17 In-polder water management

Contents

Context[edit | edit source]

Briefing Materials

The following materials illustrate concepts, interventions, outcomes and lessons learnt, including through stories from community members.

Slide decks

- Small-scale infrastructure for in-polder water management

Thematic brochures

In the polders of the coastal belt of Bangladesh, the potential to improve income of farmers is large. Compared to other parts of the country, productivity and profitability from its mainstays agriculture and aquaculture are low. To strengthen the economies of the polders, the Blue Gold Program rehabilitates main hydraulic infrastructure, capacitates water management organisations and stimulates the agricultural market system in 22 polders (see chapter 3 for the physical characteristics and for maps). Optimisation of the use of hydraulic infrastructure inside the polder, both small and large, maximises the returns from these interventions. This is called in-polder water management.

Polders[edit | edit source]

The characteristics of the rivers running across the south western coastal belt of Bangladesh partly control agricultural opportunities inside the polders. In the western part of the coastal belt, in the Satkhira District, reduced fresh water flow from the north results in increased salinization and substantial sedimentation of the rivers. This is turning polder areas into low-lying ‘bathtubs’ in between river beds that are elevated by sedimentation. This results in drainage congestion as well as in seepage, also of saline water, into the polders. This causes production systems to shift to year-round saline shrimp ghers. More eastwards, during monsoon, the rivers’ water levels in the central south rise so much so that polders cannot be drained, causing extensive seasonal waterlogging in the Patuakhali and Barguna Districts.

Cropping systems are also influenced by topography of the land and the water levels inside the polders. In the Khulna District, within the same polder rice after fish (freshwater gher-boro) and T Aman-boro cropping systems can be found – where the latter generally occurs on slightly higher lands. Small differences in land elevation have caused these distinctly different production systems. Other areas, such as in Patuakhali District, generally have high lands compared to the Khulna region. Nonetheless, farmers in Patuakhali make a distinction within their polders in high and low lands. A height difference of 30 cm in land topography can make the difference between a waterlogged situation where only local varieties of T Aman can be grown and a well-drained one where highly profitable High Yielding Varieties of T Aman are cultivated. All this implies that slight adjustments to the water levels can make a big difference.

Figure 17.1 shows how sluice operations impact on water levels. It shows water levels at two different locations (blue: near Amkhola sluice; Red: Mushuriaghati sluice) in the period from April 2018 to June 2019. The grey graph shows the water level in the river outside the older. The graph appears to have a large bandwidth due to the diurnal (twice daily) tidal fluctuations. The blue graph shows water levels inside the polder, near the Amkhola sluice. It provides evidence of sluice operation: in the period late May to early September 2018, water was drained as-and-when possible, resulting in a internal water level lower than the average external water level. From September 2018 onwards, the sluice is used to retain water, ensuring an internal water level slightly above the average of the water level in the river. The red graph represents the water level inside Mushuriaghati sluice. As the red line aligns almost exactly to the middle of the tidal amplitude (grey line) it would appear that no management of the interior water level takes place. This is indeed the case, as Mushuriaghati sluice's gates were at the time of the water level recording dysfunctional.

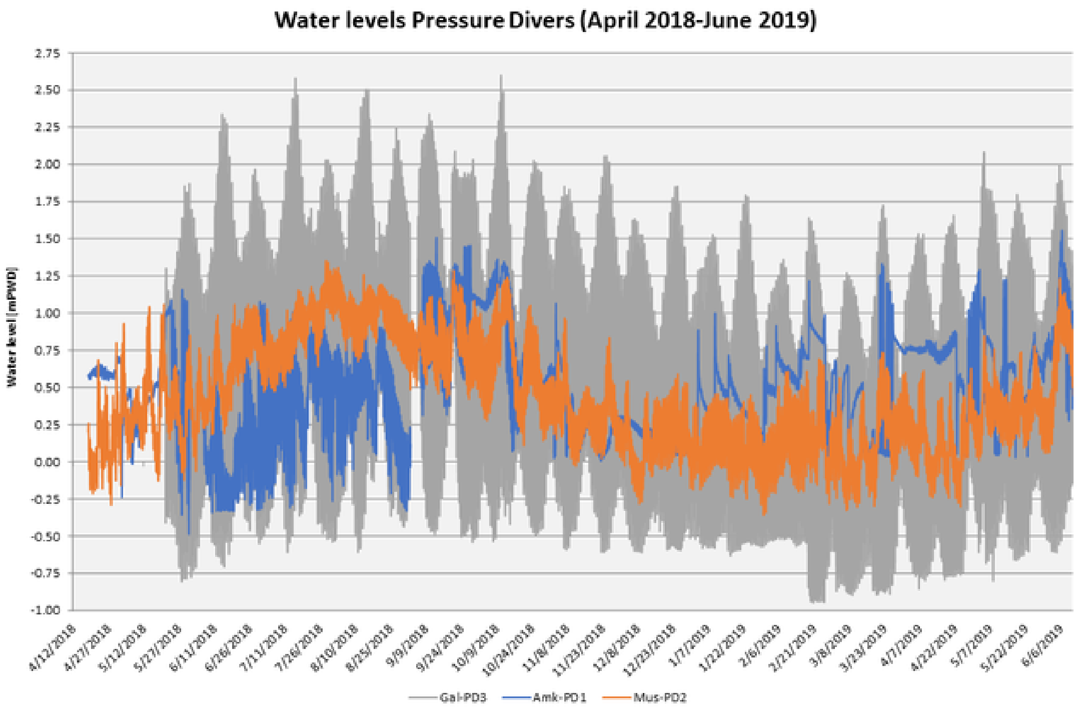

Figure 17.1: External and internal water levels of two sluice catchments

Managing internal water levels[edit | edit source]

Water levels in the polders can be managed with sluices. Each sluice has its own area of influence (known as 'catchment') and the boundaries of these depend on elevation and the connectivity of the khal system. At the catchment scale, the water levels (managed with the sluice) in the primary or main khals should ideally serve the interests of all stakeholders in that catchment, i.e. farmers, fishermen and others. However, the following challenges occur:

- Many interests need to be catered for. It is difficult to get all interests at the table and it is complex to find a proper modus operandi for the regulator. If operation is not agreed upon, this may result in a weak pursuit of the most common interests and a high likelihood of elite capture.
- Suboptimal sluice gate operation results in:
    - waterlogging and drought
    - sedimentation of and cross dams in the khal system (reducing the potential of the catchment to serve all interests), and
    - adapted but marginally profitable production systems.
- At the end of 2019, 50% of the sluices were under control of WMOs. Powerful stakeholders such as shrimp farmers or fishermen may decide when sluice gates are opened or closed – generally not benefitting the larger numbers of farmers or the larger tracts of lands.
- If under control of Water Management Organisations, proper operation and maintenance of sluices often is shouldered by the WMG nearest to the sluice; operating it as they seem fit. Other WMGs have little say over its operation.
- Main khals, serving multiple WMGs, constitute common pool resources, the management of which is often neglected. This results in water hyacinth infestation and widespread sedimentation. As a consequence, large parts of the polders become hydrologically disconnected from the sluice.

At the sub-catchment scale, secondary and tertiary khals transport water to and from the inner parts of the polder. Reduced connectivity and control of the secondary and tertiary khal fails to meet increasing demands:

- Many secondary and tertiary khals have cross dams in place to help to store water for a small group of people (e.g. for irrigation purposes or fish cultivation) living next to the khals. This reduces the connectivity of the sub-catchments and hampers drainage and irrigation for significant portion of lands. Would sluice operation be optimised, it would not have any effect on these more interior areas.
- The construction of new roads is often planned without taking into account water drainage requirements.
- When zooming in at a scale where height differences are small and water management conditions for farmers are more or less homogeneous, there is a lack of infrastructure to retain or drain water in order to harness the production potential of this particular area.

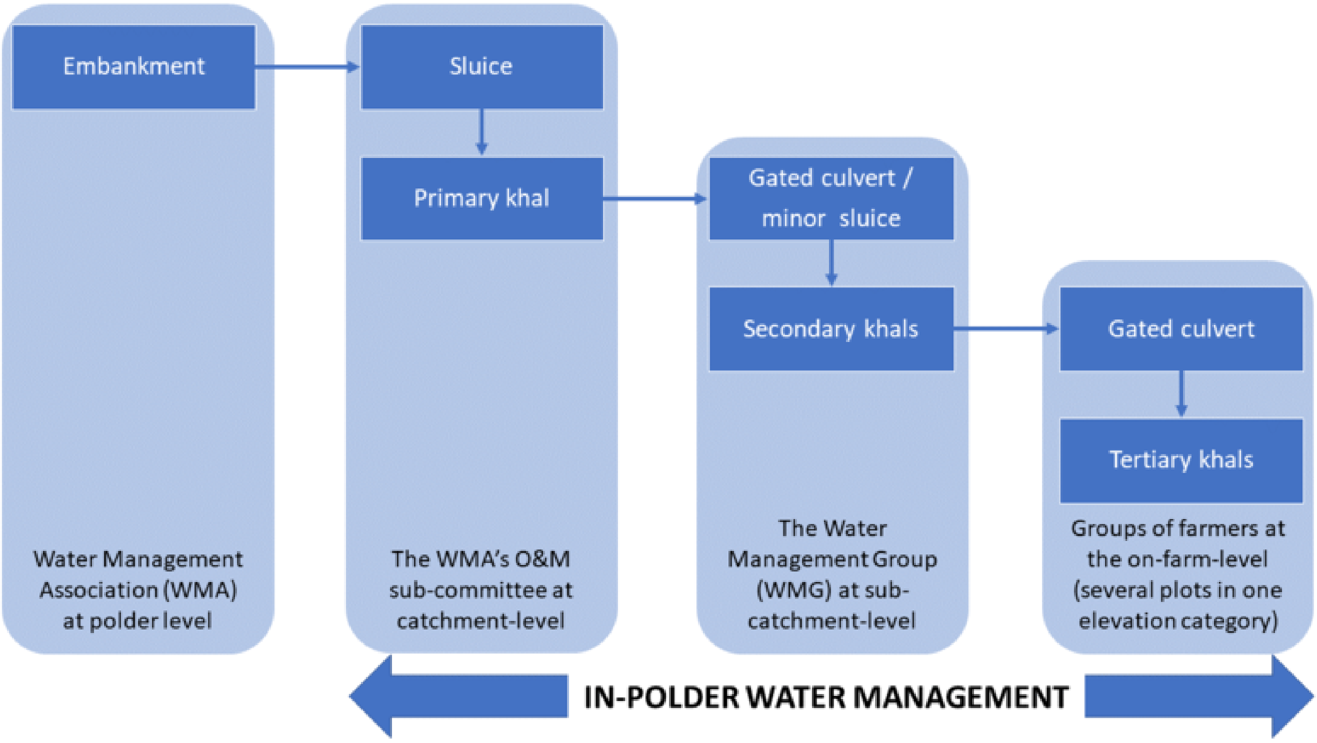

Figure 17.2: Local Water Management Organisations (WMA/WMG/group) and their area of influence

Figure 17.2 summarises this section on context, by showing how the polder and the hydrological subdivisions therein correlate to hydraulic infrastructure and organisational entities. It labels all water management efforts within the polder, including the operation of the main regulators located in the embankment, as 'in-polder water management'.

