Baseline Community Water Management Pilot






Martina Groenemeijer 28-02-2015

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Date: 28-02-2015

Acknowledgement

This publication was made possible with a financial contribution of the Netherlands Government. I would like to take the opportunity to thank everybody that has played a role in the creation of this report. Without these persons I would have not been able to gain this experience and obtain the needed data.

First of all I would like to show my gratitude to Dirk Smits and Kim Janssen for providing me with the opportunity to do my internship with Euroconsult Mott Macdonald working on the Blue Gold Program in Bangladesh. They have made sure I was able to settle smoothly in Bangladesh.

Furthermore I would like to thank several staff members of the Blue Gold Team in Dhaka and Khulna for their help with practical arrangements and their efforts for including me in their activities. I would like to especially thank Aziz Rahman for helping me start up in Khulna. Furthermore I would like to thank Asma and Jashim for welcoming me to the Blue Gold family and for their relentless support with arranging meetings with farmers and WMG for me.

I am also grateful to me office roommates, Shamim, Sani, Zahangir, Shushanto and Nurrur for creating a great working atmosphere and distractions when needed. I would especially like to thank Sani, Shushanto and Nurrur for the time they took to discuss the struggles or findings I came across in the field. These discussion have added tremendously to my understanding of the situation. Then I would like to take the opportunity to thank Hilton Roy, my driver, translator and research assistant. Without Hilton I would not have been able to understand the agricultural system in Fultala as I do now. Thank you for joining my adventures in the field and the mud. You made great efforts translating as much as possible, but you also stepped beyond executing tasks and thought along with me about how to tackle the tasks at hand.

I would also like to take a moment to thank all the farmers and in particular Mihyr Bisas, the president of the WMG of Fultala. I am very grateful to you for all the time you gave to answer my never ending questions. Myhir has furthermore supported us extensively in organizing meetings and finding farmers. I would like to furthermore thank Shorab Hossain and Mofazzal, it was a pleasure working together with you trying to from a detailed pilot project. Last but not least I would like to thank my supervisors Shorab Hossain and Andrew Jenkins. They have guided me when needed and shared their knowledge with me that they gained through years of field experience.

There are many more persons that I would like to thank for inviting me for dinner at their houses, boat rides, picnics, wedding or badminton game. You have made my experience in Bangladesh very colorful.

Disclaimer

These are the views and expressions of the author, and do not necessarily represent the view of the Netherlands Embassy in Dhaka or the Blue Gold program.

Abstract

The risk of damage to the winter crop is high with the current agricultural practices in Fultala, Batiagata, Polder 30, Khulna district, Bangladesh. At present the main winter crop, sesame is sown at the end of February and harvest during May. Hence the yield of the crop is reduced when early heavy rains in May damage the plants. The main reason for the practice of this cropping timing, is the inability to properly and timely drain the soils in the months of November and December. As the soil currently is too wet for early harvest and plowing of the soil. Therefore a pilot project was designed to improve the internal drainage within about 67 ha of agricultural land within the Fultala village.
The current main cropping pattern exists of Aman paddy followed by sesame. During the Aman season, mainly local varieties are cultivated, only around 7 ha are used for the production of HYVs. The total production of paddy in the pilot area was estimated on 190 to 230 tonnes and 54 tonnes of winter crop in a year without damage and 30,5 with damage like in 2014.
Farmers indicated that the sesame crop is damaged in 3 to 4 out of 10 years. The potential for increase of agricultural production was therefore estimated on an average of 12,5 tonnes of sesame per year, which is an increase of 30%.

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Martina

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Abbreviations

BWDB	Bangladesh Water Development Board
HYV	High Yielding Variety
IPSWAM	Integrated Planning for Sustainable Water Management program
IRRI	International Rice Research Institute
IWM	Institute of Water Modeling
IWMI	International Water Management Institute
PWD	Public Works Datum
WMC	Water Management Committee
WMG	Water Management Group

1. Introduction

From the 1960's until the 1980's the river management system in the coastal area of Bangladesh was altered with the support of the World Bank, the Dutch government and others (Blue Gold, unpublished, 2014). Embankments were created to protect the area inside the embankment from flooding and saline water intrusion. The creation of the so-called *Polders* allowed for agricultural intensification and changed the cropping system from single to double crop cultivation. (Islam, 2006)
However in the 1990's issues linked to the Polder system became apparent. Siltation of canals and rivers combined with subsidence of the land within the polder caused and causes clogging of the drainage system. Silt that previously ended up on land used for cultivation, now ends up in the canals or rivers. This causes water logging on the fields in many locations. (Islam, 2006) The inability to properly drain fields seems to be the reason for low adaptation of improved cropping systems like High Yielding Varieties (HVY) (Mondal, personal communication, 2014). These practices have been adopted in other regions in Bangladesh but still remain absent in the coastal zone. Farmers generally grow long duration local varieties of rice that are late maturing varieties. Prolonged wetness of the soil complicates the harvesting process, therefore some famers postpone the harvest until the latest possible. When the fields are harvested late, the drying of the soil also starts late resulting in a delay of the production of the winter crop. The main winter crop, sesame, is therefore often destroyed by early rains in April or May. (Blue Gold, unpublished, 2014) (Sani, personal communication, 2014)(Mondal, personal communication, 2014) Even though many organizations indicate salinity to be the main issue limiting production in the coastal zone of Bangladesh, it is needed to realize that the main issue is water logging and drainage congestion. Salinity is an issue, but different production systems, like salt tolerant varieties and rice- shrimp cultivation, are possible dependent on the salinity situation. Whereas water logging disrupts the production system and limits the cropping intensity of the fields. (Mondal, personal communication, 2014)
The Blue Gold Program is currently working in 12 polders in the coastal zone of Bangladesh with the aim of improving the livelihoods of the polder citizens. In their efforts to make use of the full potential of the polder system a community water management pilot project was initiated as part of the Innovations Fund. The main question tackled in this pilot project is:

'Can investment in improved community water management together with adoption of improved cropping systems increase the value of agricultural production significantly more than the investment cost?'

The hypothesis behind this question is that improved drainage enables farmers alter their current cropping practices. Control over the water level in the field will give farmers the opportunity to change towards a higher producing system. They for example could improve the winter crop production by starting the cultivation of the winter crop two weeks to a month earlier, which reduces the risk of crop failure. Another option is the cultivation of HYVs, for which a high control on the water level in the field is needed.
From January 2015 several more partners joined efforts and added aspects to the pilot as it became part of the Water Land and Ecosystem (WLE) and GRiSP funded research: 'Community water management for improved food security, nutrition and livelihoods in the polders of the coastal zone of Bangladesh', which is part of the CGIAR Challenge Programs. Some aspects of the enlarged project are included in this report, but many aspects are still in the formation process and have therefore been left out for simplicity sake.
The selected pilot area is located within in a sub polder of Polder 30, in Khulna district, one of the polders within the Blue Gold Program (Figure 1).

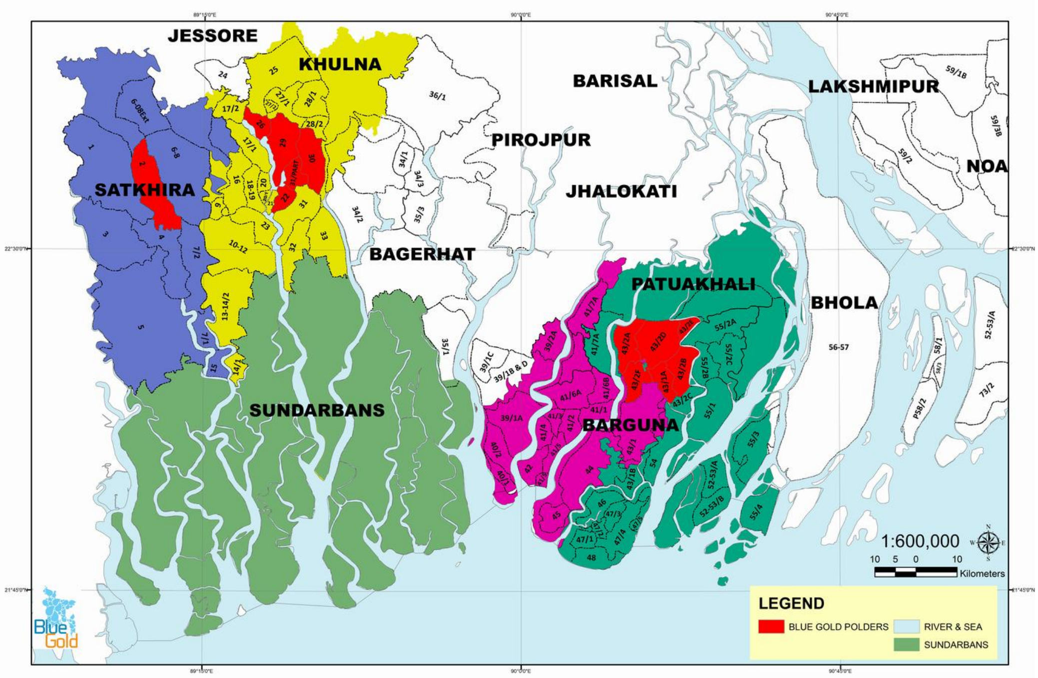

Figure 1, Coastal area of Bangladesh showing the polders where Blue Gold is active (Blue Gold, 2015)

During the IPSWAM program, followed up by the Blue Gold program Water Management Groups (WMG) were created on village level. The communities are organized into these committees to share knowledge and manage water related decision making. (Buisson, et al., 2012)
The WMG is the focus point for this pilot project to achieve the investment in community water management. The improved drainage in the area is to be achieved by the WMG and farmers. Infrastructural improvements will be a combined effort of Blue Gold, the Bangladesh Water Development Board (BWDB) and farmers. Larger infrastructure will be tackled by the first two and farmers will create their own internal farm ditches.

This report entails a review of the cropping system and production in the pilot area before the planned interventions. This information can later be compared to the cropping system and production after implementation of the measures of the pilot project.
First a short introduction of the pilot area will be given followed by a more detailed description of the pilot project in Chapter 2. After an explanation of the applied methodology, Chapter 3, an overview of the current agricultural system and its production is presented in Chapter 4.

2. Pilot project

The measures of the proposed pilot project are a combination of improvement of water infrastructure, community mobilization and organization and agricultural alterations. After an introduction to the pilot area, the different aspects of the pilot project are explained in detail.

Area

The Community Water Management Pilot (CWMP) area is located within the village of Fultala or Phultola[1], Batiaghata Upazila, Khulna district (Figure 2). The water level on the agricultural land is managed by using the tides of the Kazibacha river through the sluice gate in Kismat Fultala or Kathakali regulator Norht of Fultala and the Koria regulator South of Fultala. The village is about 15 km from Khulna city and its villagers have been involved in several programs from a variety of organizations like, Worldfish, the International Rice Research Institute (IRRI), Food and Agriculture Organization (FAO), Shusilon, BRAC and the Blue Gold program.

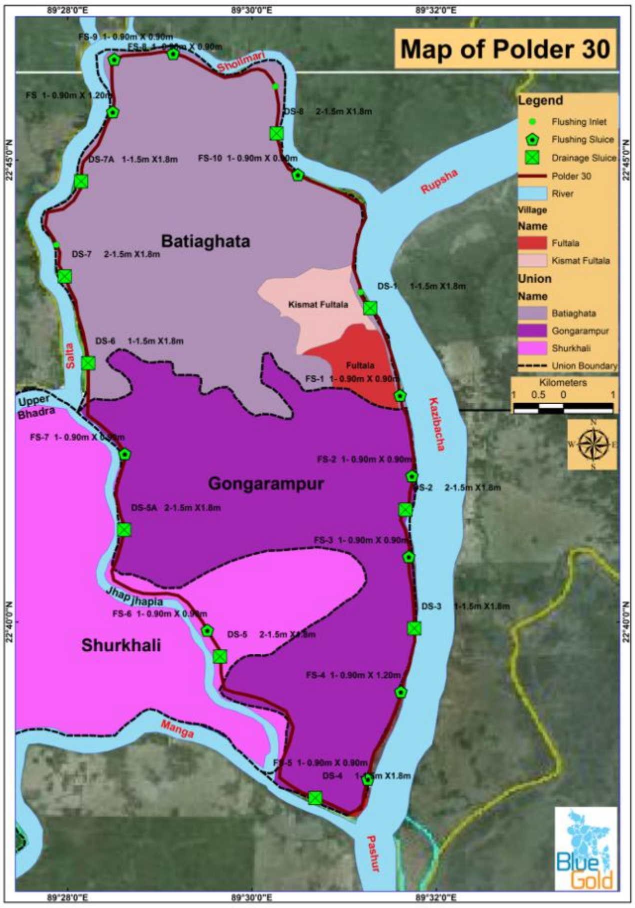

Figure 2, Overview of Polder 30 with location of Fultala village

The village area of Fultala can be divided into Lowland used for agriculture, Highland used for agriculture and settlement area (Figure 3). Due to high salinity in the Highland only one rice crop can be cultivated in this area per year. There is a high control over water as the river is close by, therefore both HYVs of rice and short duration local varieties are cultivated here. In the lowland generally one rice crop and a winter crop are cultivated. Figure 3 furthermore shows the permanent and seasonal canals within the village area. The seasonal canals are natural drains or created canals that have silted up. The seasonal canals within the Lowland are currently completely or partly used for cultivation. Hence there is little difference between the canal and the fields.

