant backlog in deferred maintenance.

Amongst all the PIPs there are common trends relating to approaches adopted, the results that derive when implementation does not comprehend fully variations in site conditions and when the overriding factor is the

[15] Sediments, such as loess, made up of windblown or water deposited sand or sediments.

rapid construction of the infrastructure without adequate quality control and funding to ensure sustainability. The resulting conditions can be addressed through systematic planning, design and implementation and the development of improved practices and approaches. If these are developed in close consultation with the farmers (Working Paper 4) this will lead to increased confidence by the farmers and to subsequently higher levels of production, profitability and sustainability for these farming systems.

The matrix developed for the identification of priority projects (Working Paper 1) and summarised in Table 2, presents the detailed the situation on the shortlisted PIPs and provides a good summary of the technical problems associated with each PIP. To have the greatest impact, schemes that are easier to rehabilitate and upgrade and that can be implemented early on in the project will have the greatest impact and provide examples for other schemes. Such sites to be considered for rehabilitation and upgrading should be utilised as training sites for all technical staff both that the design and the operational level. The identified 4 priority sites comprise those with the better agricultural soil types and topography well very suited to irrigation. The heaviest soils are in Sagaing Region with good open flat topography, however Kanni has a good area of suitable irrigation soils and Myinkun has lighter soils but with some degree of clay and reasonable fertility.

The rehabilitation and upgrading requirements for each site has been based upon the views of WRUD engineers on-site, the result of site examinations during the formulation mission field visit and an estimate of additional needs to fully complete the identified deficiencies. For each PIP these are summarised in Table 4 with the detailed cost tables presented in Working Paper 1, Annex D. On all of the PIPs, topographical maps of a suitable scale for planning irrigation scheme improvements are not available and therefore allowance has been made to carry out such surveys and to produce appropriate topographical maps. In addition to this, there needs to be a systematic inventory of the irrigation infrastructure to determine the exact works that will need to be carried out on each structure and canal.

Table 4. Summary of Investment Costs for Rehabilitation and Upgrading of Priority PIPs

PIP	Irrigated Area		Investment Cost (US$)	Cost
	Acres	Ha		US$/ha
Myinkun	550	223	620,313	2,787
Kanni	590	239	375,000	1,571
Pyawt Ywa	5,000	2,023	2,276,250	1,125
Satpagone	750	304	586,563	1,933
	6,890	**2,788**	**3,858,125**	**1,384**

The resultant average cost per hectare (US$ 1,384) have been compared with similar costs for rehabilitation works across the Asia region (US$ 1,840 – US$ 1,459) and have found the in-line with these wider estimates. It should be borne in mind that the initial very high investment costs of the PIPs have been considered as sunk costs. However, much of these early investments have not been as beneficial as was initially considered as many works require more detailed reconstruction and rehabilitation works necessitated by poor construction techniques.

Annual management, operation and maintenance (MOM) costs for the pumping system, MC system, DYC and LC system and drainage have been estimated for both the current and future with-project situation in Working Paper 4. For the proposed LIFT project, these recurrent costs have been included with the above capital investments in the analysis of the financial and economic benefits of the proposed improvement (Working Paper 7). During project implementation, the estimates of annual O&M costs for the "with project" situation will be confirmed together with levels of appropriate cost sharing with the communities through their water user associations.

3.3. Agriculture

The main objective of MOAI is stated as being to increase crop production. Several strategies have been identified by MOAI for meeting this objective including: (a) the provision of irrigation, (b) the application of modern agro-technologies including improved seed, (c) fertiliser and crop protection, (d) the development and utilisation of new crop varieties, and (e) the adoption of cropping patterns that fit the local agro-ecology (f) the development of new agricultural land. The 10 crops that are being promoted include paddy, long staple cotton, groundnut, sunflower, the grams (yellow, green and black), sugarcane, pigeon pea, and maize. Support for these crops in the past was provided by the Myanmar Agriculture Services (MAS) concentrated predominantly on rice production. The extension services provided by MAS were not successful in reaching the average poor farmer and it is unclear now with the absorption of MAS into the Department of Agriculture within MOAI how the support services will now be delivered to the farmers for the wide range of irrigated and rain fed crops. Although it employs around

13,000 staff across the country, low salaries and uncertainty of the future has resulted in poor frontline services to the small-scale farmers and a significant loss of more experienced staff to alternative employment with agricultural resellers, NGOs and others.

The methodology of the farm advisory services was developed out of the command economy with the weaknesses that derive from this top-down delivery approach and limited participatory contact with their target group, the farmers. This would indicate that an appreciation of the modern techniques of communicating effectively with farmers is lacking. Model farms and MAS demonstration sites are seen throughout the areas visited, but what is most noticeable is the lack of implementation of ideas and practices onto the immediate neighbouring farms. Research and farm extension messages are focused largely on increased production of individual crops, with the use of correct techniques and inputs that are mostly beyond the resources of the disadvantaged farmers. Most extension messages are conceived centrally and are passed down with limited adapted testing, feedback or adaptation. Advice on the full range of crops that are actually being grown is lacking as well as the availability of many of inputs, including quality seeds, and access to seasonal credit. Marketing and farm economics advice are largely absent from advisory messages.

It is widely recognised, not least by MOAI itself, that research and farm advisory services are unable to respond effectively to the current needs of farmers, and are certainly not equipped to support the type of farming systems that exist on many of the PIPs. Within MOAI alternative approaches are taking place, such as with MICDE providing support to cotton, but this has yet to be effectively realised in the support provided to the PIPs.

After further lifting of sanctions in April 2012, restrictions on key crops (sesame; groundnuts) have been removed and the government appears to be more open to a wider choice of crops grown by the farmers and to the development of agricultural markets for export opportunities. Markets for high value horticulture tend to be limited to local markets although some non-perishable products such as mangoes, find wider and export markets. However, access to reliable markets for agricultural products continues to be variable and is dominated by exports to China. Until this is adequately addressed, farmers will continue to aim more for local markets for all crops except the dominant crop of rice. Even with this crop, low quality has meant that it is currently demanded only in the less lucrative markets such as West Africa. One of the main reasons for farmers' conservative approach is their lack of access to good market intelligence. Without clear and substantiated options in terms of alternative markets, this situation will not change. This is discussed further in chapter 4 and Working Papers 3 & 5.

In all agricultural production areas of the Central Dry Zone there is an obvious need for improved agronomic practices. Both the irrigated and rainfed systems are not employing good agricultural practices within the farming system. The main agricultural constraints are similar on all PIP sites, with all farmers highlighting the lack of consistent water supply and in many cases no irrigation water at all as a primary constraint to production. In practice the technical reasons for this were quite varied (see WP1 & WP2) but the effect is the same. Second to this, the majority of farmers identified the high costs of production of many of their crops and the need for technical information on all aspects of crop production as significant constraints. This was exacerbated by the cultivation of rice on the highly permeable sandy soils that produced negative gross margins that impacted greatly on the farm family cash income (see Working Paper 3). Many farmers appreciated the high crop water requirement of rice and the considerable additional labour requirements of growing it on permeable soils. They also did identified a lack of technical information on crop production, cost of crop inputs, pest problems, high harvest losses, weed control, market volatility, lack of crop choice, commodity market information and suitable microcredit at low interest and collateral rates.

When the crop yields on the PIPs are compared with the national averages (Table 5), it can be seen that yields on the PIPs for rice these are lower than the national average in both seasons, possibly due to the lower efficiencies of irrigation achieved on the predominantly sandy soils, but that for other pulses and oilseeds yields are higher than the national average yield figures. This indicates the potential that could be achieved on the PIPs considering adapting cropping patterns to prevailing conditions. Growers would prefer to have autonomous crop choice to provide the best cropping options for their soils and economic situation, and show a clear understanding of what needs to be done. As was evident from the rainfed cropping patterns, the farmers know their soil and topography intimately, so are able to make sensible decisions regarding crop choice and production cycles. One of the farmers to significant constraints is the cost of labour and when and suitable soils resulting excessive irrigation applications and short intervals, the additional labour requirements dominate the farmers crop budget and resulting negative returns.

Table 5. PIP Yields Compared to National Average Yields

Crop	PIP Yield (t/ac)	National Average Yield (t/ac)	PIP Yield (t/ha)	National Average Yield (t/ha)
Summer Rice	1.20	1.62	2.97	4.01
Monsoon Rice	1.10	1.34	2.72	3.30
Chickpea	0.40	0.54	0.99	1.34
Green gram	0.80	0.34	1.98	0.85
Groundnut	0.90	0.50	2.22	1.24
Soybean	0.62	0.49	1.53	1.20
Sesame	0.20	0.15	0.49	0.36
Source: Talking Figures: Some Statistics in Agriculture in Myanmar and Asia-Pacific Region, 2011 and Mission Farmer interviews, 2012				

With reliable and systematically delivered irrigation water on the target PIPs (see Working Papers 1 & 4), cropping intensities will be raised to a consistent 3 crops per annum over a much larger area with resistance to the adversities of climate change significantly increased. Cropping patterns suggested (Working Paper 3, Annex D.) are the result of a combined assessment of site conditions on each PIP including soils, ability for uptake of improved practices, access to new markets, potential gross margin returns, suitability of rotation from an agronomic perspective (i.e. sequence effects on weeds, disease, insect pests) and climatic conditions.

The soil types for all PIPs in Sagaing Region are consistently better than all the other PIPs in Magwe and Mandalay Regions. Due to their higher water holding capacity and greater fertility, crop yields and gross margin returns were higher at these sites. Crop diversity was also higher, which could possibly be attributed to greater food security of the farmers who also had cash income and were thus less risk averse to producing alternative crops. Returns at Pyawt Ywa and Satpagone in Sagaing Region (Working Paper 3, Annex E), were highest for green gram (US$326 to US$330/acre; US$806 to US$815/ha.) and lowest for summer irrigated and monsoon irrigated rice (-US$23 and -US$20/acre; -US$57 and –US$49/ha. respectively). Thus, even on these fertile, well structured soils, very suited to irrigation, farmers are still losing money growing rice. The loss is not large but is significant when alternative crops are giving good returns.

The constraints to production common on all PIPs can be addressed through relatively simple means of improved agronomic practices that will cumulatively lead to increased levels of production, profitability and sustainability for these farming systems. Solutions include (i) reliable irrigation water to enable increased cropping intensity, (ii) cropping pattern changes in timing, crop selection and crop sequences, (iii) adoption of improved crop varieties, (iv) use of crop residues for mulching, (v) introduction of reduced tillage and zero tillage farming, (vi) rhizobium inoculation of legumes, (vii) use of basal (starter) fertiliser, (viii) targeted plant populations, (ix) integrated pest management, (x) integrated weed management, (xi) irrigation type, timing and technique, (xii) increased market opportunities, (xiii) suitable and regular agronomic extension support to farmers and (xiv) the provision of microcredit to farmers. These are described in detail in Working Paper 3).

In some of the PIPs farmers are already growing 3 crops per year, however, in many cases 2 crops per annum is most common and in some areas only one crop per year. A move to 3 crops per annum on a regular basis as a result of improved irrigation water availability would provide significant contributions to the livelihoods of the benefitting farm families

With-project input costs for existing PIP crops were calculated by applying cost adjustments to the current costs (Working Paper 3, Annex E) and where PIP-specific costs were not available, average costs from other PIPs were used. For crops new to the PIPs (maize, soybean, sorghum and wheat), farm gate prices were estimated using data on recent trends in South East Asian producer prices from FAO. For all other crops, the current PIP-specific prices received by farmers were taken and inflated by 5% to reflect expected improvements in the quality of produce under the project. Where no price existed on a specific PIP, an average price taken from other PIPs in the area was used instead.

The provision of microcredit to the farmers in the CDZ at reasonable rates would see a rapid change in farming practices on both irrigated and rainfed land. Currently credit is very expensive at 8-10% from the bank and only one NGO microcredit option has been found in the CDZ. In light of labour market pressures, an emphasis upon supporting the increased mechanisation of production may be recommended. Even at current high usage costs, the time-saving nature of machinery is expected to significantly increase returns to family labour days. With

increased know-how amongst farmers and the extension of agricultural credit for machine hire, the supply of machinery should increase and usage costs fall relative to labour over time.

It was clearly evident on all PIPs that growers are thirsty for knowledge and frustrated by the lack of agronomic extension support, which is almost non-existent. Providing this type of support to farmers is crucial in the success of adoption of new technologies. Without extension support and guidance for trialling, training and implementation of new technologies, farmers will fail to adopt proposed practices and instead stick to what they know as farmers and which is generally risk averse. There is still a mindset amongst farmers that they must grow rice to feed the family. The irony of this situation is that with irrigation farmers could produce much more grain from and with better quality crops more suited to the soil type and hence be able to afford to buy rice in for family consumption. Whilst the Myanmar farmers on these PIPs appear open to new ideas and keen for knowledge and assistance, they have a lot of cultural changes and traditional practices to leave behind with a shift to new technologies and will need strong support and encouragement through agronomic extension to make the change

Cropping patterns can be drastically improved by the lifting of the rice-growing obligation, and may further benefit from obtaining improved market intelligence and trader feedback to farmers, enabling the PIPs to fully explore their comparative advantage in response to international market opportunities. The rehabilitation of the I&D system has potential to significantly increase cropping intensity in many areas, from an average of 220% to 300%, through the enabling of water for three full cultivation seasons. Improved cropping patterns and water management should also lead to significant increases in crop-per-drop outcomes, and potential exists for raising yields across all crops through the provision of improved agricultural extension services providing advice for implementing improved agronomic practices (Table 6).

Table 6. Best and Worst Crop Budget Returns for Priority PIPs in Proposed Project

PIP	Gross Margins Current Situation				Irrigated Gross Margins Proposed Situation			
	Best return	US$/ac	Worst Return	US$/ac	Best return	US$/ac	Worst Return	US$/ac
Myinkun	Sesame black	103	Summer rice	-149	Cotton	458	Summer Rice	64
Kanni	Green gram	42	Monsoon rice	-31	Cotton	464	Monsoon Rice	94
Pyawt Ywa	Green gram	326	Summer rice	-23	Soybean	633	Summer Rice	213
Satpagone	Green gram	330	Rice	-23	Soybean	633	Summer Rice	213
Source: Current and proposed project gross margin budgets (WP-3, Annex E)								

3.4. Water User Associations and MOM

Over the last 2 to 3 decades, the need to involve the beneficiaries has come to the forefront of I & D projects so that farming communities as users of the irrigation water are considered more as “partners” rather than “beneficiaries”. Not only has this increased the sustainability of project interventions, more importantly it has reduce the burden upon government for management, operation and maintenance costs that were escalating to unmanageable levels. The large, often over-staffed but under remunerated government organisations responsible for the management, O&M of irrigation and drainage systems coupled with insufficient funds to meet the ever-growing demands of ageing infrastructure and poor performing systems have shown to be unsuitable for reliable and efficient production systems. Efforts to improve the systems through the same organisational structure have been beleaguered by serious delays in construction, poor quality of executed works and cost overruns. In spite of attempts to increase the areas irrigated through rehabilitation and expansion, funds allocated for the MOM of the I&D systems were not significantly increased in line with considerably enlarged I&D infrastructure. The concept of asset management of I&D facilities is unknown in Myanmar with the result that amounts allocated to annual MOM are insufficient to halt the deterioration of I&D infrastructure and the accumulation of deferred maintenance. Low levels of productivity of irrigated agriculture have caught the attention of many senior officials and others in government and led to a question the status quo and the need for alternative mechanisms for delivering MOM of the I&D systems.

