Cost-Benefit Analysis of Irrigation Using Pumped Water for Economically Important Crops in the Dry Zone during the Early Monsoon Season

submitted to the

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Acknowledgements and Disclaimers

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Preface

Scope and Objectives of this study

1 Introduction

UNOPS is the Fund Manager (FM) for the Livelihoods and Food Security Trust Fund (LIFT) in Myanmar. LIFT is a multi-donor fund committed to addressing food insecurity and income poverty and thereby achieving Millennium Development Goal 1. LIFT's overarching aim is to contribute to the national goal of sustainably reducing the number of people living in poverty and hunger in Myanmar, initially with the eradication of extreme poverty and hunger in Myanmar. LIFT works on various thematic areas and operates through a variety of implementation partners in 4 different agro-ecological zones of the country: the Dry Zone, the Uplands Zone (Kachin State, Chin State and Shan State), the Delta/Coastal zone, and in Rakhine State.

LIFT's impact strategy proposes "to allow smallholders with commercial potential to 'step up' the agricultural ladder; subsistence farmers to 'hang in' for food security and for landless labourers to 'step out' of agriculture, and into more productive sectors of the economy. In addition to eradicating poverty and enhancing socio-economic well-being, LIFT also has a strong learning agenda and intends to catalyse pro-poor development through continuous dialogue with policymakers and other industry stakeholders.

So far, LIFT has reached over 3 million people, roughly 6% of Myanmar's population, and is active in just under half of the country's townships. The Fund is expected to continue operations until the end of 2018.

The Dry Zone Programme commenced in early 2016 with the implementation of interventions in agriculture, livestock, micro-finance, social protection, nutrition, and WASH. LIFT has contracted eight implementing partners, working in six townships in the Dry Zone. Two partners work in the agricultural sector: The International Fertiliser Development Center (IFDC) and Golden Plain. IFDC implements interventions with the private sector and government in conservation agriculture, agricultural advisory services, as well as other services for small scale farmers. Golden Plain, a local partner, demonstrates the benefits of green manure to small and medium scale farmers.

The townships with LIFT interventions are part of the central Dry Zone, an area that is experiencing erratic rainfall patterns, changing onset periods of the monsoon season, as well as a shortening of the monsoon season. Moreover, most of the farmlands in these townships are rain-fed, limiting farmers to the cultivation of only pulses, beans and oil crops. Where possible, irrigation with pumped water is used to fill the gap between monsoon onset and the start of the main monsoon rains (usually some weeks into June). Farmers experience significant losses in yield if there is no irrigation to cover the lack of rainfall in this gap time.

2 Purpose, objectives and expected results of the study

The purpose of this study is to demonstrate the impact of effective water management in rainfed crop cultivation as part of climate smart agriculture (CSA) in the Dry Zone. The hypothesis is that ***providing irrigation during the gap time reduces farmers' risks of crop failure and enables farmers to invest in cash crops***.

The objective is to assess the scope of risk mitigation in crop production and obtain information of actual benefits and dis-benefits of using pumped water in different commercially important crop cultivations during the monsoon season.

It is expected that the cost-benefit analysis and other relevant information related to the use of pumped water in the identified commercial crops will inform and enable the choice of cultivation practices/cropping patterns and the overall approach to the use of irrigation by farmers in the Dry Zone.

Expected results

In line with the study ToR, this study has covered exclusively the current cultivation practices. The following are the expected results set out in the RFP

- ✓ Information on economic viability of (effect on increased yield by increased production cost) crop cultivation using pumped water (from different sources) during the monsoon season in different crops cultivation.
- ✓ Based on the findings from the study, farmers and extension officers should be able to access relevant information to make investment decisions in agricultural water supply systems with either own funding or with loans from reliable sources.
- ✓ Based on the findings of the study, financial service providers should be able to access sufficient financial and business information on village level agriculture water supply system to facilitate decisions on loan approval.

3 Approach and methodology for the study

In line with the proposal, M-CRIL adopted the following steps and methodology for the study which are summarised below. M-CRIL used mixed methods, qualitative and quantitative, for data collection.

1 Desk study and review of project documents
2 Preparation and submission of the draft study outline/design, method of analysis, work plan and submission of the final study design to LIFT

As part of the final study outline and workplan, M-CRIL developed and submitted checklists of questions for farmers and other stakeholders and checklists for FGDs of smallholders. The stakeholders covered in the study included

- implementing partners, The International Fertilizer Development Center (IFDC) and Golden Plain partners; officials from DoA and FGDs with farmers.

- smallholder farmers
- the DoA team in all the 6 townships and local IP teams
- Cooperative Departments in all the 6 townships and MADB financing farm equipment including irrigation facilities/infrastructure
- suppliers of irrigation equipment

The checklists of questions for FGDs and individual interviews with farmers and for various stakeholders are provided in **Appendix 2**.

3 Initial Briefing with LIFT programme officers

4 Three rounds of field visits to the 6 project townships in the Dry Zone for FGDs and individual interviews with farmers and key informant interviews with stakeholders

In line with the study ToR, the study was conducted in 30 villages (5 villages per township) in 6 project townships (Pakokku and Yesagyo in Magway Region, and Myingyan, Natogyi, Taungtha, and Mahlaing in Mandalay Region) of Dry Zone. The villages covered in the study were selected by the M-CRIL team in consultation with the township Department of Agriculture (DoA) and the LIFT implementing partners. In a few cases, when the villages suggested by DoA and/or the implementing partners were not appropriate, other villages suggested by the farmers in the context of the overall study objectives were covered.

The study covered various common crops including green gram, black gram, white bean, sesame, black, cotton, chilli and onion in the project townships. Based on the requirements of the study ToR, the M-CRIL study team made efforts to ensure that at least 3 crops in each township were covered with 3 acres under each crop. All the important information was gathered for various crops being cultivated in each township for undertaking the cost-benefit analysis. The **Table A** below presents information on the number of farmers in the FGDs conducted in the townships, the number of individual interviews with farmers and the area covered under 3-4 crops in each township. As is apparent from the **Table** below, a total of 168 farmers participated in the FGDs conducted (one FGD in each of 30 villages) and individual interviews were conducted with a total of 72 farmers in the study villages. The study covered 296 acres of land cultivated with the crops selected for this purpose.

Table A

Crops selected for C-B study and area covered in each township

Townships	Villages	# of farmers in FGDs	# of individual farmers' interviews	Area under cultivation (acre) for the crops selected	Crops selected for the study and C-B analysis
Pakkokku	5	32	16	43	Green gram, sesame, white bean
Yesagyo	5	30	13	59	Green gram, sesame, black gram
Myingyan	5	34	11	63	Green gram, sesame, black gram
Ma Hlaing	5	19	11	39	Onion, sesame, cotton
Taung Thar	5	34	12	47	Onion, sesame, chilli
Natogyi	5	19	9	45	Onion, sesame, chili
Total	**30**	**168**	**72**	**296**	

4 Limitations of the study

The study team made all possible efforts to identify suitable villages for the study based on the suggestions from implementing partners, DoA and the UNOPS team. In order to meet the required acreage criteria for the study in each township, two additional crops, onion and chilli, were covered in some of the villages as farmers grow these two crops significantly in the villages using pumped irrigation water during the monsoon period.

Most of the farmers interviewed for the study made investments in buying irrigation equipment and installing them a few years ago. So, the information on investment for the irrigation equipment and their installation cost is based on the recall of farmers. The study team made an effort to ensure the reliability of the information gathered. The study team would like to thank LIFT, in particular Mr Harald Kreuscher, Programme Officer, and U Sein Myint from LIFT for providing the opportunity to M-CRIL to undertake this interesting study. The study team greatly appreciates the support provided by Mr Harald Kreuscher and U Sein Myint in resolving various issues in the selection of villages for the study.

Additionally, the study team would like to thank all the project staff of the IPs, the farmer respondents and other stakeholders including DoA, Cooperative Department, MADB and irrigation equipment suppliers visited for their valuable time in participating in discussions. Finally, the study team would like to thank Mr Sanjay Sinha, Senior Advisor to this study for his continuous guidance and support.

Ashok Kumar, Executive Director, Livelihoods & Value Chains, M-CRIL
+ Team Leader for this study
U Aung Ngwe, National Consultant

Chapter 1

Basic profile of townships, crops grown and methods of irrigation

Agriculture in Myanmar depends highly on monsoon rains. The country's Central Dry Zone (CDZ) area, which makes up about 13% of the total land area and contributes 20% and 54% to the country's total rice and pulse production, respectively, receives the lowest rainfall and is frequently affected by drought events.

1.1 Basic profile of the townships

Table 1 below presents the basic profile of the study townships on important aspects such as total cultivable area, total number of farmers and rainfall data for the last 3-4 years. The study team gathered this information from the DoA of the respective townships.

1.2 Crops grown

Farmers in the study villages of the selected townships grow varieties of crops depending upon the soil types and weather conditions and the extent of availability of rain and other irrigation sources. The villages which have canal water and river water and located near the river were found to grow a greater number of crops including paddy as compared to the villages which are not located near rivers and/or that have canal water. **Table 2** below contains information about the crops grown in the study townships.

1.3 Cropping pattern and harvesting practices

The cropping patterns adopted by the farmers in most of the villages have remained the same for the last several years, as reported by both the farmers and officials from DoA in the townships. However, as a result of access to irrigation water during the monsoon gap period some of the farmers are undertaking intercropping wherever possible and appropriate. In most of the study villages, the harvesting of produce including of monsoon crops is carried out manually using labour. The farmers from most of the villages reported that there was an inadequate availability of labour within the village and they often depended on labourers from other places to harvest produce on time. As a result, they incur higher than expected expenses for harvesting produce. The use of machines for harvesting crops was reported to be extremely limited.