[1] In this document referred to as Fultala.

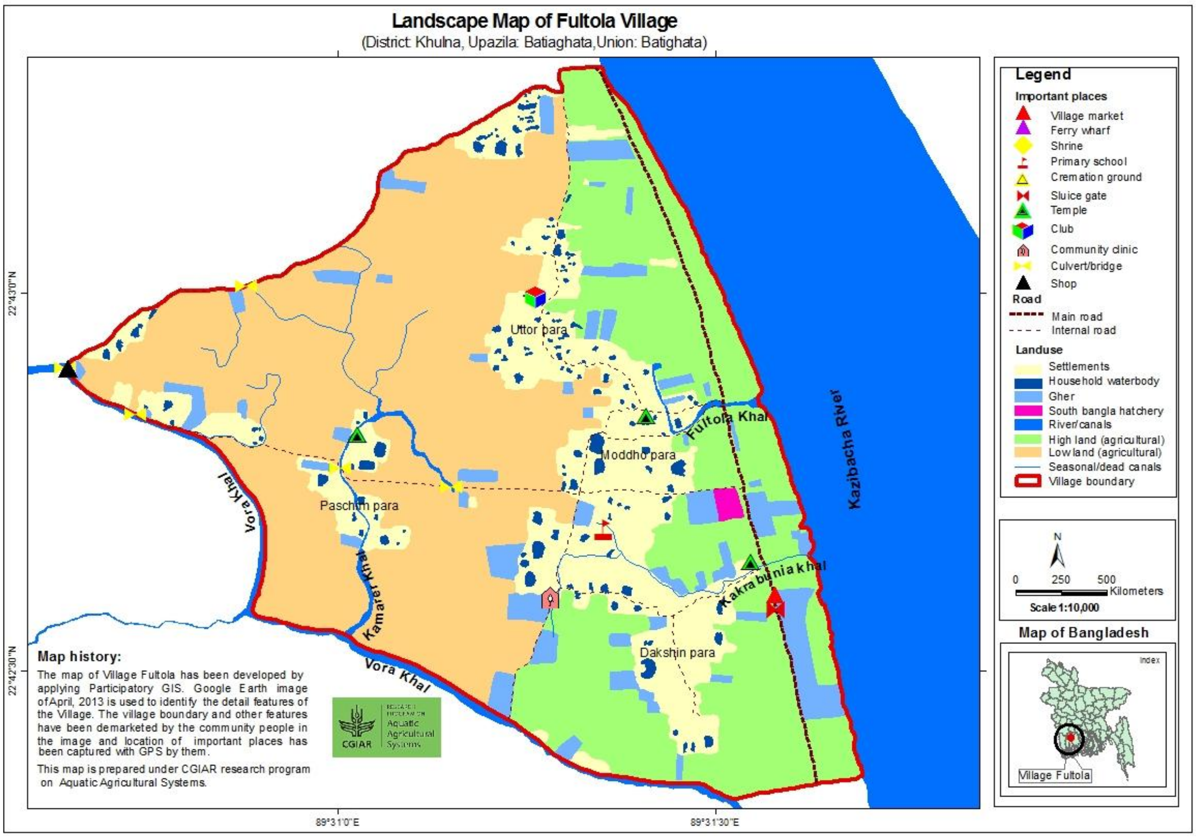

Figure 3, Land use map of Fultala (CGIAR, 2013)

Even though this project is focused on the internal drainage of the units in the village of Fultala, it is important to review the larger drainage system it is connected to.
As is common in *Polders* in Bangladesh a system of drainage channels lead to a main drain that is connected to a sluice gate. The area of Fultala at the moment is affected by the management of two sluice gates, the Katakhali and Khoria regulators. For both gates, Fultala is located in the tail end and therefore receives and drains water comparatively late. The areas close to the gates first increase or decrease the water level on their fields before anything happens in Fultala. Furthermore in order to irrigate the Highland within the pilot area, the Lowlands have to be completely inundated. In the dry season there are several sections where water accumulates that cannot be drained out.

The WMG of Fultala has been given the task to manage the water related issues. Two members of the WMG had a place in the Water Management Committee (WMC) of the Kismat Fultala gate. This group existed of 10 members, two from the five WMGs that are affected by the management of the gate. The WMC assigns two gate operators, who execute the committee's decisions. At the moment of the inventory a new WMC was being formed as the previous committee did not function properly.

The pilot area covers a smaller section of the village of Fultala, almost identical with the Lowland indicated in Figure 3, however, it excludes the South East section.

Cropping calendar
For further explanation of the pilot project it is important to review the cropping calendar in more detail. Currently the *Amon* rice is sown in the end of June and transplanted in July (Figure 4). Depending on the rice variety harvest takes place from the second week of December until the second week of January. The field then needs a month to dry before the cultivation of a winter crop

is possible. The main winter crop, sesame, is therefore grown from mid February or mid March to April or mid May.

Month	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Current												
Proposed												

Legend	
Activity	Color
Seedbed of *Amon* rice	
Amon rice cultivation	
Sesame production	
Earliest start and latest harvest of sesame of proposed cropping schedule	

Figure 4, Cropping calendars

The idea of the pilot project is that by enabling drainage of fields at the start of November it will be possible to start cultivation of the winter crop earlier. The proposed cropping schedule for *Amon* rice is the same except for the harvest as that will now take place from the beginning to end of December (Figure 4). The soil will then need less time to dry and sesame cultivation can start from half January to beginning of February. The sesame can then be harvested from mid to the end of April.

Pilot project

Hence the measures to be implemented have to ensure that the fields can be drained in November. Furthermore, control over the water level in different sections of the area will enable farmers to further differentiate in the choice of rice variety and winter crop.

Currently drainage congestion is occurring because of different types of blockages on three levels; the main drains, the internal drains and the field situation.

At present the fields are inadequately drained during November and December because it is not possible to remove water from the fields. Moreover the residues of the rice that are not always removed from the field hamper evaporation and further slow down the process of field drying.

Drainage congestion in the field is also caused by the current state of the internal drain, as part of the internal drain is silted up and used for rice cultivation (Figure 5 and 6). Additionally the culverts linking the internal drain with the main drainage canal are inadequate in size or location to ensure timely removal of water (Figure 7). Then the main drainage route is around 5.5 km, with five large blockages. In the Konar Khal, the main drain connected to the internal drain, five footbridges block the water flow in the drainage canal (figure 8).

Figure 5, Southern section of internal drain

Figure 6, Northern section of internal drain

Figure 7, Culvert at the Northern section of internal drain

Figure 8, Footbridge blocking the main drain

Therefore infrastructural improvements of the pilot will take place on the three levels; main drain, internal drain and field drainage. First of all farm drains will be created by farmers to support drainage of water from the fields to the internal drains (Figure 9) (Figure 10). Furthermore in WMU 1 full support will be given in the form of provision of inputs and training in order to ensure cultivation of HYV of rice and alternative crops, like sunflower and wheat, on all the agricultural land in WMU1. In WMU2 the community will be consulted to discuss their ideas on rice-fish cultivation.

Secondly to ensure that the field drains are properly linked to the main drainage system the internal drain will be re-excavated (Figure 9)(Figure 10)(Figure 11). Finally the main drainage route will be improved. The best way, in the opinion of the community, to achieve this has not been found yet. Several options were shown and a dialogue with the community was started. However no final decision was made yet as more consultation of the community is needed to finalize agreements on the options to undertake. Four options lie on the table at the moment. First there is the option of a bypass, figure 11. It was however found that the villagers in Kismat Fultala, the location of the bypass, were very reluctant to give up land. They would prefer an option with as less land loss as possible. The second option is to replace the footbridges that currently form blockages (Figure 12). This is not a preferable option as the drainage route remains long, the chance of new blockage to be created is large and it would mean that Blue Gold has to become involved in footbridges. The third option is a newer, which came up during discussions on the first option of a bypass. The red circle Figure 11 shows the option of the creation of another bypass. Here however two existing internal drains would be re-excavated and a small section would be newly created. The community seemed more positive about this option, but full consent and the impact of this drain for Fultala and Kismat Fultala still needs to be obtained. At the moment farmers in Fultala are not convinced this option will improve their drainage situation, as the drainage route remains around the same length. Towards the end of the creation of this report, another option was proposed by the president of the WMG of Fultala. He saw an option to connect and revitalize a canal that flows to the village of Fultala towards the Koria regulator. Unfortunately now time was left to investigate the feasibility of this option.

Therefore at the moment option 3 of connection the two internal drain seems to be the option to pursue. However it is worth to also investigate the possibility of option four. Keeping in mind that if execution of the improvements is to be done in this year a final decision and full consent of the community and possible land owners is needed.

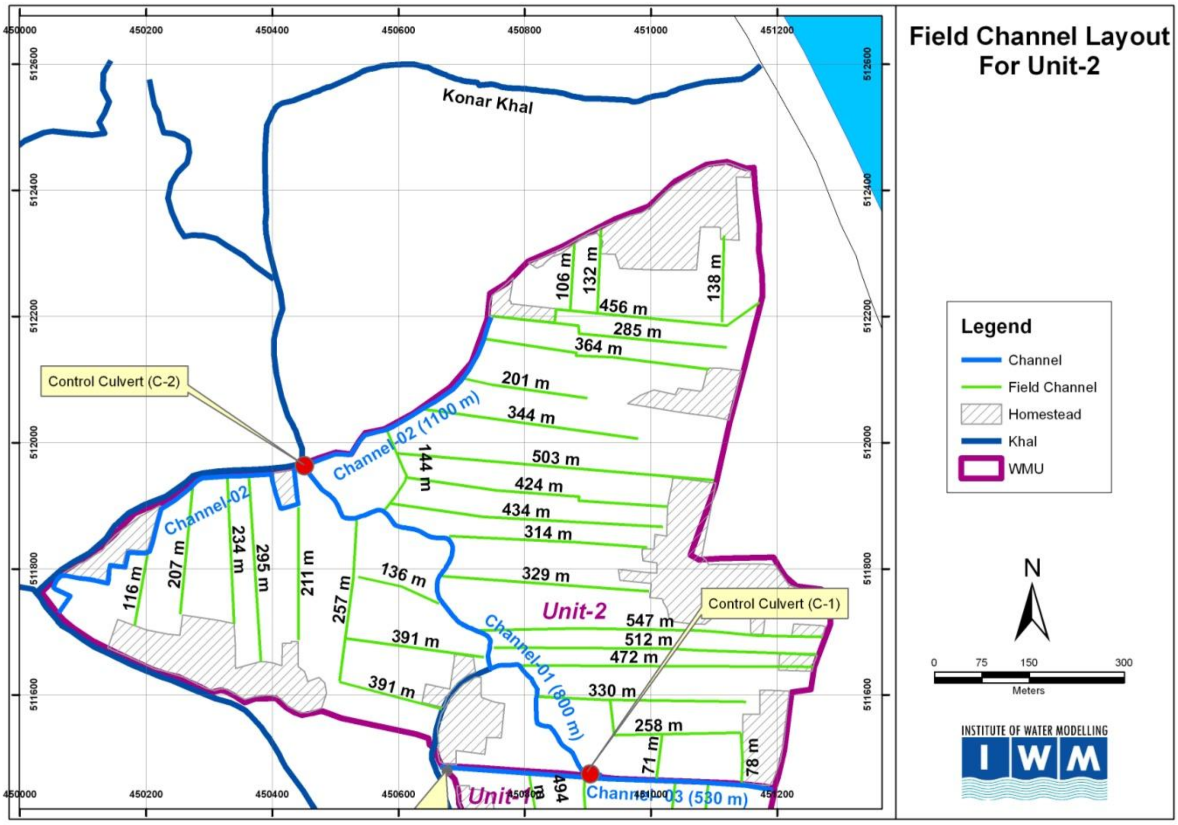

Figure 9, Layout field drains and internal drains of WMU2 (IWM)