Interventions: a mix to address all scales[edit | edit source]

In-polder water management (IPWM) is the maintenance, operation and modification of the hydraulic infrastructure inside the polders to facilitate viable and profitable production systems. IPWM helps to increase returns from interventions in primary infrastructure (see Section C) and from involvement and capacity building of WMOs (see Section D Chapters 14 and 15) which in turn provides an environment for increased agricultural production (see Section E). Since IPWM works on different scales and is context-specific, a mix of approaches has been employed:

1. ***Catchment Planning (50-1,000 ha)*** – Through coordination between WMGs through a catchment O&M committee, plans were made for improving sluice operation to manage water levels in the catchments, and agreements forged with respect to maintenance and other actions that benefit the catchment's performance.
2. ***Intermediate scale infrastructure (50-500 ha)*** – Conveying water between primary khals on one hand, and tertiary khals and fields on the other; the polders' secondary khals play a key role in the distribution and management of water. However, secondary khals are hardly ever equipped with control structures. The experience with an intermediate structure in Polder 29 may give insight in the potential of such structures.
3. ***A small-scale water management infrastructure (SSWMI) fund (10-150 ha)*** – Provision or improvement of water management infrastructure (using a 'hands-off' approach) on tertiary khals (i.e. outside the jurisdiction of the Bangladesh Water Development Board). Sometimes in combination with Demonstration plots (0.2-1.0 ha) to demonstrate the agricultural potential of SSWMI.

4. ***CAWM, Community-led Agricultural Water Management (10-50 ha)*** – The optimisation of sub-catchments (10-50 ha), a scale that allows for synchronised cultivation of crops on lands with the similar elevation; for community collective action at a scale that is replicable by other farmer groups. This is used for horizontal learning, and also for further discussion about IPWM.

Catchment planning[Notes 1][edit | edit source]

Within catchment planning, there is clear focus on improving cropping patterns, in order to directly impact the household incomes and have a clear cause and effect between catchment planning and its benefits. Catchment planning concentrates on identifying immediate and doable actions – aiming at optimised water levels for crop production. Planning of operations and maintenance of infrastructure in the catchments is the responsibility of the WMA O&M sub-committees (also known as 'catchment committees'). Every catchment has its O&M subcommittee, comprising of 2 representatives of every WMG in the catchment.

Catchment planning was supported by the BGP TA team from mid-2017 onwards. In 2017 catchment planning was piloted through a 2-day workshop in a few catchments, led by TA staff. By mid-2018 this had evolved into training one or two of the WMO members in the catchment to facilitate catchment planning. In this way, about 15 catchments could be lined up for catchment planning in one training batch.

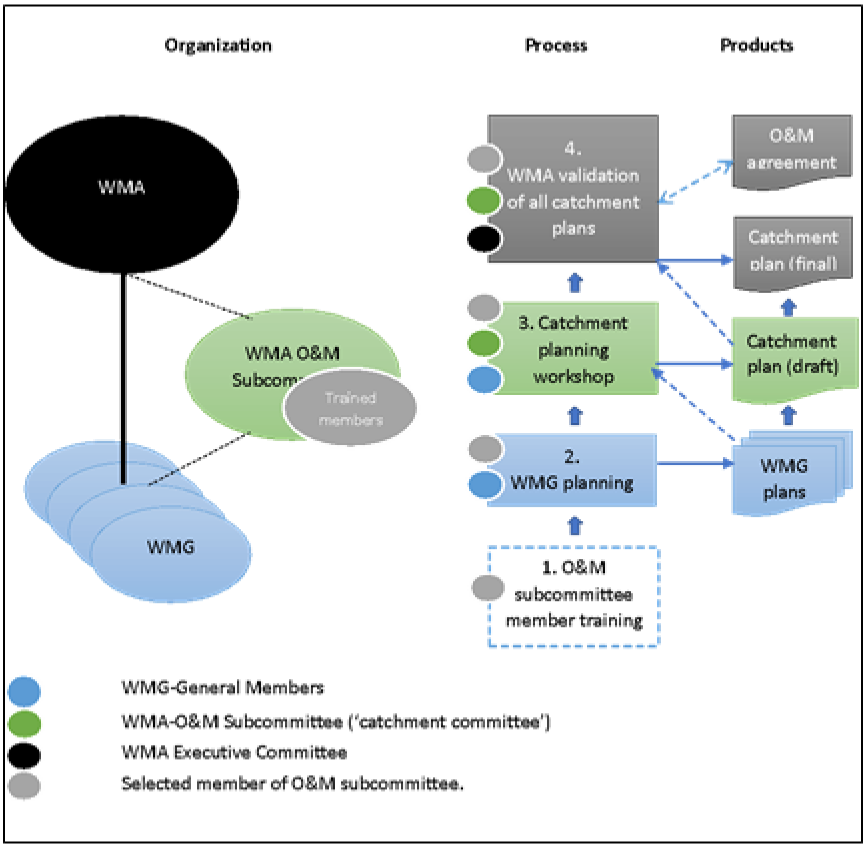

Figure 17.3: Structure of the catchment planning exercise

Figure 17.3 visualises the way the WMGs, O&M sub-committee and the WMA cooperate along the process of catchment planning. To plan proper management of the catchment, one or two of the O&M sub-committee members were trained as facilitators of the catchment planning process (Step 1 in Figure 17.3). This process starts with WMG planning (Step 2), where the trained O&M subcommittee members discuss with WMGs the actions required for improved cropping patterns. In the catchment planning workshop (Step 3), shared issues and required actions among WMGs are discussed. In a meeting with the Executive Committee of the WMA, these catchment plans are validated in front of relevant Union Parishads, in order to also obtain their commitment and support (Step 4).

Lessons learnt on the catchment planning approach[edit | edit source]

Every catchment functions in a different way, depending on the physical and socio-economic circumstances. The BGP approach aimed to harness bottom-up initiatives by WMGs to improve water management at the catchment scale. Yet at the same time it obliged WMGs to follow specific steps leading to specific products. Planning is by nature a murky process and it must be structured to ensure it leads to decisions. **Increasing the adaptability of the approach to easily follow the needs of the WMGs and WMA is recommended in future implementation of catchment planning. Some considerations are given below:**

- Before starting catchment planning, develop a toolbox of approaches, together with WMGs and WMA that may suit a variety of contexts.
- Based on the understanding of the WMA, decide, together with WMA, what kind of approach is appropriate for the different catchments.

During the piloting of catchment planning in 2017, completing one catchment planning exercise required about 20 TA person-days (including significant involvement of senior staff), excluding travel time. This intensive approach would be able to only reach about 10% of the catchments (that is 20 out of 200). This was perceived insufficient and a new approach was developed. In the ‘optimised’ approach, an O&M subcommittee member (referred to as catchment committee facilitator) would be trained to lead catchment planning. Now all catchments could be targeted as TA involvement was limited to provision of training and to the provision of stimulation and guidance. While most trained O&M subcommittee members were selected for their active role in the community, as well as their intelligence and charisma, without stimulation and guidance from TA staff, not much would happen. This meant that for every catchment about 1-2 person-days of TA staff involvement were required in addition to 1 – 2 person-days per catchment for training. **While the approach is efficient, it is important to continuously monitor and reflect on the workload involved in relation to the likely results**.