1.4 Irrigation sources during monsoon gap time

In almost all the villages covered, the farmers primarily depend on tube wells for meeting irrigation water requirements during the monsoon gap period. The farmers generally follow furrow irrigation for irrigating monsoon crops. The depth of boring of the tube wells varies depending upon the level of the water table available and the proximity to river sources. The farms in villages in the relatively upland area tend to have more deep tube wells as compared to the farms in villages which are located in the lowland areas. **The depth of the tube well borings ranges from 60-200 ft depending upon the water table level and the quality of ground water.**

Table 1
Basic profile of the study townships

Pakkoku a. Total cultivable area: about 300,000 acres including upland and lowland owned by about 11,000 farmers. Lowland area is about 20,000 acres and owned by about 3,000 farmers. b. Rainfall: 48.79 mm (rainfall days: 48) for 2015; 91.69 mm (rainfall days: 53) for 2016 and 67.61 mm (rainfall days: 50) for 2017
Yasagyo a. Out of total cultivable area of 235,540 acres, 2/3 is upland area which is dependent on rain and canal water and 1/3 is lowland area depends on river water and underground water. b. Rainfall: 65.41 mm (rainfall days: 48) for 2015; 93.47 mm (rainfall days: 53) for 2016 & 77.06 mm (rainfall days: 50) for 2017
Myingyan a. Total cultivable area: 162,979 acres including upland and lowland; lowland area is 17,763 acres b. Rainfall: 39.93 mm (rainfall days: 38) for 2014; 57.46 mm (rainfall days: 51) for 2015 and 97.74 mm (rainfall days: 68) for 2016 and 90.75 mm (rainfall days: 48) for 2017
Taung Thar a. Total cultivable area: 164,620 acres owned by 32,930 farmers b. Rainfall: 50.47 mm (rainfall days: 38) for 2014; 85.80 mm (rainfall days: 54) for 2015 and 105.28 mm (rainfall days: 56) for 2016 and 90.40 mm (rainfall days: 59) for 2017 c. In the township, there are 4 dams: Kyauk Ta Lone Dam, Sin Te Wa Dam, Wei Laung Dam and Taung Thar Dam. The latter two smaller dams, Wei Laung and Taung Thar used by farmers for irrigation.
Natogyi a. Total cultivable area: 223,719 acres owned by 30,744 farmers. b. Rainfall: 58.24 mm (rainfall days: 41) for 2014; 70.76 mm (rainfall days: 39) for 2015 and 114.48 mm (rainfall days: 47 for 2016 and 90.75 mm (rainfall days: 48) for 2017

Ma Hlaing

a. Total cultivable area: 176,923 acres owned by 34,571 farmers. Irrigated area is 26,519 acres and non-irrigated area is 150,388 and garden area is 16 acres.
b. Rainfall: 48.06 mm (rainfall days: 37) for 2014, 86.39 mm (rainfall days: 55) for 2015, 106.91 mm (rainfall days: 57) for 2016; 97.05 mm (rainfall days: 58) for 2017

1.5 Suitability of irrigation methods during monsoon gap period and duration of use

Farmers in the study villages in all the townships feel that the quality of tube well water which is usually fresh is suitable for cultivation of various crops depending upon the soil types and agro climatic factors. The farmers in various townships with needed advice and support from DoA in the respective townships selected particular crops for cultivation based on soil type and agro climatic conditions. The DoA officials from the 6 townships shared similar views about the quality of the tube well water. In most of the villages, the farmers have been using these methods for the past 5-10 years or even more. Thus, there are well established irrigation systems in the villages covered in various townships to access water during the monsoon gap period.

Table 2 below summarises the findings on important aspects such as common crops grown in the villages, irrigation arrangements during the monsoon gap period and other relevant aspects in all the townships covered by the M-CRIL study team.

Table 2
Summary of findings on important aspects in the townships

Township	Common crops grown	Common sources of irrigation	Irrigation sources in study villages	Suppliers of irrigation equipment	Suitability of irrigation methods	Duration of the current irrigation system in use
Pakkokku	• Monsoon crops - sesame, groundnut, pigeon pea, green gram, black gram • Winter crops - CP maize, groundnut. • Most of the low land area is flooded yearly; soil fertility is better than upland area.	• Rainfall, river water, pond, canal, tube wells, river water using hired pump on charges	• 2'' and 4'' tube wells (60-100 ft depth) • only in one village, farmers hire pumps from private suppliers	• Farmers buy irrigation equipment from Pakokku-based suppliers in cash • In one of the villages, DOA provides equip-ment on hire-purchase; after using for 6 months farmers buy it at a fair price	• Farmers find the current irrigation arrangements suitable for the monsoon gap time	• In most of the villages farmers have been using the current irrigation arrangement for the last several years
Yesagyo	• Monsoon crops - sesame, ground nut, pigeon pea, green gram, black gram and paddy • Winter crops - CP maize, groundnut, cowpea, sun-flower and lab bean.	• Rainfall, pond, river water, canal water, small dams and tube wells	• Usually 4'' tube well; 80-100 ft depth	• In the case of tube wells, equipment suppliers are from Pakokku and Yasagyo • Pumps are hired from within the village	• The farmers find the current irrigation arrangements suitable for the monsoon gap time because water is fresh	• Farmers have been using this method since 2007

Township	Common crops grown	Common sources of irrigation	Irrigation sources in study villages	Suppliers of irrigation equipment	Suitability of irrigation methods	Duration of the current irrigation system in use
Myingyan	• Monsoon crops – sesame, ground nut, pigeon pea, green gram, black gram, paddy. • Winter crops - chick pea, ground nut and sunflower.	• River water, rain water and tube wells	• 2'' and 4'' tube well; 70-80 ft depth	• Equipment suppliers are from Myingyan • Farmers buy equipment in cash	• Since tube well water is fresh, farmers feel it is suitable for growing crops	• Farmers have been using this method since 1992
Ma Hlaing	• Monsoon crops – paddy, sesame, ground nut, pigeon pea, green gram, black gram and cotton • Winter crops - green gram and groundnut. • Other crops include chilli, and onion	• Canal water, rain water, tube well	• 2'' tube well; depth 80-200 ft	• Equipment suppliers are from Myingyan, Mandalay, Meik Hti Lar • Farmers buy equipment in cash	• Tube well water is fresh so farmers find it suitable for growing crops	• Farmers have been using the current irrigation method for more than 5 years and in some villages for more than 10 years
Taung Thar	• Winter crops - Green gram, black gram, paddy and groundnut	• River water, rain water, tube well	• 2'' and 4'' tube wells; 60-150 ft depth	• Equipment suppliers are from Myingyan and Mandalay	• The farmers find the current arrangements	• Farmers have been using the current source for more than 5 years and in some

Township	Common crops grown	Common sources of irrigation	Irrigation sources in study villages	Suppliers of irrigation equipment	Suitability of irrigation methods	Duration of the current irrigation system in use
	• Other crops include maize, sesame, onion and sunflower			township; • Farmers buy the equipment in cash	suitable as tube well water is fresh	villages for more than 10 years
Natogyi	• Monsoon crops- sesame, paddy and pigeon pea. • Winter crops - chick pea, ground nut, sesame and sunflower • Other crops include black gram, onion, chilli, groundnut, maize and sorghum	• Rainfall, river water and tube wells	• Mainly 2'' & 4'' tube wells; 80-180 ft depth	• Equipment suppliers - from Mandalay and Myingyan • Farmers buy the equipment in cash	• The farmers find the current arrangements suitable as tube well water is fresh	• In most of the villages farmers have been using these irrigation sources for more than 10 years

1.6 Suppliers of irrigation equipment in the study township

The farmers buy irrigation equipment including diesel engines and/or motor, pumps, pipe sets and other tools either from the suppliers in the respective townships or from other townships depending upon the type of engine being purchased, price and other factors. **Table 3** below summarises information about the farm equipment (including irrigation equipment) suppliers in some of the study townships. The M-CRIL team gathered this information from officials from DoA and also from a few equipment suppliers from the townships.

Table 3
Suppliers of farm equipment including irrigation equipment

Pakokku	Myingyan	Taung Thar	Natogyi
• 10 wholesalers dealing in farm equipment including water pumps, pipes and engines • They sell irrigation equipment to farmers from 3-4 other townships One of the suppliers in the township visited by the M-CRIL study team reported • Irrigation equipment being sold to about 2,000 farmers from about 100 villages • Last year about 600 engines and pumps were sold and the sale is growing by about 5-10% every year • Installation services provided if demanded; no after sales service is provided but in case of any issues reported within the initial couple of days, the equipment is replaced with a new one • No linkage with banks • All sales are in cash	• 3 wholesalers of farm equipment including water pumps and engines • They sell irrigation equipment to farmers from other townships One of the suppliers in the township visited by the M-CRIL study team reported • Irrigation equipment being sold to about 1,300 farmers from about 104 villages • No installation service is offered • In case of any issues reported within the initial couple of days, the equipment is replaced • All sale in cash and no collaboration with banks. Usually 5% profit margin on sale • Demand for irrigation equipment is increasing every year • Plan to sell more 22HP engines because most farmers prefer this engine	• There are no wholesalers of farm equipment in the township and farmers buy irrigation equipment from Meik Hti Lar and Mandalay	• 3 wholesalers of farm equipment including water pumps and engines • They sell irrigation equipment to 4 nearby townships

Note: Farmers from Yesagyo township buy irrigation equipment mainly from Pakokku; and Ma Hlaing framers from Myingyan, Mandalay & Meik Hti Lar.

1.7 Extent of the use of pumped irrigation water by farmers

All the farmers with potential to use pumped irrigation water during the monsoon gap period are not able to install irrigation systems/infrastructure for various reasons, primarily the shortage of funds and lack of adequate financing facilities available to them. Based on discussions with the officials from DoA from the respective townships, rough estimates indicate that about 20-30% of lowland farmers who can potentially use pumped irrigation currently use tube wells during the monsoon gap period. **Table 4** below summaries information on the extent to which farmers in the study townships have access to pumped irrigation water during the monsoon gap period.

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1.8 Ease of access to irrigation equipment by farmers and troubleshooting

Most of the individual farmers interviewed reported that there were no problems in accessing irrigation equipment though at times they need to travel to other townships for the purpose. In some of the villages where farmers use pumps on a hire-purchase basis for pumping water from rivers and/or canals, there are an adequate number of suppliers within the villages or from other villages who rent out the equipment.

Additionally, farmers reported no issues in installing irrigation equipment – mechanics are available for the purpose. For minor repair and maintenance work, local mechanics are available but for any major repair and maintenance the farmers approach workshops located at the township level.

Table 4

Extent of the use of irrigation systems by farmers during monsoon gap period

Pakkoku	Yasagyo	Myingyan	Taung Thar	Natogyi	Ma Hlaing
• Out of 11,000 farmers in the township with about 3,000 farmers from the lowland areas, only about 500-1,000 farmers from the lowland area use irrigation pump/tube wells during the monsoon gap period.	• Only about 1/3 of farmers from the lowland area have been able to access irrigation water during the monsoon gap.	• Out of the total lowland area of 17,763 acres, pumped irrigation water is used only for 1,958 acres by 1,466 farmers.	• Out of thetotal cultivable area of 164,620 acres of 32,930 farmers, only 1,712 acres of lowland is being irrigated by pumps by about 500 farmers – mainly for sesame (781 acres) and onion (931)	• Out of the total cultivable area of 223,719 acres, about 1,466 farmers from the lowland have been able to access irrigation water using pumps during the gap time in the monsoon.	• Out of the total cultivable area of 176,923 acres, pumped irrigated area is 3,900 acres by about 750 farmers.

Note: information shared by the DoA of the respective townships

Chapter 2

Marketing channels and methods of selling farm produce

This chapter briefly discusses various marketing channels and methods used by farmers to sell farm produce including monsoon and cash crops.

2.1 Marketing channels for selling farm produce

Farmers from all the townships sell their produce through multiple channels – to the traders based at the local level or to the wholesalers/traders based at the respective township level and/or to wholesalers based in other townships. The farmers decide where to sell based on the price being offered, the types of produce and the overall quantity of the produce to be sold. In case of monsoon produce such as pulses and other cash crops, there is a preference by the farmers to sell produce to traders at the same township level or in other townships. The farmers transport their produce to the market on their own. All sale proceeds are paid in cash immediately by the traders to the farmers. The information about the traders to whom the farmers from various townships sell their produce is summarised in **Table 5** below.

Table 5
Summary of marketing channels for selling produce

Pakkoku Produce is sold to traders from Pakokku (Nilar, Pyi Phyo Swan, Sein Ya Da Nar)
Yesagyo Produce is sold to traders from Yesagyo, Monywa and Pakokku (Nilar, Soe and Khit Thit brokers' house)
Myingyan Produce is sold to traders from Myingyan, (Yadanar Min wholesale centre); Black gram to "999" trade centre from Myingyan; Sesame to Myat Thit Sar and Shwe Hin Thar trade centre from Yesagyo.
Taung Thar Chilli to traders from Myingyan and onion to traders from Taung Thar
Natogyi Produce is sold to traders from Natogyi (Myo Win trading ,Natogyi); Kyaul Sei(Nay La Thu Kha trading and ''999'' from Myingyan
Ma Hlaing Produce is sold to traders from Ma Hlaing (Win Win Aye trading centre, Htun Za Bu Trading)

2.2 Timing of the sale of farm produce after harvest – whether the farmers sell all the produce just after harvest or in a staggered manner?