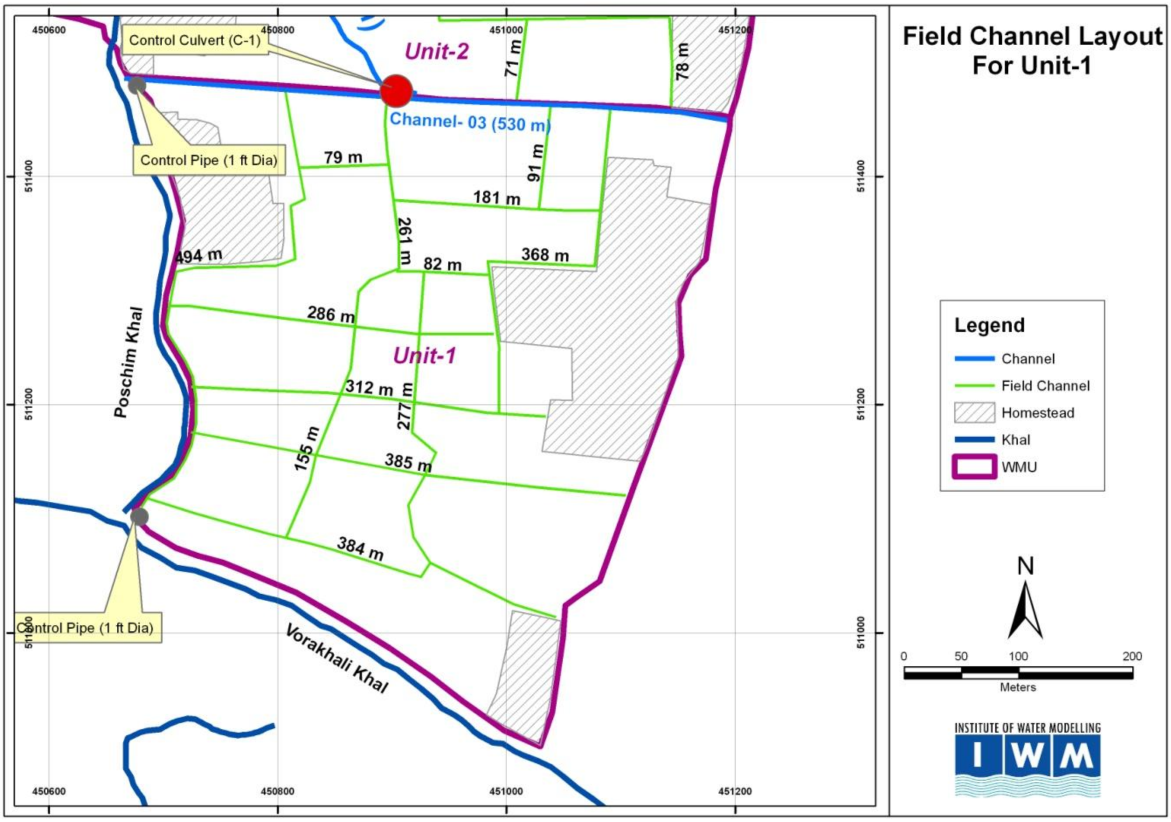

Figure 10, Layout field drains and internal drains of WMU1 (IWM)

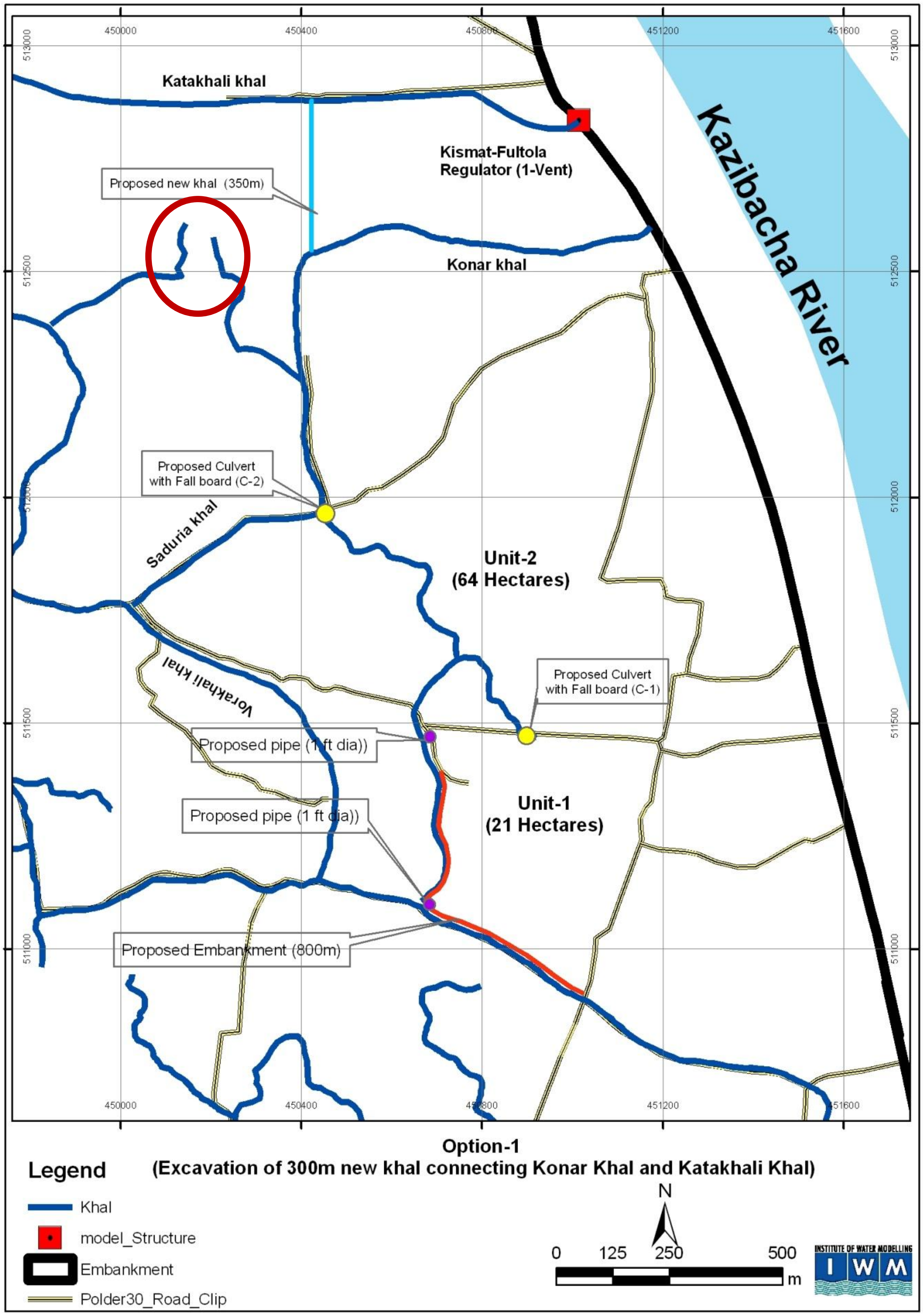

Figure 11, Overview option 1, creation of new connection

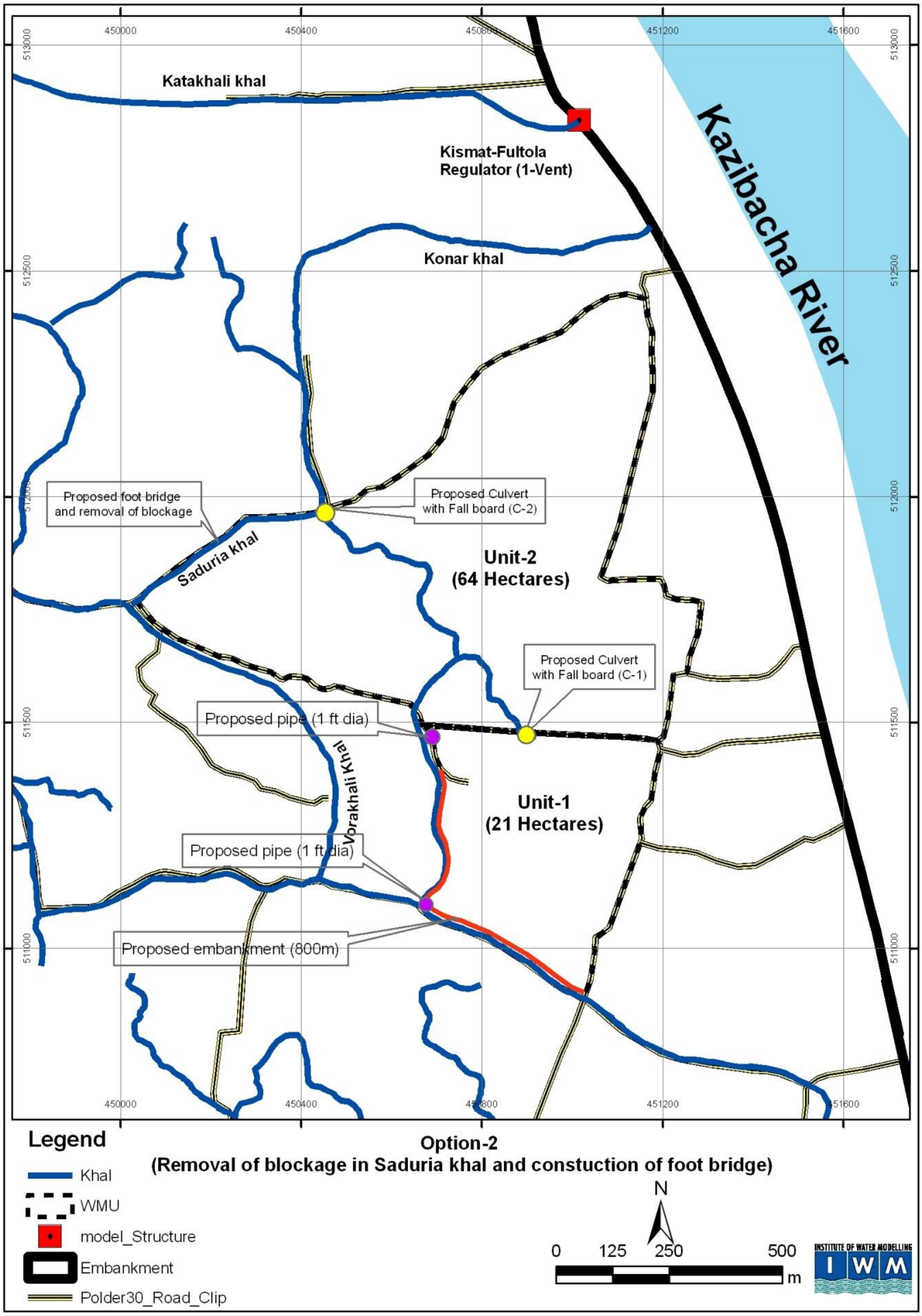

Figure 12, Overview option 2, improvement of current drainage route, by constructing footbridges

3. Approach and methods

Field data on agricultural practices was collected together with Hilton Roy in Fultala from November 2014 to February 2015, covering the dry winter season in Bangladesh. In this chapter the applied approach and methods for data collection will be explained. First the methods for selection of location and participants will be discussed after which a description of the methods around the data collection and processing will be given.

The village of Fultala was selected as a suitable pilot area during a joined field visit of Blue Gold, IRRI and Institute of Water Modeling (IWM) staff members to polder 30. The selection was based on hydrological and socio-economic criteria. (Jenkins, 2014)
Mr. Myhir, president of the WMG of Fultala was assigned as a contact person and asked to organize interviews and group discussions that formed the main data source for this report. Furthermore interviews were held with participants based on availability. Farmers and laborers working in the field were approached and interviewed.

Interviews
Semi-structured interviews with 29 farmers provided information about local practices, issues and possibilities. The interviewees explained their cropping pattern and different aspects of production of their plots within the pilot area. The information gained from these interviews was used to create an image of the agricultural system. Furthermore, the data on yields was used for estimations of the production in the area. Some of the interviews also provided insights in the water management system and local water related issues.

Group discussions
Secondly, group discussions were held to obtain deeper insights in the systems of both land holding and water management. Four different group discussions were held, each with a specific purpose. The first group discussion was held with the two presidents of Kismat Fultala, Fultala, the two Blue Gold Community Organizers (CO's) of these villages and some farmers that were attracted by the commotion. The main topic was how to manage the research ensuring the collection of information on production of specific plots. We asked for the input on how we could improve our method as we were experiencing some difficulties (Annex 1). Annex 1 gives a detailed description of the methods that were tested to map the fields or production areas.
The second group discussion was organized to identify owners of plots in a particular subsection of the pilot area, based on the landholdings map of Fultala 1982-1997. Furthermore, issues with the current water management system were discussed.
The third group discussion aimed to identify the fields of the present participants and collect information about these plots. The ten participants, with help of an elderly farmer, identified their farms and provided information on cropping pattern and variety, yield and pesticide and fertilizer application.
The fourth group discussion was organized with five knowledgeable farmers from different sections of the pilot area. Together these farmers discussed which section of the pilot area they see as Highland, Midland and Lowland. Differences in cropping patterns and varieties were also discussed.

Observations
During the period of data collection several observational activities were done. The main observational activity was done by driving around the pilot area with a motor cycle and stopping where something interesting was visible. Information on water logging was obtained by reviewing which areas in which periods still contained water above field level.

Experts
Data on agricultural practices was obtained through meetings with Blue Gold staff and staff members of several external organizations. In these meetings the elements of the pilot project and the situation at hand were discussed.

4. Current agricultural situation

In this chapter an overview of the current agricultural practices is given based on the information gained from the four months of field work. The production areas within the pilot area are described, followed by an estimation of the current agricultural production in the area and a rough estimation of the agricultural income generated. Finally a closer look at the water management system is given for better understanding of the agricultural system at hand.

4.1 Production areas

The total pilot area is about 84 ha of which 67 ha is cultivated land. The remaining 17 ha is covered with homesteads or ponds. The main cropping pattern applied is paddy followed by a winter crop. Most plots are cultivated with local rice varieties, while only a few are used to grow HYV's. The main winter crop is sesame. A farmer estimated that up to 90% of the area is cultivated with sesame. Some farmers, mainly in the higher areas, cultivate lentil or vegetables like pumpkin and water melon. In Figure 3, Chapter 2, all the land of the pilot area was indicated to be lowland, but within the pilot area a further distinction can be made based on the topography of the land. Figure 13 shows the distribution of high, mid and low lands within the pilot area as indicated by a group of farmers (FFG1). The land elevation differs from 0.7 to 0.9 mPWD. The farmers as well as staff members of the Department of Agricultural Extension (DAE) stated that the elevation of the land determines the production system. Therefore the three areas are used to define three different production systems, that are described in the following paragraphs.

