Bangladesh Water Development Board (BWDB)

Embassy of the Kingdom of the Netherlands (EKN) Dhaka, Bangladesh

Department of Agricultural Extension (DAE)

Technical Report 18

Improved water management levels

(Community Water Management Pilot Polder 30, Batiaghata, Khulna)

July, 2016

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Technical Report 18

Report on Improved Water Management Levels.
(Community Water Management Pilot Polder 30, Batiaghata, Khulna)

July 2016

Blue Gold Program

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List of Abbreviations

BGP	Blue Gold Program
BWDB	Bangladesh Water Development Board
CWMP	Community water management Pilot
DAE	Department of Agricultural Extension
HYV	High Yielding Variety
IPSWAM	Integrated Planning for Sustainable Water Management
IRRI	International Rice Research Institute
IWM	Institute of Water Modelling
LCS	Labour Contracting Societies
O&M	Operation & Maintenance
PWD	Public Works Datum
UP	Union Parishad
WL	Water level
WMA	Water Management Association
WMG	Water Management Group
WMO	Water management Organisation
WMU	Water management Unit

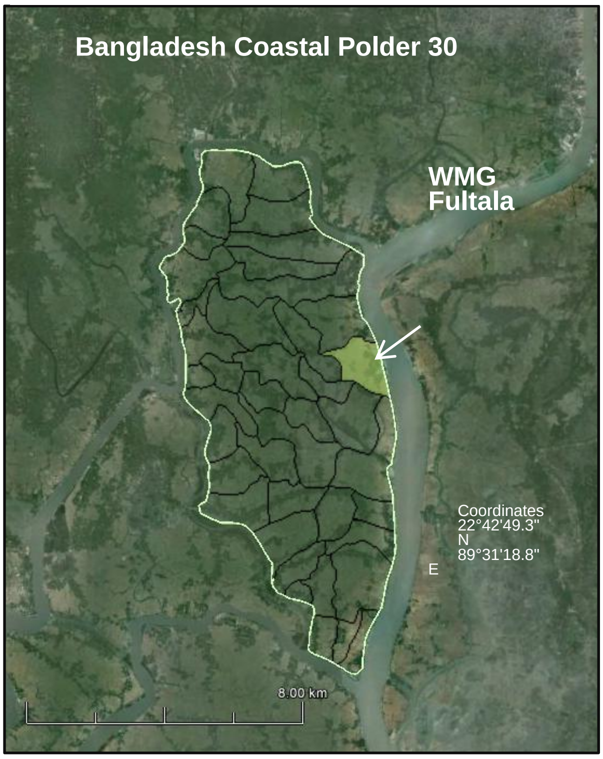
1. Polder 30

1.1 Physical features and Demography

Polder 30 is situated in the coastal area of Bangladesh and is labelled as a fine-tuning polder under the Blue Gold Program (BGP). (See appendix 1). It is part of the Khulna district in the Batiaghata Upzilla. The water resource infrastructures are managed by the Bangladesh Water Development Board BWDB- Khulna O&M Division 2.

The polder has a strong perimeter embankment that protects the polder area form tidal inundations by the surrounding estuary rivers. The Kazibacha river, on the east side, is the biggest one and functions as the main draining water body of the entire Khulna region

Figure 1: Overview Map of Polder 30 including location Fultala WMG



1.2 Polder Water Management

The most common income generating activities in the polder are of extensive agricultural nature. For this reason the water management infrastructure is designed to accommodate this. It serves drainage purposes mainly, and as a result it is not fully able to store water to accommodate a more intensive agriculture supplemented by irrigation.

Table 1
Overview general data polder 30

Polder 30	
Union(s)	Gangarampur, Batiaghata, Surkhali
Upazila	Batiaghata
District	Khulna
No. Villages	42
No. Mouzas	37
No. WMAs	4
No. WMGs	40
Coordinates	Latitude 22°-37‘-21“n to 22°-46‘-35“N & Longitude 89°-27’- 41“e to 89°-31‘-57“E
Gross area	6,396 ha (according to DPP)
Cultivable area	4,048 ha (according to DPP)
Land Elevation	1.25m PWD to 2.15m PWD

The area belongs to a part of Bangladesh, in which shallow ground water is saline and thus is not suitable for irrigation. As stated the polder is surrounded by estuary rivers, but these fresh water sources cannot be used for irrigation from March to May, due to salinity infiltration.

The main crop is T. Aman rice and it is being cultivated mostly in rain-fed conditions. In case of drought the farmers irrigate their field crops by using the tidal water which remains low saline and is suitable for paddy field irrigation in the monsoon period. All paddy fields located in high land and low land areas can get water through tidal influences.Irrigation of fresh water is mainly only applied adjacent to sluice gates for Boro and T. Aush rice cultivation, but only in a limited number of locations. Watermelon has been introduced 2 to 3 years ago and is getting more popular in the locality. The farmers irrigate their watermelon crop from their nearby pond, mainly by low lift pumps. No irrigation is provided to other field crops due to a lack of sweet water suitable for irrigation. For lack of irrigation water vast areas in the polders remain fallow in the dry season. Different kinds of vegetables and sesame are being cultivated with residual moisture or in a rain fed condition. If crops such as sesame, watermelon, pulses, oil seeds and other winter vegetables were irrigated by retaining sweet water during monsoon in the natural creeks or ponds, the crop yield would be more secure especially in a dry winter season.

Next to the lack of irrigation options a common problem is that planting and harvesting of T. Aman crop and the seed sowing of Rabi crops are often delayed due to stagnant water logging (thus insufficient drainage). Sesame cultivation for example is delayed due to late water removal from field, which increases the chance of crop loss at the maturity stage due to heavy rainfall in the early monsoon.

1.3 Water infrastructure

The embankment around these polders was constructed in early sixties under the Coastal Embankment Project (CEP) to protect the polder area from floods and salinity of the surrounding rivers. Total length of the perimeter embankment of polder 30 is about 38.996 km. The entire embankment is an interior embankment with a crest width of 4.27m and average crest level of 4.27 m PWD.

The 21 drainage/flushing sluices and outlets along the embankment allow drainage of internal rainwater during monsoon. Since the sluices are of both drainage and flushing nature, they also allow flushing of fresh river water in the monsoon and post monsoon during periods of drought. The six irrigation and flushing inlets are used for taking in fresh river water in the monsoon & post monsoon during high tides for irrigating local high land pockets. The irrigation inlets and flushing inlets have the same purpose, except that irrigation inlets constructed during IPSWAM are 450mm diameter and flushing inlets constructed before IPSWAM are 300mm diameter. Sluices and outlets are constructed across canals while irrigation inlets are constructed on the land surface.

After the polders were rehabilitated under IPSWAM program during 2004 – 2007, not much maintenance work has been done, except for some routine maintenance by WMOs. So, over this pretty long period of time, the embankment deteriorated to some extent.
Over time all the twenty-one sluices regulating the flushing and drainage of polder 30 (see appendix 2) have deteriorated to a certain extent. Most are still functional but six of them require major repair works. These are all under the scope of BWDB-Blue Gold Program. The inlets and outlets are either functional and do not require any repair works or are fully blocked by the communities when there was no more need for the inlet.

