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Technical Report 25

Improving the Productivity of Land in the Coastal Bangladesh: The Outcomes of Blue Gold Program Interventions

October 2018

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Blue Gold Program

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Issue and Revision Record

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Glossary

ADP	Annual Development Plan
ADG	Additional Director General
AEO	Agricultural Extension Officer
AGEP	Agricultural Growth and Employment Program
BAU	Bangladesh Agricultural University
BWDB	Bangladesh Water Development Board
CAHW	Community Animal Health Worker
CBO	Community-Based Organisation
CDMP	Comprehensive Disaster Management Program
CDSP IV	Char Development and Settlement Project Phase IV
CEIP	Coastal Embankment Improvement Project
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Centre
CDF	Community Development Facilitator
CPWF	Challenge Programme on Water and Food (CPWF)
CSISA	Cereal Systems Initiative for South Asia
DAE	Department of Agricultural Extension
DAM	Department of Agricultural Marketing
DLS	Department of Livestock Services
DoC or DOC	Department of Cooperatives
DoF or DOF	Department of Fisheries
DP III	Department of Planning III
DPP	Development Project Proforma
DTL	Deputy Team Leader
EIA	Environmental Impact Assessment
EKN	Embassy of the Kingdom of the Netherlands
EOI	Expression of Interest
EMM	Euroconsult Mott MacDonald
EWM	Equitable Water Management
FFS	Farmers Field School
FGD	Focus Group Discussion
GAP	Gender Action Plan
GESAP	Gender Equality Strategy and Action Plan (of BWDB)
GoB	Government of Bangladesh
GoN	Government of the Netherlands
GPWM	Guidelines for Participatory Water Management
IRRI	International Rice Research Institute
ha	Hectare
HH	Household
IF	Innovation Fund
IFMC	Integrated Farm Management Component
IGA	Income Generating Activity

IMRC	Inter-Ministerial Review Committee
IPM	Integrated Pest Management
IPSWAM	Integrated Planning for Sustainable Water Management
IPSWARM	Guidelines for Integrated Planning for Sustainable Water Resources Management
IWM	Institute of Water Modelling
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
LCG	Local Consultative Group
LCS	Landless/Labour Contracting Societies
LG	Local Government
LGED	Local Government Engineering Department
LGI	Local Government Institutions
M&E	Monitoring and Evaluation
MRL	Monitoring, Reflection & Learning
MoU	Memorandum of Understanding
MoWR	Ministry of Water Resources
MTR	Mid – Term Review Mission
NGO	Non-Governmental Organisation
O&M	Operation and Maintenance
PCD	Project Coordinating Director
PCWM	Polder Community Water Management
PD	Project Director
PDP	Polder Development Plan
PMC	Project Management Committee
PM	Progress Marker
PSC	Program Steering Committee
PWMR	Participatory Water Management Rule
SDE	Sub-Divisional Engineer
SVC	Strengthened Value Chains
SWAIWRPMP	Southwest Area Integrated Water Resources Planning and Management Project
TA	Technical Assistance
T&C	Training & Communications
TL	Team Leader
TNA	Training Needs Assessment
TOT	Training of Trainers
UAO	Upazilla Agricultural Officer
UP	Union Parishad
WAP	Water Management Group Action Plan
VC	Value Chain
VCA	Value Chain Analysis
VCD	Value Chain Development
VCS	Value Chain Selection
WASH	Water Sanitation and Hygiene education

WMA	Water Management Association
WMG	Water Management Group
WMIP	Water Management Improvement Project
WMO	Water Management Organisation
WRM	Water Resource Management
WUR	Wageningen University and Research Centre
XEN	Executive Engineer (BWDB)
ZSEs	Zonal Socio-Economists

Contents

Executive Summary

This report has been prepared in response to the request from the 2017 Annual Review Mission that a number of studies to be undertaken to document the economic changes and significant income increases bought about by changes in cropping patterns. In addition the credit activities of WMGs were investigated.

This report is the outcome of two rounds of data gathering – a pilot study in two polders followed by a brief questionnaire from virtually all the WMGs in 12 polders, and eight FGDs. The 14 polder covered are those phased out in June 2018 and those due to be phased out in June 2019. Reference has also been made to data on cropping intensity derived from satellite images.

Improvement in water management

BGP water management works have improved drainage and increased the supply of water for irrigation. WMG have also contributed their own labour for routine maintenance and minor works, and have sometimes made contributions to the cost of BGP works. Three of the eight FGD reported that BADC had undertaken significant khal re-excavation works which contributed to improved drainage and irrigation supply in two polders.

Scarcity of water for irrigation was reported most frequently by WMG as the principal water-related constraint to crop production prior to the implementation of BGP. This applied to most polders in both the Khulna and Patuakhali zones. A significant, but smaller, number of WMGs placed waterlogging as the major water-related constraint, this being top of the list for WMG in polders 43-2E and 55-2A in Patuakhali. WMGs in Polder 31 in Khulna rated salinity as the major problem, and the four other Khulna polders identified this as a secondary problem. This pattern of problems is much the same now, although water scarcity rather than waterlogging are now the main problems in polders 43-2E and 55-2A, and salinity no longer seems to be a significant issue for WMG in polder 26.

Although water management problems still exist, they are now less severe. Overall over half of WMGs (55%) say the situation is now good or very good, compared with only 8% in the pre-project situation. But there is considerable variation, with 5% of WMG saying that water management problems have actually got worse, and another 21% saying there was no change. Local factors are important in determining the effectiveness of water management improvements. In polder 2 improvements to drainage in order to grow paddy were constrained in some locations by the preference of larger land owners for fish rather than rice production. In two polders, operation of sluices for the purpose of fishing limited or prevented drainage improvements. At some locations improvements by BGP were yet to become effective, and most WMG still have problem areas within their commands.