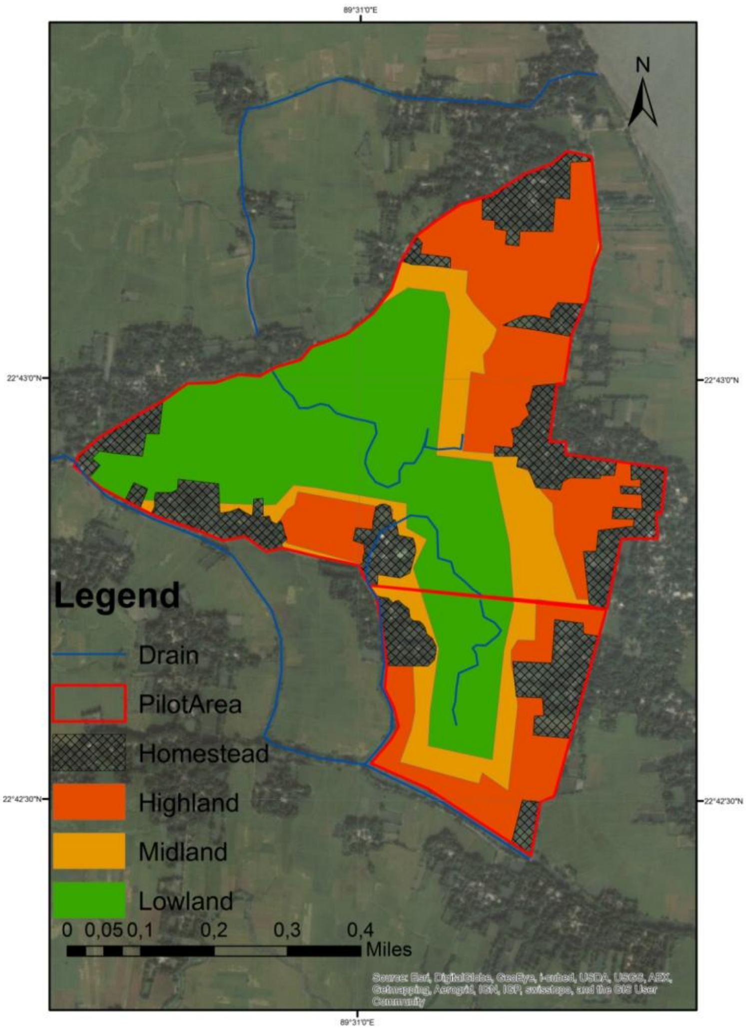

Figure 13, Distribution of land elevation in the pilot area of Fultala, Batiaghata, Polder 30, Khulna source: farmer focus group 10-12-2014

Highland

In the highland local varieties of rice referred to as *Balam* rice as well as High Yielding Varieties (HYV) are cultivated. A popular local variety in the area is Jotai. The area indicated as highland includes 22 ha of cultivated land. Farmers on these lands are more likely to apply fertilizer as most land is easily accessible from the road or home and the water depth allows fertilization. Most farmers apply TSP (phosphate) and Urea (nitrogen), some also apply potassium or zinc. The application of a solid pesticide is common in the highland. A limited number of farmers with HYV apply pesticides in the form of a spray called *Basudin*.

The land in the area naturally dries earlier than the mid and lowland. In the beginning of December the highland is already solid enough to walk on. As the HYV and the *Balam* rice are early maturing varieties the harvest takes place in the first until the last week of December. Figure 14 to 16 show the same location in the highland from the end of November to the end of January.

Figure 14, Rice fields in the Highland on 19-11-2014

Figure 15, Rice fields in the Highland on 10-12-2014

Figure 16, fields in Highland on 18-01-2015

Midland

The Midland was indicated as the land between the High and the Lowland, in other words the transition area. The area consists of 13 ha cultivated land. The main variety cultivated here is Morishail. Morishail matures relatively late, about 10 to 15 days later then Jotai. As the land is unreachable in most periods of production, no fertilizer or pesticides are applied. Figure 17 shows the rice fields in the Midland in mid December. In the end of December the rice in the Midlands were harvested.

Figure 17, Rice field in the Midland 10-12-2014

Lowland

The largest area is the Lowland area (32 ha) where Kumragor was indicated as the main variety. Here no fertilizer or pesticides are applied as the water level and the low accessibility of the land make this impossible. Figure 18 to 20 show different locations in the Lowland from the end of November to mid January. The last day of harvesting this year was the 14th of January. Farmers stated that the last day of harvest is around the 10th of January. This year harvesting was further delayed because of a rather heavy rain in the end of December.

Figure 18, Rice fields in the Lowland area 24-11-2014

Figure 19, Rice fields in Lowland area 17-12-2014

Figure 20, Rice field in the Lowland area 14-01-2015

In all the three production areas rice cultivation is followed by sesame production. Some fields are used for lentil cultivation or vegetables dependent on the location and dryness of the soil in February. Sesame can be seen as a cash crop. However in contrast to the cultivation practices and investments often assumed with cash crop cultivation, the investment in sesame is low. Farmers explain that they sow the seeds and forget about the sesame until the harvest. This is an extreme statement but it shows the general practice around the sesame production. In reality some weeding and taking care of the plants is done. The main reason for the low investment seems to be the risk of crop failure. When heavy rains damage the sesame plants, yields are badly affected. Some farmers especially in the lowland decide to not harvest the field at all, if the salvageable produce is not worth the labor.

4.2 Productivity and Income

Production

Based on the identified production areas an estimation of the productivity of the pilot area was made. Table 2 shows the estimated number of ha for the different production areas as well as the average estimated yearly production of paddy rice. The data gained from interviews was used for the estimation, see Annex 2 for an overview of the estimation.

Table 2, Summary of the production of paddy rice in the pilot area in Fultala, with average production from interviews

Area	Size (ha)	Average production (t/ha)	Total production (t)
Highland – local	15	2.8	42.0
Highland – HYV	7	4.7	32.9
Midland	13	2.6	33.8
Lowland	32	2.7	86.4
Total	**67**	**2.9**	**195**

The 7 ha of HYV is a rough estimate. During the interviews around 4.5 ha of HYV was identified. Some other locations with HYV became prevalent through field visits. Therefore the total area was estimated on 7 ha. Still this is a rough estimate and the number should be handled with care.
From these first estimations it can be assumed that the production of paddy rice of the area is around 195 tonne. When an area of 4.5 ha with HYV is assumed a total production of 190 tonne is achieved.

Table 3 gives an overview of the production estimation based on data obtained from 4 yield measurements. The yield measurements gave a higher productivity, especially for the Highland local varieties and HYV's. Dependent on the area taken as HYV, respectively 7 or 4.5 ha, the total production in the area varies from 227 to 233 tonnes.

Table 3, Summary of the production of paddy rice in the pilot area in Fultala, with average production from yield measurements

Area	Size (ha)	Average production (ton/ha)	Total production (ton)
HighlandLocal	15	3.7	55.5
HighlandHYV	7	7.3	51.1
Midland	13	-	33.8[2]
Lowland	32	2.9	92.8
Total	**67**	**4.1**	**233**

As indicated before most of the land is used for sesame cultivation in the winter. However some lentil and vegetable cultivation takes place. Hence if we assume sesame production on 90% of the area and we take an average obtainable yield the total sesame production would be 47 tonnes (Table 4). If we assume the remainder of the area to be under lentil cultivation, with an average production of 6 maunds per acre, a total production of 3.8 tonnes is obtained, making the total winter production 54 tonnes. In this case the total yearly production of the pilot area is around 244 to 287 tonnes. However in a bad year with early rains the crop can be completely destroyed or the yield of sesame can be as low as 5 maund[3] per acre on average, like in 2014. This would mean a total production of 0 to 30,6 tonnes.

Table 4, Summary of the production sesame in the pilot area in Fultala

	Area (ha)	Average Yield (maund/acre)	Average yield (t/ha)	Total Production (t)
90 % Sesame and 10% lentil	67	8.8	0.8	54
Total	**67**			**54**

Hence the 244 to 287 tonnes per year can be seen as the potential yield. A rainfall analysis could be done to estimate the reoccurrence of rainfall pattern that causes lower yield. This could then be used as a reference of the yield information obtained after the pilot project implementation. At the moment no rainfall data was done, due inaccessibility of the needed data due to time constraints.
However a number of farmers stated that in 10 years, 3 to 4 years the sesame crop is damaged by rains. Hence if we assume 2 years of low yields, 1 year of no yield and 7 of normal yield we should obtain a better estimate of the average current production. The average sesame production then becomes 42 tonnes. The total production then varies from 232 to 275 tonnes per year (Annex 3).

When the drainage improvements indeed enable famers to plant their sesame earlier avoiding crop damage by early rains. Hence obtaining the potential yield of 241 to 284 tonnes per year. The average improved sesame production in the area would be 12,5 tonnes, which is an increase of sesame production and income from sesame of 30%. Based on the cost benefit analysis of Shusanto Roy (Annex 4), this would mean an increase in income for the whole area of 479.000 to 396.000 Taka, dependent on the cultivation of red or black sesame.

[2] The average from the interviews was taken as no yield measurement was available
[3] Maund is the unit used in Bangladesh to express weight. One maund is equal to 37.3242 kg.

Cost benefit estimation

Annex 4 shows a first attempt of a cost and benefit estimation of the rice cultivation. Dependent on the amount of laborers hired by the producer the profit of BRRI rice was estimated around 20.000 to 30.000 Taka per acre (Table 5). For local rice dependent on the ownership of a power tiller income was estimated around 20.000 Taka per acre. It is important to be aware that for these income calculations, the fact that households use the rice for own consumption was not taken into account.

Table 5, Overview Profit per cultivation practice

Type of rice cultivation	Profit/acre (Taka)	Profit/ha (Taka)
BRRI 23 (Shusanto Roy)	21.693	54.000
BRRI 23	29.390	73.000
Local rice with own power tiller	21.320	53.000
Local rice without power tiller	19.720	49.000

4.3 Land ownership pattern and labor arrangements

Land holding and labor arrangements are very dynamic in the village of Fultala. There are the globally occurring phenomena of land division and partition due to inheritance. Moreover, local social processes of land tenure and exchange of labor make it seem like production in the area is a combined effort. Farmers however clearly state that they make individual decisions on when to grow what, usually based on the situation at hand. A clear understanding of the complex influences of the land ownership system and associated social system on farmer decision making is still lacking.

Land ownership

The land holdings of farmers are generally small, varying from 0,5 to 10 ha. It is important to realize that this is the total land holding of an individual or a family. These land holdings are divided into several plots in different locations. The surveyed plots in the pilot area varied from 0,02 to 1,5 ha in size, with an average plot size 0.2 ha or 0,5 acres (Figure 21)(Figure 22)(Figure23). Annex 6 shows a map with the complete overview of the around d 300 identified plots within the pilot area.

A farmer stated: ‘ there are basically two types of farmers in the village; one that owns one plot and leases more plots and one that owns several plots but only cultivates a limited amount and leases the rest’. Other farmers reconfirmed that all owners of the land live in the village.

Figure 21, Showing the size and variation in land holdings in the Pilot area. On the left a picture of the Highland in the North of the pilot area.

The fact that farmers own plots in different locations, can be seen as risk averse farming. By cultivating plots in different location the risk of full crop loss is reduced as the local problems will not immediately destroy your complete production area. (T’jonck, personal communication, 2014)

A farmer explained that he had fields in different location because of the quality of the fields. The good fields are located in different areas.

Figure 22 shows the Southern section underneath the road that separates the pilot area in two parts. The Southern section has been named Water Management Unit 1 (WMU1) and the Northern section WMU1.