2. CWM Pilot area

The research institute IRRI selected for the Community Water Management Pilot (CWMP) an area on the east side of polder 30 near the village of Fultala. The selected area, as shown in detail in Figure 2 (overview) and (Aerial view) , exists actually out of two separate so called water management units (WMU). These are areas that are hydro logically can be isolated easily from the rest of the catchment. The two WMU are divided from each other by a rural road. The pilot area is in total about 84 ha. The first WMU takes up 21 ha and the second WMU 46 ha. The remaining 17 ha is covered with homesteads or ponds of the Fultala village.

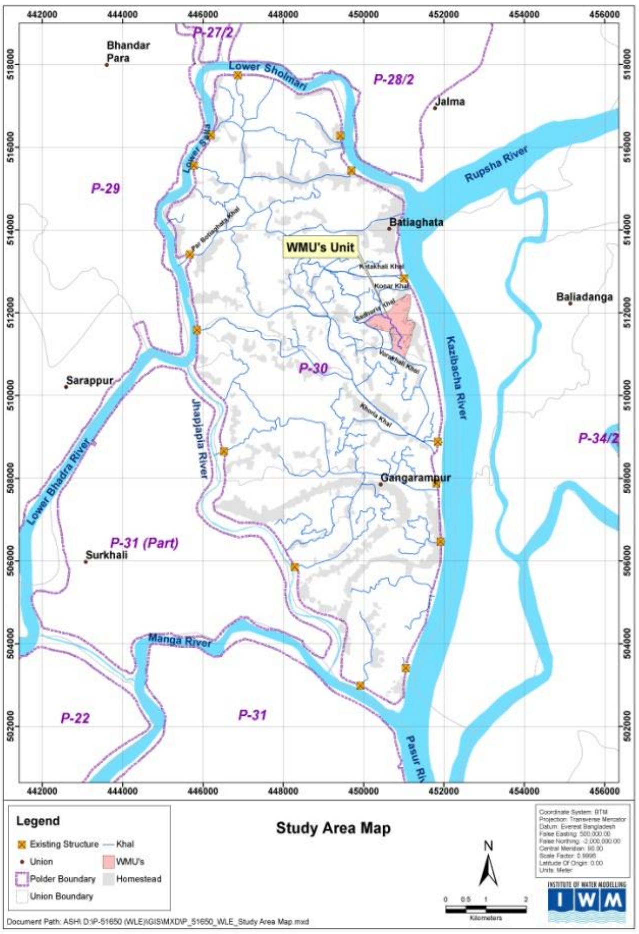


Figure 2: IWM Map showing an overview of Polder 30 with highlighted CWMP area

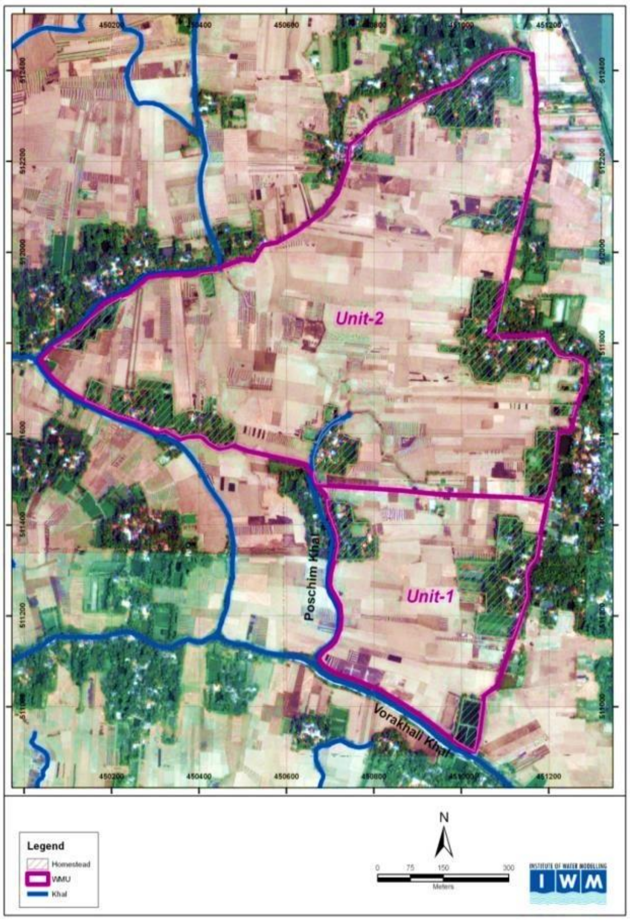


Figure 3: IWM mao showing an aerial view of the two Watar Management Units

2.1 Baseline information

General cropping pattern

The main cropping pattern in the WMUs is only two crops a year. Starting with a rice crop in the monsoon followed by a rabi crop in the winter. Compared to the rest of Bangladesh this rabi crop has a delayed start of about a month. The main reason for this is the inability to apply timely drainage for the area. This delayed plantation results in a relatively late harvesting of the crop, and this in its turn makes the crop

vulnerable for crop loss by early monsoon rains. 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
Of the Amon crop most plots are cultivated with local T. Amon varieties, only a few farmers use their lands to grow HYV's.

The main winter crop is sesame. Based on the estimations of a farmer about 90% of the area is cultivated with sesame during the winter seasons. The other 10 % are farmers, mainly in the higher areas, that cultivate lentil or vegetables like pumpkin and water melon.

Land elevation and detailed cropping patterns
The average land elevation in the polder is around 1.5 mPWD. With an average land elevation between 0.7 and 0.9 mPWD both WMUs are part of the so called lowlands of polder 30. However based on statements of the farmers as well as staff members of the Department of Agricultural Extension (DAE) a further distinction in production systems can be found.

This differences in cropping patterns is not so much the result of height differences of the land, but more of the way this area drains its excess water before the harvest of the rice. According to the farmers the inundation after monsoon is a bit high (on average a foot of stagnant water) but after some drainage transplanting of the rice is possible. The problem occurs when the lands have to be drained completely for the harvest. Globally you can say that the green parts of the map below (fig 2.3) have a drainage delay of 4 weeks, Yellow 10 to 15 days, and red about one week in this period.

Due to small differences in height unguided field-to-field drainage is now occurring. Slightly higher fields that do not receive water from other fields will over a period of time drain to the slightly lower lands, and finally to the low lands. From here it can flow out of the area through the khals. In this order the lands will be suitable for harvest and Rabi as they are naturally dried first.