Water management issues are often complex and it can be difficult to generalise at the WMG level, let alone at the polder level. Farmers with higher land may want to maintain water levels for irrigation, while those on lower land want water drained out.

Changes in crop areas

In the Khulna zone there has been a significant increase in the land used for paddy – this is mainly due a large expansion in the area of boro. Only in polder 31 has there been a decline in the area of land used for

fish/shrimp ghers, with almost 50% of the cultivable area no longer being used for as ghers[1], and there has been a large expansion of aus paddy. In the other polders there has been expansion in the area of ghers, and better water management was mentioned in one FGD as supporting gher expansion. There has been a move to high value crops (water melon and vegetables) and a move away from less valuable dry land crops such as sesame.

Change in crop areas in the Khulna zone

	Change as percentage of cultivable land – total for three seasons					
Polder	22	26	29	30	31	overall
paddy	7.5	31.1	21.1	16.0	88.4	28.1
gher	7.4	30.3	32.3	9.4	-49.9	13.2
HVC*	36.5	14.1	11.4	8.9	7.8	12.3
Other crops	-2.7	1.9	-17.1	-31.8	-9.3	-17.2
total	48.8	77.4	47.7	2.5	37.0	36.4

*High value crops – water melon and vegetables

In polder 2 in Satkhira, better drainage in some WMG commands have resulted in an increase in the area of aman paddy- with an overall increase in paddy area of 30% of cultivable land. However very little land has been converted from gher to paddy and the gher area has only fallen by 1% of the cultivable land. However this only applies to the beel areas in six WMG of one catchment, and so cannot be taken to represent polder 2 as a whole.

In the eight BGP polders in the Patuakhali zone ghers are not a significant land use. There has been some growth in in the area of paddy, with aus, aman and boro all increasing in different polders. Compared with the Khulna zone, less high value crops are grown, but there has been significant expansion of water melon in polders 43-A1 and 43-2B. The main expansion has been in dryland rabi crops, mainly mung bean, which has also very largely replaced keshari.

Change in crop areas in the Patuakhali zone

	Change as percentage of cultivable land – total for three seasons				
	paddy	gher	HVC*	other	total
Polder 43-1A	17.1	-1.4	10.1	9.9	35.7
Polder 43-2A	-6.3	-1.4	0.1	39.9	32.2
Polder 43-2B	16.3	0.0	14.0	18.7	49.0
Polder 43-2D	10.5	1.8	0.3	32.4	45.0
Polder 43-2E	17.8	0.4	-0.7	26.7	44.2
Polder 43-2F	1.4	1.5	0.4	36.2	39.4
Polder 55-2A	4.2	0.0	1.1	16.2	21.5
Polder 55-2C	6.8	0.0	1.9	11.3	20.0
total	7.5	0.2	3.2	23.5	34.5

*High value crops – water melon, chilli and vegetables

Increase in cropping intensity

The increase in c.i. for the five polders in the Khulna zone, based on data from the WMG survey, is 36 percentage points (from 178% to 215%). Satelligence data for the same polders shows a rather lower

[1] This is the total over three seasons – so 6.4% went out of gher in the rabi season, 20.3% in kharif-I and 23.2% in kharif-II = total of 49.9%

increase in c.i. of 23 percentage points (from 144% to 167%), but this does not seem to take account of harvests in fish ghers. Comparison (control) polders have a marginally higher increase in c.i. Both sources of data show that polder 30 only had a small increase in c.i. and here 45% of WMG reported a decline in c.i. with another 5% reporting no change.

Data from the pilot survey for polder 2 in Satkhira only covers some land in the central part of the polder. Data from Satelligence shows a small (13 point) increase from 129% to 142%, but this is greater than surrounding polders which, on average, only had a 3 point increase.

Data from the eight polders covered by the WMG survey and pilot study show an overall increase in c.i. of 34 percentage points (181% to 214%). Satelligence data for the same polders shows a much larger increase in c.i. (91 percentage points) due to a much lower pre-project estimate of only 113%. Seven nearby non-BGP polders have been used as a control group, with Satelligence data showing a very similar pre-project c.i. of 114%, and a current c.i. of 184% - significantly lower than the 205% in BGP polders. As a result, the 91 percentage point increase recorded in the BGP polders using Satelligence data is significantly higher than the 70 percentage point increase in the control polders. This provides some convincing evidence of the possible impact of BGP in this zone.

There appears to be a link between the reduction in the severity of water-related constraints in each polder and data from Satelligence on the increase in cropping intensity.

Feedback from farmers on outcomes of BGP interventions

In the Khulna zone better water management has allowed increased cultivation of paddy and other crops in the rabi season, and increased areas of HYV aman paddy and aus paddy in the kharif seasons. In polders 26 and 30 better water management is also reported to have contributed to increased areas of fish ghers in the kharif seasons. Vegetables are now also grown in the aus as well as rabi seasons in polder 29, with okra being particularly profitable. In this polder the sesame that has been replaced by boro (thanks to improved irrigation water supply) was a risky crop due to erratic rains prior to harvest.

In the Patuakhali zone farmers report that better water management brought more land under cultivation, and allowed the adoption of HYVs in the aman and aus seasons. Better drainage has allowed expansion of rabi cropping, while supplies of fresh water in khals has allowed irrigation of water melon and boro in some locations. Boro is preferred to rabi crops such as mung bean as it is seen as being more profitable and less risky.

Farmer field Schools (FFS) have resulted in adoption of line sowing of paddy, improved paddy seedbed management, and more judicious use of fertilisers and pesticides, along with better management of pests. These have disseminated to between 10% and 80% of other farmers. Farmers have also been told about the use of irrigation and fertilizer in mungbean cultivation, but do not follow this as they say that they normally get sufficient rain, and yields without fertilizer are not bad. Farmers in polders 22 and 43-2D reported that the introduction of BR-52, a submergence-tolerant and early maturing variety of aman, has not been very successful.

