6 BGP Outcomes and Impact on the Livelihoods of Coastal Communities

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The Blue Gold lessons learnt report (LLR) will be completed in full at project closure at end-

December 2021. Meanwhile, in order to pass on the knowledge and experience gained from the implementation of Blue Gold to planners and policy makers working towards the realisation of the Delta Plan, and to those responsible for the design and implementation of future projects in the coastal zone, the report is published in a partially-complete form. Those sections of the report which are either incomplete or missing will be marked accordingly in the draft report, and then finalized before end-December 2021.

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Contents

Introduction[edit | edit source]

Bangladesh has experienced significant economic growth in recent decades and classifies as a lower middle-income economy (World Bank 2016). The incidence of poverty has declined but is still 31.5% overall and 35.5% in rural areas. One-fifth of the country's GDP comes from agriculture and two-

thirds of the workforce is directly or indirectly engaged in agricultural activities. Hence the country's economy is highly vulnerable to the degradation of natural resources and to variability and trends in climate. To eliminate poverty, Bangladesh has a long way to go. The incidence and severity of poverty is even more pressing in the predominantly rural coastal region of Bangladesh (see chapter 3). Alleviating this, requires high and inclusive growth of the rural agricultural economy in a sustainable manner. To address this situation, the 'Blue Gold Program' became operational in March 2013 and extends over an 8-year period to improve agricultural water management in 22 polders of four districts: Khulna, Satkhira, Patuakhali, and Barguna (see chapter 5). This project aims to reduce poverty and improve food security through equitable water management and strengthened value chains resulting in improved livelihoods for communities.

This chapter explains the outcomes and impacts of the BGP interventions. In other words, this chapter assesses the effectiveness of BGP's interventions and judges the significance of changes in the livelihoods of BGP beneficiaries. Here, outcomes and impacts are seen as the contribution of the BGP interventions to the overall goal of the program.

This chapter is not complete chapter as yet. It is a living chapter that will be updated once outcomes from additional surveys become available:

- Sections 7.2 and 7.3 cover the outcomes and impact of improved water management and of adoption of new technologies on agricultural production, using data presently available. The main data source is the WMG survey-2019[1] that gathered data from almost all WMGs (501) from all polders (22), and that mainly focused on the improvement in water management and agriculture production. Some data from the WMG survey-2018[2] are also used here. This chapter will be revised after completion of the end-line survey-2020 and WMG survey-2021.
- Sections 7.4 to 7.6 cover changes in homestead production, economic changes of coastal households and women empowerment. These will be prepared after the completion of the end-line survey-2020 and WMG survey-2021.

Improvements to water management[edit | edit source]

Increased resilience against climate variability: outcomes of rehabilitation work on water infrastructure[edit | edit source]

WMG report a reduction in water-related constraints to crop production. Data shows that Blue Gold has improved the local management of water resources and thereby removed water-related constraints to crop production. Apart from improving conditions for crop production and aquaculture, in some areas the quality of water in the khals has improved ("less polluted") and can sometimes be used for domestic purposes. Comparing the present and pre-project situations, there has not been much change in the type of main problems. These changes primarily relate to water scarcity (for irrigation) and waterlogging – with salinity and flooding mentioned considerably less often. Water scarcity is now slightly more frequently reported than waterlogging. Data on the main type of water-related problem in Table 1 shows that water scarcity (for irrigation purposes) is, as would be expected, the main problem for farmers in the rabi (boro) season, with waterlogging the main issue in kharif 2 (aman) and with a more even problem division between water scarcity and waterlogging in kharif 1. For the three BGP zones, taking the average for each season, waterlogging is the major issue for WMGs in Satkhira, while water scarcity is number one in Khulna and Patuakhali. Flooding and salinity are much less likely to be the major constraint.

Table 1: Principal water management problems

Main problem	rabi	kharif-2	kharif-1	Khula	Satkhira	Patuakhali	All

Before BGP	Waterlogging	13%	78%	32%	37%	59%	41%	41%
	Flooding	1%	3%	1%	1%	1%	2%	1%
	Water scarcity	69%	6%	44%	40%	25%	44%	39%
	Salinity	12%	3%	9%	9%	6%	8%	8%
Now	Waterlogging	12%	71%	20%	33%	54%	29%	34%
	Flooding	1%	1%	0%	1%	1%	0%	1%
	Water scarcity	58%	5%	52%	39%	26%	40%	38%
	Salinity	9%	1%	7%	8%	0%	5%	6%

Percentage of WMG reporting in each season. The percentages for zones are the average number of WMG reporting for each of three seasons. As some WMG did not report a main problem in all seasons, the totals in each row may not add up 100%.

Other water management problems are shown in Table 1. In the rabi season and in the Khulna zone, salinity was and still is the main other problem; but this issue seems to have now largely been eliminated in some polders (26 and 29), while remaining significant in one polder (polder 30). In the Patuakhali zone, there is no over-riding other problem, but salinity was an issue for two polders (47/3 and 47/4), where it is now much less significant. In the 2018 WMG survey, a slightly higher proportion of WMGs reported that salinity was another problem, but more WMGs now put waterlogging as the other problem.