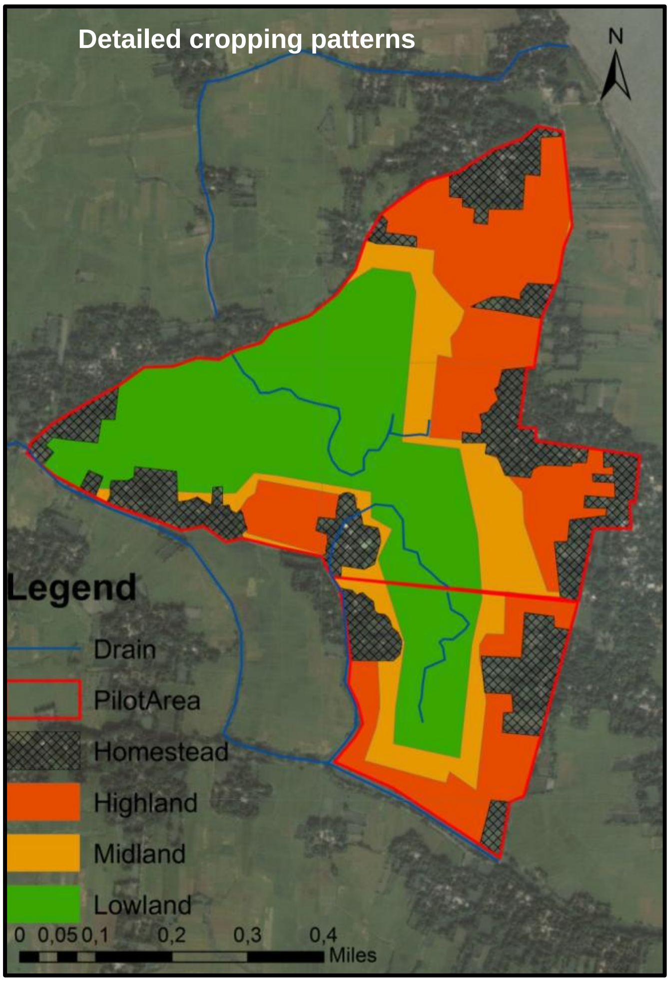


Figure 4: The three different Production systems as they were defined by the farmers

Based on statements of the farmers and DAE staff, small differences in land elevation within the WMUs, and apparent cropping patterns the following three production systems were defined:

Production system High low lands *(32.8%)*
In the slightly higher land on the outskirts of the WMUs 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 includes 22 ha of cultivated land and takes up 32,8 per cent of the total area. The average height of the lands is around 0.9 mPWD. 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 these plots. A limited number of farmers with HYV apply pesticides in the form of a spray called Basudin. Due to the slightly higher elevation the land in the area naturally dry earlier than the lands closer to the central draining channel. The water is drained by gravity to the lower lying lands. (field to field drainage) In the beginning of December the land 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.

Production system Medium low lands *(19.4%)*
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 that did not suit the highlands or the low land production system. The main variety cultivated here is Morishail rice. 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. In the end of December 2015 rice in the medium low lands was harvested..

Production system Low lands *(47,8%)*
The largest area (32 ha) are the lowest lying lands. These have an average height of 0.7 mPWD and are situated close to the central channels. For these lands it was indicated that Kumragor is the main rice variety. Here no fertilizers or pesticides are applied as the water level and the low accessibility of land make this impossible. The last day of harvesting in 2015 was the 14th of January. This year harvesting was even further delayed because of a rather heavy rain in the end of December.

Pilot area Water management
The following paragraphs will give an overview of the different levels of water management that were visible at the pilot area at the start of the project.

On-farm water management
When the lands are inundated by the monsoon rains (July) the Kharif II - T. Amon rice is transplanted to the fields. The farmers will keep water on their lands (with field bunds) until the rice has matured enough (around Nov or Dec). The lands will then be drained to be able to harvest the rice.

The Rabi- or winter crops are cultivated on dry lands. In dry years irrigation will be needed to keep the crops from wilting. Next to this the winter crops are vulnerable for stagnant water by early monsoon rains. If this water is not drained fast enough the crops will perish.

Until now the farmers in the pilot area have undertaken no real annual actions to improve on-farm water management on their plots. Drainage for the Kharif-II was done by gravity and there were no field drains to fasten and guide this process. According to the farmers the start of drainage of the lands is only possible from beginning of December. For the Rabi crops no field drains are created on forehand to ensure accelerated drainage. Field to field drainage.

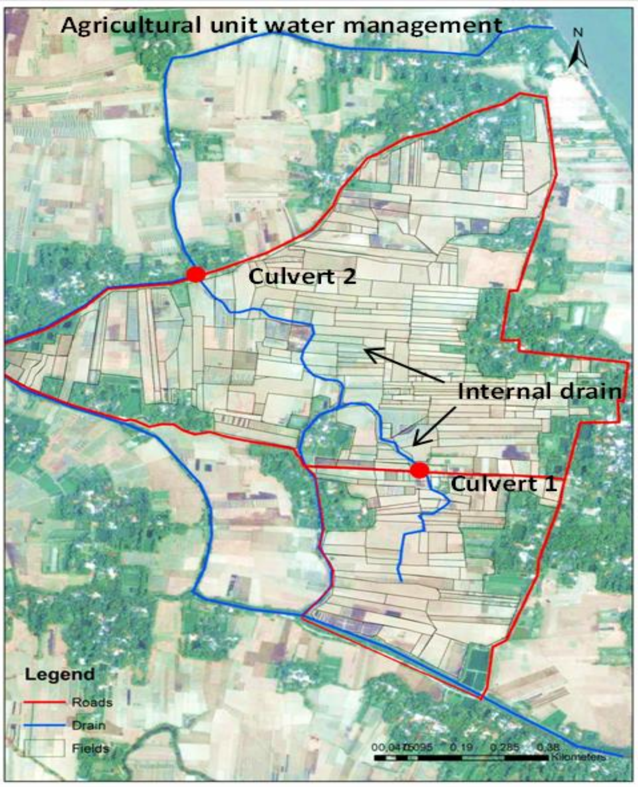


Figure 5: Agricultural-unit water management infrastructure of the two water management units

Agricultural unit water management
The WMUs, or agricultural units, are the first level of water management where on-farm water of different fields comes together and water management is really applied. In essence two ways of drainage are taking place in the two WMUs. The south part of Unit 1 (+/- 30%) drains directly by gravity to the Verakhali Khal in the south and the Poschim Khal in the west. The rest of Unit 1 drains by gravity to the lowest point of the unit where an internal drain is situated. This internal drain runs up north and is connected to unit 2 with a culvert. Currently the internal drain is inadequate in size due to the fact that it is silted up. So it cannot ensure timely drainage of water from the farm lands.

From culvert 1 this silted up internal drain runs for up 800 meter north through Unit 2 and reaches via a second culvert (C2) to lead to the Saduria Khal at the North West border of the CWM area.
As stated the field drainage ,especially during the required period in November and December, is insufficient. This is mostly because the capacity of the internal drain became insufficient.

The current culverts do not have the possibility to close off the internal drain from the main khal system so retention of water in the internal drain for the purpose of irrigation of the winter crop is not possible. Additionally the culvert linking the internal drain with the main Saduria Khal is very marginal in size thus timely removal of water cannot be ensured.

Figure 6: First culver connecting WMU 1 and WMU 2

Figure 7: Second culvert connecting the internal drain with the Saduria Khal

Figure 8: Land view of WMU 2

Catchment water management

Even though the pilot focuses on improving the water management of an agricultural unit and its farmlands it is important to review the larger catchment it is connected to. As is common in polders in Bangladesh a system of drainage khals leads to a main khal that is in its turn connected to a sluice gate. The area of Fultala is affected by the management of two sluice gates, the Katakhali and Khoria regulators.

As Figure 9 shows the drainage of the southern part of unit 1 is done through the Verakhali Khal towards the Khoria Khal and Khoria Regulator southwards. In the northern part, the drainage water flowing through the second culvert into the Saduria khal ends up in the river at the Katakhali regulator. The water flows thus from the Saduria khal to the Verakhali khal and finally through the Katakhali Khal towards the sluice.