Farmers in FGDs reported that the main problems they face are the high cost of labour during peak periods and shortages of seed, along with the need for loans at the right time and the high price of fertiliser. Collective purchase of inputs has been organised by some WMG, but this only covers 10% to 15% of members as this requires farmers to decide and pay in advance for the inputs they need. Farmers in polder 30 also mentioned pest problems, and said the training in pest management had not been very useful or effective.

Changes in land tenure

The pilot study found that, in polder 2, most land was owned by medium and large farmers, but most aman paddy is sharecropped and expansion of this crop created new opportunities for poor households to gain access to land to improve their food security. However data from the WMG survey shows a general reduction in sharecropping in all three seasons in most polders. Most land is farmed by its owner, but there is also some fall in owner-operation, while more land is now being farmed under other lease arrangements. This includes mortgaging of land and cash rental. Sharecropping of most crops is not particularly profitable for tenants, and a cash rent or mortgage tenure should normally generate more income for tenants – and provides greater incentives for tenants to use more labour and other inputs as the resulting additional crop production is not shared with the landlord.

Increase in farm income

The pilot study calculated the increase in farm income for polders 2 and 43-2B based on the change in cropping patterns and the net income per hectare for each crop. The overall increase in net farm income was sufficient to cover the investment in these polders over little more than two years in polder 2 and one year in polder 43-2B. The polders in the Khulna zone have benefited from a significant increase in the area of profitable high value crops – water melons and vegetables as well as expansion of boro paddy. Polder 30 stands out as not having much of an increase in c.i. However this polder has benefited from an increase in the cultivation of high value crops, as has polder 29 – another polder with a relatively small increase in cropping intensity – and where there has also been an increase in boro. It can therefore be projected that these polders have generated increases in income that more than cover the investment by BGP.

In the Patuakhali zone the increase in cropping intensity is larger and more clear-cut. Polder 43-1A has a significant area of water melon, which would have generated a large increase in farm income, and the payback of the BGP investment would be similar to that on polder 43-2B. The size of benefits in the other polders largely depends on the profitability of mung bean[2], although polder 43-2E also had a significant increase in paddy area. . However, apart from this crop, the switch to HYV paddy and increase in yield of HYV paddy should mean that the increase in farm income over the implementation period of BGP is at least equal to the BGP investment in these polders.

Demand for labour and role of women

More farm work needs to be done with the expansion of cropping. Farmers talk of a “labour crisis” in agriculture – with increasing demand for labour on farms as well as increasing opportunities in the non-farm sector. In some polders an increasing proportion of farm labour is being hired and, in places, the increasing demand for farm labour has reduced out-migration to find work elsewhere.

With an increasing shortage of labour, women are undertaking an increasing amount of work in the fields, including wage labour. However the amount of work done by women varies considerable between polders (and possibly between locations within a polder). In polder 2 women now do (and are being are hired for) virtually all tasks in paddy crops. In 2% to 3% of farms women have taken on management responsibilities in the absence of their husbands. In polder 22, women now provide about 50% of the labour for aman

[2] Calculations for the crop budget in the pilot study for mung bean was based on a lower yield than reported by farmers in the WMG survey. The profitability of mung bean may therefore be better, generating a larger increase in farm income in the Patuakhali zone.

paddy, and 80% for rabi crops. In contrast, in polder 30, men still do 98% of the work for aman and for rabi crops. Work on aman and rabi crops in polder 26 is still predominantly male, with women now doing 20% of the work. In some polders women only work on rabi crops, and maybe only on certain tasks in certain crops – such as harvesting mung bean. But as there has been a major expansion in the area of mung, employment opportunities have considerably increased for women.

Increased opportunities for women to earn cash by working as wage labourers gives them another option to support their families and increase living standards. As women are contributing cash to the household, their status within the family may have improved and they may get a more say in household decisions. That said, field labour is a low status and poorly paid occupation. Moreover this work tends to be in addition to their domestic duties – with men only taking a slightly larger domestic role when their wives are working.

With increasing demand for labour wages have increased – doubling over the last three or four years in some polders. In general women are still paid significantly less than men (little more than half) although in polder 22 some work is now being paid on an hourly basis with the same rate for men and women, and in some other locations changes in piece work rates suggest that that the differential may have been slightly reduced.

Other benefits and impacts

Increased paddy production has eliminated (or greatly reduced) food insecurity, while high value and other rabi crops provide a cash income. There is a general trend for more households to have non-farm incomes, but agriculture usually remains the major source of income in most villages. Improvements in agriculture have meant an increased focus on this sector. Additional farm income is spent on children's education, improved housing and sanitation, and invested in farming – including land leases, livestock and high value crops. People are also saving more.

Households also report positive impacts from BGP FFS on poultry, livestock, pond fisheries and homestead gardens. All households have poultry and FFS members (and some other households) have adopted some improved methods, although lack of access to vaccination has not reduced the disease risk. Not all households have cattle and there seems some reluctance to invest in improved housing, while materials for improved feeds may not be available. The same applies to fish ponds, which may be in shared ownership, small, seasonal and only produce fish for home consumption. However most households have homestead gardens and FFS provided some useful learning which has also been applied to vegetables grown on a commercial scale in the field.

Role of WMG in operation of group savings and credit

Savings and loans schemes are operated by a limited number of WMGs. Some of these WMGs seem to operate them successfully in terms of maintaining records and recovering loans, although one had not been able to recover loans after a crop failure. However, WMG lack the resources in terms of capital and the time of volunteer members to provide loans to all of their members, and loans are quite small – and so of limited value in funding investments. Lending to a group enterprise can result in conflict of interest within the WMG. These activities also divert WMG management and financial resources away from water management issues – which should be the focal point for WMG.