Table 2: Severity of water management problems

		Pre-project situation					**Current situation**				
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Season	Rabi	2%	9%	24%	50%	15%	8%	51%	31%	9%	1%
	Kharif-2	1%	13%	37%	37%	12%	10%	62%	16%	10%	3%
	Kharif-1	4%	7%	24%	45%	17%	7%	30%	41%	15%	4%
	Total	2%	10%	28%	44%	15%	8%	48%	29%	11%	3%
Zone	Khulna	2%	13%	28%	43%	14%	6%	42%	31%	16%	5%
	Satkhira	9%	22%	19%	30%	21%	16%	51%	21%	9%	2%
	Patuakhali	0%	1%	33%	50%	13%	8%	55%	28%	5%	1%
	Total	2%	10%	28%	44%	15%	8%	48%	29%	11%	3%

Score: 1 = very good, 2 = good (i.e. no problem), 3 = average, 4 = bad, 5 = very bad. Percentage of WMG reporting

Data shows the severity of the problem (ranked 1 to 5) for each season and each zone (see Table 2). In general, problems have reduced compared to the pre-project situation. Overall, over half of the seasonal reports from WMGs (56%) say the situation is now good or very good (score of 1 or 2), compared with only 12% in the pre-project situation. The improvement has been greatest in Patuakhali where only 1% of WMG seasons were rated as very good or good before BGP, but now 63% are at this level. WMGs in Khulna registered the lowest improvement – 15% good or very good before, compared with 48% now. Satkhira (the single polder no.2) had a relatively better position prior to BGP (31% good or very good) and now has the highest proportion of WMG seasons in these categories (67%).

The average water management scores for each WMG are summarised by season and zone (see Annex table 2). This shows that there has been a greater improvement in water management (i.e. reduction in the water management problem score) in the rabi season followed by kharif 2 with the least improvement in kharif-1. The Khulna zone showed relatively little improvement, and WMGs report that they still have higher levels of water management problems than in the other two zones.

In Satkhira, the problem score has been relatively low in the rabi season, and this season showed relatively small improvement. Patuakhali showed the greatest improvement, especially in khairif-2 – but this zone had the highest problem scores before the start of the project, so there was the greatest potential for improvement. The overall average improvement is 1.06 – meaning the WMGs have moved up one place on the problem ranking of 1 to 5.

Organised coastal communities: outcomes of institutional development of WMOs[edit | edit source]

The section of BP's lessons learnt report on participatory water management sections (Section D, chapters 14-20) elaborate how BGP organised coastal communities for participating in water management for development. The outcome surveys reviewed the WMOs' roles in better water management in BGP areas. The previous section reports a significant improvement in water management in BGP areas. The vast majority of WMGs (86%) confirm that water management infrastructure has improved. The most widely (80%) reported reason why water management was considered to have improved was re-excavation and de-silting of khals, but many WMG (30-50%) reported khal cleaning (i.e. removal of weeds, nets and cross dams), sluice repairs, new/repaired culverts, better sluice operation and repaired embankments (Table 3).

Table 3: Improvements in infrastructure and reasons for the improvement

	Khulna	Satkhira	Patuakhali	Total
Improvement in infrastructure[1]	73%	97%	100%	86%
Reasons for improvement[2]				
Re-excavate or de-silt khal	78%	77%	83%	80%
Clean khal / remove dams	25%	36%	60%	41%
Sluice: new or repair[3]	11%	34%	70%	39%
Culvert: new or repair	39%	43%	74%	54%
Better sluice operation	12%	23%	51%	29%
Embankment repair	22%	66%	51%	40%

[1] Percentage of all WMG, [2] Percentage of WMG reporting improvements, [3] Includes inlets and outlets.

Most of these works leading to improved water management in the BGP area were undertaken by BWDB with WMG support; with WMG mainly being responsible on-their-own for khal cleaning and better sluice operation. The main organisations responsible for each type of infrastructure improvement are shown in Annex Table 3. Khal re-excavation (including de-silting) is seen as the main reason for improved water management and has largely been implemented using BGP resources, usually with a form of involvement of the WMGs. Khal cleaning was mostly done by the WMG with their own resources (i.e. voluntary labour by members and non-member farmers). The same is true for improved operation of sluices. This is an outcome of BGP's work in establishing, activating and strengthening WMGs. Culverts (new and repaired) were primarily done by local government (Union Parishads), as culverts usually cross roads which are a government responsibility. In cases where BGP co-funded WMGs to place or repair culverts; the WMGs actively informed the Union about their need for work and the plan for implementation. WMGs also developed a good relationship with other agencies such as BADC, LGED (responsible for water management schemes of up to 1,000 ha), ADB (may be funding LGED schemes) and NGOs. Qualitative interviews also mentioned DANIDA.

Having control over sluice relates significantly to improved water management as well as to the WMO's institutional development. Data from the WMG survey in Table 4 shows that in 50% of

sluices are controlled by WMGs (either the WMGs interviewed or another WMG – the sluice may serve more than one WMG). Often sluices were controlled by "influentials" who operated the sluices for their own benefit rather than for that of the wider farming community. These persons are often linked with local government and may want to let water in or out to catch fish (netting fish at the sluice or in the khals) or to let water (often brackish) in for replenishing the water in the large fish/shrimp ghers that they operate. In Khulna, where there is a significant area of fish/shrimp gher, 53% of WMGs say sluices are operated by other people. To a lesser extent this also applied in Satkhira where one third of WMGs report that sluices are operated by other people. In Patuakhali, where there are no fish ghers, almost 80% of WMGs report WMG control of sluices and all WMGs say sluices are functional.