For both gates, Fultala is located in the tail end of a long system (approx. 4,5 km) and therefore the area receives and drains water comparatively late. In a drainage situation the water has to flow and drain through the entire system before reaching the sluice gate. One can observe that farmers closest to the gates will be the first to be able to drain their water through the khals and sluice. And if they do so the farmers of Fultala will not be able to drain their lands because the water levels in (the tail end-) of the system will not drop until these lands stop draining water to the khal. For the flow towards the Katakhali regulator this situation is even worsened due to obstruction of water flow . Five or six cross dams and/or obstructions block the main flow in the Saduria Khal. This makes the possibility for the WMUs to timely and quickly drain impossible. As said for the harvest of the T. Amon rice varieties the lands will have to be drained. So these difficulties of drainage negatively influence the harvest time, and thus the possibility of a full Rabi Crop cycle afterwards.

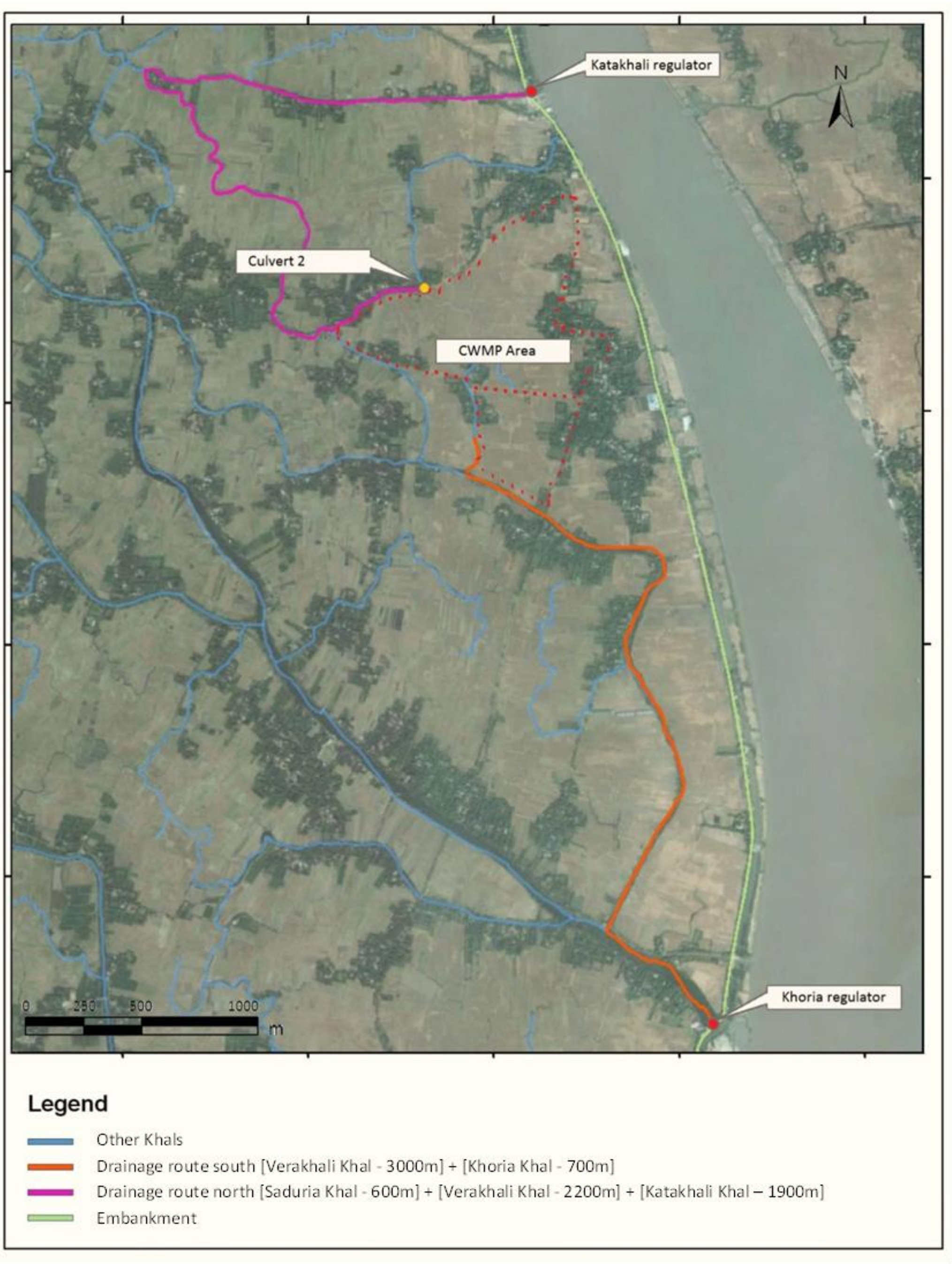


Figure 9 Overview of the two drainage ways of the CWMP area

Next to blockages in the khals, the tidal water levels in the outfall river play a role regarding the intake and drainage possibilities of the system. Figure 10 shows the tidal fluctuation of the Kazibacha River over one year. The yellow bar indicates the average land elevation of 1.5 m. This is thus the minimum level needed for flushing proposes (WLs above line). The yellow line is also the maximum line for drainage proposes (WLs below line).

Based on this, drainage towards the Kazibacha river should not be a problem during the required period in November to December. This once again shows that congestion within the system is the problem and not a poorly designed/functioning sluice-gate. The table further shows that maintaining the max. water level of 0.9 – 1.1m in the khals might be a bit more difficult during the winter crop cultivation, but with proper gate operation it should still be possible to preventively retain enough water in the khal system itself for irrigation purposes. It should be noted again that the siltation levels of the river water are too high from the beginning of March to end of May to use as irrigation water. So letting water into the system at this time of the year is highly discouraged.

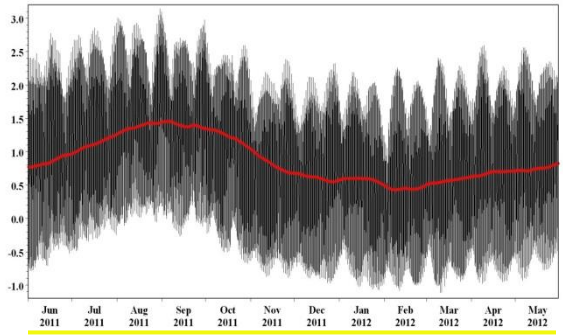


Figure 10: Tidal Fluctuation of the Kazibacha outflow river

If the WMG can motivate the WMA to makes good agreements on gate operations – So letting all users in the catchment have an optimum effect of gate operations – and the blockages were removed by the community's , the internal delay of the system will not be more than one hour. With an drainage opening of at least 8 hrs. a day the situation of the WMUs would drastically change. These 7 hrs. of drainage possibility will give them back the control of water levels in their internal khals, and so they can optimise their internal water management and thus agricultural profit.

2.2 Specific objective Pilot

The main goal of the pilot is to demonstrate and evaluate a novel approach in improved water management contributing to more resilient, productive and diverse cropping systems, and for sustainably improving water governance and equity in water use within the Katakhali sub-catchment. After a baseline study was conducted, and with this main goal in mind, the following objectives were created for the different cropping seasons;

Rabi Crops:

The three specific objectives for the rabi crops;

a) Removal of drainage congestion in November-December so that plantation of sesame and other rabi crops could be advanced by 15 days to one month. This would help safe harvest of the rabi crops before the pre-monsoon rain in April/May;

b) Minimizing crop damage due to unexpected heavy rains during February-March through construction of field drains,

Aman Crops

The specific objectives for Aman corps are directly linked with those of the Rabi crop.

c) Creating scope for early rabi crop by shortening the period of aman crop.