Recommendations:

Further analysis of WMG survey data alongside other sources of information – such as participatory monitoring and the WMG tracker – could provide further insights into the factors driving WMG performance and outcomes. Further analysis of cropping pattern and water management information could different farming system clusters within individual polders – with different water management priorities.

Further information is needed on the profitability of mung bean to understand why it has expanded so much and if it is a crop worth supporting. It would also be useful to have more information on the relative profitability of fish ghers and paddy to understand why ghers may be expanding in some locations and contracting in others.

A further round of data collection from WMGs should be planned, which would include the polders not covered in this survey, the whole of polder 2 as well as the polders covered in this survey.

Impact on women – a more in-depth investigation of the impacts of the changes brought about by BGP on women, including their roles in WMG and other institutions related to Blue Gold.

Improved farming practices: more information is needed on the outcomes of FFS for field crops, including the dissemination of technologies to farmers who did not attend FFS. The survey carried out by DAE does not provide sufficient information on this topic. A methodology for such a survey should first be tested on a pilot scale.

WMG lending operations are not a good idea for WMGs and are of little benefit to their members. WMG should be discouraged from undertaking this activity.

1. Introduction

This report has been prepared in response to the request from the 2017 Annual Review Mission that a number of studies to be undertaken to document the economic changes and significant income increases *inter alia* to provide a better understanding of:

(a) the change in profitability over previous cropping patterns (including aquaculture), as well as the increased income to the various categories of households (landless, small land owner, large land owner, crop producer, fish producer etc); and

(b) WMG small lending operations and credit activities and how they provide opportunities for poor and landless.

This report is the outcome of two rounds of data gathering. In May 2018 a pilot study was made of two polders (polder 2 in Satkhira and polder 43/2B in Patuakhali) to see if information can be readily collected from Water Management Groups and project field staff. Based on brief visits to these polders and informal data gathering by the polder teams, an interim report was produced in June 2018 with estimates of changes in cropping patterns, and calculations of changes in profitability and farm income. There was also a brief review of WMG credit activities.

After reviewing the information in the interim report, plans were drawn up for more systematic data collection covering a larger number of polders. In September 2018 data was collected via a brief questionnaire from 266 WMGs – virtually all the WMGs in 12 polders. This "WMG survey" gathered information on changes in water-related constraints to crop production, changes in crop area, crop type and yields, and also changes in land tenure. Along with the WMG survey, qualitative data was collected via eight focus group discussions with WMG members in six of the 12 polders. Together with the two polders covered in the pilot study, data has now been gathered from the 14 polders: eight that were phased out from Blue Gold activities in June 2018, and six that are due to be phased out from Blue Gold in June 2019. A further eight polders, where Blue Gold activities have started more recently, were not covered. Reference has also been made to data on cropping intensity derived from satellite images. Details of the methodology are in Appendix 1.

2. Water-related constraints to crop production

2.1 Improvements to water management

One of the central objectives of Blue Gold is to improve the local level management of water resources and so remove water-related constraints to crop production. In most polders BGP has funded repairs to sluice gates and embankments, and re-excavation of drainage khals, with other works in some polders. Apart from these works, WMG have undertaken minor works using their own labour, while some other agencies have supported water management improvements that have benefited BGP polders. For example, Gagendrapur Uttar WMG in polder 29 cleared water hyacinth from a drainage khal (while also catching valuable fish) and built a cross dam to prevent saline intrusion in the rabi season. Water hyacinth was also cleared by WMG in polders 30 and 43-2D. In polder 43-2D WMG members gave voluntary labour to clear silt from around sluice gates and from a khal, and to dig a field channel, and contributed 40% of the cost of a box culvert. FGD in polder 43-2D also report on significant (3 km) of khal re-excavation being carried out by BADC following an approach by the WMG to the Deputy Commissioner of the district, while LGED constructed some pipe culverts to reduce waterlogging on 160 ha. In polder 43-1A BADC re-excavated 9.7 km of khals and built many pipe culverts, reducing waterlogging and improving the availability of irrigation water, while WMG members provided some of the labour for almost 200 metres of field channels,

2.2 Water management problems

Table 1: Principal water management problems

Zone	Polder	Principal problem before				Principal problem before			
		Waterlogging	Flooding	Water scarcity	Salinity	Waterlogging	Flooding	Water scarcity	Salinity
Khulna	22	25%	0%	50%	14%	19%	0%	50%	17%
	26	31%	4%	47%	2%	29%	0%	47%	0%
	29	17%	1%	45%	8%	21%	0%	51%	5%
	30	25%	2%	38%	18%	26%	0%	40%	17%
	31 part	25%	3%	17%	47%	22%	0%	17%	47%
	overall	22%	2%	41%	14%	23%	0%	44%	13%
Patuakhali	43-1A	38%	0%	50%	0%	24%	0%	55%	0%
	43-2A	44%	6%	48%	2%	40%	6%	52%	0%
	43-2D	37%	1%	58%	0%	27%	1%	58%	0%
	43-2E	36%	11%	31%	8%	31%	6%	44%	0%
	43-2F	42%	1%	51%	4%	33%	0%	56%	2%
	55-2A	54%	0%	44%	0%	44%	0%	46%	0%
	55-2C	42%	0%	52%	0%	33%	4%	52%	2%
	overall	41%	3%	49%	2%	33%	2%	53%	1%
Total		32%	2%	45%	8%	28%	1%	49%	7%
Season	Rabi/boro	0%	1%	81%	14%	0%	1%	85%	10%
	Kharif-II	70%	4%	8%	1%	65%	2%	12%	1%
	kharif I	26%	1%	46%	9%	19%	1%	50%	9%

The percentages of WMG are the average number reporting over three seasons. As some WMG did not report a main or other problem in all seasons, and some WMG reported multiple other problems, the totals in each row may not add up 100%. More detained data by season and polder is in Appendix 2.