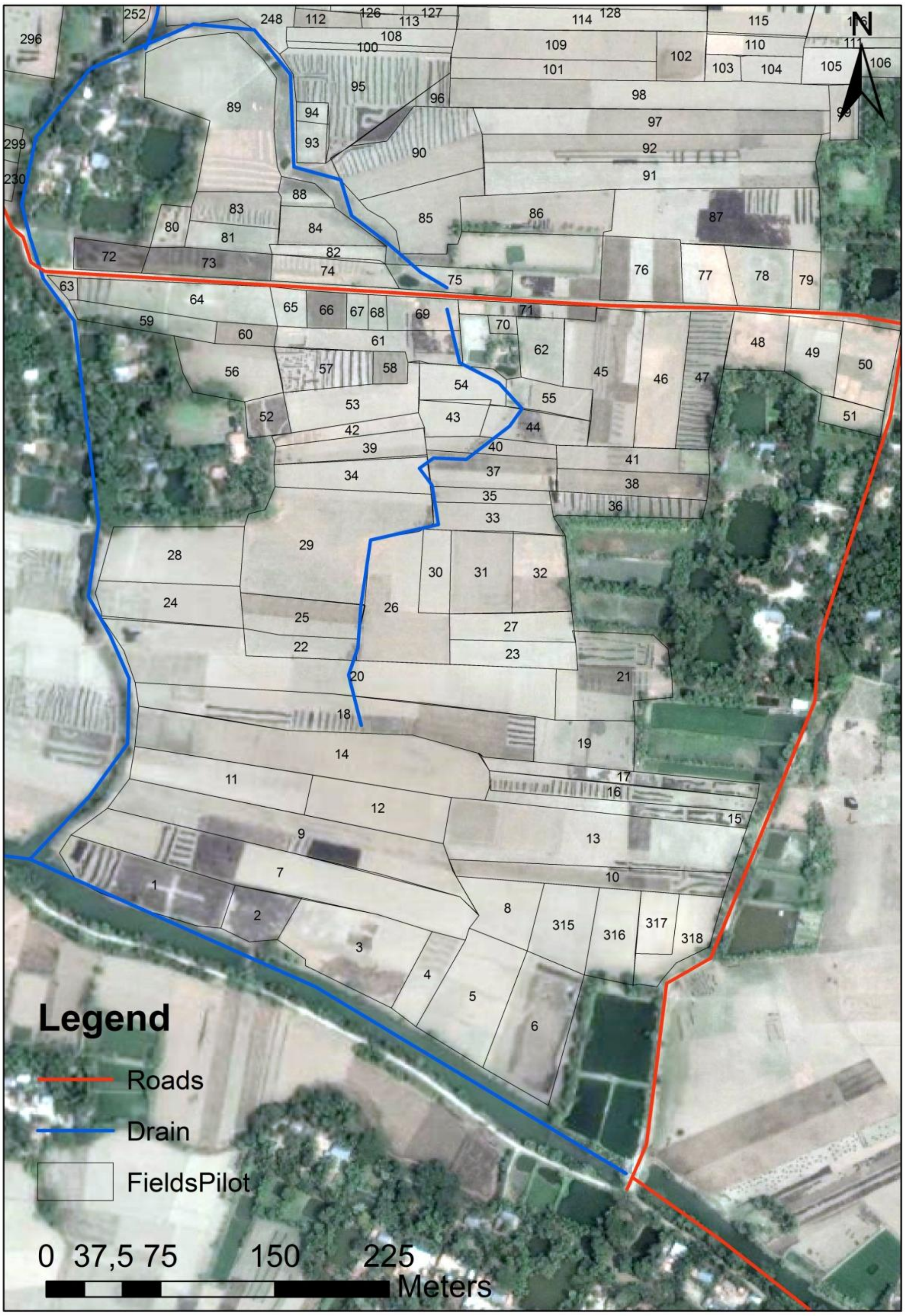

Figure 22, WMU1 with individual plots and plot numbers. Estimation of individual fields was based on Google Earth and GPS track of field boundaries made in corporation with IWM

The plot numbers were used to identify the owners and cultivators of the land. Annex 5 gives an overview of 55 persons that were linked to the 71 plots of WMU1. From this overview it became clear that 54% of the plots of WMU1 is under lease production, bear in mind that this percentage is based on the number of plots not the size of the land. In total 42 persons were identified to be the owners of the 71 plots. For 10 plots 2 to 4 persons were identified as the owners. In total 33 of the plots are cultivated by the owner. The remainder of the fields are leased out to 8 farmers that also own fields in the WMU1 and 13 farmers that do not own any land in WMU1.

The amount and timing of water levels on the field is influenced by the two gates. The fields especially the fields in the South are connected to the Vorakhali Khal that drains to the river via the Khoria Regulator. A farmer indicated that this year they experienced a period of low water level which allowed weeds to grow. Secondly the WMU1 is connected through a culvert with WMU2 (Figure 23). Via a silted up internal drain, another culvert and main drainage canal Saduria, Vorakhali kahl finally Katakhali Kal and regulator is reached. Since this drainage route is lengthy and includes drainage obstructions like small culverts and footbridges the drainage and irrigation via this route is slow reacting.

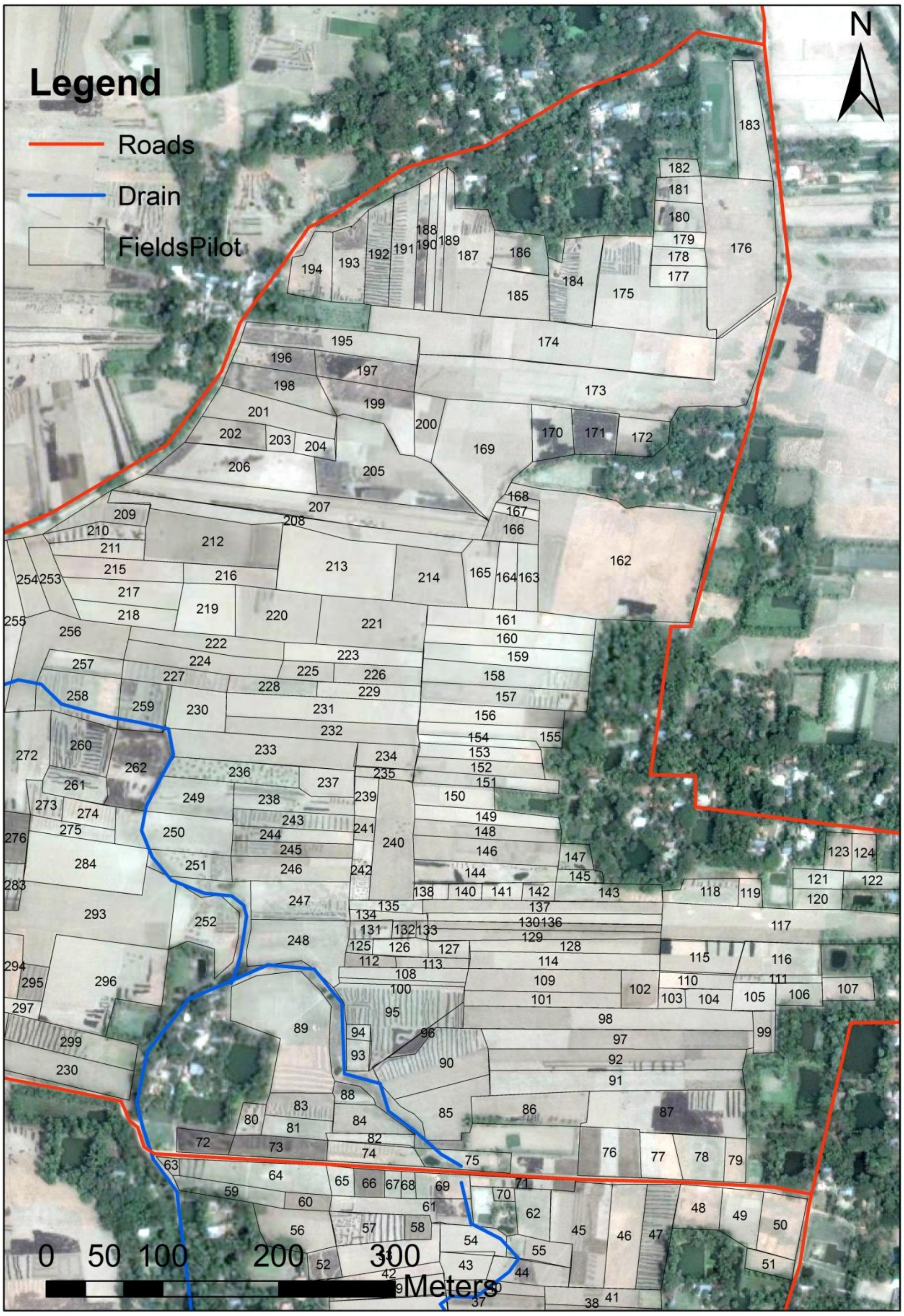

Figure 23, WMU2 East side with plot numbers

WMU2 differs substantially from WMU1 in total size, average plot size and drainage situation (Figure 23) (Figure 24). The total area is about three times as large as WMU1, while the average plot size is considerably smaller. Especially the fields in the mid Eastern section are small. The area is drained with two culverts that link the fields with the Saduria Khal that finally drains water to the river via the Katakhali regulator.

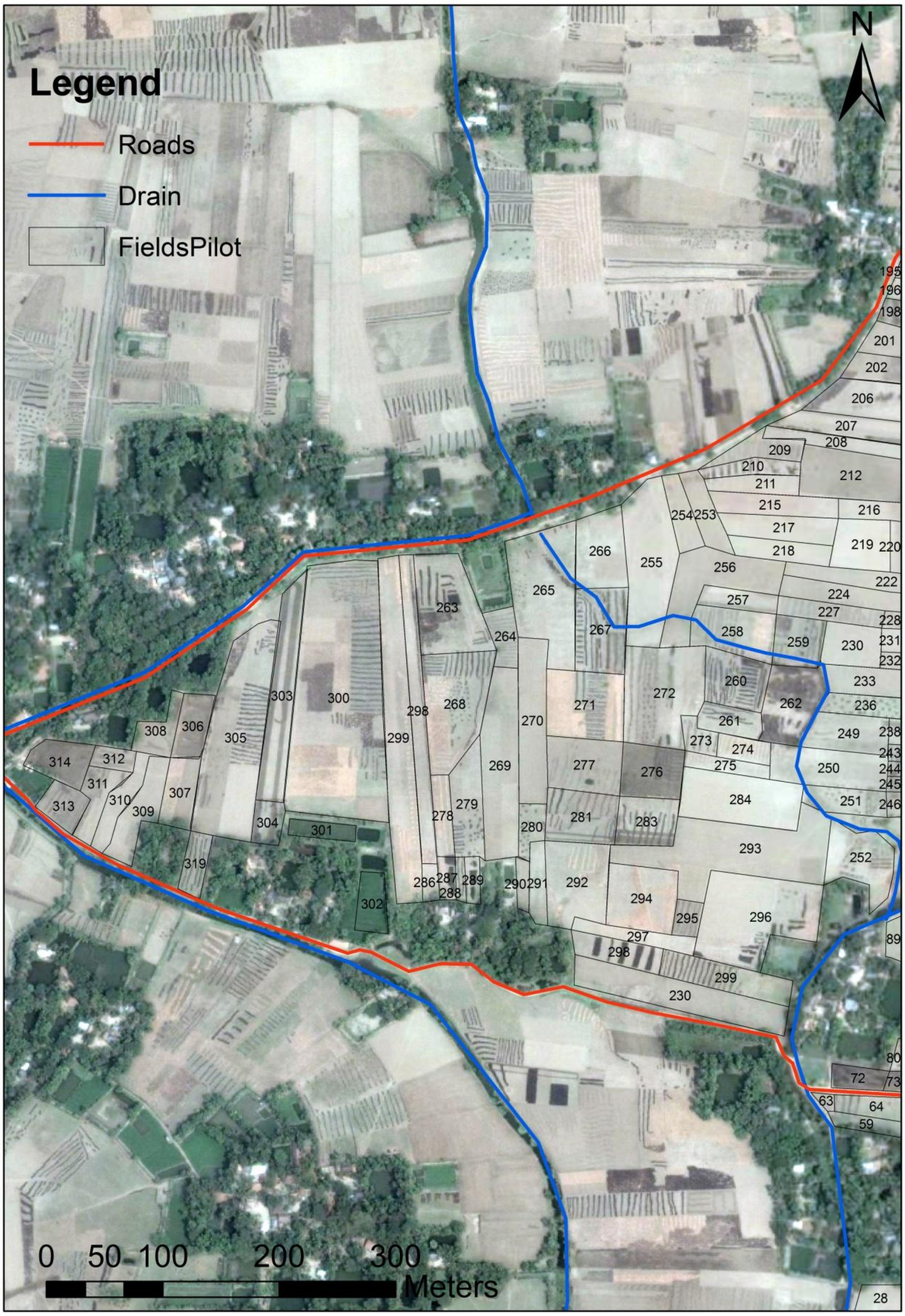

Figure 24, West section of WMU2, individual plots and plot numbers

Labor

During the harvest period it was observed that several ways of arranging labor exist. Some farmers hire a group of 3 to 10 wage laborers to do the harvesting and transportation of the rice to the homestead. The wage laborers are either paid in Taka or in rice, dependent on the preference of the farmer and the wage laborers. The rate is 300 Taka per day or 10 rice bunches per 100 bunches harvested.

Other farmers, especially the ones with small holdings or land with different harvest times, work on each other's lands in a form of exchange labor. If someone works on the land of another farmer, this person will receive assistance from this farmer at another moment. Labor is the largest cost of production. Therefore it is in most producer's interest to minimize labor costs. Exchange of labor is also a form of reducing labor costs.

Another interesting point considering labor is the separation of tasks between gender, which differs from crop to crop and social class.

The harvest of the *Amon* rice in Fultala is completely done by man, both cutting the plants and collecting the rice bunches and transporting them to the homesteads (Figure 25 to 27). The operation of the power till is done by selected men that function as power till drivers. Then the drying of the rice for home consumption and seeds for next year is done by the women. These tasks are mostly done by elderly woman as the younger women are occupied with other household tasks. Storage and selling of the rice to the market is done by men.

Only rarely women were seen in the fields during the harvesting mainly for grazing of cows. Once three woman laborers were observed cutting the lower part of the rice, that is used to build roofs or used as fire wood (Figure 28 and 29).

Figure 25, Men harvesting rice

Figure 26, Men collecting and transporting rice bunches from field to homesteads

Figure 27, Man operating a power tiller

A woman explained that it is difficult for them to go around in the rice field during the harvest of the rice as the field is still muddy. That is why they are not involved in the harvest of the rice.
However during the period of collection of the bunches of rice, landless women can be found in the field as they are gleaning. They are collecting the few rice grains that are still in the field and were left behind by the harvesters.
During the harvest of sesame, both men and women are performing the tasks of cutting and collecting. Another man however indicated that women are only involved in weeding during the sesame cultivation. The women dry the grains at the homesteads.