The objective to establish Rabi crops earlier in the year means the Kharif-II crop cycle will need to be shortened. (See Table 2) Currently almost all farmers cultivate main Aman varieties like local Transplanted Aman which have a growth cycle of about 110 days. The cultivation starts in September and runs up to December. By changing from local T Aman varieties to HYVs, the crop cycle could be shortened by approximately twenty days. The cultivation of HYVs however requires a stricter water management regime among farmers. If the harvest period is planned earlier the lands will also have to be drained earlier to make them suitable for harvest. However the current drainage capacity of the fields and Khal system is insufficient, and thus should be improved.

Table 2

Suggested crop planning for the CWMP. Shortening the Amon rice -cultivation period and shortening the land drying time between Kharif-II and Rabi by improving the drainage of the WMUs.

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	

Crop Diversification

If farmers could harvest the Kharif-II crop twenty days earlier, the Rabi crops would then -in theory- be safer. So farmers could take a bit more risk by introducing new crops e.g. sunflower, watermelon, maize, wheat etc. instead of the sesame to improve their income. This however takes more than just financial investments, it will require changes in field level water management by the communities, use of fertilizers and pest management. Next to this, the lack of available seeds, and market distribution of the crop can be a bottleneck.

With the assistance of the project team the farmers have agreed upon the following crop diversification plan for the Rabi crops in 2016 as a trail to observe and evaluate its potential.

- Sunflower (HYSON-33) planned for about 0.80 acre;
- Sesame (BARI-4) planned for 12.50 acres;
- Mung Bean (BARI-6) is planned for 02.00 acres and;
- Maize (Pacific-984) is planned for 02.20 acre.

2.3 Proposed Community Water Management Action Plan

To achieve the objectives of the pilot many actions have been undertaken. This paragraph will focus on the part of the action plan that aimed to improve the drainage and irrigation possibilities of the WMUs. However it is good to note that next to this, many trainings have been given/activities undertaken on topics like; pest control, fertiliser management, seed bed nursery preparation, seed distribution, mechanical transplanting etc.

At the start of the pilot the following actions have been planned for the different levels of water management in the pilot area;

On-field water management

1) Giving training in/ and applying small field bunds on the plots. These delineations of their own fields will provide farmers with more individual control on keeping water on their fields for rice cultivation. All earthworks will be carried out by the farmers themselves.
2) Designing and creating field channels within the WMUs to improve their drainage capacity and speed. The project team provides guidance to this by making a detailed plan together with farmers, and assisting in the implementation. All earthworks will be carried out by the farmers themselves.

Agricultural unit water management

3) Delineation of the water management units based on the system hydrology. Erecting ridges/embankments where necessary.
4) Rehabilitation of the internal drainage khal. Re-excavation of section one (500 meter) in unit 1, and section two (800 meter) in unit 2. The project team and farmers will have to agree on the trace. Blue Gold Program will provide design and funds for LCS earthwork. And all earthworks will be carried out by local LCS groups.
5) Upgrading the two current culverts to gated culverts by applying fall boards. This action will give the farmers/WMG more control on when to retain or drain the water in the internal drainage khal. This will be carried out by the Blue Gold Program after completion of the canal re-excavation.

6) Community empowerment for leading water management decisions within the WMUs and Catchment area. Empowering the community to be able to have water management discussions on Agricultural unit level.

Catchment water management

7) Rehabilitation of the Saduria Khal. This will be done by the removal of the approximately 5 cross dams that (partially) block the flow of water. Blue Gold will remove these cross dams as a part its program through LCS activities for canal re-excavation. WMG will create environment for removal these cross dams by the LCS. Any foot bridge, if required, will be arranged by the community or UPs.
8) Empowering the local water management group to be able to lead water management discussions on catchment level.

Important note is that in the first year all activities will focus on 'improving' the drainage and crops in unit one. If it is a success than unit two will too be 'improved'.