The WMG survey gathered information for each season on the type of constraint (waterlogging, flooding, water shortage and salinity) and the overall severity of water problems (very good, good, average, bad, very bad).

Data on the main type of water-related problem in Table 1 shows that water scarcity (for irrigation purposes) was the main problem for farmers in nine of the 12 polders, but water logging (poor drainage) has also been a major problem, especially in the Patuakhali zone, with salinity the major issue in polder 31[3]. Comparing the present and pre-project situations, there has not been much change in the type of main problems.

Other water management problems are shown in Table 2. In the Khulna zone, salinity was, and still is, the main other problem, but this issue seems to have now largely been eliminated in polder 26. In the Patuakhali zone the main other problem is poor drainage.

Table 2: Other water management problems

Zone	Polder	Other water management problems before					Other water management problems now				
		Waterlogging	Flooding	Water scarcity	Salinity	Other (iron)	Waterlogging	Flooding	Water scarcity	Salinity	Other (iron)
Khulna	22	3%	0%	14%	31%	3%	3%	0%	17%	25%	3%
	26	0%	4%	2%	18%	0%	0%	0%	0%	2%	0%
	29	1%	1%	6%	16%	0%	2%	0%	5%	15%	1%
	30	3%	0%	15%	23%	0%	2%	0%	17%	28%	0%
	31 part	3%	0%	31%	14%	0%	6%	0%	31%	8%	0%
	Overall	2%	1%	11%	19%	0%	2%	0%	11%	18%	0%
Patuakhali	43-1A	10%	2%	0%	2%	0%	7%	2%	0%	2%	0%
	43-2A	3%	13%	0%	2%	0%	3%	10%	3%	2%	0%
	43-2D	11%	2%	5%	0%	0%	12%	2%	2%	0%	0%
	43-2E	14%	8%	0%	3%	0%	11%	3%	6%	0%	0%
	43-2F	14%	11%	7%	2%	0%	15%	12%	7%	6%	0%
	55-2A	8%	10%	3%	3%	0%	8%	10%	5%	3%	0%
	55-2C	8%	2%	0%	2%	0%	10%	4%	0%	2%	0%
	Overall	10%	7%	3%	2%	0%	10%	7%	4%	2%	0%
Total		6%	4%	7%	11%	0%	6%	3%	7%	10%	0%
Season	Rabi/boro	0%	2%	11%	22%	0%	0%	2%	9%	22%	1%
	Kharif-II	5%	9%	5%	2%	0%	5%	6%	6%	2%	0%
	kharif I	12%	2%	6%	8%	0%	13%	2%	7%	6%	0%

The percentages of WMG are the average number reporting over three seasons. As some WMG did not report a main or other problem in all seasons, and some WMG reported multiple other problems, the totals in each row may not add up 100%. More detained data by season and polder is in Appendix 2.

Table 3 shows the severity of the problem and the overall score for each polder and each season. In general problems seem to been reduced compared with the pre-project situation, with an average reduction in score of 1.1 – i.e. on average the score has improved by just over one place. Overall over half of WMGs (55%) say the situation is now good or very good, compared with only 8% in the pre-project situation.

[3] Not all of polder 31 was covered by BGP. References to polder 31 in this report apply to that part that was covered by BGP.

Table 3: Severity of water management problems

Zone	Polder	pre-project situation- % of WMG					Severity score	Current situation - % of WMG					Severity score
		1	2	3	4	5		1	2	3	4	5	
Khulna	22	0%	11%	22%	47%	19%	3.8	6%	28%	36%	31%	0%	3.4
	26	0%	9%	24%	51%	16%	3.7	0%	51%	42%	7%	0%	2.1
	29	1%	17%	36%	36%	11%	3.4	2%	44%	43%	10%	0%	3.3
	30	2%	18%	23%	32%	23%	3.5	9%	28%	32%	20%	9%	2.4
	31 part	0%	14%	39%	22%	25%	3.6	17%	28%	36%	14%	6%	2.3
Patuakhali	43-1A	0%	0%	31%	57%	12%	3.8	29%	48%	19%	5%	0%	3.0
	43-2A	0%	2%	29%	54%	16%	3.8	13%	54%	27%	3%	3%	2.9
	43-2D	0%	1%	27%	57%	13%	3.8	10%	60%	21%	7%	1%	2.1
	43-2E	0%	3%	33%	39%	19%	3.6	17%	44%	14%	17%	3%	2.8
	43-2F	0%	0%	40%	52%	9%	3.7	0%	81%	15%	4%	0%	3.3
	55-2A	0%	0%	38%	36%	23%	3.7	10%	23%	56%	8%	0%	1.9
	55-2C	0%	4%	31%	58%	6%	3.7	6%	58%	21%	15%	0%	3.4
Total	total	0%	8%	31%	44%	15%	3.6	8%	47%	31%	11%	2%	2.7
Season	Rabi/boro	0%	3%	23%	53%	20%	3.9	9%	43%	34%	14%	1%	2.5
	Kharif-II	1%	17%	41%	34%	8%	3.3	12%	66%	18%	2%	0%	2.1
	kharif I	0%	5%	30%	45%	18%	3.7	3%	31%	40%	18%	5%	2.8

Score: 1 = very good, 2=good (i.e. no problem), 3-=average, 4=bad, 5=very bad. Severity score is the average of these over three seasons. More detailed data by season for each polder is in Appendix 2.

There is considerable variation in the changes reported by different WMGs. Table 4 shows that 5% of WMG say that water management problems have actually got worse, and another 21% saying there was no change. These is significant variation between polders, with a worsening situation being reported by 14% of WMGs in 43-2E, 12% in 55-2C and 8% in polder 30. In contrast, WMGs in polder 43-1A report large improvements in water management, with 24% of WMG moving up three or four places.