Table 4: Control of sluices and water management

Sluice control by:	Khulna	Satkhira	Patuakhali	Total	WM problem score	
					now	change
WMG interviewed	12%	17%	46%	25%	2.35	1.39
Other WMG	19%	22%	33%	25%	2.47	1.22
Other people	53%	33%	21%	39%	2.59	0.93
Not functional	16%	27%	0%	12%	2.82	0.52
Total	100%	100%	100%	100%		

Percentage of WMGs reporting (n = 501); Problem score: 1 = very good, 2 = good (i.e. no problem), 3 = average, 4 = bad, 5 = very bad

Having functional sluices and sluices controlled by WMGs is corelated to reduced water management problems. Table 4 shows that WMGs whose sluice is under the control of a WMG have lower water management problem scores. There is a large difference in the reduction in water management problems for WMGs where sluices are not functioning (where water management problems have not been much reduced), where sluices are controlled by other people ('influentials'), and where they are controlled by WMGs. Having the WMG in control is clearly linked to better water management, but having a functional sluice is even more important. It should be pointed out that many sluices that are presently non-functioning are in so because bed levels of the rivers outside the polder have risen above the original sill levels. River dredging is beyond the scope of BGP and the economic case for it has not been established.

Changes in crop agricultural production[edit | edit source]

Changes in agriculture land use[edit | edit source]

Since the start of BGP there have been significant changes in land use and cropping. Use of cultivated land has been grouped into three categories for each season: (i) paddy; (ii) other crops; and (iii) fish/shrimp ghers. Table 5 shows the seasonal land use for each of the three zones. For the Khulna zone, in the rabi/boro (winter/dry) season before the project, boro paddy and other crops were of almost equal importance, followed by fish ghers, with over one third of land fallow. There has now been considerable expansion in boro, some growth in fish and some decline in other crops, with significantly less fallow land. In the kharif 1 (early monsoon) season fish ghers were, and still are, the main land use, with the area now significantly increased. This, along with some growth in other crops, means that more than half of the land is now cultivated in this season. In the kharif 2 (late monsoon) season, over half the land was used to grow aman paddy. This has now fallen slightly, with a significant increase in area under fish.

Table 5: Seasonal land use (% of cultivable land)

		Khulna		Satkhira		Patuakhali		Total	
		Before BGP	Now	Before BGP	Now	Before BGP	Now	Before BGP	Now
Rabi/boro	paddy	27.7	46.6	74.7	84.8	0.1	2.3	23.8	35.7
	other crops	26.2	21.3	1.8	1.7	53.3	84.9	32.8	41.4
	fish	11.2	16.0	8.7	12.2	0.0	0.0	6.9	9.8
	total	65.1	83.9	85.2	98.7	53.5	87.3	63.5	86.9
Kharif 1	paddy	1.5	0.4	2.0	4.2	24.5	18.8	9.7	7.4
	other crops	9.3	13.0	5.6	6.9	0.3	0.0	5.6	7.6
	fish	30.5	43.2	23.8	54.8	0.0	0.0	18.8	29.3
	total	41.3	56.6	31.4	65.8	24.8	18.9	34.2	44.4
Khairif 2	paddy	56.9	48.3	33.0	33.2	94.5	99.4	67.2	64.5
	other crops	6.3	8.4	0.0	0.6	0.1	0.0	3.3	4.4
	fish	29.8	40.0	26.0	53.5	0.0	0.0	18.7	27.5
	total	93.0	96.7	59.0	87.3	94.5	99.4	89.3	96.5
Total	paddy	86.1	95.1	109.7	122.2	119.1	120.5	100.8	107.7
	other crops	41.8	42.7	7.5	9.1	53.7	85.0	41.7	53.5
	fish	71.5	99.2	58.5	120.4	0.0	0.0	44.5	66.6
	total	199.4	237.2	175.7	251.7	172.8	205.5	187.0	227.8

In Satkhira, land use in the rabi-boro season is predominantly boro paddy, and the area of this has increased. Along with a small increase in area of fish gher, overall land use in this season is now nearly 100%. The main land use in kharif-1 is fish, which has increased significantly as before BGP over two thirds of land was left fallow. An increasing area under fish ghers, along with small areas of paddy and other crops mean that almost two-thirds of land is now utilised in this season. In kharif-2, prior to BGP, one third of land was growing aman paddy, and just over one quarter used for fish ghers. The area under fish ghers has now doubled, with little change in aman paddy – and an overall increase in land utilisation.

In Patuakhali, there is virtually no use of land for fish/shrimp ghers. In the rabi/boro season virtually the only use of land is for other (non-rice) crops, which have expanded considerably during BGP. In the kharif-1 season almost one quarter of land was used for aus paddy, but this s now declined, with an increase in the area of fallow land. In kharif-2 almost all land is (and was) used for aman paddy.

The area under fish ghers has increased substantially (Annex table 4). There has been an increase of 50% of the cultivable area spread over three seasons. This is far greater than the increase in area of paddy (7% of the cultivable area) and other crops (28% of the cultivable area). But in none of the zones has there been a decline in the area of crops while the area of fish increased – suggesting that land has not switched from crops to fish. The expansion of fish culture occupies land that was previously fallow.

Changes in cropping pattern and crop types[edit | edit source]

For paddy there has been a move from traditional local varieties to modern HYVs and hybrids (Table 6). There are no reports of cultivation of local varieties of boro (these seem to have disappeared in

Bangladesh), but there is a move from conventional HYVs to hybrid seeds. This is particularly apparent in the Khulna zone. Only in Patuakhali a significant area of aus is grown, and there has been a dramatic switch from local varieties to HYVs. There has also been a switch from local to HYV in the aman season – less so in Satkhira where HYVs predominated before BGP, and significant (but reduced) areas of local aman continue to be grown in the other two zones.

The area of land occupied by other crops is shown in Table 7. In the Khulna zone, sesame was an important crop, but this and a number of other more minor crops have declined in importance due to a combination of unfavourable growing conditions – with more emphasis being placed on more reliable irrigated boro and on more profitable fish ghers. However, the area of two non-rice crops has expanded – vegetables and water melons – these are profitable and, farmers report that they would like to grow more water melon in particular if they would have access to the required irrigation water.