In some villages of Pakokku township, some farmers with storage capability store about 1/3 of the total harvest for about 3-4 months and sell their produce when there is a relatively better price. Similarly, some farmers from Yesagyo township reported that they store part of the produce for 3-4 months and then sell. In other townships, most of the farmers interviewed sell their entire produce soon after the harvest as they need cash to meet other responsibilities. As mentioned earlier, traders make immediate payment to the farmers for the produce.

Chapter 3

Financing of farm equipment and irrigation equipment

The government is the major provider of rural credit in Myanmar. The government-owned Myanmar Agriculture Development Bank (MADB) is by far the largest source of loans for agriculture, followed by the Department of Cooperatives, which is second in terms of the numbers of loans. Together, government sources account for 73% of the total value of loans disbursed, while traditional informal lenders account for around 10%. Loans provided by microfinance institutions represent only a small share of credit invested in crop farming, in terms of both number and value of loans.[1]

Most of the farmers from the study townships reported using their own money/savings and not credit from any source to finance and install irrigation systems. This chapter discusses the roles of the Cooperative Department and MADB from various townships in financing agriculture and farm equipment in general and irrigation equipment, in particular. Additionally, Yoma Agribusiness Finance Programme supported by LIFT which aims to enhance the credit flow to farmers and the roles of MFIs in agriculture finance are also briefly discussed in this chapter.

3.1 Cooperative Department

The cooperative department in each township is entrusted with the following responsibilities

- **Mobilization of Cooperative societies**

The Cooperative Department supports the promotion and formation of various types of cooperatives and they include

- Agriculture and General Services Cooperatives
- Microcredit Cooperatives
- Cooperative syndicates
- Marketing Cooperatives
- Bazaar Cooperative
- Industrial Cooperatives
- Livestock Breeding Cooperatives and
- General business Cooperatives

Most of the cooperatives promoted by the Cooperative Department in each township are Agriculture and General Services Cooperatives followed by Microcredit Cooperatives and Marketing Cooperatives.

- **Credit provision to farmers and cooperatives**

Another important function of the Cooperative Department is to provide loans to individual farmers and their cooperatives. This function is discussed below.

[1] Khun Moe Htun and Myat Su Tin. 2017. Agricultural Credit Access and Utilization in Myanmar's Dry Zone. *Food Security Policy Project Research Highlights, Myanmar,* 9, December 2017, East Lansing: Michigan State University

Farm development loans[2]

Farm development loans are provided in three forms

a) First class: Provided to societies and companies which own land of more than 50 acres and are aggregated as one farm. It is mainly for infrastructure development such as canal development, drainage and farm road construction. The loan amount is MMK6-12 lakhs per acre with 1.5% monthly interest. The duration of the loan is 3 years.

b) Second class: These loans are provided to cooperative members individually and the loan amount is MMK3 lakh per acre with 1.5% monthly interest and the loan duration is 3 years. This is for land reclamation by individual farmers.

c) Third class: These loans are provided to members to invest in crop production activities and the loan amount is MMK2 lakh per acre with 1.5% monthly interest and the loan duration is 3 years.

- **Financing of farm equipment on a hire purchase basis**

  In addition to various types of the loans as discussed above, another credit scheme of the Cooperative Department is the provision of credit for farm equipment on a hire purchase basis. The Cooperative makes arrangements with farm equipment trading companies for the purpose and facilitates the sale of farm equipment to its members. The Cooperative Department invites farmers who wish to buy farm equipment through credit purchase. The Cooperative Syndicate in the township and the farmers enter into a contract agreement. The farmers pay 20-30% of the value of equipment in cash to the farm equipment company and the rest 70-80% of the value is paid by the Cooperative Syndicate which the farmers have to repay. If value is between MMK10-20 million the repayments are made in 4 installments in two years; and when the value is more than MMK20 million the duration is 3 years. The payments are made on a six month basis. The rate of interest applicable on these loans is 1.5% per month.

Other responsibilities of the cooperative departments include the promotion of farm development and farm mechanization, agriculture related advice and services and education to the cooperatives.

Table 6 below provides a summary of the activities undertaken by the Cooperative Department in general and various types of farm equipment including irrigation equipment financed on a hire purchase basis, in particular, in various townships.

[2] The third and the second class loans are provided by almost all the Cooperative Department whereas the first class loans are provided by Cooperative Department, Myingyan in particular for integrated farm development

Table 6

Summary of activities undertaken by Cooperative Departments

Pakkoku The Cooperative Department has so far promoted a total of 308 cooperatives of different types comprising of 264 Agriculture General Services Cooperatives, 2 Cooperative syndicates, 17 Microcredit Cooperatives, 16 Marketing Cooperatives. During 2016-17, the cooperative provided loans on a hire purchase basis for 26 tractors for 26 members valued MMK425.35 million.
Yesagyo The Cooperative Department has promoted a total of 258 cooperatives of different types comprising of 190 Agriculture General Services Cooperatives, 1 Cooperative syndicates, 35 Microcredit Cooperatives and 15 Marketing Cooperatives. During 2016-17, the cooperative financed a total of 10 high powered tractors, 1 harvesters, 67 water pumps, 3 disc ploughs and 7 harrows.
Myingyan The Cooperative Department has promoted a total of 231 cooperatives of different types comprising of 173 Agriculture General Services Cooperatives, 3 Cooperative syndicates, 23 Microcredit Cooperatives and 19 Marketing Cooperatives. During 2016-17, the cooperative financed 32 tractors to 32 members
Taung Thar The Cooperative Department has promoted a total of 268 cooperatives of different types comprising of 205 Agriculture and General Services Cooperatives, 3 Cooperative syndicates, 30 Microcredit Cooperatives and 23 Marketing Cooperatives. During 2016-17, the cooperative has financed 15 high powered tractors,10 disc ploughs and 1 truck for 26 farmers from 26 Cooperatives valued 448.491 million.
Natogyi The Cooperative Department has promoted a total of 208 cooperatives of different types comprising of 156 Agriculture and General Services Cooperatives, 1 Cooperative syndicate, 26 Microcredit Cooperatives, and 18 Marketing Cooperatives.

During 2016-17, the cooperative department financed 15 high powered tractors, 8 disc ploughs and 2 crushing machines to 25 farmers valued at MMK464.082 million from Daedong Company; and 13 high powered tractors, 4 light trucks (High Jet), 5 disc ploughs and 2 threshing and winnowing machines to 27 farmers from other companies, valued at MMK580.303 million.

Ma Hlaing

The Cooperative Department has promoted a total of 248 cooperatives of different types comprising of 202 Agriculture General Services Cooperatives, 1 Cooperative syndicate, 24 Microcredit Cooperatives, 9 General business Cooperatives (of plum tree owners) and 7 Livestock breeding Cooperatives.

Note: most of the cooperatives promoted by the Cooperative Department were reported to be operational to varying extents

Except for Cooperative Department in Yesagyo which provided loans for 67 irrigation pumps through the hire purchase scheme, the Cooperative Department in the other townships have not reported financing irrigation equipment to farmers.

The officials from DoA from various townships informed the study team that the farmers usually prefer to acquire high value farm equipment through the hire purchase scheme but if the farmers are interested, the Cooperative Department can also finance irrigation equipment under the hire purchase scheme.

3.2 MADB

MADB provides agricultural loans to individual farmers directly as two types – monsoon loan and winter loan. The Monsoon Loan is for paddy cultivation with a loan amount of MMK 1.5 lakhs per acre. The winter loan is for beans, pulses, oilseeds and other cash crops. The winter loan amount is MMK50,000 per acre. The ceiling of area per farmer is 10 acres for loans. The M-CRIL study team managed to visit MADB in two of the townships for which the information gathered is summarised in **Box 1** below. The M-CRIL team made efforts to visit MADB in other townships but could not meet the Manager as he/she was not present at the branch.

Box 1

Financing of farm equipment including irrigation equipment by MADB

The officials at MADB reported that there were currently no specific loan products for financing agricultural equipment including irrigation equipment. But they added that MADB provided loans to farmers for farm equipment in the past during 1993-2013; the loan duration was for 3 years with 3 equal yearly instalments.

However, for 2017-18 onwards, the Myanmar Government in collaboration with JICA has planned to provide loans to farmers for acquiring agricultural equipment including irrigation equipment. Under the arrangement, farmers willing to take a loan for farm

<table>
<tr><td colspan="2">equipment will have to save money with MADB to the extent of 30% of the value of farm equipment to be financed by MADB. The loans will be for a tenure of 5 years with equal yearly instalments. MADB will appraise the loan proposal and assess the repayment capacity of the farmers.</td></tr>
<tr><td><u>Yesagyo</u>
Total loans of MMK27,773 lakhs so far to 7,591 farmers from 56 villages
▪ Monsoon loan: Provided paddy loan 13,930 acre @MMK 1.5 lakh per acre
▪ Winter loan: Provided loan for beans and pulses for 13,738 acres @MMK 50,000 per acre (green gram - 8,611 acres; pigeon pea - 2,206 acres, sesame - 1,453 acres and groundnut - 1,486 acres).</td><td>Ma Hlaing
Total loans of MMK50,829 lakhs provided so far to 13,251 farmers from 67 villages for paddy and other crops.</td></tr>
</table>

3.3 LIFT funded Yoma Bank Agribusiness Finance Programme (AFP)

Yoma Bank has been implementing an Agribusiness Finance Programme since December 2015 with support from LIFT to increase agricultural productivity in Myanmar. Backed up by a donor-funded loan loss reserve, Yoma Bank lends to rural SMEs, smallholders and intermediaries. Through a combination of risk sharing and technical assistance, the programme, among other objectives, aims to stimulate investment in agricultural mechanisation by offering financial services for investment in farm equipment by farmers and to other agricultural entrepreneurs.

This programme is mainly focused on the Delta and Dry Zones (including Magway and Mandalay regions) with smaller disbursements in Shan and Mon states. Thus this programme covers all the study townships for loans for farm equipment. These are hire purchase loans with a down payment of 10% of the value of the equipment as against prevailing norm of 25-30% down payment typically sought from farmers under hire purchase schemes. This has resulted in a higher loan amount for farmers and less immediate cash outflow. The longer loan duration with bi-annual repayment cycles accommodates farmers' seasonal cash flows from agricultural activities.

The results of the programme so far (during a 24 month period) have been impressive with a total loan provision of MMK113 billion (USD 85 million) and a total of MMK 137 billion (USD 103 million) worth of agricultural equipment purchased. Information on the types of equipment financed and the value of total loans provided under the AFP is summarised in **Table 7**.

As is apparent from table, most of the agricultural equipment financed under this programme consists of combine harvesters, transport vehicles, tractors and tillers. It is reported that while there is no specific focus on financing irrigation equipment, loans for irrigation equipment can be provided to farmers if the suppliers are amongst the 17 farm equipment dealers certified by Yoma Bank.