The pilot study of polders 2 and 43-2B illustrates why there are such variations between WMG within a polder. In polder 2, some WMG said that improved drainage works were not yet effective (or fully effective) in their area, or large land owners interested in fish production were preventing improved drainage that benefited crop growers. In polder 43-2B crop growing conditions in one sub-catchment had deteriorated due to a major breech in the embankment, while in another the outlet sluice was controlled for the purpose of fishing and there had been no improvement in drainage. But, overall, in these two polders, the picture is one of improved drainage as a result of sluice gate repairs and khal re-excavation. In the Amodkhali khal catchment of polder 2 (34% of the total area of the polder) three WMG out of six visited reported improved drainage, with little or no improvement in the other three, while in polder 43-2B, four sub-catchments out of six in the polder reported improved drainage.

Table 4: Change in severity water management problems

Zone	Polder	Change in score of water problems							Net change
		-2	-1	0	1	2	3	4	
Khulna	22	0%	0%	33%	50%	17%	0%	0%	0.83
	26	0%	4%	13%	44%	36%	2%	0%	1.18
	29	1%	3%	32%	45%	20%	0%	0%	0.81
	30	1%	7%	38%	33%	18%	1%	1%	0.65
	31 part	0%	0%	44%	28%	17%	11%	0%	0.94
Patuakhali	43-1A	0%	2%	7%	26%	40%	19%	5%	1.81
	43-2A	0%	5%	6%	37%	35%	17%	0%	1.54
	43-2D	0%	1%	13%	31%	40%	12%	1%	1.51
	43-2E	6%	8%	0%	31%	31%	19%	0%	1.31
	43-2F	0%	2%	10%	35%	44%	9%	0%	1.47
	55-2A	0%	3%	15%	46%	26%	8%	0%	1.18
	55-2C	2%	10%	2%	38%	44%	4%	0%	1.23
Total		1%	4%	21%	37%	29%	7%	1%	1.13
Season	Rabi/boro	0%	3%	12%	41%	34%	9%	0%	1.35
	Kharif-II	1%	3%	20%	36%	32%	7%	1%	1.20
	kharif I	1%	5%	30%	35%	22%	4%	0%	0.84

FGD in polders 22, 26, 29, 30, 43-1A and 43-2D also reported that there were still parts of individual WMG command areas that suffered from poor drainage and/or lack of water in khals for irrigation in the rabi season, and further works were needed.

Water management issues are often complex and it can be difficult to generalise at the WMG level. Let alone at the polder level. Farmers in polder 29 with higher land may want to maintain water levels for irrigation, while those on lower land want water drained out. In polder 22, growers of early maturing paddy varieties want water drained out earlier than those with later maturing varieties. In this polder it was also reported that land owners had refused to give up the land needed for field drainage channels.

3. Changes in crop areas

3.1 Khulna zone

The cropping system in the Khulna zone polders was basically aman paddy followed by irrigated boro paddy along rabi crops such as sesame. A significant amount of land may be utilised by fish/shrimp ghers – more so in the kharif seasons, with some of this land being used to grow boro in the rabi season. The WMG survey shows small increases in the proportion of land used for aman (as almost all land was growing aman prior to BGP) and aus (overall from 1.0% to 5.9%), but the main change has been in the rabi season with an increase in area of boro – with an overall increase from 10.2% to 35.6% of total land available (i.e. of crops+fish gher+fallow). At the same time the area sesame (the main rabi non-rice crop) has fallen considerably. There has been a moderate increase in the area gher in all three seasons. A significant and expanding area of high value crops are grown – with watermelon now occupying 5.7% of land in the rabi season and vegetables over 8% of land in both the rabi and kharif-I seasons. Data is shown in Tables 5, 6 and 7.

Table 5: Land use in the rabi/boro season in the Khulna zone

Rabi / boro crops	Polder 22		Polder 26		Polder 29		Polder 30		Polder 31 part		Total (weighted)	
	before	now	before	now	before	now	before	now	before	now	before	now
Boro Paddy (HYV)	0.3	3.3	21.0	21.3	11.0	19.9	1.3	6.9	9.1	9.3	8.3	13.6
Boro Paddy (Hybrid)	0.1	4.9	7.5	47.1	1.2	26.8	1.2	10.8	0.9	19.3	1.9	22.0
Fish / shrimp gher	4.6	7.9	9.7	11.8	12.2	18.4	3.4	5.0	21.5	15.1	9.8	12.3
Mungbean	2.2	2.5	0.0	0.0	3.8	0.9	10.6	6.8	1.2	1.3	4.9	2.8
Watermelon	0.2	32.9	0.0	0.9	0.2	2.1	0.6	5.2	0.0	7.5	0.3	5.7
Sesame	8.3	5.1	1.5	0.1	20.3	3.9	41.9	14.8	14.8	4.6	23.0	6.9
Vegetable	1.5	4.4	5.1	8.5	8.0	12.3	4.0	6.8	1.8	2.8	5.2	8.4
Other crops	1.1	0.3	0.7	0.3	1.8	0.9	0.6	1.3	0.2	1.2	1.0	0.9
total crops	13.6	53.4	35.7	78.2	46.3	66.7	60.2	52.6	27.8	45.8	44.6	60.3
total crops & fish	18.2	61.3	45.5	90.0	58.4	85.1	63.5	57.5	49.3	60.8	54.4	72.6
Fallow	81.8	38.7	54.5	10.0	41.6	14.9	36.5	42.5	50.7	39.2	45.6	27.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

There has also been a significant move from local varieties of aman to HYV. Before BGP, over 70% of aman was local varieties, but now over half is HYV. Most, but not all, of the expansion of boro has used hybrid rather than HYV varieties. The area under HYV has grown from 8.3% to 13.6% of the total area, while that of hybrid has increased from 1.9% to 22.0%.