Table 6: Land under different types of paddy

		Khulna		Satkhira		Patuakhali		Total	
		before	Now	Before	Now	before	Now	before	now
Boro	**HYV**	22.6	13.7	64.1	57.2	0.1	2.1	19.8	15.1
	hybrid	5.1	32.9	10.6	27.5	0.0	0.2	4.0	20.6
Aus	**local**	1.0	0.1	0.7	0.6	19.2	1.7	7.4	0.7
	HYV	0.5	0.4	1.3	3.6	5.3	17.2	2.3	6.8
Aman	**local**	41.1	22.7	10.1	5.4	79.4	41.4	50.8	27.2
	HYV	15.8	25.6	22.9	27.8	15.0	58.0	16.4	37.4
	local	42.1	22.8	10.8	6.0	98.7	43.0	58.2	27.9
All paddy	**HY/hybrid**	44.0	72.6	98.9	116.2	20.4	77.5	42.6	79.8
	total	86.1	95.4	109.7	122.2	119.1	120.5	100.8	107.7

Percentage of cultivable land

In Satkhira, there is only a small area of non-rice crops – mainly vegetables and a little jute. The area of vegetables has been increasing. Non-rice crops are most important in Patuakhali. Mung bean is by far the most important of these crops, and its area has increased by almost five times. Prior to BGP, keshari was the principal non-rice crop, but this has now virtually disappeared, farmers report that keshari now is unprofitable and difficult to grow with uncertain weather conditions. Areas under sesame, felon (a local pulse) and sweet potato have also declined, while more groundnut, chilli, sunflower, vegetables and watermelon are being grow. As in Khulna, farmers are keen to grow more watermelon. Compared to 2018, less land in Patuakhali is now under mung bean and more under watermelon and groundnut.

Table 7: Land under other crops

	Khulna		Satkhira		Patuakhali		Total	
	before	now	before	now	before	now	before	now
maize	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0
Mung bean	3.6	1.3	0.0	0.0	12.1	59.1	6.1	21.7
keshari	0.0	0.0	0.0	0.0	22.6	1.2	8.0	0.4
felon	0.0	0.0	0.0	0.0	0.8	0.5	0.3	0.2
sesame	15.1	4.8	0.0	0.0	2.2	0.2	8.7	2.6
groundnut	0.0	0.0	0.0	0.0	4.5	8.2	1.6	2.9
sunflower	0.2	0.0	0.0	0.0	0.2	0.8	0.1	0.3

sweet-potato	0.0	0.0	0.0	0.0	2.9	1.3	1.0	0.4
Jute	0.6	0.1	3.0	2.7	0.0	0.0	0.7	0.4
Chili	0.1	0.1	0.2	0.0	3.7	4.6	1.4	1.7
watermelon	0.2	4.7	0.0	0.0	1.4	5.4	0.6	4.3
vegetable	15.1	22.3	3.5	5.5	0.6	0.8	8.5	12.5
other	6.9	9.4	0.7	1.0	2.6	2.9	4.6	1.6
total	41.9	42.7	7.5	9.1	53.7	85.0	41.7	53.5

Percentage of cultivable land

Farmers confirm the decline in non-irrigated rabi. They reported that this is partly due to excessive rainfall resulting in waterlogging. Farmers inform that crops such as keshari and sesame are not profitable, and would prefer to focus their efforts on smaller areas where irrigation is now possible and where high value crops such as watermelon can be grown.

In Patuakhali, farmers reported the switch from growing keshari to more profitable mung bean was due to better water management and the training they got in mung production. There has been a significant reduction in fallow land during the boro season, with some WMGs growing a little boro paddy as well as more groundnuts and sunflower.

In Satkhira (polder 2), farmers confirmed a general switch to hybrid boro and HYV aman paddy and a reduction in fallow area in the rabi (boro) and kharif 2 (aman) seasons. This has come about due to better drainage. More timely planting of HYV paddy has increased crop yields. Farmers reported an increased amount of fallow in the kharif 1 in some areas which could be linked to the expansion of boro paddy which tends to overlap into the kharif 1 season. In general, the area of fish ghers has expanded. Better water management and reduced risk of flooding due to repaired embankments have encouraged expansion of ghers as well as of paddy.

As mentioned earlier; while the area under fish ghers has increased substantially (see Annex Table-4), this has not gone to the detriment of areas used to produce paddy or other crops. The expansion of fish culture occupies land that was previously fallow.

Cropping intensity[edit | edit source]

The review of changes in cropping intensity shows a significant increase in cropping intensity in all three zones of BGP.

Cropping intensity has been calculated as the sum of crops and fish ghers in each season divided by the sum of crops, ghers and fallow land. This treats fish ghers as another crop in each season and takes no account of the frequency of fish harvests – so land used as a perennial (year-round) gher would have a 300% cropping intensity.

The surveys show that overall cropping intensity has increased from 187% to 228%, with a larger increase in Satkhira of 76 percentage points – largely due to expansion of fish ghers in polder 2, together with an increase in the area of paddy (Table 8).

Table 8: Cropping intensity

	Rabi /boro season		**Kharif 1 season**		**Kharif 2 season**		**Cropping intensity**		
Zone	**before**	**Now**	**before**	**now**	**before**	**Now**	**before**	**now**	**change**
Khulna	65	84	41	57	93	97	199	237	38
Satkhira	85	99	31	66	59	87	176	252	76

Patuakhali	53		87	25	19	95	99	173	205	33
Total	64		87	34	44	89	96	187	228	41

Percentage of cultivable area used in each season (including fish gher)

Changes in cropping intensity vary considerably between WMGs. Overall, 80% of WMGs report an increase in cropping intensity; 11% no change; and 8% a decrease. The proportion of WMGs with an increase in cropping intensity was highest in Satkhira at 92% and lowest in Khulna at 75% (Table 5).