Table 7
Equipment financed and value of finance by Yoma Bank Agribusiness Finance Programme

Type of equipment financed	# of equipment financed	Total value of loans	Total value of equipment
2016		**Amount in MMK million**	
Combine harvester	412	12,635	15,373
Transport vehicle	954	12,565	16,487
Tiller	233	468	546
Tractor	1,378	31,872	40,333
2017			
Combine Harvester	303	10,438	12,411
Transport Vehicle	281	4,484	5,642
Tiller	22	64	71
Tractor	1,545	40,457	46,315
Total	**5,128**	**112,981**	**137,178**

Source: Narrative Progress Report of Yoma Bank Agriculture Finance Programme

Loans to MFIs under AFP

Another important initiative through this programme is to extend access to finance to those people in rural Myanmar who are currently unbanked. Under this arrangement, Yoma Bank lends funds to MFIs for on-lending to borrowers in rural areas. Till early September 2017, a total of MMK7.3 billion (USD 5.5 million) of loans was disbursed to Proximity Finance for providing loans to about 28,000 new farmer households across Myanmar. A number of other similar loan proposals are in various stages of processing and are awaiting regulatory approval (the final step before disbursement).

Financing of farm equipment by MFIs

Proximity Finance and PGMF, in particular, are operational in the Dry Zone and also in some of the study townships. These MFIs provide loans to rural households for agriculture, livestock and small business and trading activities. PGMF, in particular, provides lease loans for purchasing business assets like motorbikes and agricultural assets including smaller farm equipment – some would have bought irrigation equipment through this loan. However, there is no specific focus on loan products for irrigation equipment and there is no information to confirm this.

Chapter 4

Additional expenses and benefits of using pumped irrigation water

This Chapter discusses various implications emerging from the use of pumped irrigation water and also the benefits the farmers derive as a result of access to pumped irrigation water during the monsoon gap period. Views from the officials of DoA from various townships are also incorporated wherever applicable.

4.1 Additional expenses resulting from pumped irrigation water during the monsoon gap period

The expenses for seed, insecticides and pesticides (with a few exceptions) remain the same in general with or without pumped irrigation water. However, there is an increase in the use of fertilizers in some case when the farmers use pumped irrigation water. However, there are other additional expenses resulting exclusively from the use of pumped irrigation water and these are listed below. **Table 8** below presents as an illustration the cost of cultivation of 3 crops from Pho Kone village in Pakokku with the use and without the use of pumped irrigation water during the monsoon gap period.

Table 8
Cost of cultivation of 3 crops with and without the use of pumped irrigation water

Types of inputs and activities	Green gram		Black gram		Sesame	
	Without irrigation, MMK	With irrigation, MMK	Without irrigation, MMK	With irrigation, MMK	Without irrigation, MMK	With irrigation, MMK
Seed	30,000	30,000	35,000	35,000	8,000	8,000
Fertiliser	80,000	80,000	76,000	76,000	60,000	60,000
Insecticides	36,000	36,000	27,000	27,000	27,000	27,000
Pesticides/fungicides	20,000	20,000	10,000	10,000	10,000	10,000
Irrigation labour	0	32,000	0	32,000	0	32,000
Fuel cost	0	24,000	0	24,000	0	24,000
Bund preparation for irrigation	0	16,000	0	16,000	0	16,000
Land preparation	36,000	36,000	48,000	48,000	36,000	36,000
Total cost	**202,000**	**274,000**	**196,000**	**268,000**	**141,000**	**213,000**
Quantity of produce per unit of area (basket/acre)	10	15	10	15	10	15

Note: For green gram/black gram each basket contains 19 viss and for sesame one basket contains 15 viss

As is apparent from the Table above, the additional cultivation costs exclusively emerging from the use of pumped irrigation water are

- Labour charges for bund preparation for irrigation
- Irrigation labour charges wherever needed
- Fuel charges for engines to pump water.

+ engine and pump maintenance charges in case farmer's owned irrigation systems

4.2 Enhanced crop productivity and produce quality

As a result of the use of pumped irrigation during the monsoon gap period coupled with the application of the necessary agricultural inputs, the productivity of monsoon crops has increased significantly in the range of 25-100% depending on the types of crops and soil suitability. Additionally, most of the farmers interviewed reported that the overall quality of produce has improved as a result of the application of irrigation water and additional agricultural inputs during the monsoon gap period resulting in better price realisation to the extent of 5-10% for the produce.

Similarly, officials from the DoA of the respective townships report that the overall quality of all the crops is better when the farmers use pumped irrigation during the monsoon gap period because of improved flowering and better quality of produce as a result. The range of productivity increase for various crops with pumped irrigation during the monsoon gap period coupled with the use of other necessary agricultural inputs is summarised in **Table 9**.

Table 9
Crop productivity increase (% range) with use of pumped irrigation & other agricultural inputs

Pakkoku Green gram – 25-50% Black gram – 50% Sesame – 30-50% White bean – 40%	**Yasagyo** Green gram – 30-50% Black gram – 50% Sesame – 30-50%
Myingyan Green gram – 50% Black gram – 30-90% Sesame – 20-80%	**Taung Thar** Green gram – 50% Sesame – 60-100% Onion – 30-60% Chilli – 25%
Natogyi Sesame – 50-65% Onion – 25-30% Chilli – 20%	**Ma Hlaing** Sesame – 20-50% Onion – 40-50% Cotton – 30%

Wide variations in productivity of the same crops across villages and townships were reported because of multiple factors including soil fertility and soil suitability for particular crops and the extent of application of other agricultural inputs.

4.3 Reduction in crop failure risks with use of irrigation during monsoon gap period

Most of the farmers interviewed reported the significant reduction in crop failure risk to the extent of 70-90% as a result of the application of pumped irrigation water and other agricultural inputs during the monsoon gap period. This is in line with the study hypothesis that *providing irrigation during the gap time reduces farmers' risks of crop failure and enables farmers to invest in cash crops.* The extent of crop failure risk does not vary significantly (usually in the range of 5-10%) across various crops, villages and townships. When the farmers did not have access to pumped irrigation water earlier, they did not have the required confidence to grow crops by making investment in cultivating crops during the monsoon period. Even though some farmers opted to cultivate crops without assured irrigation during the monsoon gap period, most of them suffered losses (except a few exceptions when there was timely rainfall) because of much lower productivity from these crops as compared to the investment incurred in cultivation.

The officials from DoA from the townships also shared similar views: the extent of crop failure as a result of access to pumped irrigation water has reduced to the extent of 80-90%.

4.4 Challenges limiting farmers' access to pumped irrigation water during the monsoon gap time

Farmers and officials from DoA cited various challenges/reasons that limit access to pumped irrigation water during the monsoon gap period. The common reason shared by the farmers in almost all the villages relate to the lack of adequate capital needed to buy and install irrigation systems. As discussed above, there are no specific loan products by MADB, Cooperative Department and commercial banks widely available to the farmers for acquiring and installing irrigation equipment. As discussed above, the hire purchase scheme of the Cooperative Department for acquiring farm equipment is mainly used by farmers for equipment of higher value such as tractors. It seems that **no specific efforts are being made by the Cooperative Department to popularise this loan product for acquiring irrigation equipment which can potentially generate much higher incomes for the farmers from various monsoon crops.**

Another important reason cited by the officials from DoA relate to the presence of ground water in different villages and the regions even in the same village. While the water table in lowland areas is higher in the range of 100-200 feet making tube well installation possible, the water table in upland areas is very deep to the extent of 800-1,000 feet making it impossible for the upland farmers to install irrigation systems. The upland farmers therefore entirely depend on rainfall for irrigation.

Chapter 5

Cost-benefit analysis of irrigation pumps

As discussed above, there is significant reduction in crop failure risk and a substantial increase in crop productivity with the use of pumped irrigation water by farmers during the monsoon gap period. This Chapter presents the cost-benefit (C-B) analysis of irrigation systems for various crops in the 6 LIFT focus townships.

The purpose of these analyses is to demonstrate the impact of effective water management in rainfed crop cultivation as part of climate smart agriculture (CSA) in the Dry Zone. The hypothesis as outlined earlier is that ***providing irrigation during the gap time reduces farmers' risks of crop failure and enables farmers to invest in cash crops***.

The objective of the C-B analyses presented here is to assess the scope of risk mitigation in crop production and benefits to farmers by obtaining information of actual benefits and dis-benefits of using pumped water in different commercially important crop cultivations in the Dry Zone during the monsoon season.

The cost-benefit analysis, undertaken in this chapter, uses the information obtained from farmers both through individual interviews and FGDs on the cost/price and investments made in installing irrigation pumps and the operational data for the irrigation system. **This analysis is based on the best estimates possible** from the information obtained and various informed assumptions made based on detailed discussions with farmers for the purpose.

5.1 The cost-benefit analysis of crops cultivated using pumps for irrigation

Two indicators have been used to analyse the cost-benefit of crops being cultivated using pumps for irrigation

- Return on capital (RoI)– rate of return to overall cost of production per acre
- Internal Rate of Return (IRR)

For farmers with their own irrigation pumps, both return on capital and IRR have been worked out, whereas in case of the hiring of irrigation pumps by the farmers for irrigation during the monsoon period (for example in some villages in Pakokku and Yesagyo hire pumps instead of having their own irrigation systems), rate of return on capital has been determined.

The following steps have been used broadly to work out the return on capital and IRR

- Estimation of the total cost of crop production with and without irrigation and productivity in both the cases
- Calculation of net surplus (revenue from crops minus cost of production) per acre from the sale of produce in both the cases (with irrigation and without irrigation) – the selling price for produce has been obtained from farmers at least for the last 3 years

and their average has been used to calculate the revenue and net surplus – this to a larger extent takes into account the price fluctuation across years for various reasons.

- Determining costs of irrigation equipment and installation cost – these include cost of the diesel engine, irrigation pump, pipes and tube well boring expenses.
- Estimation of an appropriate life for various pieces of equipment and tube well boring to estimate the per year cost – these have been estimated based on farmers' experience and responses
- Allocation of irrigation installation cost per acre based on the number of crops (2 crops with average of 5 acres of land) being irrigated using irrigation pumps – two crops each year have been assumed since irrigation enables double cropping
- Estimation of annual repair and maintenance cost per year per acre of irrigation systems
- Calculation of rate of return and IRR based on the data obtained from interaction with farmers.

Table 10 below summarises the calculations worked out for the indicators – return on capital and IRR per acre for 3 crops in each township – without taking into account crop failure risk during the monsoon gap period. **Table 10** also presents other relevant information. The detailed calculations are contained in **spreadsheet files** (in MS Excel) that accompany this report.