Lessons learnt on polder hydrology[edit | edit source]

The Blue Gold Program had a strong focus on the organisational part of catchment planning, while in general little was known on the actual hydrology of the catchment. Sluice operation or maintenance of main khals might have little effect on the actual waterlogging conditions. In research by Deltares over the years of 2018, 2019 and 2020 in polder 43/2B, it was found that up to 50% of the polder’s water levels did not change regardless of sluices being open or closed. These areas are therefore hydrologically disconnected from the main polder infrastructure. This may be caused by, *inter alia*, the multiple cross-dams constructed inside the khal system. While these ensure local water retention, the water flow within the catchment is completely blocked. Eventually, this becomes a normative catchment condition as other land users will adapt to the situation. **In future catchment planning, we suggest a stronger focus on the restoring the connectivity of the khal network. If so, it is more likely that all catchment inhabitants have prospect for improvement.**

One of the principles of catchment planning is that all stakeholders in the catchment must be consulted. Sluice catchment boundaries are difficult to define as they often overlap – and some areas are more influenced by the sluice than others. This makes it difficult to make sluice catchment planning effective: a good representation of stakeholders is difficult to define. A confounding factor is that a substantial number of WMGs fall within two catchments as their delineation is sometimes based on local community or village boundaries. Some participants in the catchment planning deemed the exercise ineffective, as they had never been part of the catchment. To build stronger water management organisations, their boundaries should be based on a sound understanding of the khal system, informed by local knowledge. **A stronger understanding of the khal system is required, based on local knowledge but also on surveys, monitoring and modelling.**

Start early for partnership development and capacity building[edit | edit source]

We stimulated WMAs to use their catchment plans as a basis for engaging with Union Parishads and officials from BWDB and DAE, but also with other departments such as LGED and BADC, to petition their support. In many cases these UPs and government departments were able to provide some of the resources at their disposal – be it cash, expertise or influence – to support planned activities. Based on this experience, BGP decided to strengthen the opportunity to petition local governments and government departments by organising Upazila workshops, where WMAs can present their ambitions and plans in a formal setting. Having concise and concrete plans empowers WMOs to solicit support. The importance of the relationships between WMOs and local governments are described in chapter 18. **An early start with catchment planning is important so that WMOs have the opportunity to develop this partnerships under guidance of the project and with its financial backing.**

As catchment planning was addressed by BGP only from 2017 onwards, the project has hardly had opportunity to repeat the exercise and to capacitate the WMOs further. Ideally – after the introduction of catchment planning by the BGP TA team – the WMOs would take up recurrent planning henceforth, although this was not explicitly suggested to them. At this stage, it is clear that most of the WMAs or catchment committees do not update or review their catchment plans a year after the initial planning exercise. Repetition of the catchment planning exercise, would have helped lodge this as a routine within the WMAs. **We argue that, even if a catchment planning approach has not been fully developed, projects should start implementing it as soon as possible and repeat it yearly to improve the plans, the planning process and to build organisational continuity.**

Intermediate-scale infrastructure[Notes 2][edit | edit source]

In Polder 29, Gajendrapur Uttar WMG and the surrounding WMGs have planned to retain water to irrigate land at the end of the monsoon season and during the Rabi (dry) season. However, most plots have too little water at the end of the kharif II (wet) season and during the Rabi (dry) season - and in addition, saline water enters Dholvanga Khal because Telikhali sluice remains open during the dry season to serve the interests of other water users (in this case, fishers). To solve these problems, Gajendrapur Uttar WMG and other farmers campaigned for the construction of a small regulator in the Dholvanga Khal.

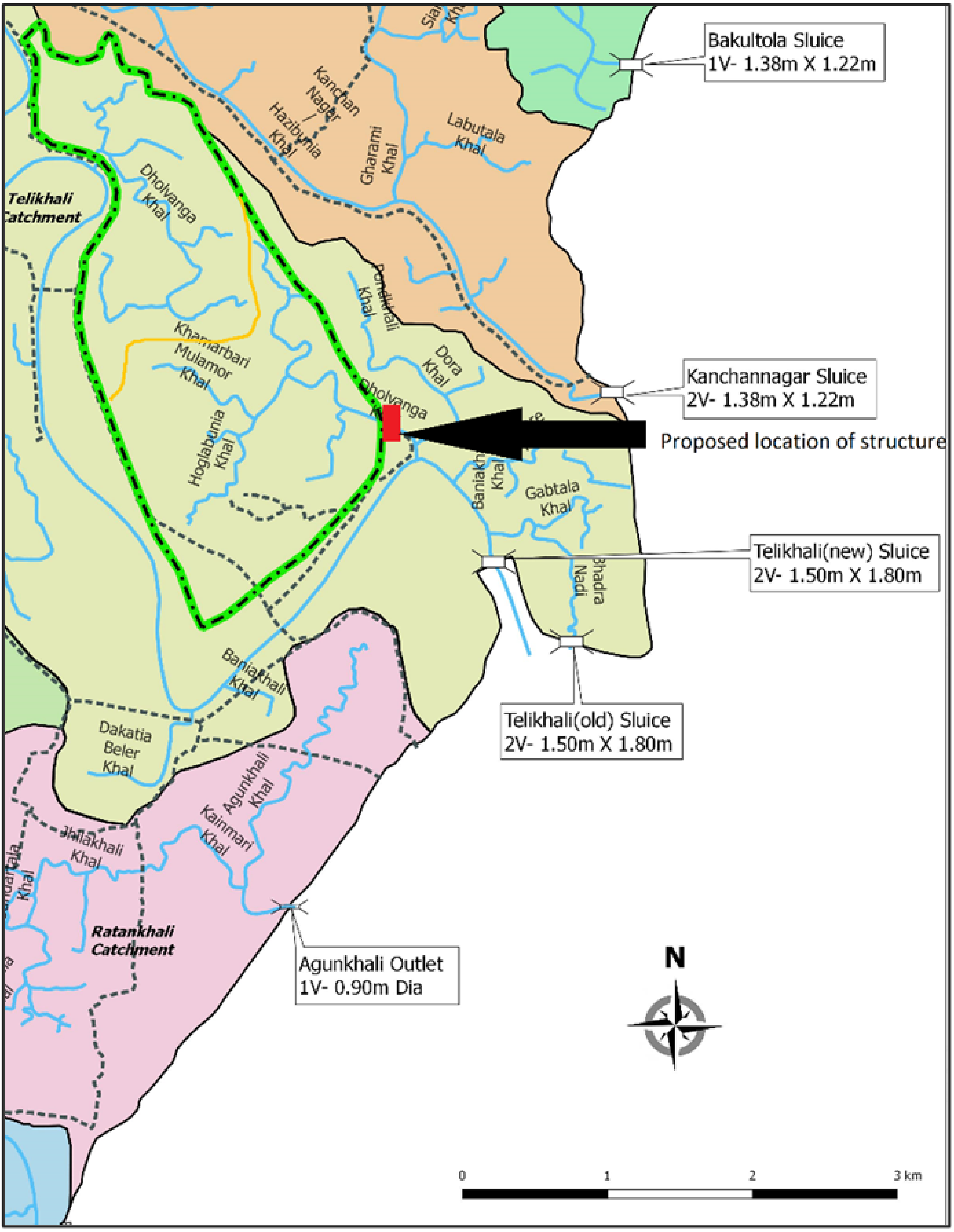

Figure 17.4: Gajendrapur retention structure location map

Most in-polder water management interventions by Blue Gold had been for a sub-catchment area of a single WMG serving 100 ha and typically requiring some limited amount of khal excavation and a gated culvert. The case presented by Gajendrapur Uttar WMG was of a larger scale (some 500 ha) and involving five WMGs. Given the interest of the five WMGs and their willingness to jointly manage the completed structure, the decision was made to use this as a pilot case from which to extract lessons for future in-polder investments.

In December 2018, a topographic survey was conducted to map the hydraulic system. Subsequently, boreholes were drilled to provide information on soil conditions, and a design was prepared by the TA team. After discussions with the community about the proposed design, the WMGs agreed to adopt the design and proceed with construction. The WMG was contracted to construct the retention structure (also known as a mini 2-vent regulator), with the TA engineering staff providing technical guidance and quality control. A map of the catchment in **Figure 17.4,** shows the location of the regulator as a red block, the approximate catchment boundary with a dashed green line - with a yellow line indicating a possible sub-catchment boundary to the north of which the benefits may be more limited.

A design report was prepared in March 2020 with a hydrological analysis, design criteria, a stability analysis, structural and hydraulic design, and construction recommendations. A short construction report was prepared after commissioning the structure in October 2020 showing the contract value, start and finishing dates, itemised cost estimate, and a photographic record showing construction activities. Both reports are available in the File Library. A short case study (in Bangla) is available for visitors and neighbours, explains the background and purpose of the regulator.

Lessons learnt on relations with the WMG[edit | edit source]

The relationship between Blue Gold and the leading representative of the community (Gajendrapur Uttar WMG) has been complex. The following factors shaped this relationship:

- From the start, the WMG leadership has been very convincing. The WMG has received CII and CAWM demonstrations, FFS schools and have consistently identified the need for water retention in Dholvanga Khal. Some would argue that the WMG has received enough benefits from the BGP project. Others see a mature WMG organisation presenting their analysis of their local water management situation and seeking assistance with implementation.
- The type of structure that is required has been the subject of many discussions within the TA team: some have argued for a minimum construction, arguing the hydrological situation is as simple as it gets; others have said that more research was required - which led to delays in decisions.

Lessons to be learnt from operating the structure[edit | edit source]

The success of an investment in a water management structure which is community-operated depends on whether the community can put in place governance systems to serve the wider interest of all users, including rules for opening and closing of the gates, and for maintenance. All five WMGs in the catchment area gave verbal approval to proceed with the structure, but were unable to provide convincing explanations of the arrangements for operating the structure. Further discussions were therefore held with representatives of the five WMGs to obtain their joint agreement to the intervention on the understanding that the benefits were to be shared amongst the communities in the entire area served by the structure - and not just by the main sponsor, Gajendrapur Uttar WMG. An agreement with all parties was signed. The difficulty here is that there is little experience of joint-management, and - during the design stages - the WMGs were unable to imagine the benefits the structure would bring. Close monitoring of the operating modalities has been difficult during 2020/21 because of the COVID-19 travel restrictions, and because of other commitments of TA staff during the final few months of implementation. Future in-polder interventions should build on the Gajendrapur experience, taking account of how the community has jointly managed the asset for the benefit of all five WMGs.

Lessons learnt on a missing link affecting development of intermediate infrastructure[edit | edit source]

While polder communities have a history of constructing and modifying tertiary infrastructure, and BWDB has a long track record with polder-level major infrastructure, neither government nor the community has any experience with this type of intermediate infrastructure. It falls into a gap: too small for BWDB but too large for communities. LGED does focus on infrastructure of this type (covering up to 1,000 ha), but the institutional patterns (WMOs, planning processes) set-up for the polders does not link well to LGED's investment decisions. However, a mechanism for investments in this form of intermediate (or secondary) water management infrastructure, similar to Gajendrapur, will be required - to allow the management of water levels in different areas of a polder, thereby enabling the realisation of the cropping potential of land of different elevations.

In addition to the development of intermediate infrastructure in Gajendrapur, Blue Gold has supported action research under the Deltares/IWM Water Management Knowledge and Innovation Program (WMKIP) for field-testing of pumped drainage in Polder 2 in Satkhira. Although the adaptive research experiment is still ongoing, it is hoped that the experience will show that in cases where the river bed is raised so high that natural drainage is impeded, local pumped drainage of agricultural lands may form a viable alternative to large-scale dredging of the river system; or to conversion of cropped land to inland fisheries.