Table 9: Cropping intensity (DAE method)

	before	now	change
Khulna	128	138	10
Satkhira	117	131	14
Patuakhali	173	205	33
Total	143	161	19

Cropping intensity was also calculated as the area of crops divided by the sum of the areas of crops, fish ghers and fallow land (DAE method). Cropping intensity calculated in this way is lower in Khulna and Satkhira, with a smaller increase (Table 9). However, it does show that, even leaving aside the fish ghers, the area of field crops has expanded.

Link between water management and cropping intensity[edit | edit source]

There appears to be a link between a reduction in water management problem scores and an increase in cropping intensity. This suggests that improvements in water management may lead to increases in crop areas. Table 9 shows that the 87 WMG where water management problems were unchanged or increased had, on average, an increase in cropping intensity of only 11.6 percentage points, while the 38 WMG where overall water management problem scores increased by under 0.5 had an average increase in cropping intensity of 19.3. In contrast, the 40 WMG where water management problem scores increased by more than 2.0 had an average increase in cropping intensity of 74.8 percentage points. There was a similar pattern with changes in the area of high yielding and high value crops[Notes 1].

Table 10: Changes in water management and cropping

Change in WMPS*	No. of WMG	cropping intensity change[1]	HYVC change[1]
over 2	40	74.8	71.8
1.5 to 2	125	60.8	64.8
1 to 1.5	55	44.7	57.6
0.5 to 1	156	36.2	40.4
0 to 0.5	38	19.3	34.8
under 0	87	11.6	11.4
Total	501	40.8	45.4

** improvement (reduction) in water management problem score; [1] Change in terms of percent of cultivable land*

Crop yield[edit | edit source]

There has been a substantial increase in the productivity of paddy (Table 10). Apart from a switch to more productive HYV and hybrid varieties, average yields of each type of paddy have increased by

around 10 to 25%. However, there is a more mixed picture regarding the yields of non-rice crops, with significant falls in yields of some of the key crops including mung bean[Notes 2] and sesame. During the Focus Group Discussions (qualitative interviews) farmers reported that unpredictable weather conditions during the growing season (excessive drought, unexpected and heavy rainfall) have adversely effected non-irrigated rabi crops. Data on aquaculture yields needs to be used with caution as seasonal yield data may not reflect the annual productivity of ghers.

Table 11: Average crop yield

		Before BGP (kg/acre)	Now	change
Paddy	**boro HYV**	2,023	2,287	13%
	boro hybrid	2,808	3,114	11%
	aman local	1,088	1,256	15%
	aman HYV	1,604	1,975	23%
	aus local	894	1,116	25%
	aus HYV	1,431	1,746	22%
Other crops[Notes 3]	**Maize**	1,173	1,211	3%
	mung bean	368	289	-21%
	Keshari	463	430	-7%
	Felon	496	444	-11%
	Sesame	459	338	-26%
	Groundnut	847	895	6%
	Sunflower	458	1,055	130%
	sweet-potato	5,342	5,325	0%
	Jute	922	1,006	9%
	Chilli	608	866	42%
	Watermelon	18,476	19,872	8%
	Vegetable	1,480	1,507	2%
Aquaculture	**Rabi**	283	283	0%
	kharif-2	319	445	39%
	kharif-1	183	258	41%

Technology adoption through Farmers' Field Schools[edit | edit source]

The outcomes of Farmers' Field Schools (FFS) are shown by qualitative data. Interview participants were able to list around 22 different crop-related technologies (Table 11). Adoption rates were usually (but not always) somewhat lower for other (non-FFS) WMG members and lower again for other farmers – typically with a drop of 5% to 20% from FFS to WMG and the same from WMG to other farmers. In some cases, other farmers did not adopt at all – but this would be for technologies with relatively low adoption rates for FFS and WMG members.

Table 12: Adoption of crop-related technologies

	Technology	Percent FGD with adoption rate[1]			no. of FGD out of 24 FGDs
		high	Medium	low	
1	**Improved seeds & varieties**	91%	5%	5%	22

2	**Pulse cultivation**	80%	20%	0%	5
3	**Seedbed preparation**	74%	22%	4%	23
4	**Line sowing**	74%	22%	4%	23
5	**Balanced fertiliser**	70%	30%	0%	10
6	**Pheremone trap**	67%	33%	0%	3
7	**Seed preservation**	64%	27%	9%	11
8	**Perching branches for birds**	48%	24%	29%	21
9	**Logo sowing method**[2]	37%	47%	16%	19
10	**Leaf colour chart**	17%	17%	67%	6
11	**Pest control methods**	14%	43%	43%	7
12	**Organic pesticides**	13%	0%	88%	8
13	**Light trap**	8%	15%	77%	13
14	**Vermicompost**	0%	0%	100%	3

[1] Adoption rates for FFS members were categorised as; (i) high – over 61% adopting; (ii) medium – 60% to 31% adopting; and (iii) low – 30% or fewer adopting. [2] Logo is omitting sowing some rows in a crop to act as a guide for application of fertiliser and pesticide

Although pheromone traps were adopted quite well (though only reported upon in three WMG), other pest control methods, light traps and organic pesticides, along with vermicompost, were not much adopted. The most widely cited reason for non-adoption was “lack of awareness” which could suggest a failure in training – the participant was not made aware of the technology. However, it is more likely that participants did not feel that the technology was relevant to their situation or needs. Light traps were also said to be too costly and, along with organic pesticides and vermicompost, “not convenient” or “difficult” which may relate to a high labour requirement or a specific skill need. Leaf colour charts were not thought to add much to farmers’ existing experience.