Figure 28, Landless women collecting seeds


Figure 29, Woman drying seeds at the homestead

5. Recommendations

In this chapter some recommendations and insights gained during the start of the implementation process of the pilot project are shared.

Current situation and advised next steps for project implementation

At present the members of the WMG of Fultala as well as farmers and villagers of Fultala have shown an interested in creating farm drains. Many have either raised the problem of wet soils in November themselves or shown an understanding of the issue. So far cooperation from Fultala villagers has been high and mainly positive. During a meeting with Fultala and Kismat Fultala villagers support for the pilot project was given, with the condition that as less land as possible is lost. It therefore seems that there is a good basis to start the implementation of the Community Water Management Pilot. In this section I will give some reflections and thoughts on how to continue the implementation process of the pilot project. The local staff in Polder 30, both the community organizers (co's) and market oriented field school organizers were completely updated on the pilot project on the 17th of February 2015.

First of all there is a need for a person to bear the responsibility and overview of the pilot project and who of Blue Gold is going to be involved in further community consultation. If the field staff come across any kind of problem, who do they call or ask for help.

Secondly in my opinion it is important that Blue Gold takes a facilitating role. A preliminary design of the improved drainage system has been made. It is up to the farmers to finalize the design and create the drains, however proper assistance by Blue Gold staff members should be given to achieve this.

The (farmers of the) executive committee of the WMG group and active farmers can be used as the organizing body. The WMG group and the Market Oriented Field school are the most direct connections Blue Gold staff members have with the community. The farmers involved in these two groups could therefore be used as the organizers of the creation of the field drains. Some of the Khulna staff members proposed to make an implementation committee. It might be a good idea to create a implementation committee of some farmers of the WMG, the (no more active) Farmer Field school, Market Oriented Field school and possible other interested farmers. Preferably farmers from different location of the village and from different families.

Thirdly the preliminary design includes two slightly larger drains along the road that form the connection between many farm drains and the internal drain. These drains are an opportunity to start collaboration of farmers on creating farm drains. As many plots and many farmers benefit from these drains a one or two day excavation session could be organized by the WMG, where every farmer provides a certain amount of hours in the creation of these canals. This could be a trigger for the farmers to continue the efforts and create their own farm canals.

A method to try to support or re-enforce farmers to together create the farmer field drains could be by giving the members of the executive committee of the WMG the task to monitor and ensure the creation of the drains. This could be done by visits to the farmers, inquiring when they are planning to make the drains and if they are facing any problems.

If problems occur these can be handled by the executive committee member or taken to the WMG for discussion and solution.

Fourthly for the excavation of the internal drain also referred to as channel-01 formal consent of all the owners needs to be sought as soon as possible. The three main land owners in the area have already verbally giving their consent, but the consent needs to be formalized before excavation can start.

Fifthly a decision is needed on how to improve the main drain. The late maturing of the amon rice crop is partly caused by late arrival of the water needed for seeding or transplantation. Improvement of the main drainage would tackle this issue. Improvement of the main drainage is not needed to improve drainage from the second half of November. The main drainage could be improved by:

- removing the current blockages and creating footbridges
- connecting and re-excavating an internal drain in Kismat Fultala
- Re-excavating and connecting a drain that used to connect Fultala and the Koria regulator in the South

If connecting and re-excavating the internal drain is found to improve the drainage in Fultala then this might be the best option. However an inventory of the third option is still needed. In my opinion removal of the footbridges should be seen as a last resort, but an awareness program and discussion could be made to facilitate the WMG in showing villagers that canal obstructions are problematic.

I would advise to continue the efforts for creating the internal drain and farm drains, while a decision is made for the main drainage improvement. The farmers will only start creating their drains when they see action is taken by Blue Gold to create the internal drain.

Pitfalls to be aware of

Farmers are accustomed to cut or burn the residue of the rice just before sesame cultivation. This practice slows the process of evaporation and hence drying of the soil. Farmers are used to first finish the tasks related to processing the harvested rice before they return to the field and prepare it for sesame cultivation. Most importantly the power tillers that are used for the separation of the rice first have to become free before preparation of the soil is possible.

Most villagers of Fultala and some of Kismat Fultala are aware of the pilot project. There are however also farmers from other villages that own or cultivate land within the pilot area. Special attention should be given to also include these farmers.

Lastly it is important to be aware of the gate operation of the main gate in Kismat Fultala. The decisions made for operation of the gate influence the drainage and timing of drainage in Fultala as well. Therefore the Fultala representatives should try and influence the committee in place to operate the gate as beneficial for them as possible.

Be aware that the agricultural system is a complex situation with, wage laborers, tenants, owners and family members that are all somehow linked to the land.

Up scaling of improved drainage projects

The pilot project is meant to test whether the benefits of improved drainage in theory are actually beneficial in practice. The project is furthermore meant as an example of what is possible. Therefore trickling down or up scaling to neighboring localities should be supported as much as possible.
During the survey period polder 43/2F in the district of Patuakhali was visited to review the feasibility of up scaling in this polder. A previous demonstration plot that was part of a CGAIR challenge program project of Manoranjan Mondol has shown that farmers adopt to HVY and alternative crops like sunflower when training and slight modifications to the irrigation and drainage system are given. The situation in polder 43/2F is different than polder 30 as fresh water is available and accessible for some during the winter season. Expansion of the demonstration plot is a possible way forward to up scaling of improved drainage on field level in this polder.
The path towards up scaling should in my opinion be done by focusing on showing that WMGs with a high degree of initiative are able to facilitate and initiate improved control over water by the community. Thereby increasing agricultural production of the whole community. The start is therefore facilitating and guiding WMGs to improve their capacities and ability to organize the community. The next step is using the results of this pilot project to explain and persuade other

WMGs to make the same effort. It is of course important to realize that for the up scaling a less intensive strategy will be applied than during the establishment of the pilot project. Hopefully the improvements that are demonstrated with the pilot project will however be enough to fill in for this reduced support.

6. Conclusion

The general agricultural system within the village of Fultala exists of Amon paddy, with mainly local rice varieties followed by sesame cultivation. It was confirmed that the sesame cultivation is damaged in 3 to 4 out of 10 years, because of early heavy rains in April or May.

The production of paddy in the pilot area was estimated on 190 to 230 tonnes produced on 67 ha. While the winter crop production was estimated on 54 tonnes in a year without damage and 30,5 tonnes in a year with damage.

The potential for increase of agricultural production was therefore estimated on an average of 12,5 tonnes of sesame per year, which is an increase of 30%. For the estimation the current average yearly production was based on taking 2 years of damaged sesame production, 1 year of no production and 7 years of good production. Assuming that with the internal drainage improvements all years will have a good production.

It was furthermore plot size within the pilot area is small as in total around 300 plots were identified with an average plot size of 0.5 acre. This is however not the same as the average landholding or production plot of a farmer. A complex system of land ownership of multiple plots in different locations combined with an intricate leasing system, make the average land size that a farmer produce on within the pilot area still unclear.

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Annex 1, Change of methodology

At the start of this baseline study a plot level research was designed. After a test period however it became clear that in the months of November, December this type of study is impossible. The plots are still wet, hence they cannot be mapped. Farmers have a sense of the location of their fields but cannot point it out on a Google Earth map or even the landholdings map. Secondly it was discovered that the plots of farmers are very small, while farmers indicate the same production system and productivity. Therefore the level of detail was changed to production areas. During a group discussion with farmers of different areas within the pilot project a map with three different production areas was created. Then key informants were used to get more insights of the production areas. In this way the study became more generalized as the level of detail was reduced, but the study became feasible. It is assumed that only a small decrease in accuracy of the data obtained occurred, as farmers mostly gave the same yields and production info. Even so some smaller differences have been lost by reducing the level of detail.

During the period between the rice harvest and sesame production (end of January) it was possible to map all the plots in the area with the help of a farmer. Interviewing in this period is however more difficult as farmers are occupied with tasks related to the rice harvest.

The ideal situation is to map the area in the end of January and with the help of this map conduct interviews during rice processing and sesame production season. Then a more detailed study with similar means would be possible.

Annex 2, Average productivity

The average production was obtained per variety, based on the variety indicated during interviews. Information of 85 plots from 29 farmers was collected. The first two table show the average per variety of rice and sesame. The third table shows the productivity indicated per plot. 1 maund was taken as 37 kg. Farmers indicated most land and yields in bigha, where 1 bigha is equal to 50 decimals or 0.5 acre.

Table , overview of average production of rice varieties

Rice variety	Productivity maund/acre	Productivity t/ha
BRRI*	53	4,85
Balam	29	2,69
Kumragor	28	2,58
Morishail	28	2,60
Shapsheil	30	2,74

Table, overview of average sesame production

Crop	Productivity maund/acre		Productivity t/ha
Sesame	8,8	0,81	

Table, overview of the production information per plot

Name	Size	Variety	LandType	WinterCrop	Fertilizer	Pesticides	LandOwnership	Rice (maunds/acre)	Rice (kg/ha)	Winter crop (maunds/acre)	Winter Crop last year (Maunds/acre)
Amarish	2	Morishail	mid	sesame	yes little	no	lease 50%-50%	28,8	2629	7,5	0,5
Anadi	0,25	kumragor		sesame and lentils	yes little	no	lease 50%-50%	32	2926	14	7,8
Bihar Bishas	0,25	Kumragor	low	sesame	yes little	no	owner	25	2286	8	
Bihar Bishas	0,375	Kumragor	low	sesame	yes little	no	owner	25	2286	8	
Bihar Bishas	0,375	Kumragor	low	sesame	yes little	no	owner	25	2286	8	
Bilash Goldor	0,5	Kumragor	low	sesame	yes	yes	lease 50%-50%	35	3200	11	
Bilash Goldor	1,5	Kumragor	low	sesame	no	no	lease 50%-50%	31	2834	8	
Biman Roy	0,65	Kumragor	low	sesame	yes	no	owner	42	3840	8	4
Binoi Goldor	1	Jotai	hig	sesame	yes	no	unkow	17,5	1600	8	

			h		little		n			
Binoi Goldor	0,4	Kumragor	low	sesame	no	no	Leases out	29,5	2697	8
Binoi Goldor	1,75	Kumragor	low	sesame	no	no	Leases out	29,5	2697	8
Binoi Goldor	0,375	Kumragor	low	sesame	no	no	Leases out	29,5	2697	8
Binoi Goldor	0,125	Kumragor	low	sesame	no	no	Leases out	29,5	2697	8
Binoi Goldor	0,3	Kumragor	low	sesame	no	no	Leases out	29,5	2697	8
Binoi Goldor	1,25	Kumragor	low	sesame	no	no	Leases out	29,5	2697	8
Binoi Goldor	0,5	Kumragor	low	sesame	no	no	Leases out	29,5	2697	8
Binoi Goldor	0,35	Kumragor	low	sesame	no	no	Leases out	29,5	2697	8
Binoi Goldor	0,125	Kumragor	low	sesame	no	no	Leases out	29,5	2697	8
Binoi Goldor	0,125	Kumragor	low	sesame	no	no	Leases out	29,5	2697	8
Binoi Goldor	0,125	Kumragor	low	sesame	no	no	Leases out	29,5	2697	8
Binoi Goldor	0,125	Kumragor	low	sesame	no	no	Leases out	29,5	2697	8
Binoi Goldor	0,5	Kumragor	low	sesame	no	no	Leases out	29,5	2697	8
Binoi Goldor	1	Kumragor	low	sesame	no	no	Leases out	29,5	2697	8
Binoi Goldor	2	Kumragor	low	sesame	no	no	Leases out	29,5	2697	8
Deb Nareaon	0,33	IRRI22	Hig hIR RI	sesame	yes	yes	owner	55	5029	8
Deb Nareaon	0,3	IRRI22	Hig hIR RI	sesame	yes	yes	owner	55	5029	8
Deb Nareaon	0,4	IRRI41	Hig hIR RI	lentil	yes	yes	owner	55	5029	3
Deb Nareaon	0,4	IRRI41	Hig hIR RI	sesame	yes	yes	owner	55	5029	8
Deb Nareaon	0,3	Mohini	hig h	sesame	no	no	owner	29	2651	8
Debas Hisroy	0,15	IRRI41	nex t to rive r	none	yes	no	owner	65	5943	0
Indru Jid	5	Morishail	mid	sesame	yes	yes	lease	25	2286	5,5