Farmers' Involvement in I & D Development in Myanmar

Water Users Groups have been established in earlier donor funded projects but did not prove successful as the formation of farmers' groups was not established early in the project life and was not coupled with adequate training at all levels. Under WRUD, WUAs have been formed at different levels in the PIPs but are found to be inadequate to undertake many of the roles, functions and duties normally attributed to WUAs. In particular this relates to involvement in the O&M of irrigation, drainage and associated infrastructure, contribution towards the funding of the same and the selection and delivery of water to the beneficiaries. The current framework is given in Table 7).

Table 7. Formal Framework for WUOs in PIPs

Canal Level	Type of WUO	Main Aspects
LC	Water users' group (WUG)	Farmer having land at end of LC is elected as Canal Leader by other farmers and responsible for allocation of irrigation water among all farmers within LC command area
DYC	Water users' committee (WUC)	Farmer from tail reach of DYC elected as WUC Head by other farmers for a period of one year, number of WUC members depends on length of DYC and farm size, and main role is allocation and distribution of irrigation water between all LCs within command area of DYC
MC/PIP	Water users' association (WUA)	Formed by Township General Administration Department (GAD) following request from WRUD with Village Tract Administrator as Chairman and following members: Engineer/Pump Station Superintendent from WRUD, SLRD staff/field supervisor, Department of Agriculture (DA) staff/village tract field supervisor, Clerk of Land Survey Department, and village representatives/marginal farmers
Note: When the term WUO is used in this report, it refers to all levels of water user organisations including WUA, WUC and WUG		

Depending on the staff involved in the formation of water users groups, different organisational structures and subcommittees have derived. In most PIPs, some form of WUO structure has resulted. The frequency of WUO meetings varies considerably as does the main tasks and duties (Table 8).

Table 8. Task and Duties of WUOs at PIP Level

Name of PIP		Main Tasks and Duties
1	Myinkun	Formulating rules for water allocation and distribution Coordinating between Township Agricultural Supervisory Committee and farmers Coordinating crop marketing Resolving water-related conflicts
2	Kanni	Organising allocation and distribution of canal water Fixing date for start of paddy nurseries
3	Pyawt Ywa	-
4	Satpagone	Organising water allocation and distribution on all canals Organising cleaning of all canals Resolving water-related disputes

The modalities for the maintenance of the conveyance and distribution systems varies but in general WRUD is responsible for maintenance works on the MC, DYC and LC systems, mainly using hired labour. Operation of the I&D system is the responsibility of WRUD but in some PIPs, some duties have been delegated to WUOs. Where government funds are inadequate, cleaning and simple maintenance of DYCs and LCs are often undertaken by the farmers, who provide free labour, with Canal Leaders organise the works. The quality of cleaning and the condition of the canals varies considerably across the PIPs (Working Paper 4).

Allocation and distribution of water along the distributary canals (DYCs) is generally the responsibility of farmers through their respective WUOs. In some PIPs, it is the responsibility of WRUD. Any water-related dispute at DYC level is resolved by the Village Tract Administration, Village Leader and/or the WUO. The modalities of operation are generally proportional but in some PIPs rotation system is adopted.

In general however the existing WUOs cannot be considered as farmer-managed as most members represent government agencies and Village Tract Administrator or Village Leader is Chairman. In addition, although WUAS have been established at PIP level, they do not function realistically at lower levels. Farmers have a say in allocation and distribution of water but are dependent upon the overall management of the PIP by WRUD and government officials. All recognise that the levels of budget available for MOM are inadequate but are unable to do much about it as the considerable funds that are already collected, depending on the crop grown and acreage,

do not get channelled into the PIP but are delivered to a different organisation at union level. This means that even though WRUD admits that it is their responsibility to maintain and repair pump stations, canals, control/distribution structures and outlets along the canals, they are unable to do this and many of these structures are damaged and non-functional. These problems and the design and construction related issues described in Working Paper 1, mean that few distributary canals receive the full designed discharge and that all canals suffer from considerable conveyance losses, even on the lined sections.

Water management throughout the system is poor due to inappropriate structures, significant water losses along the system, a lack of rotation of supplies and scheduling leading to small flows being delivered over to widen area, and the on-farm water management practices used by most farmers. The lack of any measurement of flows delivered means that locations within the systems (either physical or Farmer contributed) that are responsible for excessively high losses cannot be easily identified.

The concept of an irrigation and drainage system refers not only to the physical aspect, such as canals and control structures, but also to the management structure by which the physical system is planned, designed, constructed and operated. These two aspects are functionally inter-dependent and need to be understood as a whole. Managing an I&D system is a much more complex and difficult problem than is commonly recognised. Part of the explanation for limited success results from inadequate recognition that delivery and allocation of water involves complicated social, organisational, legal and economic questions as well as important technical matters.

The promotion of greater farmers' participation in the development and management of irrigation and drainage systems is often motivated by several different and possibly competing objectives. If designed effectively and implemented together with other support policies and programmes, effective farmers' involvement in irrigation development could have the following outcomes: a) transformation of supply-driven government administration into responsive, demand-oriented service provider; b) reduction in requirements for government staff and resources in the irrigation and drainage sector; c) improvement of the O&M of irrigation and drainage systems; d) reduction in need for loan-financed rehabilitation projects; e) diversification of cropping pattern towards high-value crops due to more responsive irrigation and other services; f) increase in the amount of funds available for O&M due to greater farmers' control over management and resources as well as better incentives and accountability; and g) promotion of empowerment of farmers through development of strong WUOs.

It is expected that the successful implementation of PIDM will have the following important benefits (i) better functioning I&D systems due to "sense of ownership" among farmers, (ii) active involvement in the planning, design and construction supervision of the civil works, (iii) improved O&M of the schemes as farmers have a large involvement if not full control over the planning and execution of the maintenance works and water distribution, (iv) lower O&M costs as farmers are able to undertake the works at cheaper rates with their own (financial) resources (cost awareness), (v) more efficient and equitable distribution of irrigation water as farmers have better control over irrigation supply and distribution, (vi) improved payment of ISF as farmers organisations are allowed to keep a significant portion of the collected fees for the O&M of the I & D facilities, (vii) less dependency on Government budget as farmers will share in the costs, (viii) more transparent and accountable relations between farmers and the irrigation agency under the service contracts, (ix) Increased irrigated area and higher yields due to more adequate, timely and equitable supply of irrigation water, (x) less corruption and favouritism in the allocation and distribution of irrigation water, and (xi) the provision of adequate irrigation extension services.

Proposed Framework for Water Users' Organisations

The main purpose of establishing WUOs at different levels within the command area of a PIP is to facilitate the effective participation of all farmers in the MOM of their irrigation and drainage system in a structured manner. Based on the existing framework of WUOs in the PIPs and the layout of the distribution systems, it is proposed that WUOs are formed at three levels:

- Water Users' Groups (WUGs) at level of one or more LCs (tertiary level);
- Water Users' Committees (WUCs) at level of each DYC (secondary level); and
- Water Users' Association at level of PIP (primary/main level).

The recommended size of a WUG is 20 to 30 acres with 10 to 15 farmers cultivating and irrigating land within the command area of one or more LCs. Where LCs with have less than 10 acres, it is recommended to establish one WUG for two or three LCs together assuming that the concerned farmers agree to become members of one

WUG[16]. More details on the background to the proposals are contained in Working Paper 4.

The main objective of the WUA is to ensure the effective and efficient O&M of the I&D infrastructure, which have been constructed for the purpose of irrigation of the arable areas within the command area of the PIP, including the supply of irrigation water to all farmers in an adequate, efficient, timely and equitable manner. The proposed institutional framework and modalities for the MOM of the pump, MC, DYC and LC systems of a PIP are summarised in Table 9 together with the expected farmers' contributions.

Table 9. Proposed Institutional Framework and Modalities for the MOM of PIPs

Type of Infrastructure	Responsible Institutions	Implementation Modalities		Funding
		Maintenance	Operation	
Pump system	WRUD	WRUD staff	WRUD staff	Farmers pay existing water charges to WRUD through WUA.
MC system	WRUD and WUA	WRUD with hired labour Farmers may contribute free labour	WRUD staff	Farmers contribute to O&M costs by paying part of their ISF to WRUD through their WUA.
DYC system	WUC	Farmers contribute free labour WUC arranges repair works	WUC	Farmers contribute to costs related to repair of control/ distribution structures and outlets along DYC by paying ISF to WUC. Farmers may have to pay fixed rate per acre as remuneration for WUC members.
LC system	WUG	Farmers contribute free labour	WUG Leaders	Farmers may have to pay fixed rate per acre as remuneration for WUG Leader.

***Note**: When the term WUO is used in this report, it refers to all levels of water user organisations including WUA, WUC and WUG.*

In principle, farmers have to pay all the costs related to the supply of irrigation water to their fields and the safe removal of any surplus water, including the maintenance and repair of all irrigation and drainage infrastructures. Therefore, farmers must pay an ISF for the right to obtain water for the irrigation of their fields. One of the basic principles is that the WUO must have the authority to decide its own method of charging the farmers for the delivered irrigation services, namely the O&M of the irrigation and drainage infrastructure. Another basic principle is that the WUO has to adopt a method for assessing ISF that is simple, transparent and not too costly. ISF could be in accordance with one of the following methods (see Working Paper 4, Annex G for more details):

- Crop-area method based on types of irrigated crop and total area cultivated;
- Volumetric charging method based on actual volume of irrigation water supplied; or
- Area-based method based on payment of a flat rate per unit of irrigable area, irrespective of crops cultivated or volume of water supplied.

The average electricity costs for supply 6 acre-feet of water for the cultivation of paddy is Ks 35,598 per acre (US$ 44.5/acre), whereas the average pumping costs for other crops requiring 2 acre-feet of water is Ks 11,866 per acre (US$ 14.8/acre). The electricity costs for supplying one acre-feet of water is Ks 5,933 per acre (US$ 7.4/acre) or Ks 14,633 per ha (US$ 18.3/ha). This illustrates that there is a high level of subsidy by WRUD under the current arrangements whereby the water charge to the farmers for monsoon paddy (Ks 6,000/acre - $7.5/acre) and summer paddy (Ks 9,000/acre - $11.25/acre) covers 17% and 25% of the electricity costs. For other irrigated crops (Ks 3,000/acre - $3.75/acre) the payment covers 25% of the pumping costs.

After PIP rehabilitation and upgrading, future O&M charges will be US$25/acre excluding pumping costs with the costs split between WRUD and farmers of 30%:70% excluding pumping costs (Table 10).

Table 10. Annual O&M Cost Estimates for 4 selected PIPs (US$/acre)

Name of PIP	Annual Pumping Cost (3 acre-feet)	Annual Estimated Operation Cost, excluding Pumping Costs	Annual Estimated Maintenance Costs	Total Estimated Annual O&M Costs
Kanni	24.6	7.5	17.5	49.6
Myinkun	16.8	7.5	17.5	41.8
Pyawt Ywa	20.4	7.5	17.5	45.4
Satpagon	22.2	7.5	17.5	47.2

Note: Assumed that average crop water requirement is 3 acre-feet

[16] The functions and duties of the WUG, WUC and Canal Leader are briefly described in Working Paper 4, Annex F.

The proposed changes between existing and future charges is dependent upon the completion of the rehabilitation and upgrading works and the recommended split and change of level of charges is given in Table 11. At present, farmers in the priority PIPs do not have the ability to pay the estimated annual O&M cost as their net returns from crop production are low. However, following the completion of the rehabilitation of upgrading works and the improvement of the MOM of the PIPs and the implementation of the proposed agriculture support services and activities this will change. Therefore, it is proposed that farmers gradually pay more for the provision of irrigation services as net farm incomes increase.

Table 11. Annual O&M Cost Estimates for 4 selected PIPs (US$/acre)

Pumped Irrigation Project		Area (Acres)	PY1	PY2	PY3	PY4	PY1 to PY4	Annual Estimated Costs (US$/acre)			
								Pumping Cost (3 acre-feet)	Operation excluding	Maintenance Costs	Total O&M Costs
Myinkun		550	15.0	15.0	15.0	41.8		16.8	7.5	17.5	41.8
Total Cost	**US$**		**8,250**	**8,250**	**8,250**	**22,990**	**47,740**				
O&M	Cost (US$/acre)		0.0	0.0	0.0	25.0					
Energy			15.0	15.0	15.0	16.8					
	WRUD		30%	30%	30%	30%					
	Farmers		70%	70%	70%	70%					
Kanni		590	15.0	15.0	15.0	49.6		24.6	7.5	17.5	49.6
Total Cost	**US$**		**8,850**	**8,850**	**8,850**	**29,264**	**55,814**				
O&M	Cost (US$/acre)		0.0	0.0	0.0	25.0					
Energy	Cost (US$/acre)		15.0	15.0	15.0	24.6					
	WRUD		30%	30%	30%	30%					
	Farmers		70%	70%	70%	70%					
Pyawt Ywa		5000	15.0	15.0	15.0	20.4		20.4	7.5	17.5	45.4
Total Cost	**US$**		**75,000**	**75,000**	**75,000**	**102,000**	**327,000**				
O&M	Cost (US$/acre)		0.0	0.0	0.0	0.0					
Energy	Cost (US$/acre)		15.0	15.0	15.0	20.4					
	WRUD		30%	30%	30%	30%					
	Farmers		70%	70%	70%	70%					
Satpagone		750	15.0	15.0	22.2	47.2		22.2	7.5	17.5	47.2
Total Cost	**US$**		**11,250**	**11,250**	**16,650**	**35,400**	**74,550**				
O&M	Cost (US$/acre)		0.0	0.0	0.0	25.0					
Energy	Cost (US$/acre)		15.0	15.0	22.2	22.2					
	WRUD		30%	30%	30%	30%					
	Farmers		70%	70%	70%	70%					

Notes:

1. The proposed division between the Main canal system and the lower systems is given in Table 20.

2. The Energy costs occur in the year immediately following rehabilitation and upgrading whereas the O&M costs occur the following year after the one year maintenance period has been completed.

3.5. Training and Capacity Building

Although substantial improvements in irrigation infrastructure are essential to improve the performance of the pumped irrigation schemes, the current formulation mission is in no doubt that the capacity to plan, design, build, and operate the systems will be a vital component for the success of the proposed project. The rehabilitation process itself is seen as an effective means of improving the capacity of staff to design PIPs and to ensure that water is delivered with the intention of minimising losses and production costs and maximising the delivery to meet the crop water needs. Many middle and lower level staff from WRUD have only limited experience in practical design and implementation of PIPs and few of the WRUD staff have experienced any formal training or gained experience in irrigated agriculture. Staff need to develop an awareness in their designs of the needs of the farmer and also the need to engage with other appropriate technical disciplines other than those currently employed (mechanical and electrical engineers, and geologists).