With BWDB focussing on main investments in polder infrastructure, and with polder communities having limited capacity to develop intermediate-scale infrastructure, there is a missing link in the process of realising the full agricultural potential of coastal polders. **There are a number of organisations who could take on this role, including the Department of Agricultural Extension, Bangladesh Agricultural Development Corporation, Local Government Engineering Department, Union Parishad - which will *inter alia* require staff to develop practical skills and experience in small-scale water management and to put in place mechanisms for coordination between the organisations (as set out for example in Water Rules 2018).**

Small-scale water management infrastructure[edit | edit source]

A fund to encourage the uptake of small-scale water management infrastructure (SSWMI) was established under Blue Gold in 2018 with the aim of improving in-polder drainage and irrigation conditions.

The improvement of secondary and tertiary infrastructure across the coastal zone will involve a large number of small-scale structures and huge volumes of earthwork. The planning, design, contracting, supervising and monitoring of this small-scale infrastructure would be highly resource-intensive if provided with the same level of involvement as is provided by government engineering departments in large-scale infrastructure. Building on the success of the CAWM schemes (see next section), a fund was made available so that WMOs could plan and implement small-scale water management infrastructure (SSWMI) with a relatively low-level of supervision.

As small structures are beyond the remit of BWDB, the fund for small-scale infrastructure was provided through the TA budget, based on the following assumptions:

- Individual WMGs are eligible to apply for a single scheme (up to a ceiling of BDT 2 lakh, equivalent to approx. Euro 2,000) - assuming that they will choose an application that will

maximise their benefits.
- Since the communities have a financial stake and will benefit from a significant increase in agricultural production, the WMG will ensure good quality construction work.
- Communities must make a financial contribution but may also mobilise funds or other resources from third parties such as Union Parishad or BADC.
- Since the SSWMI provides benefits to the community, the WMG will have a direct interest in maintaining the infrastructure.
- SSWMI schemes are to be chosen where the full drainage system is functional ie water from the sub-catchment can be drained through the various channels and *khals* up to the point of discharge to the outside river or channel via a sluice or regulator.
- By involving the WMA in the supervision of the WMG, there is a check and control on the implementation process.

The SSWMI fund adopted the following staged process:

1. During a 2-month period, WMGs are familiarised with procedures and requested to apply
2. Checks of the WMG's provisional application are made by field-level TA staff
3. The final application is submitted by WMG to the TA office
4. The cost estimation is checked using a simplified cost model
5. For successful applicants, a standard form of contract (in Bangla) is entered into by WMG representatives and with the Zonal Coordinator representing the TA team
6. Payments are made to the WMGs through their bank account in instalments with the final payment based on a confirmation by the TA field team that all works have been completed
7. Demonstration plots are developed to show the agricultural potential of the implemented SSWMI to other farmers.

A total of 335 SSWMI schemes were funded through Blue Gold: 167 in 2018/19 and 168 in 2019/20 at a cost of BDT 39.9 million (equivalent to Euro 400,000) or some BDT 1.20 lakh per scheme (equivalent to Euro 1,200 per scheme). An overview map presents the distribution of these SSWMI schemes.

Lessons learnt from the SSWMI Fund[edit | edit source]

In preparation for the first round of applications for SSWMI funds in 2018/19, a number of steps were taken: (a) application procedures were developed which encouraged participation from as many WMGs as possible and which provided reasonably equitable access to available funds; (b) methods were devised for checking cost estimates prepared by WMGs; and (c) a standard form of contract between Blue Gold and the WMGs was developed.

Approaches to Implementation varied slightly between zonal offices, reflecting the local context. Although this was generally acceptable, the variable quality of small structures was recognised as one specific area where improvement and greater consistency would benefit the durability of the schemes. Although in many areas, there was some experience with the construction of pipe and box culverts from the implementation of CAWM schemes, under SSWMI, communities were left to arrange construction of small structures with very little guidance or direction and without standard design drawings and specifications. One of the main concepts of SSWMI was that responsibility for construction would be delegated to the community who would operate the structure, and would thus be invested in ensuring the structure was strongly-built and functional. Practical experience showed that completed structures were often not well-built and that essential elements were missing - such as the control gate. For the 2019/20 season, a manual (in Bangla) for the construction of a standard culvert was developed. The manual provides practical guidance, alongside a series of photographs illustrating the steps in the construction process, all written in simple Bangla. The main lesson from this experience, is that **a construction manual should be provided for communities for the construction of simple, functional and durable small-scale water management structures.**

Lessons learnt with respect to polder hydrology[edit | edit source]

In a short period of around two years, the fund has contributed to the functioning of around 335 small sub-catchments: culverts in road embankments have extended the catchment area served by inter-connected drainage systems, and silted khals have been re-excavated to increase the drainage capacity. Generally, communities are pleased with the investment, and there is plenty of anecdotal evidence that cropping intensities have increased. But there are other uncertainties, about the wider impact - such as whether the improvement causes waterlogging or drought elsewhere. **A review of the impact of SSWMI as a means of promoting investments in tertiary infrastructure would help in further refining the design and outcome of any future SSWMI initiatives.**

Tertiary infrastructure should not be developed in a vacuum. The polders in the southwest are traversed by a fairly intensive network of local roads, constructed by Union Parishads, the Local Government Engineering Department (LGED) or the Roads and Highways Department (RHD). Road embankments often obstruct water flow, so the provision of culverts sized to serve the drainage catchment can be used for local water management if - for example - they are provided with simple facilities for closing off the flow in either direction. Though roads and their structures are not designed with any consideration for optimisation of local water management; their presence provides an opportunity for improving local water management conditions.

Blue Gold focuses on the rehabilitation of primary infrastructure (by BWDB) and - through SSWMI schemes - also on tertiary infrastructure. Field experience has shown that the secondary system – conveying water between the primary and the secondary drainage channels – is often in poor condition. These khals (with widths ranging from 5 to 50 metres) generally serve areas between 100 and 500 ha. As primary and tertiary systems are upgraded through initiatives such as SSWMI, reduced discharge capacity in the secondary system because of siltation or blockages from cross-bundhs or fishing nets can limit the flow of drainage water from the field through the drainage channels up to the point of discharge to the outside river or channel via a sluice or regulator.

Small-scale project interventions such as SSWMI require good local knowledge of the complex interconnectivities required to drain relatively small areas and a sound understanding of the local hydrology to be fully effective. But field experience has shown the importance of **understanding the operations of the related secondary drainage system, allowing where necessary for the secondary drains or *khals* to be re-excavated and provided with structures to control water flow.**

Lessons learnt with respect to institutional responsibility[edit | edit source]

We realised that small-scale infrastructure is in high demand by the communities. To ensure a swift implementation, the hands-off fund has mainly been developed by the Technical Assistance team of BGP. Neither the implementing partners nor the Local Government Institutions gained experience in handling the fund.

The Department of Agricultural Extension has expressed its interest to implement a SSWMI-fund across the coastal zone; and has applied for external funding for such a project. The Bangladesh Agricultural Development Corporation – which like DAE is situated within the Ministry of Agriculture – has sufficient engineering knowledge to guide the implementation of such a fund; whereas DAE's SAAOs should be able to reach out to communities to discuss the agricultural benefits and potential negative effects of small-scale infrastructure. Accountability may, however, be an issue as hands-off funding to community initiatives is a novel concept.

To ensure accountability during the implementation of a small-scale infrastructure fund, it is worthwhile exploring whether the responsibility could be shared with the Union Parishad. They have experience with funding similar structures, are accountable to their constituents and often have close connection to WMOs. They handle their own budget, but don't have sufficient resources focused on water management.

Lessons learnt with respect to matching grants[edit | edit source]

When making use of the SSWMI fund, WMGs are to make a matching contribution. In case of earthwork this would be 30% of the total estimated value, and in case of culverts 10%. Cost estimates are made using the standard schedule of rates; and costs are split according to the above ratios. The WMGs, however, mobilise the requisite labour from among the local day labourers and rather than paying them the standard daily rate on which the schedule of rates is based; they pay roughly 70% of this rate. In this way, the matching contribution is de facto made by the hired labourers and not by the WMG.

An alternative would have been to insist on an upfront cash contribution from the WMG. WMGs have, however, not been successful in building up capital reserves (e.g. a Maintenance Fund). There are several reasons why building up a reserve for investment in water infrastructure modification, operation and maintenance has not taken off:

- There is a fundamental contradiction between the WMG's voluntary membership – implying that not all beneficiaries of better water management are part of and contributor to the WMG – and the collective nature of the benefits created by water management improvements. Simply put: the members are not eager to develop a capital reserve that is spent on measures that may also benefit non-members.
- In many cases, WMG leaders and members are averse to building-up capital, as it brings along issues of transparency and accounting. Rather than facing possible mistrust over how funds are used and accounted for, WMGs choose to not have capital reserves.
- When building up a reserve, there is an unknown lead time between member contributions and the moment that the collected resources are used, and the time when this generates benefits. People would like to have the use of their money in the intervening period.
- Even when financial resources are there, members could question whether investment in SSWMI is a priority. Purchase of fertilisers would possibly bring more direct benefits; while households themselves might prefer to reserve their resources for investment in education.

Nonetheless, WMGs facing urgent challenges (e.g. when responding to a flood threat) have been found to successfully collect funds for financing emergency works. Often, such fund collection campaigns are organised with or supervised by the Union Parishad (or by its chairman), which could help address concerns over social justice. There are also other rural development programmes that have been able to marshal upfront cash contributions from communities, provided the matching grant is released immediately upon the contribution being made available.

Future project interventions for SSWMI should remain critical on how the matching contribution is actually made and should seek ways to ask the benefitted community of the SSWMI to make cash upfront contributions. The experience of other rural development programmes should be used as reference, while close involvement of the LGIs can be explored as a way to ensure that the contribution is primarily made by those that would benefit from it.