Major differences between the five polders covered in the WMG survey are:

- Polder 22: very little boro is grown here, and there is also less gher and other rabi crops – but water melon has recently expanded enormously and covers one third of the area in the boro season.
- Polder 26: has a larger area of boro (now covering over two-thirds of land), and a significant area (18% of land) of vegetables in the kharif-I season, but less water melon is grown. Fish ghers now cover over one third of land in both kharif seasons
- Polder 29 also has a large area of fish ghers in kharif season and quite a bit of land (over 12%) under vegetables in the rabi and kharif-I seasons.
- Polder 30 does not have so much boro (increase from 2.5% to 17.7%), or fish gher (maximum of 10% of land in kharif-I)

- Polder 31 part: in contrast to the other polders, there has been a sharp drop in the area of gher from almost one quarter of land in all three seasons to almost none in both kharif seasons and 15% in rabi. This is the one polder where quite a lot of aus paddy is now grown, accounting for almost half of all land in kharif-I. Unlike the other polders there has also been a significant increase in aman – from 75% to 99% of land in kharif-II.

Table 6: Land use in the kharif-I season in the Khulna zone

Kharif-I crops	Polder 22		Polder 26		Polder 29		Polder 30		Polder 31 part		Total (weighted)	
	before	now	before	now	before	now	before	now	before	now	before	now
Aus Paddy (Local)	0.0	0.2	0.7	0.1	2.1	0.0	0.0	0.3	0.0	4.3	0.9	0.6
Aus Paddy (HYV)	0.0	0.0	0.0	0.0	0.2	0.4	0.0	0.1	0.0	41.8	0.1	5.3
Fish / shrimp gher	9.0	13.6	28.1	43.5	30.2	47.1	6.3	10.5	23.2	2.9	20.2	27.6
Vegetable	1.7	2.5	8.0	17.8	7.6	12.8	1.9	3.5	0.8	0.0	4.6	8.3
Other crops	0.0	0.0	1.0	0.3	0.9	0.4	3.5	1.1	0.0	0.0	1.5	0.5
total crops	1.7	2.7	9.7	18.2	10.8	13.6	5.4	4.9	0.8	46.1	7.1	14.7
total crops & fish	10.7	16.3	37.8	61.7	40.9	60.7	11.7	15.4	23.9	48.9	27.3	42.3
Fallow	89.3	83.8	62.2	38.3	59.1	39.3	88.4	84.6	76.1	51.1	72.7	57.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 7: Land use in the kharif-II season in the Khulna zone

Kharif-II crops	Polder 22		Polder 26		Polder 29		Polder 30		Polder 31 part		Total (weighted)	
	before	now	before	now	before	now	before	now	before	now	before	now
Aman Paddy (Local)	54.6	9.5	29.7	4.1	41.0	11.9	82.5	74.2	58.8	42.5	55.4	33.6
Aman Paddy (HYV)	35.3	80.0	29.7	46.9	28.8	46.5	6.7	15.5	16.6	56.8	21.1	40.7
Fish / shrimp gher	8.1	7.6	24.3	37.2	22.2	31.4	5.1	8.6	23.2	0.0	16.3	19.6
Other crops	2.0	2.9	7.0	11.5	6.4	9.9	0.9	1.7	0.2	0.0	3.7	5.9
total crops	91.9	92.4	66.3	62.5	76.2	68.4	90.2	91.4	75.6	99.3	80.3	80.2
total crops & fish	100.0	100.0	90.7	99.7	98.4	99.8	95.3	100.0	98.8	99.3	96.6	99.8
Fallow	0.0	0.0	9.3	0.3	1.4	0.4	4.8	0.0	1.3	0.7	3.4	0.2
Total	100.0	100.0	100.0	100.0	99.8	100.1	100.0	100.0	100.0	100.0	100.0	100.0

3.2 Satkhira (polder 2)

The pilot study only covered the central part of this very large polder where improvements to drainage in the Amodkhali khal catchment were expected to have resulted in more low-lying beel land being used to grow aman paddy. The main paddy crop is boro, occupying all virtually beel land in the rabi season, with most of this this land either being fallow or used for fish ghers in the kharif seasons. The pilot study only covered beel land (about half of the area of the catchment), and only six out of 24 WMG in the catchment. Therefore it is not possible to draw any conclusions for polder 2 as a whole. Of the six WMG visited, one (Koikhali khal) has been able to convert 90% of beel land to aman – previously this was 30% used for seasonal fish ghers and 70% was fallow. Now all the fallow land and most of the fish ghers have been converted to aman. Two more of the six WMG reported a substantial increase in aman cultivation – in the order of 40% to 50% of the beel area. Goshkhali khal WMG reported that, with better drainage, the area of aman was increased from 30% to 80% of the beel area, with a commensurate reduction in the area of fallow land. Some jute is also now grown. After Amodkhali khal was re-excavated, all of the beel area of Darikkha WMG was planted with aman. This area had previously been fallow in the aman season. However the crop was flooded and submerged, and 60% of the

area failed to produce a harvest. A small part of this land was then used as a seasonal fish gher. As further re-excavation of Amodkhali khal is now taking place, farmers are keen to try and grow aman next season.

The remaining three sample WMG reported growing aman on no more than 5% of their beel area. Chellar beel khal WMG has expanded their area of aman from 28% to 33% of beel land, and Hazikhali WMG has expanded the area of aman from 11.5% to 15.4% of the beel area. But Jhyar khal still grows no aman at all on its beel land. More details are in Appendix 3.