The logical approach to addressing capacity needs would be to undertake a comprehensive capacity needs assessment (CNA) of the I & D sector. This would involve a study of both the demand for trained staff and the supply available and from which it would be possible to draw up a programme of training, possible recruitment, and institutional change to fill the identified gaps. But this logic does not fit well with the time constraints of this

project and also the urgent need to get training underway as soon as possible for the benefit of the farming community and the country as a whole. So a twin-track approach to capacity development is proposed:

- **Meeting immediate capacity needs** of MoAI professionals, technicians, and farmers in order to take full advantage of the proposed rehabilitation project and to improve the performance of the existing irrigation networks.
- **Long-term capacity planning** means looking ahead to find out what capacity will be needed to support future irrigation development in Myanmar over the next 10 years and beyond.

Meeting immediate capacity needs

Training individuals or groups will be the main thrust rather than institutional change. Without the benefit of a CNA, the training needs will be based on the assessments made by the irrigation experts in discussions with local staff and farmers and reported in the recent project reviews. The rationale for this approach is that the perceived demand for trained professionals, technicians, and farmers in irrigation is so significant that any training in irrigation that this modest capacity development project component can provide is likely to do a great deal of good. Provided it is planned responsibly and carefully and takes account of the opinions of experienced training specialists and irrigation professionals working on the 'front line' there is every likelihood that it will produce useful capacity both for immediate benefit and for the future.

What is clear is that many of the problems facing irrigation development in Myanmar are not unique. They are similar to those in many other developing countries, which have been isolated from international influence and which are now in a process of transition from an autocratic (top-down) approach to development to one that is more democratic in nature and is based on improving the livelihoods of the rural poor.

As the budget available for training is not known at this stage, the outcome of this analysis will be a list of different options for meeting the immediate capacity needs which can be organised either in-country and/or abroad. Training options can then be chosen to meet priority requirements as and when the funding is available. Whatever form the training takes it should focus on 'training the trainers' so that there is every chance that the new skills and knowledge acquired will be passed on to others. Participants would be mostly MOAI engineers and agriculturalists, but university and college staff should also be included in any formal training courses to develop and improve the irrigation curriculum and to help forge closer links between the training institutions and the MOAI.

Long term capacity planning -- Looking ahead

The second step is to tackle the longer term capacity needs of professionals, technicians and farmers looking some 10 to 15 years ahead. Developing strong and sustainable capacity is not something that can be done quickly, particularly if there are major institutional changes planned in the way that irrigation will be organized and managed in the future. For example it can take 10-15 years to produce an experienced irrigation engineer who is useful to the country and to farmers. So planning must begin now to address future needs.

Though implementing long-term capacity planning is not part of this current project. It is proposed to set out an outline strategy for this in this report so that the limited training can be viewed in the wider context and proceed should additional separate funding be made available.

Myanmar professionals, technicians, and farmers have not had the opportunity to access up to date information on the latest developments taking place in irrigation in other countries. So in addition to the anticipated needs for basic knowledge and skills training in traditional and modern irrigation technology and management, the training will also provide an opportunity to up-date people on recent developments in irrigation taking place in other parts of the world such as the integration of engineering and agriculture in irrigation development, irrigation management transfer, irrigation demand management, the development of water user organisations, and irrigation cost recovery. All these developments have come about as a direct result of acute water shortages, rising energy costs, and a desire to improve water use efficiency in irrigation – factors which are very relevant to the situation in Myanmar.

The potential impact of these issues on irrigation development in Myanmar and on capacity needs will be quite profound in terms of human resources, knowledge, skills, and attitudes. Future irrigation capacity needs will be very different from those at present. So, although there are immediate short-term training needs to rehabilitate existing distribution and on-farm systems, '*more of the same*' may not serve Myanmar well in the longer term. For this reason it is prudent to begin to build these issues into the various training courses and also to look ahead and

consider what human resources will be needed and what knowledge and skills they must acquire to support future irrigation development bearing in mind that it takes some considerable time to develop human resources. Answers will be needed to such key questions as: – *What capacity is available at present? What capacity is needed now and in the future? What are the capacity gaps that already exist and what gaps are likely to occur in the future? How can the gaps be filled?* And finally – *How can the capacity be maintained and enhanced once it is in place?*

It is important to recognise that developing capacity is not just about education and training individuals. It includes building good organisations and strong institutional structures within which individuals can work effectively and a socio-economic environment that encourages rather than discourages successful irrigation development. Individuals are rightly at the centre of capacity development but their working environment is an essential foundation on which individuals stand. They need knowledge and skills but they also need good organizations in which to work. If either of these is weak then it becomes difficult for individuals to work effectively on the key issues of efficient and effective irrigation water management.

4. PROJECT COMPONENTS

This project proposal builds upon existing infrastructure designed and constructed by Myanmar Government staff, in an effort to increase productivity of these irrigation schemes and achieve sustainable food security through crop diversification, generation of cash income and commercialisation. The engagement of the commercial and education sectors as well as research and extension providers will be necessary to ensure development and delivery of viable alternative commercial crop enterprises.

4.1. Project Goal and Objectives

The project goals and objectives are in line with those of LIFT.

Project Goal: Enhanced livelihoods and food security of households of those living in the Central Dry Zone of Myanmar through sustainable development of profitable irrigated agriculture.

Development Objective: To improve the efficiency and effectiveness of pumped irrigation projects in the Central Dry Zone of Myanmar

Outcome (Component) 1: Priority pumped irrigation projects improved and upgraded to give effective and efficient systems for water delivery and crop production.

Outcome (Component) 2: Crop Diversification and Best Management Practices in Farming Systems

Outcome (Component) 3: Improved management, operation and maintenance (MOM) of all I&D infrastructure of PIPs with full participation of farmers through their WUOs.

Outcome (Component) 4: Through the Provision of training, capacity building and technical assistance, the skills of WRUD, NGO and RSU staff enhanced to better support the improvement of PIPs in rehabilitation and upgrading and subsequent MOM.

4.2. Logical Framework Analysis

The logical framework analysis for the proposed project is given in Annex C. The Project Components are described more fully below and draw heavily upon the existing situation described in chapter 3 and in more detail in the relevant Working Paper. P

4.3. Project Components

(a) <u>Component 1.</u> To rehabilitate and upgrade the pumping and I & D system of selected PIPs

This will be achieved through the provision of short-term technical assistance from an international consulting team assigned to the Regional Support Units and working closely with staff from WRUD. It is essential that their services are utilised effectively and not spread too thinly and therefore it is strongly recommended that the staff would provide inputs to both RSUs and will interact both with regional and union WRUD staff assigned to the RSUs and PIPs. They will work systematically across the two teams guiding them in the process of redesigning and upgrading the four PIPs. They will carry out initial assessments and data evaluation and follow this by establishing criteria or redesign and upgrading and they proceed through the various detailed designing processes guiding all the engineering staff so that they learn by doing the work themselves.

Training and hands-on practical design sessions would also be provided to selected design staff at WRUD headquarters. The aim would be to produce standard design documents including specifications and tender documents for all of the works to be undertaken. It is envisaged that construction of the rehabilitated and upgraded systems will be implemented by WRUD construction teams supported through local and national contractors to ensure that works are completed to a high standard and specifications. This will be carried out in close coordination with Component 4.

The support would also involve improvement and standardisation of designs and O & M practices. In the case of improved pump station design, the aim would be to equip RSU teams to support projects with planned and routine maintenance and the stocking of routine spare parts. They would also be equipped to carry out such tasks as pump alignment, replacement of gland packing of pumps, shaft sleeves etc. The team would also be able to support HQ in the event of any major problems.

Considerable multidisciplinary and experienced technical assistance support to the PIPs will be needed to improve planning and design approaches. By delivering this support at regional rather than union level, the capacity of the regional units will be enhance both to assist other PIPs but also to be able to prepare designs for damaged works as part of the routine maintenance backup to the PIPs. Improved technical approaches and more detailed design will be introduced through a series of training sessions linked to an improved technical design manual. At the field level, implementation will be improved through targeted practical training for farmers, water users associations, site staff linked with more formal technical training of high-level professionals. Not only will this benefit the four target PIPs, it will also assist WRUD and the regional governments in the proposed handover of smaller pump stations to the Regions.

All PIPs will require a full set of redesign and technical support documents to facilitate approval by LIFT of the funds for rehabilitation and upgrading and to ensure that designs have been developed with full involvement of the beneficiary farmers through their WUAs. The rate of implementation that is considered feasible is given in Annex B. LIFT will provide capital investments for improvement/upgrading of the physical infrastructure of the PIP facilities including investments in MEICA to improve the efficiency and performance of pumps stations and associated equipment to reduce long term O&M costs.

Output 1.1. Four PIP Project Designs and Implementation Plans for rehabilitation and upgrading of selected PIPs

The implementation of this part of the Component will be achieved through the technical support and guidance to be provided by the technical assistance delivered through the RSUs. The periodic inputs from these TA's will facilitate the preliminary information and data collection necessary for the preparation of detailed designs for rehabilitation and upgrading. The TA staff will not execute the work themselves but will work as a team with the technical staff of WRUD assigned to the RSUs and also located on the PIPs. The design of the improvement works for each PIP will be carried out separately but certain schemes such as Kanni PIP can proceed relatively quickly as the works required are relatively straightforward.

Output 1.2. The concept of whole life period introduced into the preparation of detailed designs relating specifications and capital costs and anticipated life period and to ultimately reduce annual O, M & R costs

An important part of the design documents is the production of standard specifications for both civil and mechanical works for the PIPs. These will provide the means for quality control of the works and staff will be trained on each of the PIP sites to understand the meaning and requirements of the specifications. In addition to this, to improve the quality of supervision, standard contract management and construction manuals (CMM) will be prepared and introduced for implementation of the rehabilitation and upgrading proposals. Staff will be trained on the four priority PIPs on how to use these documents to improve quality control of the works undertaken.

In the implementation of these aspects of Component one, not only will regional and PIP staff the closely involved in the production of the documents and how to use them, suitable members of the farming community and WUOs will also be trained so that the quality of maintenance will be improved both when handled by WRUD and when parts of the system had been handed over to the WUAs. The concept of asset management will be introduced to the WUAs and to WRUD so that sufficient attention is given to the need to provide adequate funds on a regular basis for the MOM of all aspects of the systems. Again this will be done in close collaboration with Component 3.

Output 1.3. Production of standard design and construction and O&M manuals for WRUD.

During the course of the preparation of the plans for rehabilitation and upgrading of the selected PIPs (Output 1.1), the RSU technical staff will prepare design modules and guidance leaflets that will lead to the production of a

standard design manual for the improvement and upgrading of PIPs. They will also produce technical inputs into an operation and maintenance manual for each scheme that will assist the RSUs to implement regular and systematic annual and preventative maintenance programs. This will be done in close collaboration with Component 3.

The deficient details identified during the formulation mission (**Error! Reference source not found.**Working Paper 1& 2) will all be addressed in these design manuals to ensure that equipment specifications are more accurately prepared to better suit the particular requirements of the designs and that pumping equipment and canal designs are compatible and fully integrated.

Standards for pump station design, operation and maintenance will also be produced to overcome many of the problems that have been identified.

Output 1.4. Improved layout and distribution system for on-farm works

Particular attention will be given to the layout of canals, structures and drainage of the on-farm systems of the PIPs. This will aim to improve the availability of water at on-farm level and to ensure the more logical and efficient connection of the on-farm systems to the main, distributary and lateral canal systems. Water measurement and control structures will be introduced at strategic points to ensure water user organisations (WUOs) are fully aware of how much water is being diverted to the farm systems and how it is being utilised. This will facilitate proper scheduling of irrigation water so that equitable and timely supplies of water are delivered to all farms.

This part of the Component will be closely linked with the on-farm water management proposals contained in Component 2 and Component 3. Designs will be related to feedback received from the field and WUOs during the initial detailed re-design stage of the rehabilitation process so that on-farm delivery systems are capable of providing water in a timely and appropriate manner for the chosen irrigation methods.

Output 1.5. Improved reliability of water supplies to the farm gate.

The designs prepared for the rehabilitated and upgraded conveyance and distribution systems will be prepared considering the water requirements of different cropping patterns. There will be sufficient flexibility incorporated in the canal designs to enable the possibility of inclusion of high-value horticulture in the future and alternative crops that depend upon consistent water supply. This will be closely linked to the work of the RSU under Component 2 and Component 3 to ensure that technical support is provided by the RSU to WUOs to improve the level of system management and operation on a regular basis. Annual inspections of the system to identify areas with problems or constraints will be conducted and measures for preparing plans for improved MOM will be illustrated and explained to the farmers and the water user organisations.

Through the involvement of the regional WRUD and the secondment of senior WRUD staff to the RSUs, it is anticipated that the details and measures incorporated in the rehabilitation and upgrading of the priority PIPs will naturally extend to other PIPs through the capacity building carried out through the interaction of the technical assistance and the National technical staff at the RSUs.

(b) Component 2. Crop Diversification and Best Management Practices in Farming Systems

This Component will be centred on providing improved crop technologies and practices that are not only more profitable but more socially and environmentally sustainable. Recommendations for crop diversification with alternative cropping patterns to the rice based monoculture will be proposed together with training and demonstration of new technologies that could be adopted, soil fertility assessments and analysis of the value chain. This agricultural support for the PIP farmers will provided by suitable qualified NGO staff assigned to each RSU. These organisations have shown their experience in dealing with communities and transferring ideas and appropriate technology successfully to them. They have developed means for capacity building of both individual farmers and their organisations and the transfer of appropriate technology and messages relating to better agronomic practices.

There will be a number of outputs achieved as result of the input from the RSUs and the services provided to agriculture from that unit.

Output 2.1: Improved level of extension service and support to farmers on PIPs provided through enhanced service delivery by INGO service providers in cooperation with DAR and RSUs

This objective will seek to develop the skill set of farmers to aid them with improved crop production through

training in a farmer field school environment involving technical transfer workshops, in field practical teachings, one on one extension support, and capacity building through field trips to other PIPS and DAR Research farms. *Farmer training groups* are an effective means of continuous extension to farmers. They provide momentum by meeting once per month during the growing season of each crop and providing training on topical issues. Set training is provided but it also gives farmers a chance to interact with each other and discuss as a group the issues they are facing in their farming systems. It creates a bond between farmers and also integrates the extension agronomists seamlessly into the environment. A range of topics will be covered (Working Paper 3) and it is envisaged that at certain points throughout the year (3-4 times), an international expert will assist short term capacity building. An important part of this will be technology transfer workshops that will take the place of the regular farmer training groups for that session and involve more technical information on a given topic. The international technical expertise that will be provided to RSUs will comprise an experienced Agronomist, a Water Users Association expert, and I & D Engineer and a Mechanical Engineer.

Field days would also be conducted at a strategic point within the growing season of each of the 3 cropping windows. These provide valuable extension to a wider group of farmers who can visually assess the current trials and demonstrations and discuss project results to date. These days provide a good reference point for assessing farmer evaluation of technologies on display and project progress.

Based on past experiences in Cambodia and Australia and trial data for Myanmar from an ACIAR project, it is assumed there will be strong uptake of the rhizobial inoculation technology by farmers on the PIPs. Trials to demonstrate the effect of rhizobium on yield of legumes are proposed for PY 1 & 2. If these are successful then rhizobium packages will be rolled out to farmers in PY 3 & 4. This will coincide with a *technology transfer workshop* on correct application of inoculants to seed and planting technique before each sowing window commences.