Other lessons with respect to small-scale water management infrastructure[edit | edit source]

The SSWMI fund provides a rich and diverse experience, and the final word on its value and practice cannot yet be given. Replication and further improvement by further roll-out of such a fund would be useful. Some practical recommendations, based on BGP's experience, include:

- **Emphasise construction-safety** – An accident during construction made clear that safety instructions are needed for box culverts.
- **Aim to realise the full potential benefit of the small infrastructure by promoting introduction of High Yielding Varieties, high value crops and intensified cropping patterns** – This requires a focus on agricultural commercialisation and on the opportunities within the market system.
- **Investment in SSWMI can also make sense in areas where the primary infrastructure is not (yet) fully functional** – The relatively inexpensive investments helps enhance control of water resources in a sub-catchment. Investment in the tertiary system does not have to wait – as was done in BGP – until the primary infrastructure is largely rehabilitated, but can be incorporated in polder development from its onset.
- **Monitor operation and maintenance of the small-scale infrastructure** – as the effects, be it positive or negative, of SSWMI are not yet fully understood.
- **Scale-up and scale-out the SSWMI-fund** – The SSWMI investments generated a high demand. The strong desire for improving water control at the sub-catchment is in all likelihood not confined to the BGP project area. Once standards for design, costing, cost sharing and contracts are established, the approach can easily be scaled-up and -out.
- **Consider incremental investment cycles** – WMGs that did well in year one, should be given further opportunity in subsequent years, possibly with different arrangements for sharing investment costs.
- **Make planning for SSWMI an explicit part of the planning cycle of the WMOs** – In BGP, the SSWMI-fund was executed as a stand-alone campaign. In hindsight, it could have been incorporated in the water management planning that WMGs do as part of the catchment planning (see above). In this way, coherence with wider developments (i.e. opportunities offered by development of primary and secondary infrastructure) is sought, and the practice of regular planning and review is more strongly promoted in the new organisations.
- **Discuss operation and maintenance ahead of the investment decision** – Though not always easy, it is important to get the communities commitment to using and caring for the infrastructure. Insist on explicit definition of responsibilities.

Community-led agricultural water management[edit | edit source]

Community-led Agricultural Water Management (CAWM) aims to improve sub-catchment agricultural production and profitability by an integrated approach. CAWM introduces improved cropping varieties, enhanced crop (and crop-fish) practices in combination with timely and well-coordinated drainage of fields and khals by the involved WMG members. Attention is paid to operational coordination at the catchment level (sluice), as well as conflict management at WMA level to make sure khal blockages are removed and water can drain smoothly. CAWM improves the local situation with respect to water management, and CAWM areas were used to demonstrate the benefits of better local water management, through horizontal learning[Notes 3].

Within BGP the approach was developed in 2015 and 2016 through a collaborative program led by IRRI[1] with Phultala WMG and Kismat Phultala WMG in Polder 30. A baseline report on the program was prepared in February 2015 by a TA intern (Martina Groenemeijer), and this was then developed into Technical Report 19 'Improved Water Management at the Polder 30 Community Water Management Pilot' in September 2016. This report built on the baseline information, reviewed the current status of the community water management action plan, summarised lessons learnt and made recommendations for disseminating the experience. In order to upscale the work, Blue Gold prepared plans for developing a network of CAWM schemes for 2016/17 and for 2018/19. Over the period 2017 and 2019, CAWM schemes were developed at 71 locations, covering 1,480 ha and involving over 4,300 farmers. DAE was responsible for all agricultural extension aspects and the Blue Gold TA team assisted with organisation and investment.

The approach consists of a mix of interventions, largely led by the community:

- Introduction of modern crop varieties, such as early maturing HYV T Aman and sunflower.
- Farmers field schools (FFS) led by DAE for knowledge transfer to support the introduction of modern crop varieties.
- Improved water management including:
  - Coordination with WMA and catchment level (sluice) for conflict resolution, removal of blockages from khals and smooth and timely release of drainage water
  - Construction of small-scale water management infrastructure, to regulate water at the sub-catchment (tertiary) level
  - Hand-dug field canals (‘nullah’) for better drainage and water retention.

To accomplish and coordinate this, the following steps were taken:

1. Select suitable area (primary infrastructure functional, secondary or tertiary infrastructure can be improved, social coherence, good organisation)
2. Regular meetings with CAWM farmers to inform about process
3. Regular coordination meetings between BGP TA and DAE-staff
4. General planning at District level with DAE field staff and selected lead farmers
5. Specific CAWM sub-catchment planning with WMO and farmers to define the new cropping pattern, decide on water management interventions and improve infrastructure
6. Farmer Field Days or crop cutting ceremonies to share the experience with neighbouring farmers and LGIs.

Lessons learnt on farmers’ crop choice – convincing all farmers[edit | edit source]

BGP has stimulated farmers to shift from local T Aman paddy varieties to modern varieties, which have a shorter duration and produce higher yield. As these varieties mature earlier (usually 4 weeks), they have a different irrigation and drainage calendar from the surrounding crops. To overcome this, CAWM funds seeds and other inputs not for just one farmer but for all farmers in a particular sub-catchment. CAWM also intervenes with FFSs and small-scale infrastructure to ensure the success of the improved T Aman crop in order to convince farmers to continue growing modern varieties. But is this sufficient to convince farmers?

The cropping system a farmer adopts is dependent on multiple factors (see Figure 17.5)[2] that are not necessarily obvious towards implementers of a water management project. In the Blue Gold Program, water management and cropping systems are assumed to be exclusively related. Therefore, farmers’ decisions with respect to crop and variety choice need to be well-understood in future CAWM interventions.

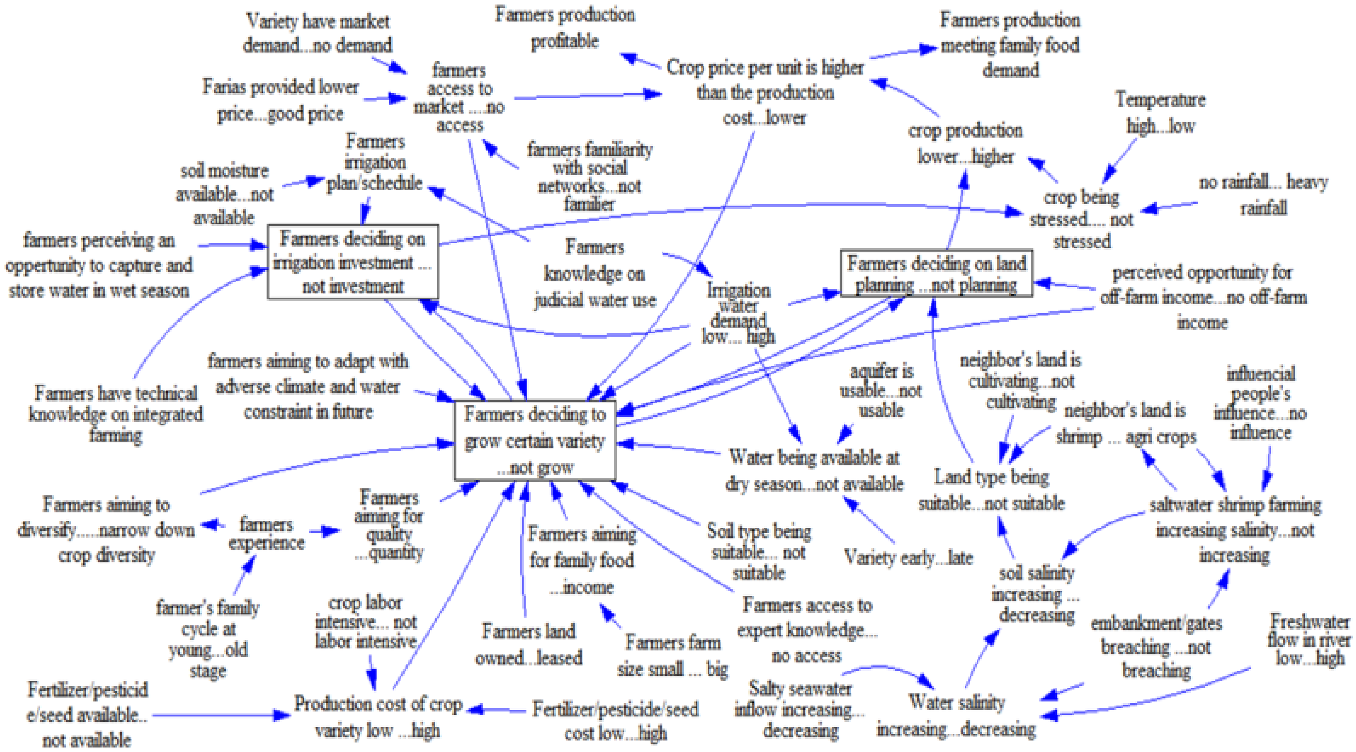

Figure 17.5: Factors in a farmers' choice of crop variety

CAWM is a uniform package of interventions (infrastructure, FFS, varietal change), while farming requires a broad set of choices grounded *inter alia* in norms, beliefs, intentions and experiences. While the interventions are well-accepted by the community; this does not mean that the adoption of the varieties propagated by CAWM will be continued. For example, a new rice variety may on the long run not be to the liking of a farmer because of its taste, workload and input requirement, or marketability. It is desirable that all farmer considerations in crop choice are reviewed before determining the cropping pattern that CAWM will support.

Interventions within CAWM are planned through group workshops. Generally, vocal farmers lead the discussions. When it comes to varietal selection as well as infrastructure interventions, BGP invites lead farmers (together with SAAOs) to make the decisions. These lead farmers are generally well-respected and can create Union among farmers. This is helpful, as considerable portions of land become simultaneously cultivated with a new variety (crop synchronisation). This prevents conflicting drainage and irrigation requirements between short duration and local varieties of T Aman. Smaller farmers however, often grow a substantial amount of their crop harvest for their own consumption and may on the longer run revert back to varieties that have a better taste, size and structure than the modern variety. Future CAWM interventions need to take the numerous small farmers into account by facilitating multiple varieties of rice to be grown.