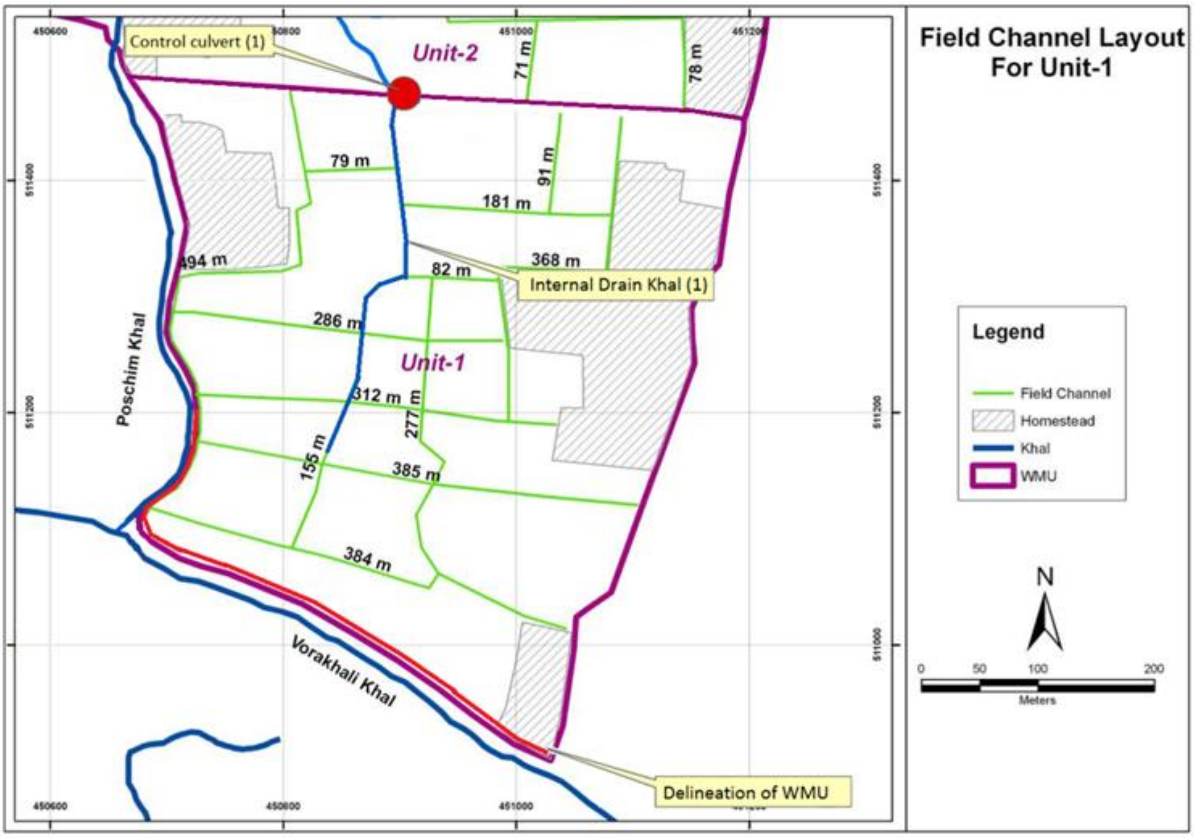


Figure 11: Proposed Community Water Management pilot Action Plan for WMU 1

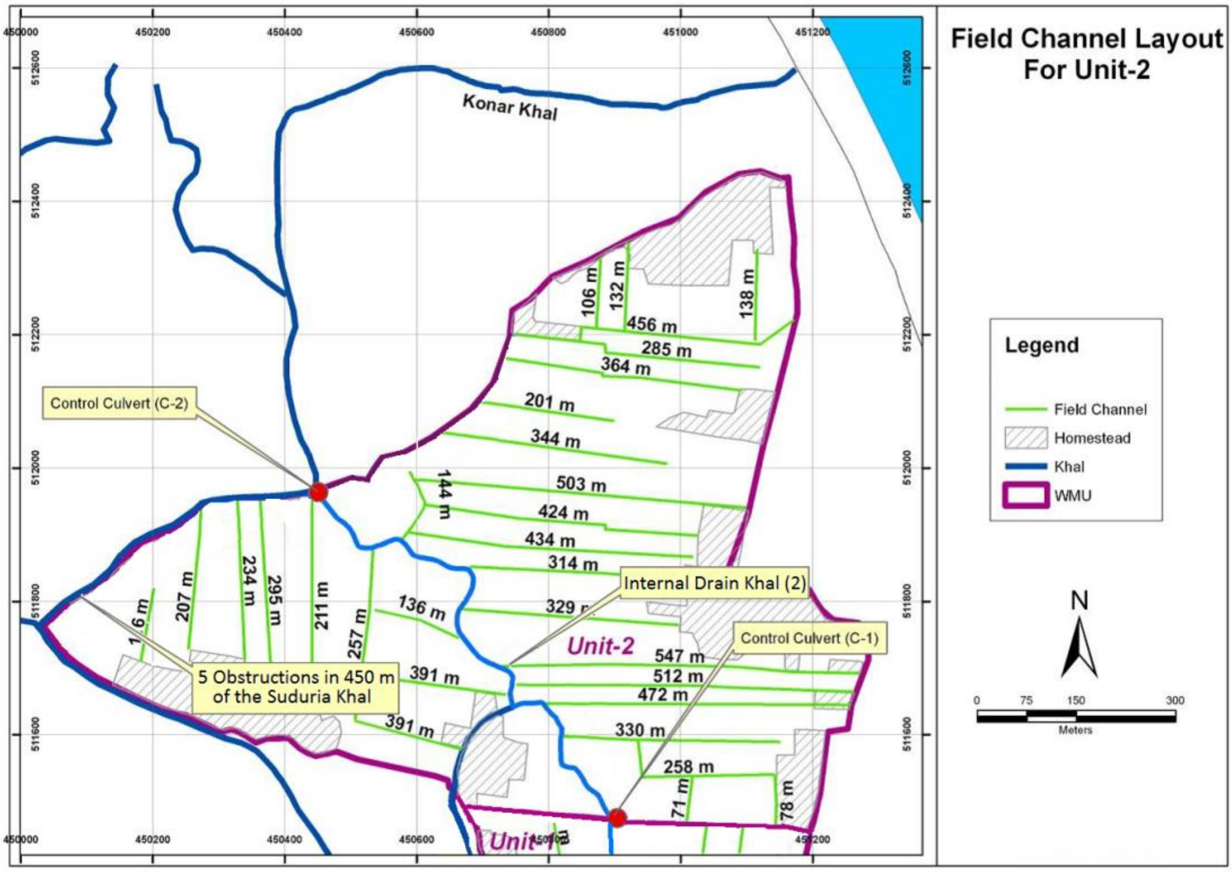


Figure 12: Proposed Community Water Management pilot Action Plan for WMU 2

3. What happened so far?

3.1 Current Status of Action Plan

With the pilot now one year into action, several actions of the so called action plans as described in §2.3 have already been carried out. The pilot started by conducting capacity building among the farmers.

One of the main objectives of the pilot is not only to improve the infrastructure for water management, but also to build the capacity among the community to get the most out this infrastructure. So complementing the physical activities the following trainings were given by the project team;

- On-farm water management
- Catchment water management[1]
- Importance of drainage for improving productivity of the polders
- Sluice gate operations and its importance for water management at sub-polder scale
- Water depth and salinity measurement inside the sub-polder and peripheral rivers
- Improved cropping systems and high yielding varieties of rice and Rabi crops
- Importance of early establishment of Rabi crops

Progress report on the physical activities as described in the action plan:

Table 3
Progress report on the physical activities as --described in the CWMP action plan

	Improvement of infrastructure	Progress	Carried out by	Remarks
On-field water management				
1)	Applying Field bunds	Done	Individual farmers	Only applied in WMU 1
2)	Applying Field channels	Done	Community	Only applied in WMU 1 and only applied for the Kharif-II crop. Siltation of the Kharif-II drainage water and land preparation for Rabi crop made them (partially) inactive again. New field trainings should be conducted to emphasize the importance of maintaining these channels
Agricultural unit water management				
3)	Delineation of WMUs	Done	Community	-
4)	Rehabilitation Internal drainage Khal a) Channel one [500 m] b) Channel two [800 m]	Not yet started Done	Fultala LCS (Male) in order of Blue Gold Program Fultala LCS (Male) in order of Blue Gold	There is a social conflict on the chosen trace for this part of the internal drainage khal. Discussions are being held to come to an agreement. Continuation of work is planned again for 2016 -

[1] Or more often called 'sub-polder water management' in the CWMP approach

			Program	
5)	Upgrading two culverts	Not yet started	Blue Gold Program	Will start after Rehabilitation of internal drainage Khal And Saduria Khal
Catchment water management				
7)	Rehabilitation of the Saduria Khal	Not yet started	Blue Gold Program	There is disagreement between the project team and the community living next to the Khal. This disagreement is on how to keep the village accessible after removal of the blockages and who should invest in it. E.g. footbridges

3.2 Outcome of Action Plan

With the first crop year now nearing its final stages, a first analysis can be given on what the outcomes are of the Community Water Management Pilot approach.

Rabi crop

The application of field drains and field bunds have made it possible for the farmers to dry their lands faster after the harvest of their Kharif-II crop. About seventy per cent of the crops were established +/- 14 days earlier than compared to the years before. Normally the land was only dry enough to begin land preparation from mid-February, but this year the farmers could start already start in the last week of January.

Heavy rains occurred right after most farmers started to establish their corps, and thus part of the seeds were unfortunately washed away. Most farmers did sow again but lost the advantage of an earlier start. The ones that did not start again left their lands fallow.

As not all physical activities on agricultural unit- and catchment water management have jet taken place (see §3.1) the needed drainage was still insufficient to advance the start of the crop by the planned one month. The current two weeks was now mostly gained by the on-farm changes done by the farmers themselves.

As said the Rabi crops were delayed and thus not yet harvested during the drafting of this report. A possible improvement in yields can therefore not be shown in numbers. Mostly due to these unfortunate natural events it is also expected that the yield will not be up to its highest potential.

The approach of CWMP to increase crop diversification did result in adoption of mung bean, sunflower, wheat and maize crops by the farmers in this pilot area.

Figure 13: Showing 3 differed Rabi crops. On the left side mung bean, right side sesame and in the back Sunflower. Between the crops a field bundh is still visible.