Publications will be produced over the course of the 4 year project and extended through farmer training groups, WUAs and RSUs. A publication outlining the best management practices for irrigated agriculture on the Ayeyarwaddy River should be published by the conclusion of the project.

Output 2.2 Links established with DAR and other research projects to provide improved varieties for evaluation on PIP trial sites and farmer access to seed

This aims to provide varietal evaluation of alternative crops through on farm small plot replicated trials to identify locally varieties adapted to irrigated conditions. Trials would include locally farmer grown varieties, several varieties of each crop species, commercially available varieties and experimental lines close to release. Locating such trials within the PIPs enables farmers to see first-hand the varieties growth habits and characteristics. Farmers identified preference coupled with yield and quality results will facilitate the short listing of varieties suitable for local conditions and favoured by the farmers.

This gradual introduction to improved varieties encourages farmers to introduce them into their farming systems, leading to higher yields and product quality and hopefully greater returns. Such trials therefore need to be coupled with improved access to the seeds and this could derive from close collaboration and supervision by DAR working with RSU staff. It is envisaged by PY4, farmers would be growing the first of the recommended varieties.

Inter PIP exchange visits by project farmers will be an essential part of the knowledge learning process by the farmers. These will include interaction and discussion between farmers relating to trials and demonstrations in the same region and different cropping patterns, soils and PIP design in the other region.

Output 2.3 Opportunities and technologies for sustainable irrigated crop production systems in the context of declining soil fertility and moisture conservation evaluated, demonstrated and extended

The agricultural Component will focus on participatory action research through a series of on farm demonstrations and small plot replicated trials in each of the PIPs, aimed at learning by doing in a joint venture between project staff and farmers to manage the trials. One major irrigated trial site per priority PIP is proposed with a series of trials and demonstrations co-located in each cropping season (see Working Paper 3, Annex J for timeline of events). Trials will include evaluation of new technologies for adoption including varietal improvement, rhizobial inoculation of legumes, nutrient management, integrated weed, pest and disease management, mulching and no tillage systems.

Currently there is an absence of detailed soil information relating to the priority PIPs. Soil surveys will need to be

carried out across each PIP to determine their current status and soil type classifications. Re-sampling should be conducted on the same sites in the final year of the project across each of the PIPs to determine their status with regard to soil sustainability indicators. Various activities for the RSUs project staff have been detailed in Working Paper 3. As the project proceeds, additional specific requests may drive and need to be followed up by demonstrations. These may involve demonstrations on how to improve the planting or cultivation of monsoon rice or alternative monsoon and summer crops. This will be carried out in close collaboration with the farmer to encourage greater interest in the technology and early adoption. Such demonstrations are simple, low cost and extremely effective.

Output 2.4 Assess, develop and introduce options for crop diversification and adaptation of alternative crops to rice based farming systems to improve cash income to farmers on the PIPs

The evaluation of alternative crops and cropping patterns for diversification of irrigated crops in the CDZ together with agronomic management of new crops and alternative management systems for rice will be closely linked with all of the preceding outputs. RSUs staff will work closely with farmers to identify factors affecting such evaluations including agronomic and economic constraints. An important aspect of this section is that farmers will be educated in whole farm production systems, crop sequencing options, crop budgets and methods to increase cropping intensities.

Output 2.5 Develop an understanding of the livelihood of current and alternative whole-farm crop-livestock production systems with regards to potential for a shift in cropping intensity and the status of the value chain to support agricultural change with linkages to end users and potential markets

This will be directly related to the baseline survey planned at the initiation of the project. This could be covered by a specialist NGO or by using in-house expertise contained within the contracted partner INGO. Such surveys require good design, implementation and analysis and it is essential that organisations with such previous experience are contracted. Data collected at project start-up provides an invaluable foundation of information to assess the farmers starting base and enable changes over time to be measured. It will further highlight priority areas that need to be addressed by the project and will provide an analysis of existing market value chains and identifies gaps in the chain.

(c) Component 3: Improvement of Management, Operation and Maintenance (MOM) of PIPs

The basis for improved MOM of the PIPs through the enhancement of existing WUOs exists on all PIPs. However, there is little experience currently in Myanmar on how to achieve greater farmer involvement especially in the timely, equitable allocation and distribution of water. This Component will be achieved through the provision of short-term targeted inputs supporting the RSUs. The framework for future effective WUOs will be based on the existing organisations through the establishment of groups and committees at different hydraulic levels[17]. This is explained in detail in Working Paper 4 and the accompanying annexes.

WUA formed at PIP level will be the main channel for farmers to liaise with staff of the regional and district WRUD offices to ensure that the MOM of the entire PIP, in particular the pump and MC system, are carried out properly. This is also the most appropriate channel to establish functional linkages with both governmental and non-governmental service providers. By maintaining close relationships with the local administration, including the village leaders, village tract administrator and township administration they can be closely informed about the functioning and performance of the PIP together with any problems encountered during the O&M of the scheme.

The support that will be provided for the strengthening of MOM and WUAs will include the establishment of appropriate organisational structures together with appropriate composition and functions of the management committee and subcommittees, including measures for electing of members and convening meetings.

Contributions towards improved service delivery are an essential part of the enhancement process and the modalities for the Irrigation Service Fee (ISF) will be examined with all involved with aim of greater involvement of the farmers in the full MOM costs including WUA management costs (office costs; meeting costs; specialist support) and Fixed contribution to WUA Reserve Fund for emergency repairs or future rehabilitation of I & D infrastructure.

[17] Water Users' Groups (WUGs) at level of one or more LCs (tertiary level); Water Users' Committees (WUCs) at level of each DYC (secondary level); and Water Users' Association at level of PIP (primary/main level).

Detailed below are the range of estimated outputs that will contribute to the overall strengthening and involvement of the WUOs.

Output 3.1 Formation of effective farmer-managed WUOs at LC, DYC and PIP level

This involves the formation of farmer-managed WUA formed at PIP level with necessary institutional, administrative and financial skills to be managed in effective, efficient, transparent and accountable manner and responsible to plan, coordinate and supervise O&M of MC in collaboration with WRUD. (Model) Statutes will be prepared for the WUA at this level and options to legally register the WUA will be examined. This involves a detailed institutional assessment of all existing WUOs in PIP command area and based on the results obtained, a restructuring of existing groups and committees at all three levels into farmer-managed WUOs. Where WUOs do not exist, new farmer organisations will be established. To facilitate the functioning of the WUA, an equipped WUA office will be established. It is estimated that approximately 276 WUGs, 26 WUCs and 4 WUAs would be operational in the command area of the 4 PIPs by the end of the project.

It is important that the WUA to be formed at PIP level has an office at a centrally located and easily accessible location within or close to the command area to have: a) working place for the WUA office bearers (i.e. Chairman, Secretary and Treasurer); b) convenient venue for conducting meetings, including the monthly meetings of the WUA Management Committee and any sub-committee formed; c) accessible place where all important information and decisions are published on a notice board; d) secure place to store all WUA files, cash money and any equipment owned and/or leased by the WUA; and e) suitable venue for conducting training sessions for members of the WUA Management Committee and any sub-committees. The WUA Office will be the focal point where farmers can (a) acquire information about the O&M of the I & D system and the management of the WUA itself, (b) inform the WUA about any O&M problems, (c) pay their ISF and/or any imposed fines, and (d) review any WUA records.

Output 3.2 Effective WUCs and WUGs formed at respectively DC and LC level responsible for O&M

This targets both WUOs and WRUD to ensure that they are well equipped to handle the greater involvement of the farmers in the MOM of the PIPs. The support that will be provided relates to WUA at PIP level in administrative and financial management, all WUOs in O&M skills and water management, and WRUD staff in effective and efficient O&M of pump stations and MC system. The overall aim of the proposed capacity building programmes is to ensure that the WUA, WUOs, WUCs and WUGs and concerned WRUD staff have all the necessary technical, managerial and administrative skills and knowledge that are required for the effective and efficient MOM of the PIP. A range of the capacity building topics including (i) Administrative and Financial Management, (ii) Maintenance, and (iii) Operation and water management are detailed in Working Paper 4 together with planned WUO and WRUD capacity building activities (WP-4, Annex H) and Guiding Principles for Effective Capacity Building (WP-4, Annex I).

Output 3.3 Rules and procedures for efficient and equitable allocation and distribution of canal water adopted and implemented at all levels by WRUD and WUOs

Improvement in the operation of the water conveyance and distribution system can only be achieved if adequate measuring and control structures are in place. Under Component 1, these will be provided at key locations within each PIP to facilitate daily recording of water levels. This will enable the identification/rectification of operational constraints that are present in the MC system and DYCs and will lead to the formulation of improved operation plans (rules and procedures) for I&D system based on seasonal water availability, irrigation efficiency and adopted cropping patterns. Once these have been agreed between WRUD and WUA, they will form the basis of an Irrigation Service Contract between the two organisations.

For effective distribution of water at on-farm level, the network of lateral canals needs to be completed and connect with an effective quaternary and watercourse system. Under Component 1, farmers will be closely involved in identifying the most appropriate locations for structures and outlets to farms and also in making contributions to the construction of the low level canals.

In close cooperation with component one, appropriate O&M Manuals will be prepared for the various levels of the I&D systems of the PIPs.

More details of the above are available in Working Paper 4 and its supporting annexes.

Output 3.4 Improved OFWM through appropriate water-saving techniques and practices at farm level

The improvement of OFWM will be achieved through capacity building developed and implemented through the WUGs aimed at enhancing field application efficiency, distribution efficiency and operational efficiency at farm level by reducing unnecessary wastage of available irrigation water. The activities involved will include an assessment of existing OFWM techniques and practices, including application efficiency, the introduction and demonstration of improved OFWM techniques and practices and the provision of training in improved OFWM techniques and practices to farmers through WUGs. The OFWM capacity building programme for farmers is expected to include improved land levelling, dissemination of information on water requirements for different crops and recommended number of irrigations during the cropping season and the introduction and promotion of appropriate alternative irrigation methods. It is envisaged that demonstrations of various water-saving techniques and practices will be planned and carried out as part of the demonstrations envisaged under Component 2.

Output 3.5 Improved financial sustainability of PIP

Financial sustainability can only be achieved if the detailed requirements for MOM have been established and funds collected and allocated to each item. This will depend upon the service level determined by the WUOs and a detailed assessment of anticipated operation and running costs for the pumping stations and all of the conveyance and distribution canals. Once the service level has been determined by the WUOs, the levels of payment that will be necessary from the farmers can be determined. This will then be related to the financial ability of farmers to meet the anticipated costs by providing cash and/or labour. An assessment will be made of how irrigation service fees (ISF) could be collected and in relation to the payment ability of the farmers, how the new ISF could be introduced and phased aligning with the predicted increases in crop revenues.

(d) Component 4. Training and Capacity Building

This is the most important Component of the proposed project as if successful, it will have a direct impact upon the improvement of the performance of the PIPs. The training and capacity building will utilise the rehabilitation upgrading process to improve the approaches to the designs of the PIPs to that staff are fully trained and equipped to understand the necessary changes being recommended and be capable of applying the improvements elsewhere. Many of the middle and lower staff from WRUD have limited experience in practical design and implementation of PIPs and few of the WRUD staff has received training or experience in irrigated agriculture. The involvement of the farmers in the re-design of the systems will be essential for ensuring the sustainability of the rehabilitation and upgrading of the PIPs. The hands-on on-the-job training will be provided through the short-term international and longer term national technical assistance provided to the RSUs. They will act as trainers utilising modules developed through the rehabilitation and upgrading process of the irrigation schemes. Under this assistance, a range of technical disciplines will be engaged to provide the full range of skills necessary for the redesign process (section 6.4). Through this process is envisaged that the capacities of Regional and PIP staff will be enhanced and provide long-term sustainable support to the PIPs. An essential part of this on-the-job training will be the improvement of agriculture support, MOM and WUOs and improved on-farm water management.

For longer-term sustainable development it is essential that training links are made with established institutions such as Yezin Agricultural University, State Agricultural Institutes, Irrigation Training Centres and the Central Agricultural Development and Training Centre. Links should also be established with the Department of Agricultural Research (DAR) and research farms. Although it is not anticipated that large amounts of funding will be available at this stage to support this, it is hoped that additional funds will be made available through LIFT donors to reintroduce irrigation into the curricula and ensure that training is geared towards delivery of graduates with skills appropriate to the future needs of the I & D sector. In Table 12, the immediate short term training courses covering all relevant disciplines and proposed for staff and farmers are provided. This will be linked closely with the proposals for longer-term sustainable training and capacity building discussed in Working Paper 6.

Table 12. Training and Capacity Building (2 RSUs)

	DESCRIPTION		Unit	Quantities				
				2013	2014	2015	2016	Total
				PY1	PY2	PY3	PY4	
1	I&D Rehabilitation	7 days short course	sum	2	2	0	0	4
2	Design of an I&D System	7 days short course	sum	2	2	0	0	4
3	Flow Measurement	5 days short course	sum	2	2	0	0	4
4	O&M	7 days short course	sum	0	2	2	0	4

5	Operation Plan	3 day short course	sum	0	0	2	2	4
6	O&M Manual for System	3 day short course	sum	0	0	2	2	4
7	Pumping System Design / Specification	5 days short course	sum	2	0	0	0	2
8	OFWM	3 day short course	sum	0	2	2	2	6
9	O&M and Water Management - WUO	3 day short course	sum	0	1	2	2	5
10	Audit, Admin, etc,- WUA	3 day short course	sum	0	2	2	2	6
11	Technology transfer workshop (Agric)	3 day short course	sum	0	8	0	8	16
12	Technology transfer workshop (Agric)	2 day short course	sum	8	12	8	12	40
13	Technology transfer workshop (Agric)	1 day short course	sum	0	0	4	4	8
14	Farmer field school	1/2 day short course	sum	28	28	28	28	112
15	Field day to inspect trials and demos	3 per year	sum	12	12	12	12	48
16	Extension Publications	BMPs for irrigated crop production	No	1	1	1	1	4
17	Other Extension Publications	All technical topics	No	2	2	2	2	8
18	Translation of publications		sum	1	1	1	1	4

5. PROJECT BENEFITS, COSTS AND FINANCING

The financial and economic analysis seeks to assess the viability of the proposed investments in improving the efficiency and effectiveness of PIPs in the CDZ. The analysis includes a full breakdown of the proposed project costs, details of operation and maintenance (O&M) costs that will continue beyond the four years of investment and the benefits that will accrue. The purpose of the financial analysis is to assess the net financial benefits expected to accrue to the farm household as a result of the investments made. The economic analysis assesses the viability of the project from a national point of view, including full economic costs not covered by the financial analysis, such as the cost of water.

The results show that with rehabilitation and upgrading of the PIPs, supported by parallel capacity building and training and strengthening of the village communities through their Water User Organisations, have considerable potential for agricultural development driven by improved irrigation with an EIRR of around 17% and an estimated increase in farm household income by as much as three times in some of the poorest areas.

The success of the project will, however, hinge upon two critical factors. Firstly, the Government of Myanmar (GOM) must ensure that adequate provisions are made to support the operation and maintenance of the PIPs, as well as the project offices and extension services, in the years following the four-year project life. Secondly, further progress must be made in ensuring that farmers have free choice of crops, so that the cultivation of loss-making rice is no longer obligatory.