It is recommended that CAWM increases its option for improving the relation between crop production and local water management. CAWM's menu presently comprises introduction of the early maturing BR52 T Aman variety, supported by a field crop FFS (for the aman season) and the provision of small-scale infrastructure. This narrow menu of choice increases the likelihood that only a small portion of farmers is served well. Expanding the 'toolbox', should be considered, by e.g.:

- Ascertaining what aspects of the crop choice are most important to farmers in a CAWM area and explicitly include and address these in CAWM planning exercises.
- Shifting focus from paddy production towards Rabi crops. While early aman harvest (and therefore drainage) is required for proper Rabi production, it can also be argued that the need for early aman harvest becomes apparent if more high value crops can be produced in the Rabi

season.

- Developing a diversified irrigation and drainage schedule within a CAWM scheme that does not synchronise all water management efforts in the sub-catchments, but streamlines it. A group of farmers would still agree on cultivating the same paddy variety, but other choices are possible.

Lesson learnt on the challenge of an integrated approach[edit | edit source]

The Community-led Agricultural Water Management approach (as set out in TR24 CAWM Strategic Plan for 2018/19) aimed to have a holistic approach towards improving the cropping pattern[3]. A main assumptions of CAWM is that higher income at the tertiary scale – i.e. the sub-catchment – can be achieved by improving water management, agricultural practices, crop varieties and marketing *simultaneously.* This integrated nature of CAWM places a large demand on the capacities and skills of the staff implementing it. Inevitably, staff having a background in say agronomy, are less likely to be confident in community mobilisation. Staff with a background in WMO-organisation are less likely to know the intricacies of rice varieties. The TR24 CAWM Strategic Plan for 2018/19 stated that *"insights coming from Value Chain Analysis (VCA) for relevant crops to be promoted under CAWM, and lessons learnt from BGP's market orientation activities and market-oriented FFS (MFS) were used too"*. For nearly all staff this is a novel perspective and – while these insights were used to develop a new curriculum for FFS to be used under the CAWM umbrella – BGP and DAE staff often could not make the translation to the activities in the field.

Guiding staff – in this case from the BGP TA team as well as from DAE – in implementing the highly integrated CAWM approach requires a high level of coordination with the local teams and good cooperation with the subject matter experts supporting them. This was done by placing the program under one senior member of the TA team.

While the dedicated high-level attention can be understood from the special, highly integral nature of CAWM; the heavy central hand does not sit easy with BGP's management philosophy, in which local polder teams play the key role in guiding the. This constitutes a contradiction, which was not solved by BGP:

- In order to upscale the pace of implementation of CAWMs, the lead would need to be vested more strongly in the Polder Team. To facilitate this, the approach would need to be simplified and standardised.
- In order to optimise the impact of CAWM on farmer livelihoods, the approach needs to be more flexible, more responsive to farmers' diverse crop choices, more innovative and more locally adapted. Doing so, would require close involvement of senior staff.

Lessons learnt on local adaptation of CAWM[edit | edit source]

CAWM has primarily focussed on the benefits of improved aman production. In the Patuakhali area, where aman is the mainstay, the relative impact on income of a better aman rice variety is high. In Khulna and Satkhira, boro rice is the mainstay and the relative effect on income by improving aman is lower. Therefore, 60% of the area covered by the CAWM approach is in Patuakhali; and the CAWM crop choice was replicated by farmers (with some support through extension) to roughly thrice this area. Therefore, it is more logical to continue to implement the current CAWM approach with this crop choice in the Patuakhali area. It is recommended to:

- Expand implementation in CAWM in Patuakhali with the present T Aman focus.
- Explore crop choice opportunities for the Rabi season (see also the lesson on 'farmers' crop choice, above) and include irrigated crop options, by including infrastructure investments for

- surface or groundwater irrigation.
- Explore other combinations of water management and agricultural products. As an example, within Khulna and Satkhira CAWM could be used to optimise indigenous systems, such as smallholder ghers and cultivation on sorjhon (raised beds).

A further opportunity for CAWM is to include novel agricultural practices. For example, incorporating ideas from Bangladesh' research institutes. Research institutes often do trials at a small-scale, but innovations in water management will only be truly convincing if tried at the scale of CAWM (about or above 10 hectares). Inclusion of novel ideas can be achieved by keeping most of aspects of the CAWM approach intact, but changing the extension, input and infrastructure based on the new idea. In this way, CAWM remains a platform for agricultural water management innovation – in keeping with its own origin. **It is recommended to reach out to IRRI, BRRI, BADC or other organisations and to invite them to do trials within CAWM schemes.**

Lessons on the institutional home for CAWM[edit | edit source]

During the implementation of CAWM, DAE has been involved continuously. In 2020, DAE has taken the CAWM concept further on board as a potential mainstream activity and aims to implement it in the wider coastal belt. This is a big achievement for BGP. Key to this were the following factors:

- DAE initially entered the CAWM approach by supporting it with Farmer Field Schools. This was appreciated and enabled DAE to link its package on crop production to the perspective on water management.
- DAE District Directors, SAAOs and Farmer Trainers (FTs) were involved in the planning workshops for CAWM, so that DAE staff that was not directly involved in BGP also learned about CAWM and water management.
- The obvious synergy between DAE's usual practices – especially farmer field schools (which are aimed at groups) – and the community-oriented CAWM activity made it relatively easy for DAE staff to find their way in the program.

It is recommended that DAE remains a leading party in CAWM implementation. CAWM could provide a testing ground for novel combinations of crop choices and local water management and thereby helps DAE to remain relevant in a changing rural setting.

Lessons on monitoring, reflection and learning[edit | edit source]

Using the experience of a successful IRRI-led pilot in Polder 30, plans were developed to scale-up and transfer the knowledge and experience across the Blue Gold Program area using CAWM demonstrations. By the end of the 2019/20 season, there were 71 CAWM demonstrations across Blue Gold. Presently, DAE is considering mainstreaming (parts of) the approach. While the potential of CAWM has fuelled such ambitions; the actual benefits may be less than anticipated. A 2019 sample survey of 24 CAWM sites found positive outcomes only in 11 locations[4]. This outcome needs to be qualified by further research and follow-up interviews, and it is difficult to draw many lessons from a one-off survey.

To understand the impact of CAWM, the yardsticks have to be clear. The implementers of CAWM measured its success by the area of BR52 paddy in a polder (which showed a strong upward trend in Patuakhali, where this was assessed); whereas the sample survey focussed on the impact on income. In future, **monitoring staff should be involved in defining the objectives of a project activity, such as CAWM, and help ensure that its outcomes and outputs are clearly established by management**.

Some of the lessons learnt from operating a network of demonstration schemes under the Blue Gold Program over four to five years are as follows:

- **Provide follow-up support** – The CAWM approach was implemented at a particular location over the course of a single year, only. The consensus now is that a 3-year support period is required; the first year to construct new infrastructure, the second year to introduce a new cropping pattern and the third year for further finetuning. It follows that it is recommended that follow-up support is provided to the CAWM locations that were completed in preceding years.
- **Establish SMART targets, outcomes and outputs** – to ensure greater clarity of the respective roles of implementers, partner agencies (DAE) and BGP management.
- **Diversify production choices supported by CAWM –** In Patuakhali, the focus should remain on short-duration T Aman in combination with attention to rabi cultivation. However, elsewhere other combinations of product and water management can be supported, such as:
  - Low lift pumps (LLPs) or shallow tube wells (STWs) for irrigated rabi crops
  - Involving BRRI and IRRI in CAWM activities
  - For Khulna, introduce other land use such as smallholder ghers.
- **Standardise procedures** – SSWMI cost estimates and designs should be adopted for future CAWM schemes.

In-Polder Water Management as a step forward[edit | edit source]

Neither the track record of polder development nor that of participatory water management in Bangladesh is particularly good. Where polders (and other water management infrastructure, for that matter) are caught in a vicious cycle of 'build – neglect – rehabilitate'; participatory water management has not – or hardly – lived up to its promise of changing the neglect of infrastructure maintenance into lasting care. In fact, only few water user organisations continue to exist beyond the duration of the projects that established them. Nonetheless, polders and embankments are recognised to be an essential part of water security in the coastal zone, as seen by the hue and cry over eroded embankments and defunct sluice gates. Likewise, local water management organisations have proved their worth in pinpointing and addressing water management issues, be it often only for the duration of a project intervention.

While the deeper causes of the above dual problem of failing infrastructure and failing care merit a profound analysis; this section – rather than dwelling on shortcomings – puts forward the strong conviction that **in-polder water management has the potential to make the combination of polder development and participatory water management work better**.

This assertion is made in the full realisation that BGP started systematically addressing in-polder water management only from 2016 onwards; and that BGP's initial steps in this arena were cautious and therefore lacked momentum. The conviction that IPWM would help make polder development and participatory water management more sustainable is therefore only loosely based in evidence, and more rooted in the expert judgement of those involved.

Lesson 1: In-polder Water Management adds value to 'peripheral' polder infrastructure

Embankments, sluices and primary khals alone help reduce the occurrence of flooding; the inflow of brackish water and sediments; as well as some waterlogging in a polder; but it does little to speed-up drainage of the interior lands, does not help retain water for relatively elevated lands and does not improve conditions of interior areas that are altogether disconnected from the main system.

Internal polder water management – which can be defined as establishment of desired local water levels through development of arteries into the polder and the control over the water flows therein – uses the opportunity provided by the main infrastructure to ensure locally-specific optimised combinations of water management and production choices. Primary infrastructure alone cannot serve the interests of all polder dwellers. To improve livelihoods in all parts of the polders, secondary and tertiary infrastructure is needed.

Investments in in-polder water management are relatively cheap, while the increase of income for involved farmers can be high. Payback times of less than one year are no exception. A typical sluice would cost around 200 lakh BDT per catchment, while BGP estimate that with 10 to 30% of this amount, most of the secondary and tertiary infrastructure in a catchment can be constructed, excavated and optimised.