Figure 14: Field of new Rabi crop sunflower (HYSON-33) in WMU 1

Figure 15: Field of new Rabi crop watermelon in WMU 1

Figure 16: Many sesame crops were damaged due to heavy rain right after crop establishment. Not all farmers had the means to start again, so lands were Fallow lands during rabi crop cycle

Kharip II Crop

With the farmers making the in §3.1 described changes in the on-farm water management, the right conditions were created to be able to apply the IRRI CWMP approach. E.g. new rice varieties, seedbed preparations, transplanting, fertilizer use, pesticide control etc.

By applying these, for the farmer new, approaches the yields of these Kharif-II crops have according to the farmers increased significantly. This amplification of the yield can mostly be subscribed to applying newly introduced BRRI Dhan 52, 53, 54, 55 and 62 rice seeds varieties as alternative for local varieties.

This crop intensification was not the only positive outcome visible for the plots that applied the HYV rice for their Kharif-II Crop. As shown in Figure 17 the crop cycle itself was also shortened by approx. 20 days (in comparison with their neighbouring plots applying local varieties). This early harvest made it possible for the farmers to start with drying their lands in an earlier stage too.

Figure 17: A local variety of rice in the front, and in the back a newly introduced HYV. The difference in their maturing stage is well visible.

4. Lessons learned

4.1 Major Players of Positive and Negative Outcomes

In general the pilot can be called a success due to that fact that the WMG farmers made it possible to successfully apply HYVs in the Kharif-II crop. With this it did not only increase the yield but also shortened the crop cycle. Making it possible for them to start drying their land in an earlier stage, and farmers were able to start land preparations for a Rabi crop already in January. With this the pilot achieved to start the Rabi crop cycle in the first week of February and thus reached one of its objectives.

The Rabi crop was a bit less successful this year due to natural events like a heavy rain just after establishment of the crop, and whirlwinds. Nonetheless the pilot did succeed in diversifying the Rabi crop slightly. A few new crops were introduced in WMU 1.

However not all objectives were reached. Especially the improvements on the agricultural unit- and catchment water management levels are seriously delayed due to some non-social coherence. There are disagreements among the farmers on the trajectory of the internal drainage khal in WMU 1, and the communities are not agreeing to the suggested solutions on how to remove the cross dams in the Saduria khal.

4.2 Lessons Learnt for Horizontal Adaptive Learning

Next to the in-depth approach at the WMUs pilot site, the location was also used to promote improved water management and cropping systems, and water management organizations based on water management units on a larger scale. Within this first period the following horizontal adaptive learning approaches were applied or observed;

a) As for the first year all community activities were solely focused on WMU 1. However it was observed that some farmers in unit 2 directly copied the activities that were carried out in the pilot area. This mainly focused on adoption of new HYVs and applying field bunds.

b) The success of this community based action-approach is an ideal showcase for the farmers to show off their novel activities to others. To facilitate this other communities in the vicinity were invited for an exhibition of the activities. As neighbouring WMGs they are most likely facing similar water management problems they will be able to relate to what has been done. This was however only partly effective probably because it was not a two-way exchange in which CWM-WMG representatives would visit non-adopters areas and no vertical learning took place in non-adopter areas.

An extra plus point to this approach is that it could create awareness among neighbouring WMGs on what Catchment water management is, and what the role of the WMA is within this.

4.3 Recommendations for Further Improvement:

a) After a field training on On-farm water management at the start of Kharif-II the farmers created field channels. These field channels fulfilled their task during the Kharif-II crop cycle. However with the start of the Rabi crop cycle (land preparation/seed bed preparation) the channels were not maintained. With this the result was partial (or full) loss of the drainage capacity of the lands. This has a negative effect on the resilience of Rabi corps to temporary inundation by heavy rains after crop establishment. Giving more emphasis to the importance of maintaining these channels during the raby crop cycle trainings will be needed.

b) The WMG or WMA will have to come to an agreement with the landholder that is not willing to give up his land for the internal drainage khal. If they do not come to an agreement the investments for the second part, it will be less useful. The community will have to take the lead in ensuring the WMG evolvement. The WMA, or UP could play a key role in motivating the farmer to cooperate.

c) There is still a mind-set among some farmers that they need to retain water up to the moment they harvest their Aman crops. This delays the up following drying of the land for the Rabi crop significantly. More training will have to be given on this subject.

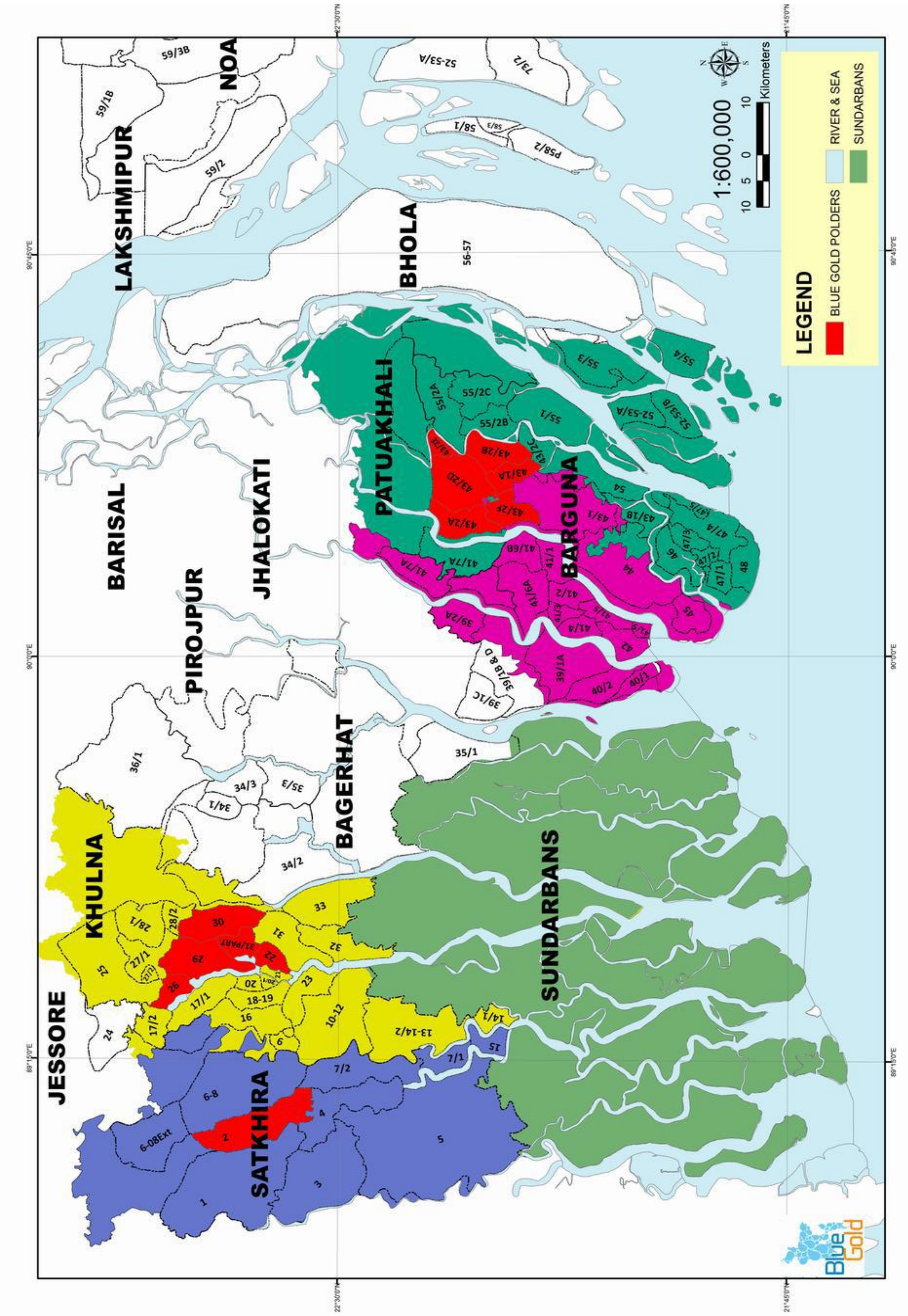
d) The WMA will have to come to an agreement with the community living near the Saduria khal on how to continue. The community will have to motivate the WMG to discuss this with the WMA.