The detailed cost tables to facilitate either 100% financing by LIFT or part financing through NGOs is accommodated in the tables prepared in this chapter of the report. To facilitate this process, the location of the relevant cost tables is presented in Table 13.

Table 13. Location of Project Costs/Benefits and FIRR and EIRR Tables

Terms of Reference Requirement	Location
Project budget and detailed cost tables	Summarised in Table 5.2. Detailed tables in Working Paper 7, Annex B.
Financial analysis of the proposed interventions	Summarised in Table 5.5 Detailed tables in Working Paper 3, Annex E.
Economic analysis of the proposed interventions	Summarised in Table 5.7 Detailed tables in Working Paper 7, Annex D.

5.1. Financial Analysis

(a) Costs

Project costs were compiled using information obtained during the field mission, data provided by WRUD and other Government Departments, NGO field and project data and from a range of on-going NGO projects. As the

project is tax-exempt, all costs shown are before tax. An allocation of US$100,000 has been included for supporting the extension of microfinance services to the PIPs[18]. A summary of the total project costs is presented in Table 13, with base costs totalling just over US$8 million. Detailed cost tables for each Component are included Working Paper 7. The on-going reform programme in Myanmar is likely to see significantly increased capital flows into the country strengthening the Kyat against the US Dollar, whilst strong growth should drive higher inflation than recent years. The price contingencies in Table 14 reflect these phenomena. Details of the underlying macroeconomic forecasts are included in Working Paper 7, Annex A. Physical contingencies for all civil and MEICA works are included at 5%.

Table 14. Total Cost Summary by Year

	Costs (US$)				
	2013	*2014*	*2015*	*2016*	*Total*
PIP Rehabilitation	1,064,042	2,340,673	775,507	189,654	4,369,876
Project Implementation Unit	79,250	73,550	73,550	73,550	299,900
Technical Assistance and RSUs	1,162,150	983,450	683,200	529,200	3,358,000
Training and Capacity Building	29,800	40,440	28,800	27,640	126,680
Subtotal (Base Costs)	2,335,242	3,438,113	1,561,057	820,044	8,154,456
Physical Contingencies [1]	*48,035*	*111,866*	*33,006*	*..*	*192,906*
Subtotal *(Base + Phys Contingencies)*	*2,383,277*	*3,549,979*	*1,594,063*	*820,044*	*8,347,362*
Price Contingencies [2]	*81,686*	*209,715*	*132,164*	*88,415*	*511,980*
Total *(Base + All Contingencies)*	**2,464,963**	**3,759,694**	**1,726,227**	**908,459**	**8,859,342**

[1] A physical contingency rate of 5% has been applied to all civil works. All other costs have been exempted from physical contingency calculations.
[2] Price contingencies reflect expected Kyats/US$ inflation differentials and exchange rate forecasts. All macroeconomic forecasts were obtained from the IMF World Economic Outlook and the Economist Intelligence Unit. Price contingencies are omitted from the cost-benefit analysis to ensure that all cost-benefit streams are in constant 2012 US$, but are included in the financial analysis to reflect the likely increase in nominal costs faced by the project in later years.

Beyond these costs, a number of recurrent costs will continue after the four-year life of the project but have not been included in the project cost tables as the Government of Myanmar (GOM) is expected to cover them. These costs include the operation and maintenance of the PIPs, the continued running of the Project Implementation Unit (PIU) and the two Regional Support Units (RSUs) and a range of training and extension services. They are summarised in Table 15 with full costings included in Working Paper 7, Annex C.

Table 15. After-Project Recurrent Costs

(a) Direct PIP Costs

	Annual Cost (2012 US$)		
	Per Acre	*Acres*	*Total*
Pumping (Average) [1]	**21**	**6,890**	**142,404**
Pumping (Myinkun)	*17*	*550*	*9,240*
Pumping (Kanni)	*25*	*590*	*14,514*
Pumping (Pyawt Ywa)	*20*	*5,000*	*102,000*
Pumping (Satpagon)	*22*	*750*	*16,650*
O&M	**25**	**6,890**	**172,250**
O&M: Pumps and main canal	*19*	*6,890*	*129,188*
O&M: Distributary and lateral canals	*6*	*6,890*	*43,062*
Total	***46***	**6,890**	***314,654***

[1] Pumping costs based upon 3 acre-feet of water per acre per season. The programme for improvement of WUO and MOM (Working Paper 4) aims to encourage farmers to participate more fully in O&M costs. The items to be included in this transfer of obligations will be discussed during project implementation.

(b) Other Recurrent Costs

	Annual Cost (2012 US$)	Cost per Acre (2012 US$)
Project Implementation Unit	24,050	3
Regional Support Units	133,700	19
Training and Capacity Building	15,320	2

[18] More details of the existing credit market limitations and the need for microfinance are included in Working Paper 5.

Total	*173,070*	*25*

(b) Benefits

The estimated annual benefits of each PIP and for the project are presented in Table 15. Details on the crop budgets, farm models, and detailed with-project scenarios that were used to arrive at these estimates are included in Annex E of Working Paper 3. For the with-project situation, potential future yields and prices were estimated for each crop and input costs adjusted accordingly. Suggested crop rotations were established for each PIP and the best performing rotation was selected for determining the project gross margins and potential benefit. Three scenarios were modelled illustrating the impact on the project of Government's policy on choice of crops and especially rice cultivation. At present, farmers are obliged to grow rice whenever sufficient irrigation water is available in both the monsoon and summer seasons, with most farmers making a financial loss on the crop Working Paper 3). Under the best-case scenario where farmers are given free choice of crops in all seasons, the average annual net benefit per acre will be US$491, compared to just US$130 in the event of farmers continuing to grow rice in both the monsoon and summer seasons.

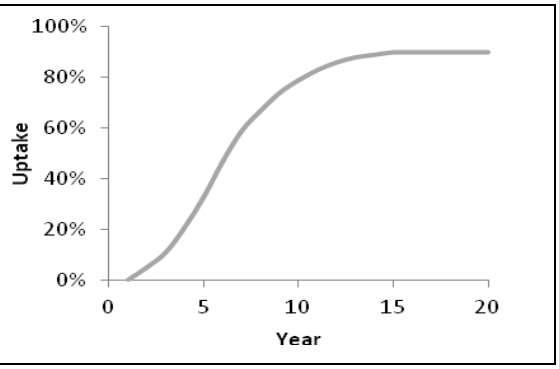
Table 16. Estimated Net Benefits under Crop Choice Scenarios

PIP	Acres	[A] Without Project Gross Margin per Acre (US$)	[B] With Project Gross Margin per Acre (US$)			[C] Annual Potential Benefit per Acre (US$)		
			S1	*S2*	*S3*	*S1*	*S2*	*S3*
Myinkun	550	356	1,009	857	440	653	501	84
Kanni	590	282	911	593	512	629	311	230
Pyawt Ywa	5,000	767	1,241	1,104	904	475	337	138
Satpagon	750	871	1,241	1,104	904	371	234	34
All Sites	6,867	704	1,194	1,041	834	491	337	130
Note: Data obtained during the field visits and the farmer field surveys established the without-project situation.								
Scenarios								
S1	Farmers have free choice of crops in all seasons.							
S2	Farmers are obliged to grow rice in the monsoon season but are otherwise free to choose.							
S3	Farmers remain obliged to grow rice in both the monsoon and summer.							

The build-up of benefits assumed in Table 16 has been assumed to follow an 'S-curve' over the life of the project. Initial uptake by farmers will be relatively slow with the greatest gains occurring from PY4-PY8, when PIP rehabilitation works are completed and farmer farming improvements have gathered momentum (Table 17). By PY10, further gains are expected to slow having reached around 80% of potential benefits.

Table 17. Project Benefit Realisation Curve

Year	Uptake	Year	Uptake
1	0%	11	83%
2	5%	12	86%
3	11%	13	88%
4	21%	14	89%
5	33%	15	90%
6	47%	16	90%
7	59%	17	90%
8	67%	18	90%
9	74%	19	90%
10	79%	20	90%



5.2. Economic Analysis

The economic internal rate of return (EIRR) was determined by removing price contingencies from total project costs to ensure that all cost and benefit streams were in constant prices (2012 US$). Total costs were included before tax to ensure that no transfer payments are captured. The after-project recurrent costs from Table 5.3 were also added to the cost stream. Direct PIP operating costs from panel (a) of Table 5.3 were included for the full 20 year life of the project as the benefit stream is dependent upon them at all times, whilst the other recurrent costs in panel (b) of Table 2 were only included until Year 10, when 80% of benefits should have been realised. In the two rice-growing scenarios, the pumping costs were increased to reflect water requirements of 4 acre-feet for monsoon rice and 6 acre-feet for summer rice. The average annual potential benefits per acre were scaled

according to the 'S-curve' in Table 5.6 and applied to the 20-year project lifetime.

The resulting EIRR are presented in Table 18. With the free-choice Scenario 1, an EIRR of 17% derives. Whilst Scenario 2 (where rice is only grown in the monsoon) has a reasonably high EIRR, this results largely from the influence of the Sagaing PIPs. These make up over 80% of the total project area and have some of the better soils in the CDZ that are more suited to the cultivation of rice in the monsoon season and requiring around 25% of the number of irrigations applied on other PIPs. If the growing of rice is extended to both seasons, Scenario 3, the investment becomes economically unfeasible assuming an opportunity cost of capital of 12%. The full cost-benefit streams are presented in Working Paper 7, Annex D.

Table 18. Economic Internal Rates of Return (EIRR)

Scenario	Potential Benefit per Acre (US$)	EIRR
1	**491**	**17%**
2	337	10%
3	130	-5%

(a) Sensitivity Analysis

Using a 12% discount rate, in the best-case scenario of free crop choice the project could sustain a 22% decrease in benefits or a 37% increase in costs before becoming economically infeasible (Table 20). If potential benefits have been overestimated by 10%, or costs underestimated by 10%, the EIRR would fall to only 15% showing that the project would still be economically feasible. A 10% lower uptake amongst farmers has a similar effect (Table 19).

Table 19. EIRR Switch Values at a 12% Discount Rate

	Switch Value		*Actual Value*
Benefits	-22%	US$383/acre	*US$491/acre*
Costs [1]	+37%	US$11.4 million	*US$8.3 million*

[1] *Total costs including physical contingencies but excluding price contingencies.*

Table 20. Sensitivity Analysis

Variations on Scenario 1		EIRR
[1]	Potential benefit 10% lower	15%
[2]	Potential benefit 20% lower	13%
[3]	Costs 10% higher	15%
[4]	Costs 20% higher	14%
[5]	Uptake 10% lower	15%
[6]	Uptake 20% lower	13%
[7]	Only 25% uptake	0%
[8]	*[1]* ***and*** *[3]*	14%
[9]	*[2]* ***and*** *[4]*	11%
[10]	*[2]* ***and*** *[4]* ***and*** *[6]*	8%

For more details see Working Paper 7.

Continued support by the GOM or other financiers for the project beyond its planned 4-year lifespan is of critical importance. The benefit stream used in calculating the EIRR assumes a continued programme of training and capacity building, supported by the RSUs and PIU, running until 2022. Without this support, it is unlikely that uptake will progress far beyond its end-of-project level in 2016. Scenario 7 in Table 5.9 shows that such an eventuality would generate a rate of return of 0%.

Whilst the benefit stream in the EIRR captures the direct financial benefits to PIP farm households, there are also likely to be a number of indirect benefits that have not been captured here, such as improved nutritional status of farm households and knowledge spillovers to other local farmers. These would both increase the EIRR.

Whilst no distributional weights have been applied to the benefit stream, it is worth noting that the project has the potential to bring substantial benefits to some of the poorest CDZ farm households, particularly in the Magwe Region.

6. IMPLEMENTATION AND INSTITUTIONAL ARRANGEMENTS

6.1. Proposed operational organisation and management arrangements

One of the key problems facing the productivity in the CDZ is the lack of practical support to farmers who are not located on government model farms. Even when the MAS existed, the services that were provided were directed towards rice production and had minimal impact on ordinary farmers who were unable to access quality seeds and the supporting inputs. Some MAS staff was trained in other crops but was inadequately resourced to be able to offer regular and sustainable support to farmers. Engineering related problems can be solved but for farming and community training related issues that relate need continual support, attention has to be given to the provision of this support especially in the short term. It is unlikely that the Department of agriculture will be able to provide continuous and regular support to the PIPs during the project life.

This led to the decision to suggest the formation of a separate organisation outside government structure but working closely with the respective players both in and out of government (WRUD, DA, NGOs, Regional Governments, and LIFT). The pumped irrigation projects are currently supported by three regional governments and the respective divisions from the ministry of agriculture and irrigation. These have no real autonomy and are unable to make the necessary technical and financial decisions without referring them to the union ministry. In addition to this, the support provided at regional level is geared towards immediate operation and maintenance decisions and there is no experience design capability outside Union level.

The prioritisation exercise indicated that the preferred PIPs could be grouped together by region and therefore would be well served by establishment of regional support offices or units. It had been originally considered that three Regional Support Units (RSUs) would be established in the CDZ however considering the budget needed and the amount of work involved, it was considered more feasible to start with two RSUs for this first LIFT project to support the PIPs (see Section 6.3).

One of the key considerations is the mechanism to provide required support services directly to the PIPs with the minimum amount of bureaucracy and to ensure good communication and a full range of experienced advice. As experience has shown, if reliance is put upon government departments to provide the required services, it is likely to follow a very top-down approach and not be provided in a timely manner. By channelling the services through the RSUs where all the service providers would meet and provide the services needed to the PIPs in a coordinated and timely manner and most importantly with the RSUs is having their own budget, the type of services and the time for provision of these services can be controlled and coordinated to meet farmer and farming needs.

Non-Government Organisations

LIFT has experience with working with NGOs in the CDZ to channel services and resources to the farming communities. Past restrictions has meant that until recently such services have not included the type and level of services required for the proposed LIFT project. However, the NGOs have however good experience of working with the communities particularly in the CDZ and this has been an important consideration in the proposed organisation. What also has to be considered is the short and longer term sustainability of such an organisation that will be stand-alone and remain after the project completes its input. The political future is still uncertain and therefore to put such a proposed project within the government organisation is very risky and certainly would jeopardise the community driven proposals that are contained in this report. If funds are delivered directly to government, it is likely that a target driven top-down approach would derive even though the necessary assurances may be given.

A wide range of services are needed and proposed to improve efficiency and effectiveness of the pumped irrigation projects in the efforts to improve the livelihoods of the farming communities living within the command area these projects. Many of these services are currently not available within government or if available, are not easily accessed at project level. In addition to this, WRUD has no professionals adequately experienced in irrigation and drainage engineering and support. There are such professionals available in the emerging private sector in Myanmar, but even they do not have the required level of experience needed due to the countries relative technical isolation for a long period. However, with guidance and support from international professionals who would work with them to upscale their practical knowledge, this local support base can be enhanced and ensure a longer term sustainability.