Table 10
Return on capital and IRR per acre – summary for crops for each township

Township: Pakokku

Village	Crop	Net surplus		Return on capital		IRR	Remarks
		without irrigation	with irrigation	without irrigation	with irrigation	with irrigation	
Kywe Te	Green gram	1,29,000	1,94,500	75%	76%	NA	Hired pump
A Nauk Nga Kyaw	Green gram	64,333	1,08,000	28%	31%	42%	Own tube well
Kywe Te	Sesame	2,47,000	2,78,500	152%	109%	NA	Hired pump
Pho Kone	Sesame	2,52,333	3,74,000	179%	164%	233%	Own tube well
Kywe Te	White bean	1,87,833	2,16,667	178%	112%	NA	Hired pump

Note: NA refers to Not applicable

Township: Yesagyo

Village	Crop	Net surplus		Return on capital		IRR	Remarks
		without irrigation	with irrigation	without irrigation	with irrigation	with irrigation	
Sint Kine	Green gram	3,08,500	3,72,000	180%	127%	55%	Own tube well
Kyi Kan	Green gram	2,01,500	2,96,750	125%	109%	96%	Own tube well
Ta man Ta Po	Sesame	3,02,000	3,68,500	256%	150%	55%	Own tube well
Thin Thi	Sesame	3,00,667	4,29,500	259%	196%	140%	Own tube well
Chit Thu	Black gram	1,77,300	3,47,800	144%	162%	NA	Hired pump

Township: Myingyan

Village	Crop	Net surplus		Return on capital		IRR	Remarks
		without irrigation	with irrigation	without irrigation	with irrigation	with irrigation	
Ta loke	Green gram	1,51,500	1,89,250	91%	64%	78%	Own tube well
Thar Baung	Green gram	2,62,500	3,80,000	144%	121%	110%	Own tube well
Ta loke	Sesame	1,51,500	1,89,250	108%	101%	278%	Own tube well
Ah Naint	Sesame	3,09,000	3,89,000	192%	120%	217%	Own tube well
Taung kyun	Black gram	1,77,000	4,76,000	79%	154%	315%	Own tube well
Myauk Kyun	Black gram	2,97,000	3,97,000	162%	147%	90%	Own tube well

Township: Taung Thar

Village	Crop	Net surplus		Return on capital		IRR	Remarks
		without irrigation	with irrigation	without irrigation	with irrigation	with irrigation	
Thar Yar Gyi	Onion	6,10,500	14,38,000	79%	161%	876%	Own tube well
Min Kyo	Onion	6,58,500	12,03,250	90%	136%	1513%	Own tube well
Lei Gwet Gyi	Sesame	69,250	1,26,500	80%	60%	43%	Own tube well
Ta Mike Thar	Sesame	75,750	1,63,500	43%	52%	78%	Own tube well
Thar Yar Gyi	Chilli	8,30,500	9,86,750	354%	273%	162%	Own tube well

Township: Ma Hlaing

Village	Crop	Net surplus		Return on capital		IRR	Remarks
		without irrigation	with irrigation	without irrigation	with irrigation	with irrigation	
Hnaw Kan/Ywar Thit	Onion	7,47,000	15,54,000	99%	161%	867%	Own tube well
Ma Gyi Kone	Onion	6,85,500	11,67,500	103%	133%	459%	Own tube well
Myet Thee Kyin	Sesame	39,500	94,050	20%	34%	139%	Own tube well
Kyaung Su	Sesame	1,15,500	2,23,500	63%	91%	32%	Own tube well
Kyaung Su	Cotton	3,00,000	3,65,000	133%	110%	187%	Own tube well

Township: Natogyi

Village	Crop	Net surplus		Return on capital		IRR	Remarks
		without irrigation	with irrigation	without irrigation	with irrigation	with irrigation	
Let Ware	Onion	4,98,000	7,87,500	54%	70%	502%	Own tube well
Shwe Pyay Yin	Onion	4,29,000	6,01,250	54%	63%	206%	Own tube well
Kan Nar	Sesame	2,99,500	4,42,500	171%	152%	174%	Own tube well
Khet Lan	Sesame	1,81,500	3,59,000	90%	121%	252%	Own tube well
Shwe Pyay Yin	Chilli	6,58,000	8,16,250	113%	115%	212%	Own tube well

5.2 Major highlights from the cost-benefit analyses of crops

The following are the major highlights from the C-B analyses without considering crop failure risks associated

- The net surplus from the crops with assured irrigation during the monsoon gap period (either with own tube well or hiring of irrigation pumps) is always higher as compared to that without assured irrigation during the monsoon gap period.
- Returns on capital per acre for various crops with and without irrigation during the monsoon gap period are not consistent. For some crops, RoI is higher with pumped irrigation than without irrigation but for other crops this is not the case. The lower RoI with pumped irrigation for some crops in some of the villages is primarily because of the additional capital investment (per acre) in the irrigation pump/system. Additionally, this could be because of variations in cultivation activities and practices for the same crops in various villages – farmers may incur additional expenses on inputs and other activities which may drive the cultivation cost up but not necessarily to the optimum level or even in the most appropriate manner to obtain optimum productivity.
- Similarly, IRR with irrigation without considering crop failure risks for all the cases works out in various ranges – minimum being 32% and maximum about 1,500% in the case of onion cultivation which has turned out to be a very remunerative crop so far.

The next chapter modifies this analysis in the context of risk, perhaps the key determining aspect of returns to agriculture.

Chapter 6

Cost-benefit analysis considering crop failure risks

In this chapter, the above analysis is modified to allow for crop failure risk in undertaking agriculture without and with pumped irrigation water during the monsoon gap period.

6.1 Risk adjusted return on capital

For both the scenarios (with and without irrigation during the monsoon gap period) an overall median RoI has been worked out for individual crops by combining the RoIs worked out for the respective crops from the villages in various townships. The median RoI has been considered to offset for the wide variations in RoIs for a specific crop across villages due to various reasons. The % of crop failure risk associated with and without irrigation has been applied to the median returns to estimate the risk adjusted returns for individual crops.

The risk adjusted crop wise summary of median returns on capital presented in **Annex 1** and **Annex 2** below assume 80% risk in cultivation without irrigation and, based on feedback from farmers, a much lower 20% risk in cultivation with irrigation. As is apparent from the tables below, there are significant reduction in adjusted median returns without irrigation when the crop failure risks are factored in the calculations.

Figure 1 and **Figure 2** below depict the median returns on capital without and with risk adjustment for crop failure.

Figure 1: Median returns on capital without adjustment

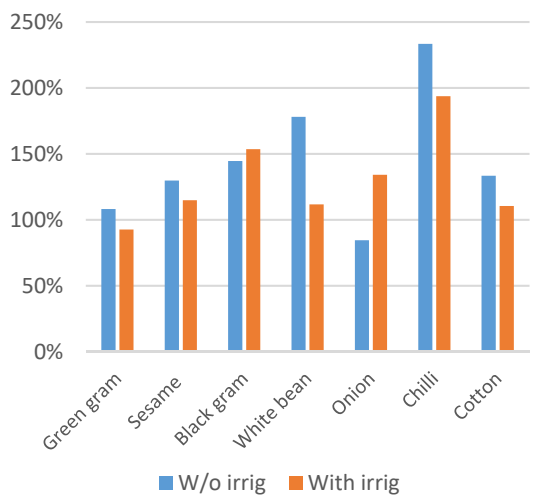
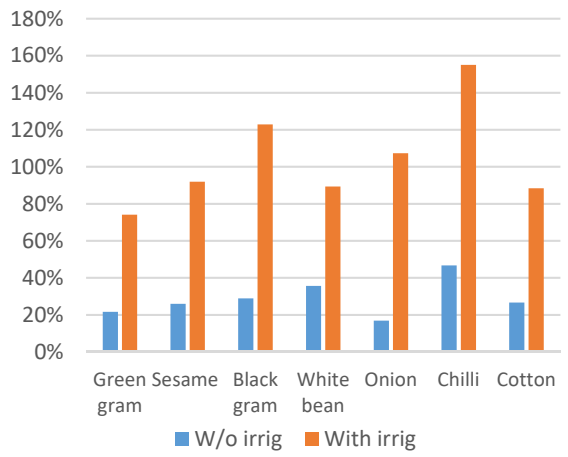


Figure 2: Median returns on capital with risk adjustment

*Risk for unirrigated crops, 80%; irrigated crops, **20%***



Comparison of the two figures shows that

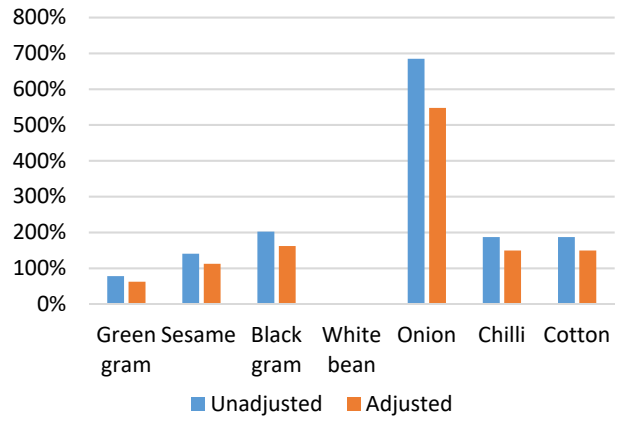
1 With adjustment for crop failure risk, the median return on capital for all the crops when irrigation is used during the monsoon gap period works out to be much higher order (one and half times to five times). This essentially suggests that the assured irrigation during the monsoon gap period brings much higher assured return to the farmers.

2 Without risk adjustment irrigation is only worthwhile for black gram and onion since returns on the capital invested are significantly higher only for these two crops and may not be appropriate for sesame, green gram and chilli. But this could also suggest that the lower RoI for crops with irrigation could be due to cost intensive cultivation practices resulting from higher cost of cultivation due to hopes of much higher returns.

6.2 Internal rate of return

Annex 3 below **and Figure 3** shows the IRR of investment in irrigation. The IRR for all the cases works out in various ranges – minimum being 78% (for green gram) and maximum about 700% (for onion). IRR in the case of onion cultivation works out to be of a much higher order than that for other crops mainly because onion cultivation is a moisture intensive crop and its productivity is, therefore, highly affected by the availability of timely and adequate water. Crops like sesame and green gram are not as sensitive to moisture in the soil.

Figure 3: IRR of investment in irrigation



There is a small decline in IRR for all the crops after the adjustment for risk – with the lowest IRR of 62% (for green gram) and the highest of about 500% (for onion). The overall average of risk adjusted IRR for all the crops stands at about 170%.

Chapter 7

Summary of key conclusions & recommendations

7.1 Key conclusions

The purpose of this study and C-B analysis is aimed at demonstrating the impact of effective water management in rainfed crop cultivation as part of climate smart agriculture (CSA) in the Dry Zone and testing the hypothesis that ***providing irrigation during the gap time reduces farmers' risks of crop failure and enables farmers to invest in cash crops***.

Based on the findings and the C-B analyses of both the scenarios (with and without irrigation) the following conclusions emerge

- There are higher returns on capital (RoI) per acre for some of the study crops without irrigation (due to various reasons) including the low moisture sensitivity of some crops (such as sesame and green gram).

- With the use of pumped irrigation during the monsoon gap period and the application of the necessary agricultural inputs, the productivity of monsoon crops increases significantly in the range of 25-100%.

- There is a significant reduction in crop failure risk to the extent of 70-90% as reported by the farmers with the application of pumped irrigation water and other agricultural inputs during the monsoon gap period. This is corroborated by local officials from DoA in the study townships.

- The overall quality of produce has improved as a result of the application of irrigation water and additional agricultural inputs during the monsoon gap period resulting in better price realisation to the extent of 5-10% for the produce.

- The median return on capital for all the crops when irrigation is used during the monsoon gap period works out be of a higher order after adjusting for risk, suggesting that assured irrigation during the monsoon gap period brings higher assured returns to farmers.

- The IRR for all the cases works out in various ranges – from 80% to about 700%.

- The risk adjusted IRR for various crops works out be in the range of 62% to about 500%.

Therefore, the overall study findings of this study indicate that farmers can reduce the crop failure risks significantly and thus realise much better assured returns from monsoon crops when they have access to and apply timely irrigation water during the monsoon gap period provided farmers select suitable crops for cultivation based on agro-climatic conditions and soil types and adopt appropriate cultivation practices; an excessive application of irrigation water or sub-optimal and/or untimely use of other inputs can adversely affect productivity.