In Khulna and Satkhira zones (but not in polder 30), FFS also covered fishery technologies. Adoption rates for these technologies are shown in Annex-Table 6. In general adoption rates were higher than for crop-related technologies. Some respondents say that FFS have directly encouraged expansion of fish ghers in Khulna. However, it should be pointed out that BGP FFS for fisheries were targeted at operators of small fish ponds, not those of much larger ghers. However, the FGD clearly saw these FFS as supporting gher production. For example, an FFS topic on preparation of fish ponds prior to stocking was identified in the Focus Group Discussions as “gher preparation”.

Changes in land tenure[edit | edit source]

Data shows (Table 12) that less land is now being farmed by its owner and less is being sharecropped, with a significant increase in other lease arrangements (mainly annual cash rental). This pattern is followed in all three zones and in most seasons. In Satkhira, there has been a smaller decline in cultivation by owners, and Khulna has seen a slightly smaller drop in sharecropping and a smaller increase in other types of lease. Although land for fish ghers is often rented in by large operators, there has also been an increase in cash rental in Patuakhali, where there are no ghers. A similar trend was observed in the 2018 WMG survey.

Table 13: Land tenure

Owner cultivator		**Sharecropper**		**Other lease**	
before	**now**	**change**	**before**	**now**	**change**	**before**	**now**	**change**

	rabi/boro	53.2	44.8	-8.4	21.8	16.2	-5.6	23.8	37.9	14.1
Khulna	**kharif 1**	58.6	52.1	-6.4	9.4	6.0	-3.4	25.5	38.0	12.5
	kharif 2	57.1	49.7	-7.3	19.2	12.6	-6.7	23.3	37.7	14.4
	rabi/boro	58.3	55.2	-3.1	28.5	13.0	-15.5	11.7	31.8	20.2
Satkhira	**kharif 1**	37.5	44.6	7.1	13.9	7.2	-6.7	16.9	45.0	28.1
	kharif 2	45.3	46.5	1.2	19.0	9.4	-9.7	16.6	44.1	27.5
	rabi/boro	59.4	48.0	-11.4	22.7	14.2	-8.5	17.3	37.2	19.9
Patuakhali	**kharif 1**	44.1	36.5	-7.6	14.9	9.5	-5.4	12.9	27.5	14.6
	kharif 2	59.0	47.8	-11.2	22.7	14.5	-8.1	17.8	37.1	19.3
	rabi/boro	56.0	47.2	-8.8	23.0	15.1	-7.9	20.0	36.9	16.9
Total	**kharif 1**	50.8	45.6	-5.1	11.9	7.4	-4.5	19.9	35.2	15.2
	kharif 2	56.3	48.6	-7.6	20.4	12.9	-7.6	20.5	38.3	17.8

Average percentage of land under different tenure arrangements

Qualitative data shows a mixed picture. At a few locations less land is being leased out or sharecropped as land owners now want to grow highly profitable crops such as watermelon on newly irrigated/drained land. But in most of the locations with improved water management much more land is now being leased-out (in line with the WMG survey data) as farming has become more profitable for tenants. Where improvements in water management were limited, there may not be much increase in the amount of land being leased out. Here, more land was being sharecropped in the rabi season (as it was more profitable for tenants than cash rental), but less was sharecropped in kharif as aman production had become unprofitable. There were large increases with the amount of land being leased out for cash rents. In general people who rent or sharecrop in land are farmers with limited land holdings (landless, marginal and small farmers), but who have labour available within their families. But at some locations in Khulna and Satkhira land is being rented in by larger farmers and businessmen for fish/shrimp ghers, along with vegetables and paddy.

Cash rents have risen significantly during the BGP period – often by multiple times. Typical annual rent per acre reported in Khulna were around Tk 20,000 – less in polder 30, but up to Tk 50,000 in polder 29. In Satkhira rents were higher – typically around Tk 30,000, while Patuakhali Tk 13,000 per acre was typical – lower as fish ghers are not a land use option here.

Farm labour and the role of women in agriculture[edit | edit source]

With an increased area of crops, more labour is now hired. Participants said that much of the available male labour has been absorbed in the non-farm sector and by fish and poultry enterprises. As a result, women are now hired. Earlier they were either not hired at all or only for limited tasks such as post-harvest work on paddy. In Khulna and Satkhira, women are now hired for almost all farm operations, including transplanting and weeding paddy, and preparation of fish ghers, and have, to some extent, replaced male labour. Women provide 50% or more of the labour for some operations. However, this pattern varied between different locations, with the amount of women's participation varying. In Patuakhali, women are still primarily hired for work in mung beans and other non-rice crops (but they may provide all the hired labour for these crops). Here women provide little or none of the hired labour for paddy. They do at most only limited tasks, such as uprooting aman seedlings.

Women are almost always paid less than men – typically being paid between 50 and 80% of the male wage. Only in a few instances (e.g. weeding of paddy) are equal wages paid. In many areas, it is reported that the differential between male and female wages has narrowed, at least in relative

terms, with female wages doubling since the start of BGP, while male wages have only gone up 50%.

Increased participation in the workforce has added to the overall workload of women – although a greater contribution to domestic tasks my men was also mentioned. But FGDs said that women thought that, overall, they were better off – with additional income in their hands to meet the needs of their households. As they now earn an income, they have a greater say in household decision-making and their position in the household has improved.

Increase in farm income[edit | edit source]

An increased area of crops, intensified cropping patterns and increased yields have resulted in increased farm income. This increase in income has been assessed based on budgets for the main crops[Notes 4][1] in each zone and using cropping patterns and yields derived from WMG survey data. These budgets were drawn up prior to collection of WMG survey data and yields have been subsequently adjusted in the crop budget to

1. be in line with those from the WMG survey, and
2. to reflect what farmers tell about the relative profitability of crops.