It has therefore been proposed that an international NGO should be recruited or appointed to run to RSUs, one in Magwe and one in Sagaing Region, and that these RSUs will be supported directly by funds from LIFT. They will be

required to deliver to the PIPs the appropriate services and to coordinate the inputs of other service providers including WRUD, DA and consultants or consulting firms. The past experience of working with NGOs has shown the need for them to be elevated to provide the higher level of services required for such a project. Although to date, some few NGOs have been providing the sort of services required by the project, discussions and interaction with them have shown that they need more experience professional technical support than are currently available. During the formulation mission, it was clear that experienced national professionals are available in the NGO community and are attracted them from government by the more favourable working conditions. Although these professionals are well trained and experienced, they have not been exposed to the type of situation that they will find themselves in this type of project. The proposed project therefore relies upon significant technical assistance during its four-year project period. The inputs for such TA have been minimised and by coupling each international TA with a national counterpart, sometimes from government and sometimes from the private sector, it is considered that the periodic inputs proposed (section 6.4) would be sufficient. The services of international technical assistance will be provided across the two RSUs whereas national technical assistance will be provided specifically to each RSU.

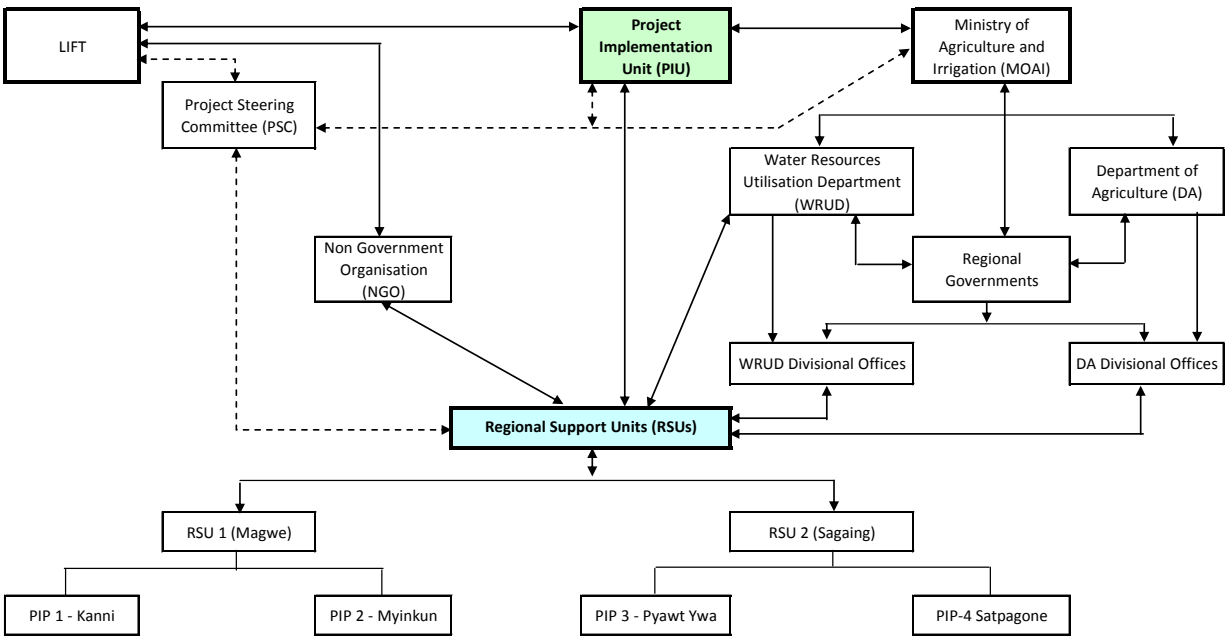
Project Steering Committee

The Project Steering Committee (PSC) chaired by the Deputy Ministers of MoAI will provide overall oversight of the Project. Its main responsibilities will include the review and approval of the annual report, work plan and budget for the LIFT Project as prepared by the PIU. The PSC is formed by representatives from WRUD, DA, LIFT/UNOPS, NGOs and be supported as necessary by co-opted members from specialised technical Departments and organisations such as Irrigation Department, Settlement and Land Records Department, SLRD and the Department of Agricultural Research (DAR). The national coordinator of the PIU will be the secretary of the PSC.

Project Organisation Structure

An Organogram is given in Figure 3 illustrating the proposals. Although such ideas were discussed briefly during the formulation mission, it was not possible to discuss these ideas in great detail with the decision-makers due to the internal conflict of ideas within MOAI. However, significant roles are given to the appropriate government departments of WRUD and the Department of Agriculture. To facilitate the coordination of the services for the project and particularly to focus those that need to be provided by government, it is proposed that a project implementation unit is established within MOAI (see Section 6.2). This would need to be staffed by a small core of experienced professionals who will probably be recruited from the private sector and be familiar with both government and donor procedures.

Figure 3. Proposed LIFT Project Organisation Structure



6.2. Project Implementation Unit

A Project Implementation Unit (PIU) located within the Ministry of Agriculture and Irrigation at Union level is proposed to ensure good communication between the various government departments and service providers and also to provide the main linkage between LIFT and government. Although the project would be implemented through an MOAI and in particular WRUD and DA, it would need to provide the mechanisms for the channelling of funds and services to the project sites. Many of these services will be delegated to the RSUs who would maintain direct contact and linkages with the PIU. The unit would comprise a professional staff of three (Table 21) who would be housed in offices provided by and serviced by MOAI in Naypyidaw. They will have their own budget for the full project period (see chapter 5) but it is intended that the unit would continue functioning beyond the project period and be eventually be absorbed into an MOAI in the absence of further donor support.

The PIU will provide the support to the implementation of the proposed project. It will facilitate the provision of technical assistance, equipment, staff, NGO services, equipping and improving Regional Support Units including office equipment, small equipment and transport. It will also ensure that support is provided to the improvement of procurement, quality of construction works through clear specifications and contract documents.

Table 21. National Level Project Implementation Unit (PIU)

Description			Unit	Quantities				
				2013	2014	2015	2016	Total
				PY1	PY2	PY3	PY4	
1	National Project Coordinator	INGO/National Consulting Firm	month	12	12	12	12	48
2	Procurement Officer	INGO/National Consulting Firm	month	12	12	12	12	48
3	Administrator/Finance	INGO/National Consulting Firm	month	12	12	12	12	48

The National Project Coordinator (NPC) would be the senior person responsible for and the focal person for the project. He/She would be in charge of the PIU and responsible for the key roles of coordinating between MOAI and LIFT and assist with liaising between WRUD and DA at Union level, regional and district governments and the PIPs. The RSUs heads will report directly to the NPC and all reports and work plans prepared by the RSUs would need to be submitted to government through the PIU. The NPC will also be responsible for preparing documents for the steering committee and arranging meetings and visits.

At the start of each financial/project implementation year, each RSU will prepare an annual work plan with corresponding budget, which must be approved by the PSC. Throughout the year, each RSU member will prepare and submit monthly work plans and progress reports to the respective heads of the RSUs for onward transmission to the PIU. To facilitate progress monitoring of the planned activities and the performance of the individual RSU members, it is recommended to put in place a simple management information system (MIS) at RSU level by the M&E expert and maintained by the RSU Coordinator. At the end of the financial/project implementation year, the RSU Coordinator will prepare an annual progress report in which the achievements will be compared with the planned targets.

6.3. Regional Support Units

The basic building blocks for the implementation of the project and for the services to be provided to the PIPs are the Regional Support Units (RSU). The purpose of the RSUs is to provide a full range of skills and approaches that are currently lacking in WRUD and MOAI and through this involvement increase their knowledge and understanding of the full development requirements for PIPs in Myanmar. The project will be implemented at regional level through the RSUs and these units will contain a range of disciplines and technical assistance to provide the identified services to the PIPs. WRUD will be part of the implementation process by seconding staff (and resources) to work part/full time with the RSUs. Although some of the Union level staff will probably work only part-time on the LIFT project, it is anticipated that significant benefits will be achieved on the other projects through the enhancement of the skills of all those working with the RSUs.

It is proposed that the project will fund the establishment and running (staff, equipment and facilities) of these RSUs in two regions (Magwe and Sagaing) and that these RSUs act as 'PIP Support Offices' for those PIPs located in their area. The RSUs will be the support base for all staff providing services (Engineering; Agriculture; Water Users Associations (WUAs); Management, Operation and Maintenance (MOM); Training;) to the PIPs under the proposed LIFT project. It is envisaged that agricultural support for the PIPs will be best achieved utilising the experiences of a suitably qualified international NGO (INGO) and reinforcing this capacity with additional specially

recruited well experienced technical staff comprising both international and national professionals (section 6.4). These organisations have shown their experience in dealing with communities and transferring ideas and appropriate technology at the township and community levels and have also developed the means for capacity building of both individual farmers and their organisations. However, in most cases they do not have sufficient experienced staff to handle an ambitious project of this nature with their current staff and technical support. As part of the project support, it is envisaged that during the lifetime of the project, such staffs are recruited under the project financing to provide the guidance, experience and driving force to provide the services indicated.

Although it had been intended that RSUs will be established in each region in the central dry zone of Myanmar, where investments would be made in PIPS, at the moment it is considered that there would be insufficient funds for this to be achieved. It is therefore proposed that if the project implementation in the two regions of Magwe and Sagaing proceeds satisfactorily, the additional region of Mandalay should be added later during PY2 or PY3. The main function of the RSU is to provide consistent and complete technical assistance and support to the two PIPs in each region and through the utilisation of targeted international and national technical assistance, assist with and enhance the planning, preparation, implementation and follow-up on activities related to pumped irrigation developments in Myanmar.

6.4. Technical Assistance

The international and national TA consultants will support both RSUs with the preparation, planning and implementation of the envisaged activities of each sub Component. This TA and support will be provided both at Regional and Union level. Based on detailed assessments of existing I & D infrastructure on the priority PIPs, the international TA consultants will develop appropriate guidelines, manuals and training materials in collaboration with the concerned RSU subject matter specialists and involving the WUA on each PIP. Prior to and during the implementation of the planned activities, the international TA consultants (Table 22) will provide formal and on-the-job training to the concerned RSU National staff (Table 23) using the prepared guidelines and manuals. The execution of the planned activities at PIP is the responsibility of the concerned RSU National subject matter specialists, whereby the international TA consultants will provide advice, guidance and backstopping, where necessary. The inputs envisaged are given in Table 22 by project year (PY). The terms of reference for the international consultants can be found in the relevant Working Paper Annexes.

Table 22. International Technical Assistance for RSUs

Description			Unit	Quantities				
				2013	2014	2015	2016	Total
				PY1	PY2	PY3	PY4	
Consultants Providing Support to Two RSUs and WRUD								
1	Irrigation Engineer	International Consulting Company	month	5	3	1	2	11
2	Structures/Design Engineer	International Consulting Company	month	2	1	0	0	3
3	CAD Engineer	International Consulting Company	month	2	1.5	0	0	4
4	MEICA Engineer	International Consulting Company	month	2	2	1	0	5
5	WUO-MOM Specialist	International NGO	month	5	2	2	1	10
6	Irrigation O&M Specialist	International NGO	month	1	2	0	0	3
7	Agriculturalist	International Consulting Company	month	3	3	3	3	12
8	OFWM Specialist	International NGO	month	0	1	1	1	3
9	Procurement/Tender Documents Expert	International Consulting Company	month	1	1	0	0	2
10	Construction Specialist	International Consulting Company	month	0.75	2.25	1	0	4
11	Short-term unspecified international TA	International Consulting Company	month	1	1	0	0	2

As the Project will be implemented in two regions (Magwe and Sagaing), the total input of the RSU specialists will 60 person months of international technical assistance and 634 person months of national specialists. The international technical assistance will divide their staff equally amongst the two RSUs whereas the national specialists will be divided equally between each RSUs being assigned and located in one or other RSU.

Table 23. National Technical Assistance for RSUs

Description	Unit	Quantities				
		2013	2014	2015	2016	Total
		PY1	PY2	PY3	PY4	

RSU specialists - RSU 1 & 2 - equally divided between both RSUs								
1	Irrigation Engineer	National Consulting Firm	month	20	20	20	8	68
2	Structures/Design Engineer	National Consulting Firm	month	12	12	4	0	28
3	CAD Engineer	National Consulting Firm	month	8	12	8	4	32
4	MEICA Engineer - Mechanical	WRUD	month	12	12	8	8	40
5	MEICA Engineer - Electrical	WRUD	month	12	12	8	8	40
6	M&E expert	International NGO	month	12	6	6	8	32
7	Extension agronomist	International NGO	month	24	24	24	24	96
8	Agricultural Technical Assistant	International NGO	month	24	24	24	24	96
9	Agricultural Economist	International NGO	month	8	8	8	8	32
10	National WUO-MOM Specialist	International NGO	month	14	14	14	6	48
11	National O&M Specialist	International NGO	month	6	12	16	4	38
12	National OFWM Specialist	International NGO	month	0	10	10	10	30
13	Construction Supervision Specialist	International NGO	month	0	16	12	0	28
14	National training expert	International NGO	month	8	8	6	4	26

Equipment and other facilities are all provided under the project to the Regional Support Units. All of the staff assigned to the RSUs irrespective of the Component under which their services are included will share and utilise the equipment and transport. The major costs incurred by the RSUs will be salaries and staff costs, both national and international. These are presented in Working Paper 7.

6.5. The Collaborative Framework

Project integration and team work will be at the core of ensuring that this project is a success and that all Components work to ensure a more consistent and reliable supply of irrigation water, rehabilitated and upgraded I & D network to deliver water efficiently and effectively to farmers in all parts of the PIP and most important of all an effective and active WUA to co-ordinate and facilitate allocation and sharing of water to farmers in the PIP and to provide the required MOM of the PIP.

Initially it is to be expected there will be a period of evaluating the selected sites and identifying the works required. This work will need to be programmed together for all Components to ensure that all aspects of the project are aligned. The project will consist of several separate but connected Components dealing with the different facets of engineering, agriculture, policy, facilitation, capacity building and extension. Although these will each have their own activities and programs, an important part of the project support will be the interaction between these Components, and the close involvement of the beneficiary farmers. The programs for these different activities, presented separately in the Working Papers, will be unified through common threads and activities with an emphasis on farmer support through training and involvement of farmers groups. In the case of the agriculture, this will include the on-farm trials and demonstrations, training and introduction of new ideas to the farmer training groups. Improved water management coupled with improved access to suitable seeds and crop verities proposed under the agriculture and WUA Components (2 & 3) will considerably enhance farmers' incomes. Through the training of RSU staff, they will be able to use these same skills on areas outside the project interventions and hopefully with improved approaches will lead to wider adoption of the techniques and practices. Capacity building with the communities will increase the ability of the communities to form effective groups that are capable of managing both the facilities and the resources within the domain (see Working Paper 6 - Training and Capacity Development).

Through the work of the RSUs, the water users organisations and PIP management will hold regular planning meetings to discuss and implement agreed cropping plans for the whole year, prepare cash flow budgets, conduct gross margin analysis, plan how much water per crop they will need and determine with the technical representatives how the system can feasibly deliver the required amount of water to all farmers within the PIP.

6.6. Construction and Project Implementation Plan

Construction for the rehabilitation and upgrading of the four priority PIPs will be carried out by WRUD using their existing equipment and supplement this through hiring of specific construction equipment particularly for construction and compaction of embankments and maybe other skills to support WRUD construction teams. Agreements for the will be set out in specific construction contracts that will include clear specifications and bills of quantities in an attempt to ensure that quality of construction is improved and that sufficient funds for the works are provided. The role of WRUD would be to manage and supervise the construction works as part of the

project, and they will be guided and supported by a senior international construction supervisor and national deputy. Both would be responsible for improving the quality and supervision works and to develop contract management and supervision manuals including standard specifications, conditions of contract and other related aspects. One of their key tasks will be to work closely with the WRUD staff to ensure that they understand fully the requirements of the specifications and the contracts and are able to interpret them on the ground.