Like the infrastructure of large irrigation systems, the infrastructure of a polder is 'nested'. This means that there is a local or tertiary level, which sets its water management routines within the possibilities of the sector- or secondary system; which in turn depends on the conditions determined by the main- or primary system. The interconnectedness of these three spheres of a polder and their coherent functioning, maximises the benefit that can be had from investment in polders. Polder development requires in-polder water management to be developed along and in harmony with the development of the main infrastructure, which is located on the periphery of the polder. This periphery forms the interface between in-polder water management and external river system.

Lesson 2: Actions to improve local water management enhance responsibility for higher order infrastructure

BGP showed that communities are highly interested in water management interventions in their vicinity. They are willing to plan and contribute to infrastructure that creates improved water management conditions as a common good for a group of producers. The ability to better control water in a sub-catchments (a tertiary unit) is likely to encourage the beneficiaries to pursue their water management interests at larger scale as well; i.e. in their WMG and through that in a catchment O&M subcommittee. Similarly, being able to ensure a good performance of a secondary khal through better maintenance or even through development of intermediate infrastructure, would encourage water users to pursue their interests at the level of the polder; and thereby to enhance accountability for proper maintenance and operation of main infrastructure (embankment, sluices and primary khals).

Another way in which the processes at local and catchment level provide a stronger basis of overall management of the polder is that in the development of small-scale infrastructure and of catchment plans local organisations, such as the Union Parishad and government agencies such as BADC and LGED played a supportive role. They reviewed plans, committed support to certain actions and provided financial contributions to maintenance work and even to investments. Of course, there is an element of the local authorities wanting to be associated with beneficial interventions; but these joint activities also forge a partnership between WMOs, LGIs, department and possibly other relevant actors. Such a partnership constitutes an important condition for responsible behaviour of all concerned with respect to the overall performance of a polder and with respect to the integrity of its primary infrastructure, i.e. embankments, sluices and primary khals.

Through Blue Gold, O&M Agreements (examples provided here in Bangla and English) have been used to set out the respective responsibilities of BWDB and WMAs for routine, periodic and emergency maintenance. The main purpose of the agreements is to sustain the benefits arising from bringing land into cultivation – to protect the land from further waterlogging and to bring new land into cultivation. By February 2020, these agreements have been signed for all polders by the respective Executive Engineer of BWDB's O&M Division, and by representatives of 36 WMAs.

To encourage good practice in water management, two versions of a manual for WMO executive members and BWDB field staff were prepared: a ‘text-based’ manual (in Bangla) for a more literate audience; and a ‘picture-based’ manual for an audience that is less familiar with text-based advice. During preparation of the manuals, Blue Gold worked closely with field staff, WMO executives and other WMO members and incorporated their feedback to ensure that the manuals serve the needs and interests of farmers and fishermen. Feedback sessions with BWDB zonal staff have been used to establish that all required material is covered. Copies of the manuals were distributed to WMOs during the first quarter of 2021.

Lesson 3: Polder development requires integrated top-down and bottom-up planning and realisation

While the point that polders should be understood as a nested system of primary, secondary and tertiary infrastructure is hardly contested; the traditional approach to polder development would be to work from the outside in; i.e. starting with embankments, sluices and main khals, towards secondary khals and intermediate infrastructure; and on to finish with work at the local, tertiary level. The traditional approach to Participatory Water Management, would have it the other way around: beginning with local improvements and building-up confidence towards higher order infrastructure step-by-step. Within BGP, this led to an imperfect situation: WMAs were last to be formed and therefore still immature at the time that primary infrastructure was reaching completion; whereas WMGs were established early on, but had a long wait before they were practically involved in water management through activities related to small-scale infrastructure.

In BGP, the realisation has grown that outside-in and inside-out planning are complementary processes, which can and should take place simultaneously and which should be mutually reinforcing. This can be achieved by:

- Include investment categories for main infrastructure, intermediate infrastructure and small-scale infrastructure in the development project proforma; each with appropriate modalities for (co-)investment.
- Start implementation planning by initiating cooperation for the development of the polder between implementing agencies, locally present departments and local governments, with the proviso to expand the cooperation to other relevant actors, including the private sector.
- With the help of local governments and other local actors facilitate the development of new water management organisations from the outside in: I.e. first form a WMA that is responsible to promote user participation in the polder, and then help this lead the process of establishment of catchment committees and WMGs.
- Develop an understanding of the future polder, including its production potential for crops and fish and the hydrological processes underpinning this potential through studies and interaction with the user organisations.
- Run annual planning rounds for the polder as a whole, for each catchment and for each WMG and inform decisions on investments an annual development plans with the outcomes of these rounds. In this way, implementing agencies and the WMOs may be able to improve functionality of a particular infrastructure in conjunction with other infrastructure.

Lesson 4: The significance of a well-performing polder extends beyond higher production only

In the post-independence period, investments in polder were justified by their impact on incremental production. The incremental production largely comprised of higher average aman yields caused by the reduction of flooding and the exclusion of saline water; although in time there came recognition for the contribution made by other crops and in other seasons and, eventually, for the productive potential of fisheries in a managed water environment.

At present, the coastal zone faces the enhanced risk profile caused by climate change: deeper intrusion of salinity; continued sedimentation of external rivers, higher variability in rainfall and drought, a higher risk for storms and storm surges and continued and intensified unpredictable riverbank erosion. Polder development – combining peripheral works with in-polder water management – enhances the resilience of communities to these effects. This is done by promoting a diverse production system, by building local responsibility towards the integrity of the polders and by enhancing local economic development. Polder development is part of the answer to increased climatic risks.

The significance of a polder also extends beyond the locality. A robust local economic development in the polder helps lessen the migration to urban centres, helps ensure that the urban diet is supported by nutritious food produced that needs not be imported and adds momentum to the wider development of the coastal zone. The new road, rail and port infrastructure being developed in the southwest provides the opportunity for the region to become an agricultural powerhouse for vibrant national economy.

As the infrastructure supports more than just local incremental production, it follows that the responsibility for the primary infrastructure cannot be carried by local organisations only, and requires clear mechanisms for sharing the long-term cost of maintaining such infrastructure.

References[edit | edit source]

1. ↑ Yadav, Sudhir; et al. (2019). *Community water management to intensify agricultural productivity in the polders of the coastal zone of Bangladesh, Paddy and Water Environment*. published online.
2. ↑ Kulsum, Umme; et al. (2019). "Modelling of farmers' livelihood decision making to understand their adaptation response to changing conditions in southwest coastal Bangladesh in the Ganges Delta". *International Conference on Water and Flood Management*. Dhaka.
3. ↑ *2018-2019 CAWM Strategic Plan, Blue Gold Program Technical Report 24* (PDF). Euroconsult Mott MacDonald & Associates. September 2018.
4. ↑ *Assessment of Outcomes of Community-led Agricultural Water Management, unpublished first draft*. Euroconsult Mott MacDonald & Associates. December 2019.

Notes[edit | edit source]

1. ↑ This section draws heavily on the BGP O&M Guidelines V5.0 (dated 5 January 2018) and the BGP Definition of catchment planning 2018 and 2019
2. ↑ This section draws on: - Design report water retention structure Gajendrapur Uttar V2, 31 march 2020
3. ↑ In elevated areas, where waterlogging or late post monsoon drainage is no concern, BGP supported alternative crop choices through the Cropping Intensification Initiative (CII). See Section E on the production shift.

See also[edit | edit source]

Previous chapter: **Chapter 16: Women's participation in Water Management**	**Blue Gold Lessons Learnt Wiki** **Section D: BGP Interventions: Participatory Water Management**	Next chapter: **Chapter 18: Water Management Partnership**

A defined set of temporary activities through which facilitators seek to effect change

An area of low-lying land surrounded by an earthen embankment to prevent flooding by river or seawater, with associated structures which are provided to either drain excess rainwater within the polder or to admit freshwater to be stored in a khal for subsequent use for irrigation.

In-polder water management; term used in Blue Gold to describe water management interventions which aim to deliver excess water from the field through field drains to secondary khals and thence to primary khals for evacuation through the sluice/regulator

Sedimentation is the process by which fine particles of silt and clay suspended in river water settle out, for example when there is a drop in velocity.

the south-western coastal zone is characterised by broad tidal flats and fluvio-tidal plains, lying approximately 1 metre above sea level, with drainage provided by numerous tidal creeks and channels a some major rivers. Empolderisation now protects the intrusion of sea water to agricultural areas but restricts the deposition of sediments to within the channels, thus reducing the drainage capacity of the rivers and channels, causing drainage congestion.

An area enclosed by low embankments to store either freshwater or brackish water for the production of fish, shrimps or prawns.

Soil is regarded as waterlogged when it is nearly saturated with water much of the time such that its air phase is restricted and anaerobic conditions prevail. In agriculture, various crops need air (specifically, oxygen) to a greater or lesser depth in the soil. Waterlogging of the soil stops air getting in. How near the water table must be to the surface for the ground to be classed as waterlogged, varies with the purpose in view. A crop's demand for freedom from waterlogging may vary between seasons of the year.

An area enclosed by low embankments to store either freshwater or brackish water for the production of fish, shrimps or prawns.

A rice crop planted under irrigation during the dry season from December to March and harvested between April and June. Local boro varieties are more tolerant of cool temperatures and are usually planted in areas which are subject to early flooding. Improved varieties, less tolerant of cool conditions, are usually transplanted from February onwards. All varieties are insensitive to daylength.

transplanted aman; a rice crop, with nurseries for seedlings started in June/July, for transplanting in July/August in areas liable to a maximum flood depth of about 50cm. Harvested in November/December. Local varieties are sensitive to daylength whereas modern varieties are insensitive or only slightly sensitive.