							50%-50%				
Indru Jid	1	pond	HighIRRI	IRRI hybrid 05	yes	yes	owner	55	5029	0	
Indru Jid	1	pond	HighIRRI	IRRI hybrid 05	yes	yes	owner	55	5029	0	
Joy Pal	0,25	Kalajrra	low	none	no	no	owner	16	1463	0	
Joy Pal	0,125	Ranishalot	low	sesame and lentils	no	no	owner	24	2194		4
Kartik Golder	3	Kumragor, Lol mota	high	sesame	yes	yes	lease 50%-50%	28	2560	9	5
Krisno Phodo	0,5	IRRI23	HighIRRI	water melon	yes	yes	lease 50%-50%	44	4023	1400 pieces	
Linkon	0,375	IRRI23	high	sesame	yes when possible	yes	unknown	40	3657	12	
Liton Goldor	0,25	Kumragor	low	sesame	no	no	owner	32	2926	8	
Mimaychando Monrol	2	Kumragor	low	sesame	yes	no	owner	30	2743	11	
Mital Monroy	1	Kumragor	low	sesame	no	no	owner	30	2743	7	
Moti Lal	0,5	IRRI23	HighIRRI	sesame	no	no	owner	55	5029	11	
Moti Lal	0,1	Kumragor	low	sesame	no	no	owner	25,5	2331	11	
Moti Lal	0,75	Kumragor	low	sesame	no	no	owner	25,5	2331	11	
Moti Lal	0,2	Kumragor	low	sesame	no	no	owner	25,5	2331	11	
Moti Lal	0,3	Kumragor	low	sesame	no	no	owner	25,5	2331	11	
Mouhon Dho	0,3	Kasra	High	sesame	no	no	unknown	30	2743	8	
Mouhon Dho	0,875	Kumragor	low	sesame	no	no	unknown	30	2743	8	
Mouhon Dho	0,25	Kumragor	low	sesame	no	no	unknown	30	2743	8	
Mritunjoy Biswas	1	IRRI41, 23, 11	HighIRRI	sesame	yes	yes	owner	60	5486	10	
Mritunjoy Biswas	4	Kumragor	low	sesame	yes	yes	owner	30	2743	10	
Myhir Bishas	3,5	IRRI23	HighIRRI	sesame/ lentil	yes	no	owner	52,5	4800	8	2,5

Nimu Mondol	0,75	Ranishalot		sesame	yes	no	owner	32	2895	8	4,7
Nirmol Haldar	0,3	Kumragor	low	sesame	no	no	owner	26	2377	8	
Nirmol Haldar	0,6	Kumragor	low	sesame	no	no	owner	26	2377	8	
Nirmol Haldar	0,6	Kumragor	low	sesame	no	no	owner	26	2377	8	
Nirmol Haldar	1,25	Kumragor	low	sesame	no	no	owner	26	2377	8	
Noren Soldar	0,5	Kumragor		sesame	yes	no	owner	35	3200	14	6
Ojoj Roy	4,5	Kumragor	low	sesame	no	no	unknown	30	2743	8	
Ordhinda Goldor	0,5	Banonkhir	High	sesame	yes	yes	lease 50%-50%	30	2743	8	
Ordhinda Goldor	0,5	Jotai	High	sesame	yes	yes	lease 50%-50%	30	2743	8	
Ortshana Mondol	9	Ranishalot, Kasra		sesame and lentil	unknown	unknown	unknown	30	2743	8	
Osok Goldash	0,25	Kumragor	low	sesame	yes	yes	owner	30	2743	9	
Osok Goldash	0,25	Kumragor	low	sesame	yes	yes	owner	30	2743	9	
Osok Goldash	0,1	Kumragor	low	sesame	yes	yes	owner	30	2743	9	
Osok Goldash	0,125	Kumragor	low	sesame	yes	yes	owner	30	2743	9	
Osok Goldash	0,125	Kumragor	low	sesame	yes	yes	owner	30	2743	9	
Osok Goldash	0,825	Kumragor	low	sesame	yes	yes	owner	30	2743	9	
Pran Krisnu Golder	0,5	IRRI23	HighIRRI	sunflower and pumpkin	cow dong	no	lease 50%-50%	40	3657	8	
Pran Krisnu Golder	2,5	Kumragor	low	sesame	no	no	lease 50%-50%	31	2834	7	
Pran Krisnu Golder	2,5	Kumragor	low	sesame/ lentil	no	no	family share	31	2834	7	
Pran Krisnu Golder	0,25	Kumragor	low		cow dong	no	lease 50%-50%	24	2194	0	
Prodip	0,375	Kumragor		sesame	no	no	lease 50%-50%	29	2682	13	4

Prodir Proy	1	Kumragor	low	sesame	yes	yes	unknown	28	2560	12	
Prolat	0,325	Balam	high	sesame	yes	no	owner	30	2743	14	
Prolat	0,325	Balam	high	sesame	yes	no	owner	30	2743	14	
Prolat	0,75	Morishail	mid	sesame	yes	no	owner	30	2743	14	
Prolat	0,5	Shapsheil	mid	sesame	yes	no	owner	30	2743	14	
Prolat	0,25	Shapsheil	mid	sesame	yes	no	owner	30	2743	14	
Prolat	0,825	Shapsheil	mid	sesame	yes	no	owner	30	2743	14	
Prolat	1,075	Shapsheil	mid	sesame	yes	no	owner	30	2743	14	
Prolat	0,4	Shapsheil	mid	sesame	yes	no	owner	30	2743	14	
Prolat	0,4	Shaspheil	mid	sesame	yes	no	owner	30	2743	14	
Proshat	0,25	Balam	high	sesame	yes	no	lease 50%-50%	27	2469	8	
Proshat	0,3	Kumragor	low	sesame	yes	no	lease 50%-50%	27	2469	8	
Proshat	0,5	Kumragor	low	sesame	yes	no	lease 50%-50%	27	2469	8	
Proshat	0,375	Kumragor	low	sesame	yes	no	lease 50%-50%	27	2469	8	
Proshat	0,125	Kumragor	low	sesame	yes	no	lease 50%-50%	27	2469	8	
Proshat	0,325	Kumragor	low	sesame	yes	no	lease 50%-50%	27	2469	8	
Proshat	0,2	Kumragor	low	sesame	yes	no	lease 50%-50%	27	2469	8	
Proshat	0,25	Kumragor	low	sesame	yes	no	lease 50%-50%	27	2469	8	
Proshat	0,25	Kumragor	low	sesame	yes	no	lease 50%-50%	27	2469	8	
Robin Runa Sharkar	0,5	Morishail	mid	sesame	yes little	no	owner	30	2743	10	
Rojot Bisas	0,675	Kumragor and morishail		sesame	yes	no	owner	33	2980	9	3,7
Sankati Ijarder	0,75	IRRI23	medium	sesame	yes	no	owner	40	3657	12	8
Sankati Ijarder	0,25	lowland local	low	sesame and	no	no	owner	44	4023		

				lentils							
Shunil Bishas	0,5	Kumragor	low	sesame	no	no	unknown	33	3017	9	
Somir Golder	1	IRRI23 and Morishail		sesame/ vegetables	yes	yes	owner	22	1989	15	6
Subhjat Bisas	1	Kumragor	low	sesame and water melon	no	no	owner	30	2743	8	
Unknown	2	Mohini, Kumragor	high	sesame	yes	yes	lease 50%-50%	30	2743	9	

Annex 3, Average production with damaged Winter crop

Situation	Production Amon rice (t)	Production Winter crop (t)	Total (t)
Low HYV area, no heavy rains	190	54	244
High HYV area, no heavy rains	195	54	249
Low HYV area, heavy rains 3 in 10 years	190	41,6	231
High HYV area, heavy rains 3 in 10 years	195	41,6	237
Low HYV area, no heavy rains, measured yield	227	54	281
High HYV area, no heavy rains, measured yield	233	54	287
Low HYV area, heavy rains 3 in 10 years, measured yield	227	41,6	269
High HYV area, heavy rains 3 in 10 years, measured yield	233	41,6	275

Annex 4, Costs and Benefit

Estimation of BRRI23 profit

Based on an interview with Deb Nareaon an estimation of BRRI23 profit was made. The following table gives an overview of the production costs, income and finally profit for 1 bigha.

Action	amount	Cost per unit (Taka)	Total costs (Taka)
Company BRRI seeds	10 kg	700	700
Land preparation	1 bigha, fuel	400	400
Seedbed preparation	1 laborer (+himself)	300/labor	300
Land preparation	1 laborer	300/labor	300
Transplantation	3 laborers (+himself)	400/labor	1.200
Weeding	2 laborers	300/labor	600
Fertilizer	TSP 20 kg	25/kg	500
Fertilizer	Pothasium 10 kg	25/kg	250
Fertilizer	Uria 30 kg	16kg	480
2 times pesticides	2*2kg	150/kg	600
Harvest	4 laborers	400/labor	1.600
Bring home	2 laborers	400/labor	800
Clearing the field	2 laborers	300/labor	600
Total cost			8.330
Income			
Yield rice	26.5 maund	850/maund	22.525
Straw	1 bigha	500/bigha	500
Profit per bigha			**14.695**

Hence according to this information the profit BRRI 23 is 14.695 Taka per bigha which is 29.390 Taka per acre. 30 laborers

Shushanto Roy also performed a cost benefit analysis of BRRI 23 in another region of Khulna. The following table gives an overview of the costs and benefits assumed during this analysis. It shows the costs and benefits per acre.

Action	Quantity	Cost per unit	Total costs (Taka)
Seeds	9 kg	60/kg	540
Seed bed preparation	3 labour	300/labor	900
Cultural operations			300
Seedling uprooting	6 labour	300/labor	1.800
Land preparation (Power tiller)	100 dec	750/ 33 dec	2.250

Seedling transplanting	6 labour	300/labor	1.800
Urea	30kg/33dec	16/kg	1.440
TSP	17kg/33 dec	22/kg	1.122
MP	15 kg/33 dec	15/kg	675
Zypsum	10 kg/33 dec	25/kg	600
Zinc	1 kg/33 dec	160/kg	480
Pesticide		500/33dec	1.500
Weeding 2 times	15 labour/100 dec	300/labor	4.500
Harvesting cutting, threashing and cleaning(Labour)	15 labour/100 dec	300Tk/labor	4.500
Total costs			22.407
Income			
Yield	22 md/33 dec (40 kg) or 33 md/bigha(50 dec)	650 tk/md	42.900
Straw			1.200
Sub Total			44.100
Net profit/acre			21.693

During this estimation the profit was estimated on 21.693 Taka per acre. During the previous estimation the profit obtained was is 29.390 Taka per acre. The difference between the two estimations are caused by the numbers taken for average yield and price. This causes a difference of 2000 Taka. The main difference however is caused by a difference in labor estimation, as the second estimation assumes 15 more laborers/acre.
The labor situation differs greatly per farmer. Some farmers hire most laborers others try to minimize labor costs by exchanging labor.
Hence income per acre varies between 20.000 and 30.000 dependent on the type of farmer.

Action	Amount	Cost per unit	Total costs with own power tiller	Total costs hire power tiller
Own seeds	10 kg	290/10kg	290	290
Land preparation	Fuel, rent machine	400/bigha	400	1200
Seedbed preparation	1 laborer (+himself)	300/labor	300	300
Land preparation	1 laborer	300/labor	300	300
Transplantation	2 laborers (+himself)	400/labor	800	800
Weeding	2 laborers	300/labor	600	600
Harvest	3 laborers	400/labor	1200	1200
Bring home	2 laborers	400/labor	800	800
Clearing the field	2 laborers	300/labor	600	600

Total			5290	6090
Income				
Yield	14.5 maund/bigha	1100/maund	**15950**	**15950**
Profit/bigha	14.5 maund/bigha	1100/maund	**10660**	**9860**

According to these estimations the profit made per bigha of local rice differs from 9860 to 10660 Taka. Which is 19720 to per acre 21320 Taka per acre.

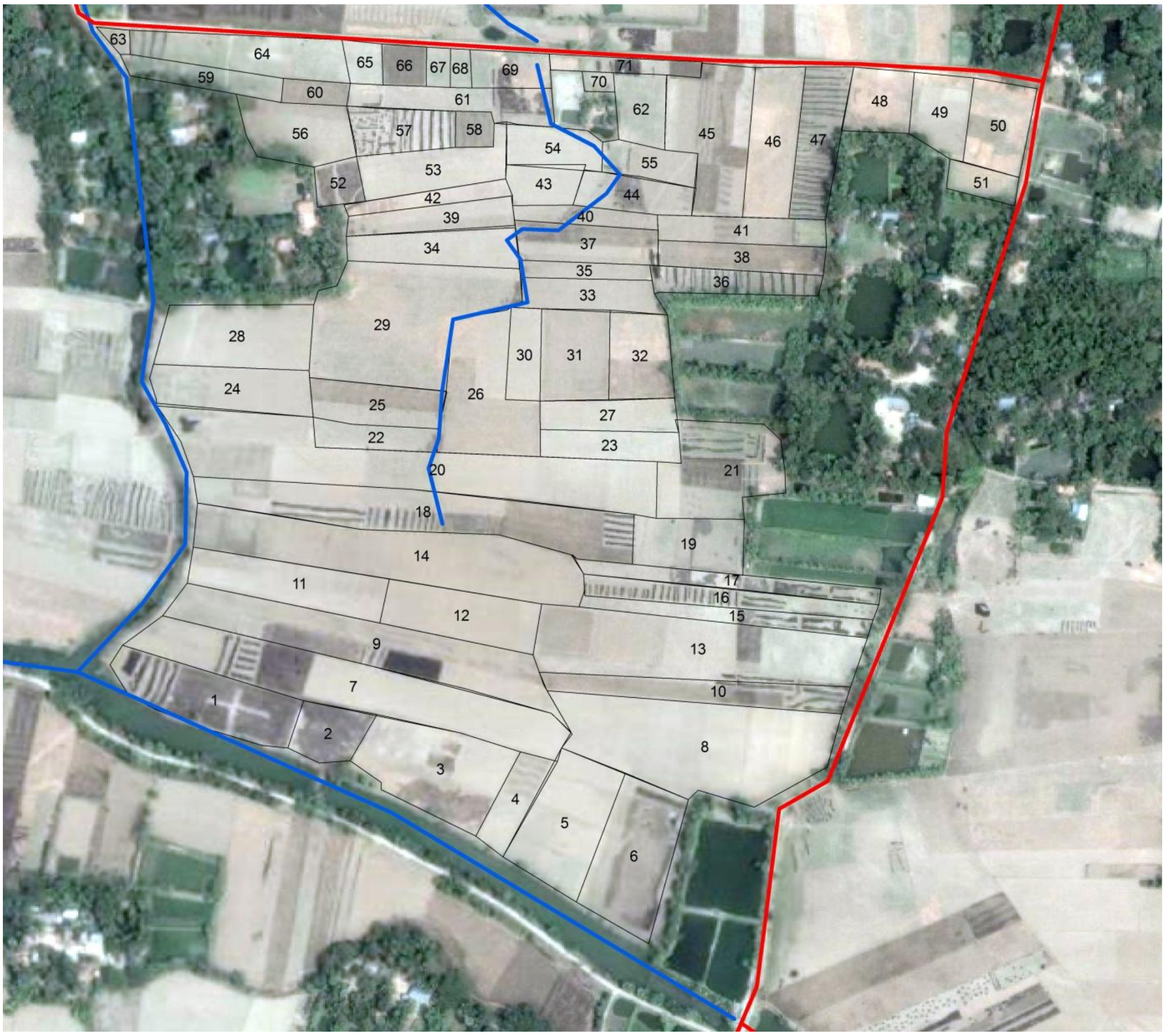
Type of rice cultivation	Profit/acre	Profit/ha
BRRI 23 (Shusanto Roy)	21.693	53604
BRRI 23	29.390	72624
Local rice with own tiller	21.320	52683
Local rice without tiller	19.720	48729

The rice kept for own consumption now has not been taken into account.