Construction works will not start until the redesign works together with supporting the tender documents have been completed and approved by the PIU (and implicitly LIFT). For some projects like Kanni where the existing system layout is adequate, it is envisaged that construction works could begin in PY1). On the larger schemes such as Pyawt Yaw, more time will be needed to prepare the redesigns and documentation and therefore it is unlikely that construction work would start before the end of PY2. Following the completion of the construction works and the handing over to the respective authority and the WUAs, it is normal to have a one-year maintenance guarantee period. This will be enforced in the WRUD contracts and will encourage the improvement of the quality of the construction works.

The project implementation plan for all Components is contained in Annex B that gives the relative timeline of all activities. The work on the formation and strengthening of the water users' organisations and with the farmers on improved agricultural practices and establishment of demonstration areas will need to start soon after the commencement of the project. It will therefore be essential that once the TA team had been established in the RSUs, attention is given to the establishment of clear and interactive work programmes giving revised timelines of activities.

6.7. Pre-implementation activities

Much could be done to improve things with a small investment in advance of the main project start-up. In particular the following activities would be beneficial to both advancing the project by providing data prior to start-up and also as a means of identifying potential WRUD staff for secondment to the RSUs once the project commences.

(a) Water Hammer Analysis

This issue is highly technical and given the number of sites at which it is an issue there would be great merit in commissioning a small study by a specialist consultant to gain a better understanding of the problem in advance of the project start up. That would then enable the project to proceed with an understanding of the system dynamics and the measures required to avoid problems occurring / prevent further problems. This may require a site survey to take place in which case this could easily be combined with pump performance testing discussed below.

(b) Pump performance testing

Given the lack of knowledge regarding actual pump performance there would be benefit in undertaking some performance testing prior to project start up. This would require a means of measuring pressure and flow and would probably require a short visit by an international consultant to lead the initial testing and train WRUD staff who could then continue with an agreed programme of testing to evaluate all the pumps on the chosen schemes.

(c) Baseline Survey

Priority agriculture activities for funding prior to commencement of the project would be to initiate and conduct the baseline survey. This activity provides invaluable information which forms the cornerstone for the project and an excellent base to build on.

Budget has been allocated for this survey to be conducted in project year 1, and this could easily be brought forward by 6 months. Analysis and interpretation of the data from a large survey takes time, so if the survey could be conducted prior to the project start date, this would be advantageous.

(d) Condition inventory of PIP irrigation and drainage infrastructure

Cost estimates have been prepared based on site visits and suggestions by WRUD engineers. For project formulation this is sufficient however for redesign and upgrading of the irrigation facilities, an up-to-date and accurate detailed conditional survey is required. Prior to the project start, this could be prepared by WRUD site staff and would present the starting point for RSUs engineers when they arrive.

(e) Topographical surveys

Detailed and accurate topographical maps to suitable scales and contour intervals as described in the Working Paper 1, will be essential part of the rehabilitation process. These will take time and if they are initiated prior to the start of the redesign and upgrading process, this will facilitate the earlier start of construction. Experienced topographical surveyors will be required using equipment that is linked closely with computer-aided design software.

(f) Data collection

All of the Working Papers have set out data and information that will be needed to implement the LIFT project. If these are collected together prior to the project start-up, this will contribute greatly to more efficient utilisation of TA support.

6.8. Post Implementation

The project needs to ensure that after the completion of the project the regional support units are able to continue in a sustainable way and that sufficient budget is allocated to allow then to apply the knowledge gained to the other PIPs in the region. Continued support by the GOM or other financiers for the project beyond its planned 4-year lifespan is of critical importance. The benefit stream used in calculating the EIRR assumes a continued programme of training and capacity building, supported by the RSUs and PIU, running until 2022. Without this support, it is unlikely that uptake will progress much beyond its end-of-project level in 2016. Scenario 7 in Table 5.9 of Working Paper 7 shows that failure to do this would generate a zero rate of return.

7. PROJECT SUSTAINABILITY AND RISKS

7.1. Risk Analysis

A development project of this type has considerable risks associated with it particularly considering the relatively long period of formal interaction and involvement with the government.

Farmers may generally be apprehensive about government commitment to assisting them due to past-unfulfilled promises. They may also be wary of past projects which had by-passed them. The LIFT project will include a consultative participatory approach with training for ensuring community participation in programming and implementation, and ensuring ownership. Women groups will in particular be organized to run their own enterprises, to earn incomes, and to take economic decisions. They will be assisted to be active members of the water users' association and to be allocated irrigation plots under the scheme.

An assessment of project risks and proposed mitigation measures are contained in the Log Frame for the project (Annex C). Thee more critical issues are summarised below.

Critical Risks

Critical risks include issues of:

- If WRUD leadership or changes its approach it is possible that it may decide not to go ahead with support from LIFT. The utilisation of NGOs through Regional Governments in the implementation reduces the impact of such changes.
- It is possible that government and MOAI may not be willing to accept implementation modalities involving NGOs in such a high profile role
- The NGOs may not be willing to undertake such a role that also involves the hiring of key personnel to supplement and reinforce their professional capacity and skills.
- There are considerable risks associated with such a development project considering the lack of direct interaction with donors over the last 20 years. The implementation of the project through Regional Units that are apart from government but that involve government and other staff will reduce the potential risks.
- There will be the risk that Government will not be willing for farmers to choose their own crops, cropping patterns and intensity. The three scenarios developed and analysed in the EIRR show the results of such decisions.
- Government may want to locate the professional international and national staff at union level. If this is done, there services will be too widely spread and may be ineffective in achieving improvements on specific PIPs. The location of these TAs at regional level is aimed at reducing such risks.

The other risks are:

- A key assumption to project sustainability is that effective community participation will result. It is possible that this will not be truly participative and thus the sustainability of somebody institutional reforms and decisions made by the communities may still result from a top-down directives. The strengthening of the water user groups into Democratic organisations will be one way of mitigating this problem.
- There may be inadequate acceptance of the need for good technical support and training for the approaches and designs introduced.
- Low government salaries and incentives may discourage full and active participation in the programme without additional incentives. Some key staff has therefore been included in the budget for RSUs.
- GOM contribution towards operational funds to travel and visit the proposed areas may not be available or may be untimely in arrival. Some funds are included in the budget for RSUs.
- Government staff may be unwilling to compile reports and data in the requested detailed and justified format. The involvement of NGOs in the key senior posts of RSUs and PIU will reduce such problems and also act as trainers for the staff in report writing and content.
- GOM may insist on using their existing staff for the programme without recognising the demands and requirements needed to complete the specified works to the required standards.
- Sufficient experienced design and site Engineers may not be readily available in Myanmar both from within Government as well as the private sector. The twinning of international TA and national TA will reinforce the latter capacity and lead to longer term sustainability.
- GOM Staff at Union and Regional levels may not be made available to work on the programme in a timely manner and to agreed work plans. Some of the tasks can be undertaken by the international and national TA. Delays in the provision of government staff will be reflected in the time taken to implement improvements and may encourage government to succumb appropriate staff at the right times.
- Other GOM programmes may put excessive demands and impact negatively on the same resources.

7.2. Exit Strategy and Post-Project Sustainability

The implementation modalities have been determined considering the still unclear future for such development initiatives in the immediate future. Sustainability and support are primary considerations in such rehabilitation and upgrading exercises. Both the formulation mission team and the assessment team fielded in 2011 identified the lack of agricultural and extension support to all farmers with land on the PIPs. In addition to this, the heavy reliance upon headquarter resources both the technical and financial reasons, has left the WRUD ill-equipped to support the MOM of the PIPs, especially those to be handed over to the regional governments. The proposed RSUs with their teams of subject matter specialists and experienced technical assistance were considered an appropriate means of ensuring that the support that has been requested by the PIP farmers is provided. Although they will be supported by staff from WRUD and DA, they will be outside the political structure should reversals of the current improved approaches to development occur. The last thing that is needed in these vulnerable areas is the interruption midstream of interventions aimed at improving the low performing pumped irrigation schemes the degree when the contribution of irrigation to poverty alleviation in the CDZ has been shown to be very significant.

Annex A. Terms of Reference

The terms of reference for the consultants are on the formulation mission are governed by the overall terms with the contracted consulting company[19] and the specific terms of reference with the consulting company. These are given below.

(a) Overall terms of reference with client

The objective of the overall formulation is to design a LIFT project for improving the efficiency and effectiveness of PIPs in the central dry zone of Myanmar.

The formulation team will provide LIFT with a draft project document including:

- Financial analysis of the proposed interventions
- Proposed operational organisation and management arrangements
- Detailed cost tables including one or more scenarios indicating LIFT financing through different implementing partners
- Technical assistance and capacity development proposals
- An assessment of project risks and proposed mitigation measures
- A log frame and associated M&E proposals consistent with LIFT's M&E framework, and
- A budget for the project.

The formulation team will ensure that the proposed project is realistic, workable and responds to the issues identified in the assessment mission of June/July 2011. The proposed project must be consistent with LIFT's overall objectives and approaches, which are summarised in the LIFT draft strategy document (September 2011).

Some special considerations will need to be taken into account when designing the project:

- In the past LIFT has invited project proposals from potential implementing partners, but on this occasion LIFT intends to design the programme and invite IPs/agencies to participate in the implementation.
- The formulation mission will have to propose an institutional set up for the project, which provides a significant role for appropriate government departments, particularly the WRUD and the Department of Agriculture.
- The programme should explore opportunities for involving local authorities in the design and implementation of the project.

Objectives and expected results for the inception mission

- Select the pilot schemes in collaboration with the MoAI and LIFT
- Agree the TOR for the formulation mission
- Agree the composition of the team for the formulation mission, including the participation of technical staff from WRUD, Department of Agriculture, etc.
- Agree on how potential implementing partners will be involved in the formulation mission
- Develop draft guiding principles on the role of the WUA
- Develop options for what the implementation modalities of the project could look like.

Methodology

- Desk study of relevant documentation including materials provided by LIFT Fund Manager's Office (FMO)
- Inception and final meetings with LIFT management and Fund Board members
- Consultation with organizations currently active in the central dry zone in the livelihoods and food security sector
- Field visits to command areas of current PIPs
- Extensive consultations with MoAI, particularly WRUD and the Department of Agriculture (WRUD should be involved in all stages of project formulation) Debriefing sessions with all important stakeholders, including LIFT management and the Fund Board, Formal review of draft programme formulation report by the MoAI, the LIFT FMO and the Fund Board

[19] Anderson Irrigation and Engineering Services Limited

Annex B. Project Implementation Plan

		Description of Activities	2012	2013	2014	2015	2016	2017
A		**LIFT Project Support to PIPs**	Pre Project Year		PY 1	PY 2	PY 3	PY 4
	1	LIFT Support to PIPs - Final Formulation Report						
	2	LIFT Board Discussions on Report						
	3	Discussions with WRUD and Government						
	4	Support for Pre Project Activities						
	5	- Flow measurements on PIP sites (at PS and Main canals)						
	6	- River flow & quality studies						
	7	- Waterhammer study						
	8	- Baseline surveys						
	9	Short list and selection of NGOs and Consultants						
	10	Start of LIFT Project Support						
	11	Establishment of PIU in WRUD/MOAI						
	12	Mobilisation of NGO/Consultants						
	13	Establishment of RSU in Magwe and Sagaing & staffing equipping of Offices						
	14	TA services (International & national). Guidance, design reviews and support to PIPs through RSUs & communities & capacity building programme						
	15	Staff seconded to RSUs from WRUD						
	16	Full staff operational in two RSUs and supporting 4 PIPs						
	17	Studies into other areas: Possible interventions for follow up						
B		**PIP Project Interventions**						
	1.	**Kanni PIP - Magwe Region**						
	1	Topographical Surveys and mapping						
	2	Soil and Land Class Surveys and mapping						
	3	Condition inventory of PIPs by both RSUs						
	4	Redesign of I & D Systems						
	5	Preparation of Tender Documents						
	6	Rehabilitation & upgrading of systems						
	7	I&D system handover & improved MOM						
	8	WUA formation & development						
	9	Establishment of Demonstration areas						
	10	Agricultural Extension support						
	11	OFWM & Water Saving Techniques - demonstrations + water management (linked with support for whole location)						
	2.	**Myinkun PIP - Magwe Region**						
	1	Topographical Surveys and mapping						
	2	Soil and Land Class Surveys and mapping						
	3	Condition inventory of PIPs by both RSUs						
	4	Redesign of I & D Systems						
	5	Preparation of Tender Documents						
	6	Rehabilitation & upgrading of systems						
	7	I&D system handover & improved MOM						
	8	WUA formation & development						
	9	Establishment of Demonstration areas						
	10	Agricultural Extension support						
	11	OFWM & Water Saving Techniques - demonstrations + water management (linked with support for whole location)						

		Description of Activities	2012	2013	2014	2015	2016	2017
			J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D
	3.	**Pyawt Ywa PIP - Sagaing Region**						
	1	Topographical Surveys and mapping						
	2	Soil and Land Class Surveys and mapping						
	3	Condition inventory of PIPs by both RSUs						
	4	Redesign of I & D Systems						
	5	Preparation of Tender Documents						
	6	Rehabilitation & upgrading of systems						
	7	I&D system handover & improved MOM						
	8	WUA formation & development						
	9	Establishment of Demonstration areas						
	10	Agricultural Extension support						
	11	OFWM & Water Saving Techniques - demonstrations + water management (linked with support for whole location)						
	4.	**Satpagone PIP - Sagaing Region**						
	1	Topographical Surveys and mapping						
	2	Soil and Land Class Surveys and mapping						
	3	Condition inventory of PIPs by both RSUs						
	4	Redesign of I & D Systems						
	5	Preparation of Tender Documents						
	6	Rehabilitation & upgrading of systems						
	7	I&D system handover & improved MOM						
	8	WUA formation & development						
	9	Establishment of Demonstration areas						
	10	Agricultural Extension support						
	11	OFWM & Water Saving Techniques - demonstrations + water management (linked with support for whole location)						
C		**Training and capacity building Interventions**						
		Training and capacity building assessment to support project interventions						
		On going inservice training with short term targetted formal sessions						

Annex C. Updated Log Frame for LIFT Project.

Narrative Summary	***Verifiable Indicators***	***Means of Verification***	***Assumptions/Risks***
Goal			
Enhanced livelihoods and food security of households of those living in the Central Dry Zone of Myanmar through sustainable development of profitable irrigated agriculture.	Net farm incomes of households cultivating land in PIPs have increased 200% by PY4 compared with PY1.	Impact studies; evaluation reports; completion reports; Reports on productivity of PIPs; Socio-economic surveys and evaluations of family incomes & production	Farmers are free to choose their own cropping patterns;
			Recommendations made in Formulation report are fully implemented by Government
	Community assets increased (quality of houses; household health facilities; TVs etc)		Government high level support for such changes and projects continues irrespective of personnel changes at senior level.
	Periods of food deficits reduced		Effective water use continues to be a priority in the Dry Zone and PIPs.
Development Objective			
To improve the efficiency and effectiveness of pumped irrigation projects in the Central Dry Zone of Myanmar	Cropping intensities on PIPs increased to above 200% by PY4	Impact studies; evaluation reports; completion reports; Reports on productivity of PIPs; Socio-economic surveys and evaluations of family incomes & production	Government commitment to the removal of production targets for certain crops continues.
			Measures introduced to improve water delivery efficiency, availability and equitability.
			Appropriate design staff experienced in irrigation and drainage are recruited
			Active and useful working links are established with other Departments in MOAI.
			WRUD management are willing to improve the effectiveness of PIPs through modification of current practices.