The cropping patterns in the current and pre-project situation are taken from the WMG survey data for each polder. These crop areas and the net income per acre for each crop are used to give the total net farm income in each polder, before BGP and for the current situation[1].

Table 13 shows that net farm income has almost doubled, and that more comes from aquaculture than from crops – and aquaculture contributes over half the increase in farm income. However, in relative terms the increase has been higher for paddy and for other crops. The relative increase has also been higher in Patuakhali zone, and lowest in Khulna.

Table 14: Total net farm income

	Before BGP - Tk million				Now - Tk million				Change	
	paddy	other crops	Fish	total	paddy	other crops	fish	total		
Khulna	453	1,640	4,316	6,408	665	3,440	7,210	11,316	4,908	77%
Satkhira	101	289	285	675	247	419	802	1,468	793	117%
Patuakhali	37	729	-	765	364	1,666	-	2,030	1,264	165%
total	590	2,657	4,601	7,849	1,276	5,525	8,012	14,813	6,965	89%
	Increase				116%	108%	74%	89%		

Return to the investment in BGP[edit | edit source]

The increase in net farm income in the 22 polders can be compared to the investment made through BGP to see if benefits (in terms of increased farm income) justify the investments made. Cumulative expenditure of BGP funds by BWDB on water management infrastructure and by DAE on its FFS[Notes 5] is shown in Table 14. In terms of average expenditure per WMG, more has been spent in Patuakhali than in the other two zones, reflecting the more extensive works reported in Table 3.

Table 15: Cumulative expenditure by BWDB and DAE

	Million Taka				Payback period (years)	
Zone	**BWDB**	**DAE**	**Total**	**Avg per WMG**	**A (BWDB+DAE expenditure)**	**B (Total BGP expenditure)**
Khulna	1,254.10	19.66	1,273.76	4.90	0.26	0.74

Satkhira	352.85	9.00	361.85	5.74	0.46	1.30
Patuakhali	1,415.06	30.07	1,445.13	8.12	1.14	3.27
Total	3,022.02	58.73	3,080.75	6.15	0.44	1.26

Right column of Table 14 also shows the 'payback period', i.e. the period it takes for the increase in annual net farm income to equal the cumulative project expenditure to date[Notes 6]. Taking column A (BWDB and DAE expenditure only) the payback period is very short – less than six months for all polders taken together. Even if only part of the increase in net income were to be attributed to BGP interventions, the payback period would still be very acceptable.

This approach in measuring the viability of the BGP investment in terms of payback is crude[Notes 7]. However, BGP is generating very rapid returns and if the increase in farm income covers project investment costs in a few years, it is fairly certain that a full economic analysis, where benefits are accrued over a 20 or30 year period, would give positive results, with an acceptable economic internal rate of return.

Taking "case B" – including all BGP costs, almost all polders in Khulna have a payback period of less than two years (and many less than one year)[Notes 8]. The payback for Polder 28/1 is under three years. Polder 2 in Satkhira has a payback period of under two years, but most of the Patuakhali polders are in excess of five years, apart from 43/1A, 43/2B (both under 2 years) and 55/2C (under 3 years).

It is not surprising that investment in BGP has generated rapid returns and the resulting increase in farm income very quickly equals the investment cost. Improvements in water management infrastructure have removed bottlenecks in an existing system. No account has been taken of the original investment in building the system in the first place as this is a sunk cost. Removing bottlenecks gets the whole system, including the original investment to work better. Similarly, training enables farmers to get their own production systems to work better. Training does not cost much, while increasing productivity generates more income for very little extra cost (mainly harvesting and marketing the increased volume of production).

Increase in Farm employment[edit | edit source]

Changes in labour use in crop and fish production have been calculated based on the crop budgets for each zone and crop areas in each polder. Before project labour use has been estimated taking into account that lower yields would have meant less labour was needed for harvest and post-harvest work. Based on information from the FGDs, the total proportion of labour that is hired has increased, with a particularly sharp increase in hired female labour. There has also been some increase in the share of work done by women on their own farms.

Table 15 shows the total labour used in crop production and gher aquaculture in each of the three zones. The total labour requirement is now estimated to be 15.4 million person-days, an increase of around 50% on the pre-project situation. Paddy production absorbs over half of this labour, followed by fish / shrimp aquaculture and then non-rice crops. The table also shows how much labour is hired (men and women) and how much comes from men and women members of farm households.

The share of each of these four sources of workers in the total supply of labour for the three subsectors (paddy, non-rice crops and aquaculture) in each zone shows that over half (57%) of the labour is hired and 43% comes from farm households (see Annex Table 7). Paddy production uses a slightly higher proportion of hired labour than the other sub-sectors. With increasing shortages of male workers there has been a four-fold increase in the number of days provided by hired female

workers. Women (including those from farm households) provide 63% of labour for non-rice crops.

Table 15: Labour inputs for crops and aquaculture (thousand person-days)

		paddy		other crops		fish / shrimp		total	
		before	now	before	now	before	now	before	now
Khulna	**hired men**	1323	1549	164	209	944	1308	2431	3067
	hired woman	165	509	71	188	0	238	235	935
	HH men	990	1083	235	212	981	1189	2206	2484
	HH women	300	404	142	192	223	297	666	893
Satkhira	**hired men**	434	457	43	45	168	360	645	861
	hired woman	152	307	23	39	44	650	219	996
	HH men	306	307	52	63	175	327	532	696
	HH women	122	150	20	27	40	82	182	259
Patuakhali	**hired men**	1700	2098	247	103	0	0	1947	2201
	hired woman	0	0	152	747	0	0	152	747
	HH men	851	940	371	431	0	0	1222	1371
	HH women	231	302	277	561	0	0	508	863
total	**hired men**	3457	4105	453	357	1112	1668	5022	6129
	hired woman	317	816	245	973	44	888	606	2677
	HH men	2148	2330	657	705	1156	1516	3961	4552
	HH women	653	857	440	780	263	379	1355	2016
	total	6575	8108	1796	2815	2574	4451	10945	15373


This portion is under development.