Area	Size (ha)	Average production (t/ha)	Total production (t)	Profit/ha	Total profit
HYV	7	4.7	33	72624	2.396.597
Local	60	2.7	162	50706	8.534.611
Total	**67**	**2.9**	**195**		**10.931.208**

Cost benefit estimation of Shusanto Roy for sesame cultivation

Annex 5, Map and list of owners and producers



Figure, WMU1 with plot numbers

The map was used to identify the landholders and the person cultivating the plot. The following table gives an overview of all the landholders and cultivators of WMU1.

Plotnumber	Owner	Producer
1	Som Nath Biswas	Kastic Golder, Polash Mollick
2	Som Nath Biswas	Kastic Golder, Polash Mollick
3	Lolit Babu	Robindsonath Golder
4	Lithu Mondol	Prosad Golder
5	Swapon and Doyal Bisas	Thakur Golder, Kader Mosol
6	Swapon and Doyal Bisas	Thakur Golder, Kader Mosol
7	Bikash Biswas	Bikash Biswas
8	Deb Nareaon	Deb Nareaon
9	Rojot Shurso Biswas	Rojot Shurso Biswas
10	Pijush Biswas, Dipok Biswas	Mokondo Roy, Thakur Golder
11	Sonkor Mondol	Subash
12	Mihir Biswas	Mokondo Roy

13	Som Nath Biswas	Kastik Golder
14	Nimu Mondol	Nimu Mondol
15	Swapon Babu	Ordendo Golder
16	Dipok Biswas	Binoy Golder
17	Doyal Biswas	Ordendo Golder
18	Mihir Biswas	Binoy Golder
19	Mihir Biswas	Ordendo Golder
20	Mistunjoy Biswas	Mistunjoy Biswas
21	Mistunjoy Biswas	Mistunjoy Biswas
22	Vojo, Brehespoti	Vojo, Brehespoti
23	Hosen, Kison, Dulal	Hosen, Kison, Dulal
24	Dipok Biswas	Binoy Golder
25	Vojo, Brehespoti	Vojo, Brehespoti
26	Bimol	Asun
27	Hosen, Kison, Dulal	Hosen, Kison, Dulal
28	Deb Nareaon	Deb Nareaon
29	Lolit Golder	Robin
30	Anondo, Ronjit	Taposh
31	Bimol	Asun
32	Anondo	Robin
33	Mistunjoy Biswas	Mistunjoy Biswas
34	Nosen Sosder	Nosen Sosder
35	Mihir Biswas	Somir
36	Swopan Biswas	Binoy Golder
37	Pijush Biswas	Mukundo
38	Pijush Biswas	Mukundo
39	Lolit Babu	Robin
40	Dipok Biswas	Binoy Golder
41	Dipok Biswas	Binoy Golder
42	Lithu Mondol	Lithu Mondol
43	Atul, Hosen, Kison	Atul, Hosen, Kison
44	Narayon Golder	Narayon Golder
45	Chasu Golder, Joypal	Chasu Golder, Joypal
46	Taposh Golder	Taposh Golder
47	Nihar Golder	Bijom
48	Sonkor Mondol	Prodip
49	Sonkor Mondol	Pran Krisnu Golder
50	Sonkor Mondol	Pran Krisnu Golder
51	Gonesh Roy	Gonesh Roy
52	Liton Mullick	Ordendo Golder
53	Hosen, Kison, Atul, Dulal	Hosen, Kison, Atul, Dulal
54	Bikash Biswas	Bikash Biswas
55	Somir Mondol	Bijom

56	Bikash Biswas, Rojot	Bikash Biswas, Rojot
57	Sonkor Mondol	Prodip
58	Khitish	Khitish
59	Somir Golder	Anadi
60	Joy Pal	Joy Pal
61	Ordendo Golder, Lolit	Ordendo Golder
62	Liton Goldor	Liton Goldor
63	Bikash Biswas	Bikash Biswas
64	Dipok Biswas	Binoy Golder
65	Binoy Golder	Binoy Golder
66	Narayon Golder	Narayon Golder
67	Robin Golder	Robin Golder
68	Prosad Golder	Prosad Golder
69	Binoy Golder	Binoy Golder
70	Joy Golder	Joy Golder
71	Binoy Golder	Binoy Golder

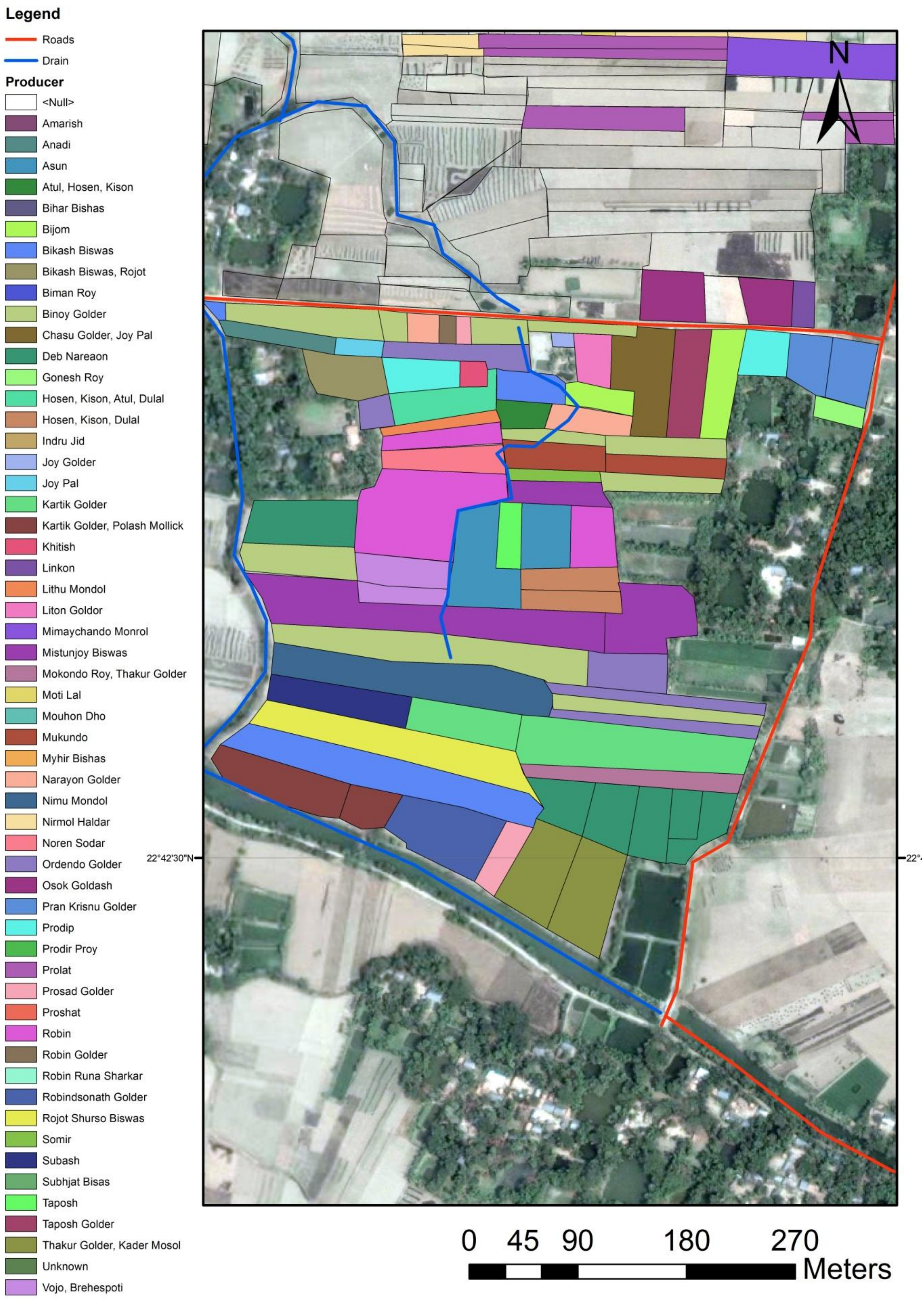
From this overview it became clear that 54% of the land is under lease production. In total 42 owners hold 71 plots. Of which 10 plots were indicated to be owned by 2 to 4 persons.
33 of the plots are cultivated by the owner. For the remainder 38 plots several phenomena are occurring. 17 owners do not cultivate any land, therefore 13 farmers without land in WMU1 and farmers with land in WMU lease these lands.
Hence in total 55 person are linked to the 71 plots in WMU1.

only owner	owner, producer	owner, producer, leaser	leaser	Total
17	17	8	13	55

Number	Name	Number of plots owned	Number of plots cultivated
1	Anondo	2	
2	Atul	2	2
3	Bikas Biswas	3	4
4	Bimol	2	
5	Binoy Golder	3	10
6	Brehespoti	2	2
7	Chasu Golder	1	1
8	Deb Nareaon	2	2
9	Dipok Biswas	6	
10	Doyal Biswas	3	
11	Dulal	2	
12	Gonesh Roy	1	1
13	Hosen	3	4
14	Joy Golder	1	1
15	Joy Pal	2	2

16	Khitish	1	1
17	Kison	3	4
18	Lithu Mondol	2	1
19	Liton Golder	1	1
20	Liton Mullick	1	
21	Lolit Babu	2	
22	Lolit Golder	2	
23	Mihir Biswas	4	
24	Mistunjoy Biswas	3	3
25	Narayon Golder	2	2
26	Nihar Golder	1	
27	Nimu Mondol	1	1
28	Nosen Sosder	1	1
29	Ordendo Golder	1	5
30	Pijush Biswas	3	
31	Prosad Golder	1	2
32	Robin Golder	1	4
33	Rojot Shurso biswas	2	2
34	Ronjit	1	
35	Som Nath Biswas	3	
36	Somir Golder	1	1
37	Somir Mondol	1	
38	Sonkor Mondol	5	
39	Swapon Babu	3	
40	Swapon Biswas	1	
41	Taposh Golder	1	2
42	Vojo	2	2
43	anadi		1
44	asun		2
45	Bijom		2
46	Kader Mosol		2
47	Kastic Golder		3
48	Mokondo Roy		2
49	Mukundo		2
50	Polash Mollick		2
51	Pran Krisnu Golder		2
52	Prodip		2
53	Robindsonath Golder		1
54	Subash		1
55	Thakur Golder		3

It was found out that Thakur is actually also Binoi Golder, hence Binoi leases 13 plots and the total number of farmers is 54.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Roads
Drain
Producer
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Asun
Atul, Hosen, Kison
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Bijom
Bikash Biswas
Bikash Biswas, Rojot
Biman Roy
Binoy Golder
Chasu Golder, Joy Pal
Deb Nareaon
Gonesh Roy
Hosen, Kison, Atul, Dulal
Hosen, Kison, Dulal
Indru Jid
Joy Golder
Joy Pal
Kartik Golder
Kartik Golder, Polash Mollick
Khitish
Linkon
Lithu Mondol
Liton Goldor
Mimaychando Monrol
Mistunjoy Biswas
Mokondo Roy, Thakur Golder
Moti Lal
Mouhon Dho
Mukundo
Myhir Bishas
Narayon Golder
Nimu Mondol
Nirmol Haldar
Noren Sodar
Ordendo Golder
Osok Goldash
Pran Krisnu Golder
Prodip
Prodir Proy
Prolat
Prosad Golder
Proshat
Robin
Robin Golder
Robin Runa Sharkar
Robindsonath Golder
Rojot Shurso Biswas
Somir
Subash
Subhjat Bisas
Taposh
Taposh Golder
Thakur Golder, Kader Mosol
Unknown
Vojo, Brehespoti
N
22°42'30"N
0 45 90 180 270
Meters

Annex 6, Individual plot map of the pilot area within the village of Fultala