Varieties developed by farmers, sometimes referred to as local improved varieties (LIVs)

A vertical gate to control the flow of water; also referred to as 'regulator'

the adjustment of gates in water management infrastructure to control hydraulic conditions (water levels and discharges) in a water management system.

an idealised hydrologically independent drainage unit within a polder - comprising a network of inter-connected khals draining to a regulator from where water is discharged to a peripheral river. Because the land levels in a polder vary within a small range (typically up to a maximum of 1.5 m), water flows can be affected by downstream water conditions and eventually drain through more than one regulator at diffferent times of year. .

drainage channel or canal

the principal function of a regulator or drainage sluice is to allow the drainage of water from the polder into a peripheral river when there is a differential head across the regulator (ie when the polder or country-side water level exceeds the level in the tidal river). The regulator is provided with a lift gate on the country-side (to allow freshwater to be held in the khal for irrigation during the dry season) and a flap gate on the river-side (to prevent water entry from the river channel into the polder during high tide conditions). A frame is provided on the river-side so that the flap gate can be lifted when there is freshwater in the river (during the monsoon flood season), thus allowing freshwater to be stored in the khal within the polder and used for irrigation during the dry season. The size of the culvert is determined from the drainage area served by the structure.

Water Management Organizations - The common name of organizations of the local stakeholders of a water resource project/sub-project/scheme. The concept WMO typically refers to WMGs and WMAs (and/or WMFs) together

actions taken to prevent or repair the deterioration of water management infrastructure and to keep the physical components of a water management system in such a state that they can serve their intended function.

Water Management Group - The basic organizational unit in Blue Gold representing local stakeholders from a hydrological or social unit (para/village). Through Blue Gold, 511 WMGs have been formed and registered. The average WMG covers an area of around 230 ha has 365 households or a population of just over 1,500.

Water Management Group - The basic organizational unit in Blue Gold representing local stakeholders from a hydrological or social unit (para/village). Through Blue Gold, 511 WMGs have been formed and registered. The average WMG covers an area of around 230 ha has 365 households or a population of just over 1,500.

Part of the catchment which is not directly connected to the regulator, and is hydrologically independent from other parts of the catchment.

Water Management Association - In Blue Gold, the polder-level representative of WMGs, and signatory to an O&M Agreement with BWDB

Earthen dyke or bundh raised above surrounding ground level, for example so that roads or railway lines are above highest flood levels, or so that an area is empoldered to protect it from external floods and saline waters.

In-polder water management; term used in Blue Gold to describe water management interventions which aim to deliver excess water from the field through field drains to secondary khals and thence to primary khals for evacuation through the sluice/regulator

The main channels or khals within a polder through which excess rain or flood water is discharged to an external tidal river channel and thence to the sea via a regulator, sluice or outlet in the polder embankment.

hectare

Small-scale water management structure: an initiative to improve in-polder drainage and irrigation conditions in Blue Gold polders which was started in 2018. The improvement of secondary and tertiary infrastructure across the coastal zone will involve a large number of small-scale structures and huge volumes of earthwork. The planning, design, contracting, supervising and monitoring of this small-scale infrastructure would be highly resource-intensive if provided with the same level of involvement as is provided by government engineering departments in large-scale infrastructure. Building on the success of the CAWM schemes, a pilot fund was made available so that WMOs could plan and implement small-scale water management infrastructure (SSWMI) with a relatively low-level of supervision from government or TA staff.

Community-led Agricultural Water Management - with DAE, Blue Gold established a network of schemes for demonstration purposes where locally-applicable annual cropping patterns are introduced along with water level control facilitated by small-scale water infrastructure, and the development of value chain skills in farmers

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Collective action - by a producer group is one way to partially overcome constraints such as in weak markets, where inputs and services essential to production innovations, are generally scarce, costly to access and/or to obtain. Collective action is working in group instead of individually in order to gain economic or social benefit. Through collective action, farmers can address constraints in their market linkages, organise their activities jointly and use their collective bargaining power to reduce input costs through bulk purchase, or to obtain services from buyers such as farm-level collection of produce

Identification and planning of both interventions and operations & maintenance within the catchment, resulting in an action plan for the catchment.

Blue Gold Program

Technical Assistance

Water Management Organizations - The common name of organizations of the local stakeholders of a water resource project/sub-project/scheme. The concept WMO typically refers to WMGs and WMAs (and/or WMFs) together

Water Management Association - In Blue Gold, the polder-level representative of WMGs, and signatory to an O&M Agreement with BWDB

Bangladesh Water Development Board, government agency which is responsible for surface water and groundwater management in Bangladesh, and lead implementing agency for the Blue Gold Program

Department of Agricultural Extension, a department of the Ministry of Agriculture responsible for disseminating scientific research and new knowledge on agricultural practices through communication and learning activities for farmers in agriculture, agricultural marketing, nutrition and business studies.

Local Government Engineering Department

Bangladesh Agricultural Development Corporation

The wet season - typically mid-March to mid-October - characterised by rain and high temperatures

a structure that provides for the storage of runoff and is designed to maintain a permanent pool of water.

A culvert is a structure that allows water to flow beneath a road, railroad, trail, or similar obstruction from one side to the other.

Cropping Intensity Initiative: Year-long demonstrations with farmers on increasing cropping intensity related to improved water management, also involving market actors, and by organising demand driven sessions and workshops

Farmer Field School - A group-based learning process through which farmers carry out experiential learning activities that help them to understand the ecology of their fields, based on simple experiments, regular field observations and group analysis. The knowledge gained from these activities enables participants to make their own locally specific decisions about crop management practices. This approach represents a radical departure from earlier agricultural extension programmes, in which farmers were expected to adopt generalized recommendations that are formulated by specialists from outside the community.

smaller channels connecting fields to secondary infrastructure, sometimes with associated small scale structures (gated pipe or box culverts) which regulate flow between secondary channels and tertiary channels. Tertiary channels may also be called sakha-khals or branch-khals.

Institute of Water Modelling

Water Management Knowledge and Innovation Program - starting in December 2017 and led by Deltares and the Institute of Water Modelling (IWM) with the aim of contributing to the long term development goals for the Southern Coastal Region as well as to objectives of the Blue Gold Program through tested and sustainable water management innovations, knowledge development and participatory action research.
https://www.deltares.nl/en/news/developing-water-management-innovations-local-communities-bangladesh/

Union Parishad - Union Council chaired by an elected Union Chairman

Bangladesh Taka

A process through which stakeholders influence and share control over development initiatives and the decisions and resources which affect them.

human intervention in the capture, conveyance, utilisation and drainage of surface and/or ground water in a certain area: a process of social interaction between stakeholders around the issue of water control.

Typically undesirable increase in concentration and deposition of water-borne silt particles in a body of water.

Sub-Assistant Agricultural Officer (DAE)

Local Government Institutions - Union Parishad, Upazila Parishad etc

Smaller channels connecting sub-catchments to main channels, sometimes with associated minor structures (e.g. small one vent sluice) which regulate flow between primary and secondary infrastructure. Secondary channels may also be called sakha-khal or branch-khals.

International Rice Research Institute

High Yielding Variety - Introduced varieties developed through formal breeding programs. HYVs have a higher yield potential than local varieties but require correspondingly high inputs of fertiliser and irrigation to achieve high yields.

Farmer Field Day - Exchange events organized at the end of each Farmer Field School to share the FFS learnings with other community members

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a rice crop usually planted in March/April under dryland conditions, but in areas liable to deep flooding. Also known as deepwater rice. Harvested from October to December. All varieties are highly sensitive to daylength.

Value chain - the set of activities that need to be performed in a specific production sector in order to deliver the end product to the consumer. Agricultural value chains typically include input supply, growing/production, processing and marketing/distribution.

Value Chain Analysis

Within BGP this refers to enhancing insights of especially FFS participants in how markets work, how to collect market information, facilitating linkages with market actors and increasing negotiation capacities

Any formal or informal structure (not necessarily a physical place) in which buyers and sellers exchange goods, labour, or services for cash or other goods. The word 'market' can simply mean the place in which goods or services are exchanged. Essentially, markets are defined by forces of supply and demand, rather than geographical location

Market-oriented Farmer Field School - Farmer Field Schools dealing with cash crops or other commercial production, such as aquaculture, integrating market orientation. Specific MFS were conducted in the first years of BGP; later all FFS included market orientation.

A livelihood is a way of making a living. It comprises capabilities, skills, assets (including material and social resources), and activities that households put together to produce food, meet basic needs, earn income, or establish a means of living in any other way.

Farmer Field School - A group-based learning process through which farmers carry out experiential learning activities that help them to understand the ecology of their fields, based on simple experiments, regular field observations and group analysis. The knowledge gained from these activities enables participants to make their own locally specific decisions about crop management practices. This approach represents a radical departure from earlier agricultural extension programmes, in which farmers were expected to adopt generalized recommendations that are formulated by specialists from outside the community.

Farmer Trainer - Well-performing and capable farmers, previously trained in Farmer Field Schools, who became FFS facilitator themselves after ToT training

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The dry season (typically mid-October to mid-March) with low or minimal rainfall, high evapotranspiration rates, low temperatures and clear skies with bright sunshine. Crops grown are boro, pulses, sunflower, sesame and mungbean.

A process by which the local stakeholders are directly and actively involved in identification, planning, design, implementation, operation & maintenance and evaluation of a water management project.

A process by which the local stakeholders are directly and actively involved in identification, planning, design, implementation, operation & maintenance and evaluation of a water management project.

the removal of materials in the river bank by water flowing in the river channel; also termed bank scour. In coastal polders, riverbank erosion - if unchecked - can result in breaches to polder embankments - where they are aligned close to rivers - and consequent loss of human and animal life as well as damage to farmland, crops, housing, and other infrastructure.

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Blue Gold Program Wiki

The wiki version of the Lessons Learnt Report of the Blue Gold program, documents the experiences of a technical assistance (TA) team working in a development project implemented by the Bangladesh Water Development Board (BWDB) and the Department of Agricultural Extension (DAE) over an eight+ year period from March 2013 to December 2021. The wiki lessons learnt report (LLR) is intended to complement the BWDB and DAE project completion reports (PCRs), with the aim of recording lessons learnt for use in the design and implementation of future interventions in the coastal zone.