e) Facilitating more local horizontal and adaptive learning groups to achieve CWM activities.

Figure 18: Utilizing the 'Showcase' possibilities of the Community water management pilot

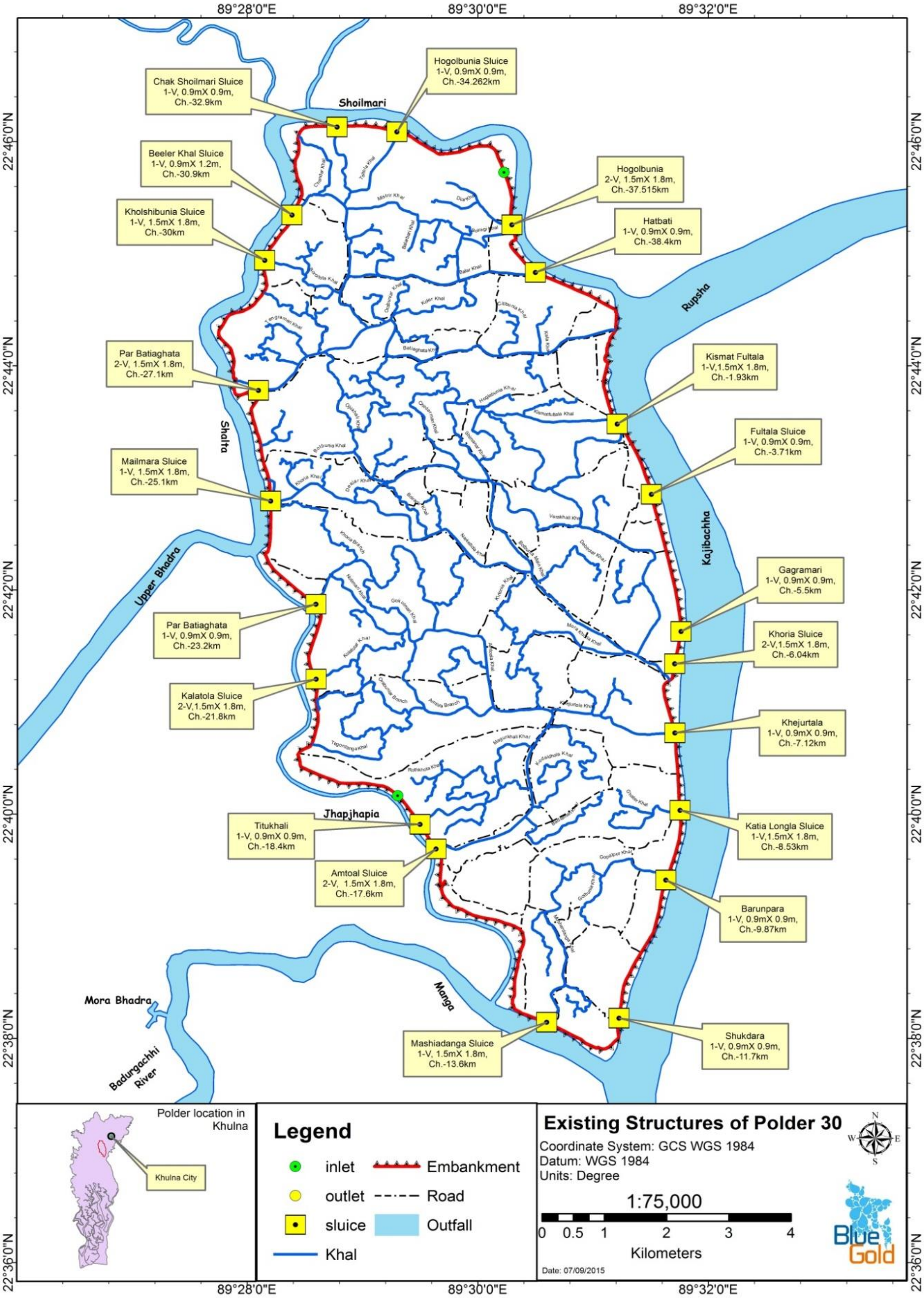
Appendix 1

Overview map of the coastal zone of Bangladesh. The polders highlighted in red are currently (2015) under the BWDB - Blue Gold Program scope.



Appendix 2

Overview map and detailed description of existing water management infrastructure in Polder 30.



Overview of the Khals and outfall rivers in and surrounding Polder 30:

Polder 30			
No. khals	134		
Total khal length	168 km		
Name outfall river:	North	Shoilmari	
	East	Kajibacha	
	South	Manga	
	South West	Jhapjhapia	partially silted up
	North West	Shalta	

Drainage+ flushing sluices in the perimeter embankment of polder 30

S.N. No.	Name of Sluices	Number of Vents	Size, (mxm)	Location, km
1.	Amtola Sluice	2-V	1.5x1.8	17+645
2.	Beeler Khal Sluice	1-V	0.9x1.2	30+935
3.	ChakSoulmari Sluice	1-V	0.9x0.9	32+940
4.	Fultala Sluice	1-V	0.9x0.9	03+718
5.	Hatbati Sluice	1-V	0.9x0.9	38+452
6.	Hogolbunia sluice	2-V	1.5x1.8	37+515
7.	Kalatola Sluice	2-V	1.5x1.8	21+800
8.	Katialonga Sluice	1-V	1.5x1.8	08+535
9.	Khalshibunia Sluice	1-V	1.5x1.8	30+080
10.	Khoria Sluice	2-V	1.5x1.8	06+040
11.	Mailmara Sluice	1-V	1.5x1.8	25+115
12.	Mashiadanga Sluice	1-V	1.5x1.8	13+660
13.	Parbatiaghata Sluice	2-V	1.5x1.8	27+102
14.	Kismatfultola DS cum FS-1	1-V	1.5x1.8	01+933
15.	Gagramari	1-V	0.9x0.9	05+505
16.	Khejurtala	1-V	0.9x0.9	07+123
17.	Dewatala	1-V	0.9x1.2	09+870
18.	Sukdara	1-V	0.9x0.9	18+424
19.	Titukhali	1-V	0.9x0.9	23+258
20.	Kismatfultola	1-V	0.9x0.9	01+633
21.	Hogalbunia	1-V	0.9x0.9	34+962