However,

All the farmers with potential to use pumped irrigation water (subject to the availability of ground water and reasonable ground water table in the respective villages) during the monsoon gap period are not able to install irrigation systems/infrastructure for various reasons, primarily due to the shortage of funds due to the lack of adequate financing facilities available to them. Most of the farmers from the study townships reported using their own money/savings and not credit from any source to finance and install irrigation systems. According to the officials from DoA, rough estimates indicate that just about 20-30% of lowland farmers who can potentially use pumped irrigation currently use tube wells during the monsoon gap period.

7.2 Key recommendations

To encourage and enable farmers to install irrigation pumps for meeting the irrigation water needed during the monsoon gap period the study team has the following recommendations

- **Development of specific irrigation loan products by MADB and the Cooperative Department**

As is apparent, financing of irrigation equipment by MADB, commercial banks and the Cooperative Department can contribute to much higher returns in the medium to long run in the cultivation of cash crops like pulses and onions by farmers in the 6 Dry Zone townships included in this study. In the experience of farmers of the region, irrigation greatly mitigates risk in crop production bringing substantial benefits to them. But as discussed, the hire purchase scheme of the Cooperative Department for acquiring farm equipment is mainly used by farmers for equipment of higher value such as tractors. Focussed efforts should be made by the Cooperative Department to popularise this loan product for acquiring irrigation equipment which can potentially generate much higher incomes for the farmers from monsoon crops. Additionally, if required the Cooperative Department should customise the loan features suitably for financing irrigation equipment and related infrastructure.

Similarly, MADB being the main agriculture financing bank in Myanmar should develop a specific loan product with appropriate loan duration and loan features for financing irrigation equipment and related infrastructure so that farmers could use this loan product exclusively for installing irrigation pumps.

It is expected that the farmers will be able to repay their loans with the increased assured returns from various crops with irrigation during the monsoon gap period. Additionally, the increased returns over the medium to long term will also enable farmers to invest more in agriculture which is currently inadequate in most regions of Myanmar including the Dry Zone.

- **Identification of potential villages and areas where irrigation pumps can be installed and working jointly by various stakeholders**

Considering that only about 20-30% of lowland farmers who can potentially use pumped irrigation currently use tube wells during the monsoon gap period, the study team suggests that DoA, MADB, the Cooperative Department and also a few more proactive commercial banks (such as Yoma Bank) jointly identify suitable villages in association with the Village Leader to finance irrigation equipment and related infrastructure. MADB, the Cooperative Department and the commercial banks can allocate among themselves a group of villages for financing irrigation equipment with some appropriate targets for financing irrigation systems. This initiative in each township can be led by the respective Township Administrator, if needed.

- **Development of specific irrigation loan products by LIFT funded Yoma Bank Agribusiness Finance Programme (AFP) and by suitable MFIs**

AFP provides hire purchase loans to farmers for acquiring agricultural equipment but most of the agricultural equipment financed under this programme are for combine harvesters, transport vehicles, tractors and tillers. While, there is no specific focus on financing irrigation equipment, loans for irrigation equipment under the programme can be provided by developing appropriate loan products and promoting these loans amongst farmers from the Dry Zone. Similarly, Proximity Finance which has received a loan from Yoma Bank through AFP and other suitable MFIs working the Dry Zone can be encouraged to develop suitable loan products for financing irrigation equipment and facilitating the development of appropriate infrastructure for agriculture.

Annex 1

Estimated risk adjusted return on capital for the crops covered by this study – without irrigation

Level of risk: 80%

Crop	Village	Pakkoku	Yesagyo	Myingyan	Taung Thar	Ma Hlaing	Natogyi	Median return	Risk adjusted return
Green gram	1	75%	180%	91%				108%	**22%**
	2	28%	125%	144%					
Sesame	1	152%	256%	108%	80%	20%	171%	130%	**26%**
	2	179%	259%	192%	43%	63%	90%		
Black gram	1		144%	79%				144%	**29%**
	2			162%					
White bean		178%						178%	**36%**
Onion	1				79%	99%	54%	84%	**17%**
	2				90%	103%	54%		
Chilli					354%		113%	233%	**47%**
Cotton						133%		133%	**27%**

Annex 2

Estimated risk adjusted return of capital for the crops covered by this study – with irrigation

Level of risk: 20%

Crop	Village	Pakkoku	Yesagyo	Myingyan	Taung Thar	Ma Hlaing	Natogyi	Median return	Risk adjusted return
Green gram	1	76%	127%	64%				93%	**74%**
	2	31%	109%	121%					
Sesame	1	109%	150%	101%	60%	34%	152%	115%	**92%**
	2	164%	196%	120%	52%	91%	121%		
Black gram	1		162%	154%				154%	**123%**
	2			147%					
White bean		112%						112%	**89%**
Onion	1				161%	161%	70%	134%	**107%**
	2				136%	133%	63%		
Chilli					273%		115%	194%	**155%**
Cotton						110%		110%	**88%**

Annex 3

Estimated risk adjusted Internal Rate of Return (IRR) on investment in irrigation for the crops covered by this study

Level of risk: 20%

Crop	Village	Pakkoku	Yesagyo	Myingyan	Taung Thar	Ma Hlaing	Natogyi	Median return	Risk adjusted return
Green gram	1	NA	55%	78%				78%	**62%**
	2	42%	96%	110%					
Sesame	1	NA	55%	278%	43%	139%	174%	140%	**112%**
	2	233%	140%	217%	78%	32%	252%		
Black gram	1		NA	315%				202%	**162%**
	2			90%					
White bean		NA							
Onion	1				876%	867%	502%	685%	**548%**
	2				1513%	459%	206%		
Chilli					162%		212%	187%	**150%**
Cotton						187%		187%	**149%**

Appendix 1

Terms of Reference

Cost-Benefit Analysis of Irrigation Using Pumped Water for Economically Important Crops in the Dry Zone during the Early Monsoon Season

1. *Introduction*

UNOPS is the Fund Manager for the multi-donor Livelihood and Food Security Trust Fund (LIFT}, which was established in 2009 to address food insecurity and income poverty in Myanmar. LIFT's donors are Australia, Denmark, the European Union, France, Ireland, Italy, Luxembourg, the Netherlands, New Zealand, Sweden, Switzerland, the United Kingdom and the United States of America. From the private sector, the Mitsubishi Corporation is a donor.

The overall goal of LIFT is to sustainably reduce the number of people living in poverty and hunger in Myanmar. LIFT's purpose is to improve the incomes and nutrition status of poor rural people by promoting resilient livelihoods and food security. Its designated outcomes are improvements in income, resilience, nutrition, and pro-poor policy developments.

LIFT works with implementing partners (IPs), such as international NGOs, national NGOs, United Nations agencies, international organisations, academic and research institutions, and the Government of Myanmar. LIFT is currently funding projects at the Union level and in the Ayeyarwady Delta, the Dry Zone (DZ), Myanmar's Uplands, and Rakhine State.

So far, LIFT has reached over three million people, or roughly six per cent of Myanmar's population, and is active in just under half of the country's townships. The Fund is expected to continue operations until the end of 2018.

2. *Background to the Study*

The Dry Zone Programme[1] commenced in early 2016 with the implementation of interventions in agriculture, livestock, micro-finance, social protection, nutrition, and WASH. LIFT has contracted eight implementing partners, working in six townships in the Dry Zone. Two partners work in the agricultural sector: The International Fertiliser Development Center (IFDC) and Golden Plain. IFDC implements interventions with the private sector and government in conservation agriculture, agricultural advisory services, as well as other services for small scale farmers. Golden Plain, a local partner, demonstrates the benefits of green manure to small and medium scale farmers.

The townships with LIFT interventions are part of the central Dry Zone, an area that is experiencing erratic rainfall patterns, changing onset periods of the monsoon season, as well as a shortening of the monsoon season. Moreover, most of the farmlands in these townships are rain-fed, limiting farmers to the cultivation of only pulses, beans and oil crops. Where possible, irrigation with pumped water is used to fill the gap between monsoon onset and the start of the main monsoon rains (usually some weeks into June). Farmers experience significant losses in yield if there is no irrigation to cover the lack of rainfall in this gap time.

LIFT would like to conduct a study on effective water management and cost-benefits analysis of using pumped water during the gap time. Such a study will provide advice and necessary information to the farmers so that they are able to assess the investment in pumping water during the gap time for commercially important crops. The results of the study will also enable financial service providers assessing the risks of investing in pumping and irrigation systems to ensure more secure harvests for farmers.

LIFT is looking for a team of qualified consultant consisting of national consultant(s) and field technicians with relevant experience and qualifications to conduct this study.

3. *Purpose and Objective of the Study*

The purpose of this study is to demonstrate the impact of effective water management in rainfed crop cultivation as part of climate smart agriculture (CSA) in the Dry Zone. The hypothesis is that providing irrigation during the gap time reduces farmers' risks of crop failure and enables farmer to invest in cash crops.

The objective is to assess the scope of risk mitigation in crop production and obtain information of actual benefits and dis-benefits of using pumped water in different commercially important crop cultivations during monsoon season.

4. Expected results

This is a study exclusively on existing cultivation practices. Describing the results in sufficient detail will enable the project staff and farmers to utilize the information to self-assess any new alternative cropping patterns.

- Information on economic viability of (effect on increased yield by increased production cost) crop cultivation using pumped water (from different sources) during the monsoon season in different crops cultivation
- Based on the findings from the study, farmers and extension officers should be able to access relevant information to make investment decisions in agriculture water supply system with either own funding or loans from reliable sources
- Based on the findings of the study, financial service providers should be able to access sufficient financial and business information on village level agriculture water supply system to facilitate decisions on loan approval

5. Scope and methodology

The study will be conducted in 30 villages (5 villages per township) in six project townships (Pakokku and Yesagyo in Magway Region, and Myingyan, Natogyi, Taungtha, and Mahlaing in Mandalay Region) of Dry Zone project. Villages will be selected by the consultants in collaboration with the township Department of Agriculture (DoA) and LIFT implementing partners. The study crops are the most common crops (suggested crops are mung bean, sesame, black gram, and cotton) in these project township and a minimum of 3 acres of land per crop will be used for study.

At a minimum, the study will be conducted on 270 acres (6 townships X 5 villages X 3 crops X 3 acres). This means, minimum three crops per township (minimum 3 acres of land per crop) is required.

The pumped water may be government run Pumped Irrigation Projects (PIP), individual, or group managed pumps using river, pond, or underground water. To obtain quality information from farmers, the study will accompany the farmers for the cultivation period and repeatedly update information on cultivation and financial issues.

Study area should consider self-irrigated farms. Alternatively, farmers using pump hiring services can be included in the study area.