The following sections will be developed after completing the end-line survey in 2021

Changes in homestead production[edit | edit source]

Changes in homestead gardening production[edit | edit source]

Changes in poultry production[edit | edit source]

Changes in livestock production[edit | edit source]

Changes in pond fisheries production[edit | edit source]

Economic changes of the households of coastal areas[edit | edit source]

Changes in HH income[edit | edit source]

Changes in HH assets[edit | edit source]

Women empowerment[edit | edit source]

Changes in participation in income generating activities[edit | edit source]

Feminisation of agriculture and impact on women livelihoods[edit | edit source]

Changes in decision-making authority[edit | edit source]

Changes in mobility of women[edit | edit source]

Reference[edit | edit source]

1. ↑ [1.0] [1.1] [1.2] *Improving the Productivity of Land in the Coastal Bangladesh: The Outcomes of Blue Gold Program Interventions – WMG survey 2019, Technical Report 26*. Euroconsult Mott MacDonald & Associates. November 2018.
2. ↑ *Improving the Productivity of Land in Coastal Bangladesh: Outcomes of Blue Gold Program Interventions 2013-2018, Technical Report 25*. Euroconsult Mott Mcdonald & Associates.

Notes[edit | edit source]

1. ↑ HYV and hybrid paddy, chilli, watermelon, and vegetables.
2. ↑ Many farmers have adopted modern, high yielding types of mung bean, especially BARI-6. However, these improved types inter-breed with older local types, so much mung bean is of a semi-improved type. For this reason, this report has not tried to differentiate between modern and local varieties of mung bean, and farmers report that, despite adopting improved varieties, overall yields have fallen.
3. ↑ Yields of crops such as maize, sunflower and felon only comes from a few WMG and so may not represent average yields.
4. ↑ Crop budgets are based on the current situation, and to incorporate yield increases net income "before BGP" has been estimated. This deducts approximately half of the value of the yield increase reported in the BGP survey to arrive at a before BGP net income. This is on the assumption that, without BGP interventions, yields would have increased by about 50% of the reported increase.
5. ↑ BWDB expenditure is to June 2019, and DAE expenditure is to June 2018. Given the timing of this survey, expenditure data to June or December 2018 is appropriate for comparison with benefits to date.
6. ↑ Column A is the payback period for BWDB and DAE expenditure only. Column B is the payback period for total BGP expenditure assuming that DAE and BWDB expenditure are 35% of cumulative total BGP expenditure including the TA team etc. (35% is approximately correct for the end of 2018).
7. ↑ It takes no account of complementary investments in water management using other resources. A full economic analysis of the project would adjust input and output prices to reflect their real value to the economy.
8. ↑ Exceptions are polder 28/2 (where there is no (or almost no) increase in farm income) and polder 34/2.

See more[edit | edit source]

Blue Gold Wiki

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Increase in the capacity of a country or an economic region to produce goods and services. It also refers to the increase in market value of the goods and services produced by an economy. It is usually calculated using inflation adjusted figures, in order to discount the effect of inflation on the price of the goods and services produced

gross domestic product

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.

Blue Gold Program

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

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.

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empowerment is a process, enabling people to make choices and convert these into desired actions and results. In doing so, people take control of their own lives, improve their own position, set their own agenda, gain skills, develop self-confidence, solve problems, and develop self-sufficiency. Empowerment leads to genuine participation of all actors as it is a process of gaining self-confidence for individual development as well as to contribute towards development of others.

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.

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.

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 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.

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

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.

The second part of the kharif season (mid-June to mid-October) characterised by heavy rain and floods. T Aman is the major crop grown in this season. Jute is harvested.

The first part of the kharif season (mid-March to mid-June). Rainfall is variable and temperatures are high. The main crops are aus, summer vegetables and pulses. Broadcast aman and jute are planted.

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.

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

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 strapline of the Blue Gold Program for a transformative approach to smallholder agriculture which combines water infrastructure and locally-led initiatives for better water management, using modern agricultural technology and a business-orientation.

drainage channel or canal

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.

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

Bangladesh Agricultural Development Corporation

Local Government Engineering Department

hectare

Danish International Development Agency

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

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

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 in March/April under dryland conditions. Matures during pre-monsoonal showers and is harvested in June/July. Insensitive to daylength.

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

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.

Local pulse crop

Cropping intensity - The number of crop harvest per unit land per year. The average cropping intensity (CI) is calculated as the total area of all crops per year divided by the area of cultivable land. In its CI calculations BGP treats fish ghers as another crop; the DAE method excludes fish ghers in its CI calculations. Hence the CI calculated by BGP is higher than as calculated by DAE.

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.

Water Management Problem Score

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.

Focus Group Discussions - in which a group of participants from similar backgrounds or experiences gather to discuss a specific topic of interest, guided by a group facilitator who introduces the topics for discussion and helps the group to participate in a lively and natural discussion amongst themselves

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assumed in this report to operate up to 0.5 acres (0.2 ha)

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

Household

Bangladesh Agricultural Research Institute

Technical Assistance

Namespaces

- Page
- Discussion

Variants

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.