Outcome (Component) 1: Priority pumped irrigation projects improved and upgraded to give effective and efficient systems for water delivery and crop production.			
Outputs			
Output 1.1. Four PIP Project Designs and Implementation Plans for rehabilitation and upgrading of selected PIPs	Participation by WRUD and RSU staff in project re-design for 4 PIPs completed by PY2 carried out at project level	RSU to have produced 4 sets of Technical designs and documents supporting rehabilitation and upgrading for each PIP by the end of PY 3	Willingness of MOAI, WRUD and regional authorities to appreciate the need for and the benefit of greater external technical guidance and support.
	12 person months of periodic and hands-on involvement of International TA and 24 person months of National TA international provided in PY1-3 for the preparation of redesign and technical documents for 4 PIPs.	Technical assistance support provided through RSUs as reported in project reports.	TA the used appropriately and efficiently and not diverted to other projects.
	4 sets of technical documents supporting proposed investments in PIP rehabilitation submitted to LIFT by the end of PY3	Funds released to 4 PIPs to implement proposed rehabilitation and upgrading of PIPs; 4 Project approvals from LIFT; 4 Project completion reports.	An understanding by WRUD management and MOAI of the need to delegate responsibilities and to equip professional staff at project, regional and central level.
	3 months of technical in-service training completed for 20 staff at regional/RSU/PIP/WRUD level to directly support and respond to routine and emergency/operational repair/maintenance needs.	3 in service training documents completed each year in PY1, 2 & 3	Electricity for pumping provided according to fix schedules and for a minimum of 12 hours per day; periods of proposed cuts advised to PIPs in advance;
Output 1.2. The concept of whole life period introduced into the preparation of detailed designs relating specifications and capital costs and anticipated life period and to ultimately reduce annual O, M & R costs	Standard specifications for WRUD projects (civil; mechanical & based on FIDIC) introduced and used for project documents of PIPs.	4 sets of completed contract documents completed by PY3.	WRUD sees the need for standardisation of contract documents.
	Standard Contract Management & Construction Supervision documents introduced for use on each PIP	CMCS documents being used on each PIP site; construction records;	the need for improving workshops utilised by WRUD for improved maintenance;
	20 staff from RSU and WRUD trained in use and details of standard specifications and how to implement them in practice	Training records; Implementation/Site records	WRUD provides RSUs and PIPs with appropriate budgets and equipment.
	Concepts of asset management introduced into MOM and determination of levels of recurrent costs for at least 4 PIPs by PY4.	WRUD, regional government and WUA allocating sufficient funds to meet annual O&M needs for PIPs.	Contract supervision procedures utilised in construction supervision.
Output 1.3. Production of standard design and construction and O&M manuals for WRUD.	4 sets of enhanced designs produced by PY 3 and utilising the design manual and referring to it.	Design manual available; completed project design reports.	Staffs see advantages of new documents and are willing and capable of using them.

	Enhanced techniques being implemented at field level on 4 PIPs for such things as construction joints, gate designs, etc. by PY 4.	Details of standards for enhanced details available.	WRUD sees the needs to improve and adopt improvements.
	Increased overall awareness in design and maintenance of PS in 4 Project documents by PY3 showing that the application of knowledge base is widened.	O&M manuals available for all 4 PIPs; manuals include modifications recommended.	Staffs see advantages of new documents and are willing and capable of using them.
Output 1.4. Improved layout and distribution system for on-farm works.	Construction drawings and layout maps available for the rehabilitation and upgrading of 4 selected PIPs by PY4.	Construction drawings; layout maps; technical documents for 4 PIPs	Staffs see advantages of new documents and are willing and capable of using them.
	4 WUAs utilising the layout and water distribution maps for the preparation and monitoring of their annual cropping and water delivery plans by PY3.	Annual Cropping patterns and water delivery schedules; WUA records; flow measurement records for each PIP.	Farmers convinced of advantages and willing to adopt new practices
	Investment in tertiary and on farming systems adapted to farmer needs and revised cropping patterns	Achievements reported in project and WUO reports.	Staff see need to involve farmers and are prepared to listen to their ideas.
	Flow measurement structures installed and calibrated and control structures improved and fitted with appropriate gates on all 4 PIPs by PY4.	Farmers recording data in the daily record sheets; WUA records; scheme records; monthly reports of WRUD.	Flow measurement devices installed and staff trained in calibration and measurement.
Output 1.5. Improved reliability of water supplies to the farm gate. E	Farmers growing a wide range of crops requiring different periods of irrigation interval; WUAs introducing water rotation and irrigation schedules on a weekly basis and according to agreed cropping patterns.	Annual Cropping patterns and water delivery schedules; WUA records; flow measurement records for each PIP.	Farmers convinced of advantages and willing to adopt new practices
	Utilisation by WRUD of approaches presented for the redesign of additional PIP projects outside the LIFT project area.	Project documents and design documents prepared for additional PIPs utilising design manual and specs etc.	WRUD ensure that staff use new improved approaches and allocate funds for training of staff in their use and application.

Outcome (Component) 2: Crop Diversification and Best Management Practices in Farming Systems			
Outputs			
Output 2.1. Improved level of extension service and support to	Selection/appointment of an NGO to coordinate/lead farmer training.	Project records; Agreement with NGO signed; Monthly report.	Possible difficulty in finding competent FFS trainers

farmers on PIPs provided through enhanced service delivery by INGO service providers in cooperation with DA and RSUs	600 Farmers trained in farmer training groups, technology transfer workshops, field day attendance in PY1, 2 ,3 and 4	Farmer practice change measured before and after through baseline surveys, livelihoods surveys and impact surveys.	Suitable staff recruited by INGO and located locally close to PIPs; suitable trial sites made available on each of the PIPs (4) for trials over a four year period
	Rhizobium packages rolled out to farmers in PY3-4 with technology transfer workshops on correct application	No. of farmers uptake of rhizobium in INGO, PIP and DA reports; annual surveys;	Rhizobium demonstrations will be successful creating farmer demand for product
	4 Publications produced and distributed in PY 2, 3 & 4 through enhanced WUAs on inter alia irrigation production best management practices (BMP) for farmers.	Publication demand, % uptake of BMP, INGO and farmer group reports, DA/RSU surveys and reports	
	Extension services provided to farmers on a weekly basis to 20 farmers in the form of advice, problem solving and lateral thinking.	M&E follow up surveys and reports covering evaluation of farmer satisfaction with extension service.	staff with ability for critical thinking
Output 2.2. Links established with DAR and other research projects to provide improved varieties for evaluation on PIP trial sites and farmer access to seed	8 Farmers groups adopting recommended crop varieties under best management practice recommendations by PY3 & 4.	Minutes of meetings; records of production surveys; seed sales	
	2 Biannual farmer field tours to observe farming practices and trials on other PIP sites, including visiting DAR research farms, carried out in PY2, 3 & 4	feedback evaluation survey on the trip	willing farmer participation
Output 2.3 Opportunities and technologies for sustainable irrigated crop production systems in the context of declining soil fertility and moisture conservation evaluated, demonstrated and extended.	Soil types defined on 125 sites (50 Pwayt Ywa, 25 per other 3 PIPs) in PY1 based on soil maps, previous history and inspection and re-sampled again in PY4 to assess soil status in regards to soil sustainability indicators.	Soil samples taken and analysed and baseline location data submitted	GPS locations are accurately recorded, as is baseline soils data. soil analysis is able to be performed to an international standard in country and within the allocated budget
	10 Profile descriptions of the main soils completed on all PIPs in PY1 to determine soil water holding capacity and to identify sub-soil constraints to agricultural production.	Soil profile descriptions (2 in each PIP completed to obtain bulk density, PAWC, soil depth in PY1	adequately trained staff to complete high quality descriptions
	3 Resource materials prepared by PY 2 for extension of improved soil management practices, moisture conservation and reduced tillage/no tillage farming practices.	workshop manuals, farmer flip charts for field schools, 2 page tech notes for farmers and resellers	adequate soils information is available

	200 Demonstrations conducted in PY 1 & 2 to evaluate rhizobium inoculation of key legumes (groundnut, soybean, green gram, chickpea) across all PIPS (20 sites x 5 legumes =100 sites p.a.).	Trial results, farmer field group evaluations	Demonstration established and sites and effectively maintained.
	24 Improved practice trials evaluating the use of starter fertiliser (NPK) at sowing completed in PY1-3		
	24 Improved practice trials evaluating the use of Ca based fertiliser at flowering for groundnut completed on all sites in PY1-3		
	Experiments and demonstrations conducted to develop mulching and no-tillage based crop sequences in PY1-4 where possible		
	Improved practice trials evaluating the use of herbicides for in crop weed control		
Output 2.4 Options for crop diversification and adaptation of alternative crops to rice based farming systems to improve cash income assessed, developed and introduced to farmers on the PIPs.	24 successful trials on 4 PIPs including improved practice technologies, improved sowing techniques,	trial results, farmer field school evaluations, farmer adoption, field days	farmers have complete autonomy in crop choice; more reliable water is delivered to farmers
	trial improved varieties of existing crops grown and new crop options in close collaboration with DAR	trial results, farmer field school evaluations, farmer adoption of new varieties	farmers will have complete autonomy for crop choice
	Farmer education of whole farm crop production systems, crop sequencing options and methods to increase cropping intensities.	farmer field school evaluations, farmer adoption of new crop sequences, cropping intensity statistics	farmers will have complete autonomy for crop choice
	assess viable cropping sequences through trial results, agronomic knowledge and soil suitability assessment		Marketing opportunities for cash crops continues to expand with prices offered to farmers and with increased inputs.
Output 2.5. An understanding of the livelihood of current and alternative whole-farm crop-livestock production systems developed in PIPs with regards to potential for a shift in cropping intensity and the status of the value chain to support agricultural change	baseline survey conducted in PY1; data analysed and report generated PY1; baseline survey in the final year of project to measure changes in livelihoods	outcomes compiled in a technical report	
	Analyse factors affecting adoption of technologies, develop understanding of, and assist the development of, value chains and smallholder access to markets.	outcomes compiled in a technical report	

with linkages to end users and potential markets.	education to farmers on markets chains and demands, small business plans	Farmer business schools no. attended	
Output 2.6. Micro credit available to farmers to enable them to hire equipment and purchase additional inputs.	Links established in PY1 with an existing INGO programme to provide microcredit at low interest rates to farmers on 4 PIPs.	INGO, PIP and project reports.	INGO is willing to expand its working area.
	Credits made available to 500 farmers by PY2, 750 farmers by PY3, 1000 farmers by PY4.		Access to inputs is increased and credit is made available at reasonable prices to facilitate this.
	Options of seed credit, input credits etc. investigated in PY2 and adopted by 500 farmers in PY 3 & 4		Results of examinations positive and potential established.

Outcome (Component) 3: Improved management, operation and maintenance (MOM) of all I&D infrastructure of PIPs with full participation of farmers through their WUOs.			
Outputs			
Output 3.1 Farmer-managed WUA formed at PIP level with necessary institutional, administrative and financial skills to be managed in effective, efficient, transparent and accountable manner and responsible to plan, coordinate and supervise O&M of MC in collaboration with WRUD	WUA formed and trained in all (4) PIPs by end of PY3	Progress reports, WUO performance assessments, WRUD performance assessments, training reports, WUA and WRUD records, KAP surveys	WRUD allocates sufficient annual budget for O&M of pump system
Output 3.2 Effective WUCs and WUGs formed at respectively DC and LC level responsible for O&M	WUCs and WUGs formed and trained in O&M and water management on at least 80% of all DYCs and LCs by end of PY3		WRUD adopts new ISF policy whereby farmers ISF that fully cover all MOM costs for MC, DYCs and LCs
Output 3.3 Rules and procedures for efficient and equitable allocation and distribution of canal water adopted and implemented at all levels by WRUD and WUOs	WRUD and WUA adopted improved operation plan for MC taking into account seasonal water availability, irrigation efficiency and adopted cropping patterns by PY3		Flow measurement devices installed
	Rotational water distribution adopted at MC and DY level in all (4) PIPs by PY3		Concept of irrigation service agreement adopted by WRUD
	Daily measurement and recording of water flows at head of MC and all DYCs in all (4) PIPs by PY3		Flow measurement devices installed and staff trained in calibration and measurement.
	Irrigation service contracts signed between		Suitable contracts presented and agreed

	WRUD and WUA in all (4) PIPs by PY3		
	MC is cleaned at least two times each year by PY3		WUOs established, willing and capable of undertaking activity
Output 3.4 Improved OFWM through introduction of appropriate water-saving techniques and practices at farm level	At least 25% of farmers in PIP command area adopted water-saving techniques/practices at field level by PY4		Farmers convinced of advantages and willing to adopt new practices
Output 3.5 Sufficient annual O&M budget for each PIP to undertake all necessary O&M at all levels	Full MOM costs for MC, DYCs and LCs is covered by ISF paid by farmers by PY4		Farmers convinced of advantages and capable of paying new charges
	WUAs in all (4) PIP have established Reserve Fund with minimum deposit of Ks 1 million by PY4		Farmers convinced of advantages and capable of paying new charges

Outcome (Component) 4: Provision of in service and on-the-job training, capacity building and technical assistance,			
Outputs			
Output 4.1. Redesigned and implemented rehabilitated irrigation schemes used as on-the-job training in design and implementation for WRUD staff through targeted short-term technical assistance and on-the-job training for improving irrigation and drainage systems at regional/PIP project level. (Sagaing; Magwe)	The skills of WRUD, NGO and RSU staff enhanced to better support the improvement of PIPs in rehabilitation and upgrading and subsequent MOM.	Progress reports, WUO performance assessments, WRUD performance assessments, training reports, WUA and WRUD records, KAP surveys	Staff willing and capable of absorbing training approaches and see that they are relevant and suitable.
Output 4.2. Regional Support Units (RSU) for the rehabilitation and upgrading process and especially implementation follow-up support established and functional.	Wide range of services being provided to all PIPs on a regular basis and as envisaged		
Output 4.3. Support to farmers provided by RSU through NGOs and upgraded staff from regional WRUD offices and covering engineering, agriculture, microcredit, WUOs and MOM and on-farm water management (OFWM).	Wide range of services being provided to all PIPs on a regular basis and as envisaged		

Output 4.4. Capacities of Regional/RSU and PIP staff enhanced through on-the-job training and targeted short-term formal training by National and international TA staff and covering agriculture and engineering support, MOM and WUOs and improved on-farm water management.	Skills and enhanced knowledge of professional staff being utilised on other PIP projects not included in the programme and WRUD adopting improvements in their regular programmes and supporting manuals.		

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