Activities to consider in the proposed methodology should include
:

- Desk study and meeting with DoA and LIFT partners to finalize village selection inventory of existing agriculture water sources in selected villages
- Collect data / information on crop cultivation practices, gap filling irrigation system and practices, and crop cultivation costs and yields in the selected villages
- Collect market information (for 2014, 2015 and 2016) for selected study crops

- Collection of relevant information from township DoA staff and farmers from selected study villages
- Discussions with farm owners
- Economic and production analysis of important and common crops i.e. mung bean, groundnut, sesame, and cotton (only in Mahlaing)
- Field visits to selected villages for data collection, visual checking
- Discuss with potential farmers and make agreement for study
- Explore potential different agriculture water sources in specific area
- Simulate the water requirement for gap filling for different crops in the selected villages
- Calculate cost of water facilities and cost of water per crop per acre for gap filling
- Analyse costs/benefits for selected crops with irrigation systems covering the gap time (use crop price for 2014, 2015 and 2016)
- Reporting
- Desk study of rainfall, soil, cropping pattern, cost of cultivation, and actual price of harvested crops in past three years

6. ***Key Deliverables and Estimated Time/ines (indicate working days):***

The consultant group will provide the following deliverables- see the estimated number of days for the consultants ;

Description	Due
1. Preparation of draft study outline/design, method of analysis, and work plan to be reviewed by LIFT FMO *(max. 4 person-days - national consultant)* The consultant group will submit the complete draft documents of design and work plan to be used for study	Two weeks after signing of contract
2. Preparation of final study outline/design, method of analysis and work plan *(max. two person-days - national consultant)* Based on provided feedback/comments, the consultant group will revise the documents and will submit them again for final approval of LIFT	One week after receiving feedback from DZ programme of LIFT
3. Data and information collection in the selected townships and villages (first round) *(max. 12 person-days by national consultants and 66 person-days by field technicians)* • Desk study / informal meeting with DoA and LIFT partners • Discussion with potential farmers for study, identify the study location, get agreement with owners of farm land for study • Inventory of village level existing agriculture water sources and exploration of potential different agriculture water source in specific area • Data / information on crop cultivation practice, gap filling irrigation	Two weeks after the acceptance of final study design, method of analysis and work plan

4. Data and information collection in the selected townships and villages (second and third round) *(max. 6 person-days by national consultants and 60 person-days by field technicians)* • Two additional rounds of data collection will be needed to get actual / more reliable data of the 2016 crop season for cultivation cost, gap filling irrigated water cost, yield and income from harvested crops.	Timing should be match with selected crops

5. Analyses of data/information collected from the villages *(max. 8 person-days for national consultants and 36 person-days by field technicians)* Simulate the water requirement for gap filling for different crops • Calculate cost of water facilities and cost of water per crop per acre for gap filling • Analyses cost/benefit for different crop with gap filling water supply system	One week after the final data collection exercise
6. Draft study report preparation *(max. 4 person-days by national consultant)* Study report with detailed analyses and data/information collected during the field visits and annexes (if any) must be submitted for review and final feedback.	Three week after the final data collection exercise
7. Final study report preparation *(one person-day by national consultant)* The length of the final report should not be more than 30 pages. Annexes will not be limited to make sure all necessary documents are included.	One week after receiving feedback from DZ programme team, LIFT

7. ***Duration***

The study must be implemented over a period not extended beyond seven months after signing of the contract. Based on the assumption of the time taken for different tasks, duration of possible work plan is suggested as follows[2]:

Description of Task

1. Preparation of draft study outline/design, method of analyses, and work plan
2. Feedback from DZ programme of LIFT
3. Preparation of final study materials
4. Review final documents by DZ programme team
5. Preparation for study by consultant group
6. Conduct field data/information collection (1st round}
7. Waiting time (approx. six weeks based on selected crop)
8. Conduct field data/information collection (2"d round)
9. Waiting time (approx. six weeks based on selected crop)

10. Conduct field data/information collection (3rd round)
11. Data analyses and simulation for different crops/different sowing timings
12. Prepare draft study report
13. Receive feedback from LIFT
14. Revised draft to final training report

Estimated Duration for Each Task

two weeks one week one week one week one week two weeks

some weeks (based on crop) one weeks

some weeks (based on crop)

one weeks

two weeks one week one week one week

Please note that we assume 37 person-days for national consultants and 162 person-days for field technicians over the study period including report preparation.

8. Qualifications/Experience of the Consultant(s)

The proposed consultant team will ideally be comprised of a national consultant(s) and field technicians to conduct the field visits for timely data collection and study. It is up to the consultants to propose a suitable team and adopt the work duration depending on these resources to ensure the fulfilment of the TOR requirements.

The team members require the following combined set of qualifications, skill and experience.

- A team leader / national consultant with a master's degree / postgraduate diploma in agriculture / agriculture economics or other relevant fields for study, plus 7 years of relevant field experience with proven knowledge of pulse and bean cultivation in rainfed areas and cost-benefit analysis for different crops cultivation
- Other team members (e.g. field technicians) should have relevant tertiary qualifications for their appointed roles
- Demonstrated understanding of the crop cultivation with a combination of rain and pump irrigation water from different sources (tubewell, creek, pond, etc)
- Experience and track record to conduct the cost-benefit study of different crops
- Proven experience and excellent skills in agriculture studies and methodologies suitable for cost-benefit analysis for different crops cultivation
- Understanding of the existing situation of cotton and high-risk crop (pulses, beans and oil crops) cultivation under unreliable weather conditions in Dry Zone, Myanmar
- Excellent analytical, research, writing and communication skills
- Excellent English language report writing skills
- National consultant team members should have fluency in English and Myanmar – both written and spoken
- Past work experience in the agriculture sector; experience in the in rural areas of the Dry Zone is an advantage.

9. ***Management Arrangement***

The Consultant will be required to report to the international Programme Officer of the LIFT Dry Zone team

The LIFT FMO will support the consultant group by communicating with its LIFT partners working in the agriculture sector in Dry Zone project townships

The consultant group is responsible for making all logistical and administrative arrangements, such as vehicle rentals and drivers, lodging, workspace, computers, internet access, and printing and photocopying of original documents. All forms of insurance are the responsibility of the Consultant team.

Appendix 2

Checklist of questions

M-CRIL Study of cost-benefit analysis of using pumped irrigation water during gap time in the Dry Zone: LIFT Myanmar, June-October 2017

Note: The study team will try to capture information on various aspects during the first round of visit using the following checklist of questions and during the second and third round of the visits, add-on information related to mid-sowing and harvest for 2017 will be gathered from the individual farmers covered in the study.

Checklist of questions for FGDs with farmers

Date:

Township: **Village:**

Name of farmers (4-5 from the village)

Introduce briefly the purpose of the discussions and about the study.

Irrigation equipment and related questions

1. Which crops are grown in the village during monsoon? Try to understand the extent of cultivation of different crops during the monsoon season in the village and identify 3 major crops grown in the village.

2. What are irrigation methods/water sources in the village- both traditional and contemporary such as government run Pumped Irrigation Projects (PIP), or individual, or group managed pumps using river, pond, or underground water. Try to understand in detail the group managed irrigation facilities, if any.

3. Try to understand the relative availability and use of the various methods of irrigation by the farmers during the gap time during monsoon season.

4. Try to understand whether the irrigation methods used are suitable in relation to soil and climatic conditions in the village and area.

5. Try to understand and capture information on the changes in irrigation sources as a result of the project's implementation efforts.

6. Try to understand relationship between weather conditions and availability of irrigation facilities at appropriate times.

Irrigation equipment, suppliers, and investment and financing

7. Which are the main irrigation equipment and who are the major suppliers?

8. What is the cost of installing irrigation equipment (cost for different types including equipment and installation cost including labour cost) and relevant accessories such as irrigation pipes etc?

9. What is the operational life of various types of irrigation equipment (please cover all the major types in use)?

10. What is the running cost of irrigation water? Also capture yearly maintenance cost of the irrigation equipment and accessories?

11. How do you finance the installation of irrigation equipment? Try to capture the names of banks/MFI or other sources for financing and terms (loan amount, duration, interest rates) of financing.

12. Do irrigation equipment suppliers offer irrigation equipment on credit? If yes, what is the duration of credit and terms and conditions.

13. Are you able to access and install irrigation equipment without any problems? If there are problems what are they and how do you resolve them or resolved them?

14. What are arrangements for the repair and troubleshooting services after installation for irrigation equipment? Any issues?

15. What other infrastructure such as power supply and irrigation channels is available for irrigation? Try to understand the issues, if there is such infrastructure?

Harvesting practices

16. What are the crop harvesting practices in your village in general and for monsoon crops in particular and whether there is an adequate availability of labour for harvesting produce? Do you also use other means of harvest, if yes, what are they?

17. Whether there is an increased use of various inputs and the changes in costs/ intensity of inputs (seed, labour, fertiliser, pesticides) as a result of the availability and the use of irrigation during the gap period? Explore this in detail.

Market and sale of agriculture produce

18. What are various methods for selling agricultural produce in general and for the monsoon crops, in particular? Where do you sell (local market, township market, others) and who are the buyers? Try to capture information on the type/profile of produce buyers.

19. Do you sell produce just after harvest or in staggered manner after storage for some time? Try to understand the % of produce that is stored and for how long.

20. Price realisation/variations over time for different agricultural produces – focus on the crops which are the focus in the township (identification of crops based on discussion with DoA and IPs and also farmers).

Produce/ commodities	**Selling price (range) per unit of produce**			
	2014	**2015**	**2016**	**2017** (if applicable)
Mung bean				
Black gram				
Groundnut				
Sesame				
Cotton (in Mahlaing)				

Note: please mention the unit of quantity used for produce.

21. Do you think that the quantity and quality of various produce has improved as a result of irrigation availability during the gap time? If yes, how? Explore in detail.

Cost of production of various crops and productivity

Costs incurred (take average, both amount in MMK and quantity, if possible) in use of various agricultural inputs for different crops and the productivity **per unit of area** – in the matrix below

Types of inputs	**Mung bean**		**Black gram**		**Sesame**		**Groundnut**		**Cotton (only in Mahlaing)**	
	Before	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**
Seed										
Fertiliser										
Insecticides										
Pesticides										
Labour										
Irrigation										
Others										
Quantity of produce per unit of area										

(**Before** means without installing irrigation facilities; and **After** means after the installation of irrigation equipment)

22. Try to ensure the collection of information on increased crop productivity (from the above table) and quality of produce (enabling the improvement of price realisation) resulting from the use of timely irrigation.

23. Are there any effects of various cultivation/irrigation practices on soil fertility and its impact on cropping patterns and future crop productivity? What are they?

24. Do you feel there has been some reduction in crop failure risks as a result of access to the irrigation water during the gap time in monsoon? Explore in detail, try to understand the farmers' perception about the extent of risk reduction in %, if possible.

25. What challenges remain in meeting the irrigation needs during the gap time during monsoon?

26. What are the areas where you think that more support/work is required for meeting your irrigation needs during the gap time?

+ follow up questions emerging from the discussion on the above

Checklist of questions for individual interview with the farmer/farm owners in a village

Note: The study team will capture information on various aspects during the 1st round of visit to selected farmers based on following checklist and during the 2nd and 3rd round of the visits, add-on information on mid-sowing and harvest for 2017 will be gathered from the individual farmers based on the pre-designed format supplied by the study team to the selected farmers during the 1st visit.

Date:

Township: **Village:**
Name of the farmer:

Introduce briefly the purpose of the detailed discussions (the CB analysis).

Crops grown and irrigation equipment/methods used

1. Which crops do you grow during the monsoon? Try to understand the extent of cultivation of different crops during the monsoon season by the farmer. Focus on 2-3 main crops for the rest of the discussion.

2. Which irrigation methods/water sources do you use during the gap time. Capture information if they use in combination of various irrigation sources and why they do so.

3. Try to understand the relative use (extent) of the various methods of irrigation during the gap time during monsoon season.

Irrigation equipment, suppliers, and investment and financing

4. In case the farmer has his own irrigation equipment/infrastructure, find out which equipment/irrigation methods he uses and when he installed it.

5. What is the operational life of your irrigation equipment?

6. What is the cost of irrigation equipment (including of equipment and installation cost including labour cost) and relevant accessories such as irrigation pipes etc?

7. What is the running cost of irrigation water? Also capture yearly maintenance cost of the irrigation equipment and accessories?

8. How have you financed the purchase and installation of irrigation equipment? Try to capture the names of banks/MFI or other sources for financing and terms (loan amount, duration, interest rates) of financing.

9. Were you able to access and install irrigation equipment without problems? If there were problems what were they and how have you resolved them?

10. What are arrangements for the repair and troubleshooting services for irrigation equipment? Any issues?

11. Is there an increased use of various inputs and the changes in costs/intensity of inputs (seed, labour, fertiliser, pesticides) after you have started using irrigation during the gap period? Explore this in detail.

Market and selling of agriculture produce

12. What methods do you adopt to sell your produce cultivated in monsoon? Where do you sell (local market, township market, others) and who are the buyers? Try to capture information on the type/profile of produce buyers.

13. Do you sell monsoon produce just after harvest or in staggered manner after storage for some time? How long do you store before selling?

14. Price realisation/variations over time for different agricultural produces – focus on the crops which you have identified earlier for the further discussion.

Produce/ Commodities*	**Selling price (Range) per unit of produce**			
	2014	**2015**	**2016**	**2017** (if applicable)
Mung bean				
Black gram				
Groundnut				
Sesame				
Cotton (in Mahlaing)				

Note: please mention the unit of quantity used for produce.
*Strike down the crops not being used for discussion

15. Do you think that the quantity and quality of various produce has improved after you have started irrigation during the gap time? If yes, how? Explore in detail.

Cost of production of various crops and productivity

Costs incurred (take actuals, both amount in MMK and quantity, if possible) in use of various agricultural inputs for 2-3 crops identified and the productivity **per unit of area** – in the matrix below. *Leave the boxes blank for crops not covered.*

Types of inputs	**Mung bean**		**Black gram**		**Sesame**		**Groundnut**		**Cotton (only in Mahlaing)**	
	Before	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**
Seed										
Fertiliser										
Insecticides										
Pesticides										

Labour										
Irrigation										
Others										
Quantity of produce per unit of area										

(**Before** means without installing irrigation facilities; and **After** means after the installation of irrigation equipment)

16. Do you think there is an increased crop productivity (please check with the productivity information in the above table) and improved quality of produce (enabling the improvement of price realisation) after use of timely irrigation during the gap time?

17. Have you made any changes in your cropping patterns after access to irrigation during the gap time? If yes, what are those changes?

18. Do you feel that you have been able to reduce crop failure risks as a result of access to the irrigation water during the gap time in monsoon? Explore in detail, try to understand his/her perception about the extent of risk reduction in %, if possible.

19. What challenges do you think still continue at your level in meeting your irrigation needs during the gap time during monsoon?

20. What are the areas where you need more support/work to meet your irrigation needs during the gap time?

+ follow up questions emerging from the discussion on the above

Checklist of questions for team members of DoA

Date:

Township:
Name of the DoA staff members:

1. Tell us about farming in your township and general methods of irrigation used by farmers, climatic conditions, extent of rainfall inconsistency in the township during monsoon, soil fertility, crops grown, quality of produce.

2. What are your roles and responsibilities? Tell us the specific activities you perform.

3. How do farmers address the issues related to untimely arrival of monsoon and erratic rainfall during monsoon?

4. What are your views about the use of pumped irrigation water by farmers from the township during the gap time in Monsoon?

5. Do you think that the irrigation equipment and methods used by farmers for gap time is appropriate considering the weather conditions, soil conditions and other agronomical aspects? If not, why and which would be appropriate equipment/methods?

6. How many or what proportion of farmers in your township have been able to access irrigation water during gap time in the monsoon?

7. Which villages in the township do you suggest for us for the study? Please suggest 6-7 villages from the township to be covered and the 5 priority villages? *IP staff presence during the village selection will be requested.*

8. Try to obtain information (rough idea) about the number of farmers in the selected villages, major crops grown by farmers the in the villages and the irrigation methods used by farmers in general and during the gap time in monsoon in particular.

9. Please help us identify 4-5 farmers in each of 5 villages for the FGDs and individual interviews in each of 5 villages identified – the identification of farmers should be such that 9 acres of land per village is ensured by covering 3 acres for 3 crops**.** *IP staff presence for the village selection will be requested. (*we may need to cover more farmers if individual farmer doesn't grow 3 crops or 3 acres per crop)

10. Discuss about the agreement arrangement with owners of farm land for the study.

11. Please tell us about the irrigation equipment suppliers in the townships, rough idea on installation cost, ways for financing such equipment by farmers, major banks and MFIs providing loans for irrigation equipment and irrigation infrastructure development.

12. What would be 3 major crops from the township which can be covered for the detailed cost benefit analysis – for the villages identified?

13. Do you think that there is an increased use of various inputs and the changes in costs/ intensity of inputs (seed, labour, fertiliser, pesticides) after the farmers have started using irrigation during the gap period and has the productivity of various crops increased as a result? Try to capture their general perception about this.

14. Do you think that the quality of various produce has improved after the farmers have started irrigation during the gap time? If yes, how?

15. Do you think farmers have made any changes in the cropping patterns after access to irrigation during the gap time? If yes, what are those changes? Are those changes appropriate to maintain and improve soil health and other agronomical factors?

16. Do you feel that the farmers have been able to reduce crop failure risks as a result of access to the irrigation water during the gap time in monsoon? Explore in detail, try to understand their perception about the extent of risk reduction in %, if possible.

17. What challenges do you think still continue at farmers' level in meeting irrigation needs during the gap time during monsoon?

18. What are the areas where you think more support/work to meet your irrigation needs during the gap time?

+ follow up questions emerging from the discussion on the above

Checklist of questions for IPs – The International Fertiliser Development Center (IFDC) and Golden Plain

Date:

Township:
Name of IP and staff members:

1. What has been your role in this project and which are the townships you cover? Tell us the specific activities undertaken in the project by your institution.

2. How do farmers address the issues related to untimely arrival of monsoon and erratic rainfall during monsoon for the townships you work in?

3. What are your views about the use of pumped irrigation water by farmers from the townships during the gap time in monsoon?

4. How many farmers (guesstimate) in each township have been able to access irrigation water during gap time in the monsoon?

5. Which villages in the township do you suggest for us to study? Please suggest 5 villages from the township to be covered. *IP staff member/s will be requested to accompany the study team during the meeting with DoA for the village selection*.

6. Try to obtain information (rough idea) about the number of farmers in the selected villages, major crops grown by farmers the in the villages and the irrigation methods used by farmers in general and during the gap time in monsoon, in particular.

7. Please help us identify 4-5 farmers in each of 5 villages for the FGDs and individual interviews in each of 5 villages identified – the identification of farmers should be such that 9 acres of land per village is ensured by covering 3 acres for 3 crops**.** *IP staff member/s will be requested to accompany the study team during the meeting with DoA.*

8. Discuss about the agreement arrangement with owners of farm land for the study – *this will also be carried out in presence of DoA staff members.*

9. Who are the major irrigation equipment suppliers in the townships, rough idea on installation cost, ways for financing such equipment by farmers, major banks and MFIs providing loans for such irrigation equipment and irrigation infrastructure development.

10. What would be 3 major crops from the township which should be covered for the detailed cost benefit analysis?

11. Is there an increased use of various inputs and what changes in costs/ intensity of inputs (seed, labour, fertiliser, pesticides) is there after the farmers have started using irrigation

during the gap period and has the productivity of various crops increased as a result? Try to capture their general perception about this.

12. Do you think that the quality of various produce has improved after the farmers have started irrigation during the gap time? If yes, how?

13. Do you think farmers have made any changes in the cropping patterns after access to irrigation during the gap time? If yes, what are those changes? Are those changes appropriate to maintain and improve soil quality?

14. Do you feel that the farmers have been able to reduce crop failure risks as a result of access to the irrigation water during the gap time in monsoon? Explore in detail, try to understand their perception about the extent of risk reduction in %, if possible.

15. What challenges do you think still continue at farmers' level in meeting irrigation needs during the monsoon gap time?

16. What are the areas where you think more support/work is needed to meet farmers' irrigation requirements during the gap time?

+ follow up questions emerging from the discussion on the above

Checklist of questions for banks/MFIs financing irrigation facilities/infrastructure

Date:

Township
Name of bank/MFI:
Name of staff members:

Introduce briefly the purpose of the discussions and about the study.

1. In how many villages have you provided agricultural loans to farmers? How many farmers have received agricultural loans from your bank branch and for which purpose?

2. What are various loan products for agriculture and farmers?

3. Do you have any specific loan products for irrigation equipment and irrigation infrastructure for farmers? What are they?

4. Which are the various types of irrigation equipment you have financed in the last 2-3 years?

5. How many farmers have received loans for irrigation equipment (during 2015-16 and 2016-17)?

6. Please tell us how you determine the loan amount for irrigation equipment financing – is this based on farmers' land holding or the type of equipment being financed?

7. For irrigation loan products, what are different terms and conditions
   - amount per acre for the crops during monsoon
   - loan duration
   - repayment frequency
   - interest rate per annum (flat or declining)
   - important indicators of farmers' ability to repay their loans

8. What has been your experience with the irrigation loans in terms of repayment by farmers?

9. What are the risk parameters you consider for financing irrigation pumps?

10. What are your views about the extent of use of irrigation equipment/water by farmers from the townships during the gap time in monsoon? Does it offer a good business opportunity for your bank? If yes or no, why?

11. Do you have any target for 2017-18 for financing irrigation equipment to farmers from the township?

12. Do you feel that farmers have been able to reduce crop failure risks as a result of access to the irrigation water during the gap time in monsoon? Try to understand their general perception about the extent of risk reduction in %, if possible.

13. What challenges do you think still continue at farmers' level in meeting irrigation needs during the gap time during monsoon?

14. What are the areas where you think more support/work is needed to meet farmers' irrigation needs during the gap time?

+ follow up questions emerging from the discussion on the above

Checklist of questions for key suppliers of irrigation equipment/systems

Date:

Township:
Name of staff members:

Introduce briefly the purpose of the discussions and about the study.

1. Which are the major agricultural equipment you sell to farmers? List 4-5 major types of agricultural equipment.

2. What are various types of irrigation equipment (including accessories such as pipes, etc) you sell to farmers?

3. What is the cost of various types of irrigation equipment and their operational life, if maintained properly as per the norms? What is the actual operational life when in use by farmers.

4. In how many villages and to how many farmers have you sold irrigation equipment?

5. Do you think that the sale of irrigation equipment has been increasing over the last few years? If yes or no, why?

6. Do you offer installation service and after sales service to farmers? What are these – do you charge farmers for these services?

7. Do you sell irrigation equipment for cash or credit? If on credit, what % of value of the equipment in credit? Do you have any collaboration with banks for credit?

8. What is the duration of credit and do you charge some interest for it?

9. What has been your experience with the repayment of credit by farmers if you sell equipment on credit?

10. What are the risk parameters you consider for providing credit to farmers for irrigation equipment?

11. Do you have any target for 2016-17 for selling irrigation equipment to farmers?

12. What challenges do you think still continue at farmers' level in buying irrigation equipment?

+ follow up questions emerging from the discussion on the above