3.3 Patuakhali zone

Most groundwater in this zone is saline, which means that very little irrigated boro can be grown. There iare also very few fish/shrimp ghers. As in Khulna, in kharif-II most land is used to grow aman but, unlike Khulna, aus paddy is also widely grown in kharif-II (although the area of this crop has been slightly reduced during the BGP period). There has been considerable growth in the area of non-rice rabi crops, which get little or no irrigation. Data from the seven polders covered in the WMG survey shows that mung bean is now the principal rabi crop, being grown on two thirds of all land in the rabi season. An increase from one fifth prior to BGP. Prior to BGP, keshari was the principal rabi crop, covering one quarter of all land, but this has now dramatically declined to under 1%. The overall area under rabi crops has grown from 63% to 94% of all land – with improved drainage being a major contributor to this change. Data is in Table 8, 9 and 10.

The pilot survey gathered data from all six sub-catchments of polder 43-2B. This shows a similar pattern of change as that in the seven WMG survey polders. The area of rabi crops has increased from 48% to 81% of all land, and there was a similar switch from keshari (down from 20% to 0.5%) to mung bean (up from 13% to 54%). More details for this polder are in Appendix 4.

Table 8: Land use in the rabi/boro season in the Patuakhali zone

Rabi / boro crops	Polder 43-1A		Polder 43-2A		Polder 43-2D		Polder 43-2E		Polder 43-2F		Polder 55-2A		Polder 55-2C		Total (weighted)	
	before	now	before	now	before	now	before	now	before	now	before	now	before	now	before	now
Boro Paddy (HYV)	0.0	7.1	0.0	0.0	0.2	4.8	0.2	4.2	0.0	0.1	0.4	3.8	0.4	8.3	0.2	4.2
Boro Paddy (Hybrid)	0.0	0.0	0.0	0.0	0.0	3.8	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9
Fish / shrimp gher	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mungbean	15.7	42.4	8.3	68.8	14.7	68.3	8.3	72.9	2.6	67.0	32.8	70.2	32.8	67.2	19.5	66.4
Watermelon	10.9	21.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	2.5	1.0	2.6
Chilli	4.2	4.6	4.3	5.6	3.7	4.0	4.8	6.9	3.7	8.0	3.9	5.5	3.9	3.8	4.0	5.1
Ground-nut	8.0	7.9	8.0	11.0	5.0	6.0	3.9	5.2	4.1	7.4	2.5	4.9	2.5	6.8	4.5	6.8
Sweet –potato	1.4	0.1	4.0	2.6	2.6	1.2	4.1	1.5	5.0	1.6	1.8	1.4	1.8	0.5	2.7	1.3
Keshari (grasspea)	20.0	1.9	22.9	1.6	21.3	0.2	40.7	1.3	37.2	0.6	23.4	0.2	23.4	0.0	25.0	0.6
Vegetable	1.1	0.7	0.2	0.3	0.4	0.7	1.2	0.5	0.6	1.0	0.8	0.6	0.8	0.3	0.7	0.6
Other crops	4.4	6.7	5.1	2.9	4.3	4.3	2.3	3.0	1.4	5.6	8.2	6.7	8.2	5.7	5.5	5.2
Total crops	65.7	92.9	52.8	92.8	52.1	93.2	65.4	95.8	54.6	91.3	73.8	94.6	73.8	95.0	62.9	93.6
Fallow	30.7	7.1	47.4	7.2	47.9	6.8	35.4	4.2	45.4	8.7	26.2	5.4	26.2	5.0	37.1	6.4
Total	96.4	100.0	100.1	100.0	100.0	100.0	100.8	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

As in the Khulna zone, there has been a switch from local to HYV aman and aus paddy (the small area of boro is mainly HYV rather than hybrid). In the WMG survey polders and in polder 43-2B, prior to BGP, over 90% of aman was local varieties, while now over half is HYV. Aus paddy has also switched from being 75% local to 93% HYV in the WMG survey polders, and from being 99% local to 95% HYV in polder 43-2B.

Table 9: Land use in the kharif-I season in the Patuakhali zone

Kharif-I crops	Polder 43-1A		Polder 43-2A		Polder 43-2D		Polder 43-2E		Polder 43-2F		Polder 55-2A		Polder 55-2C		Total (weighted)	
	before	now	before	now	before	now	before	now	before	now	before	now	before	now	before	now
Aus Paddy (Local)	29.6	4.3	27.6	5.1	16.3	0.4	10.4	0.8	24.9	3.0	10.0	0.2	10.0	0.0	17.2	1.5
Aus Paddy (HYV)	5.0	41.8	11.9	19.8	0.2	17.5	2.5	10.0	16.2	38.1	4.6	10.5	4.6	8.9	5.8	18.9
Fish / shrimp gher	4.3	2.9	0.0	0.0	8.8	6.8	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	2.3	1.9
Other crops	0.0	0.0	0.0	0.0	0.0	0.0	3.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Total crops	38.9	48.9	39.5	24.9	25.2	24.6	16.3	11.3	41.1	42.6	14.6	10.8	14.6	8.9	25.5	22.4
Fallow	62.5	51.1	60.5	75.1	74.8	75.4	83.8	88.8	58.9	57.4	85.4	89.2	85.4	91.1	74.5	77.6
Total	101.4	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Major differences between the eight polders (seven WMG survey plus 43-2B) are:

- Polder 43-1A has a significant area of water melon – which has doubled to 21% of the area. This polder also has a small area of fish gher in the kharif-I season (declining from 4.3% to 2.9%). This polder has a relatively large area of aus paddy which has increased (from 35% to 46%).
- Polder 43-2A had a relatively large area of aus paddy, but here it has declined from 40% to 25% of land.
- Polder 43-2B is the only other polder with a significant area of water melon – increasing from nothing to 14% of land in the rabi season. Improved drainage khals are reported to have allowed farmers to provide supplementary irrigation for this crop. The area under aus paddy has increased from 20% to 30% of cultivated land.
- Polder 43-2D has a small area under fish gher in the kharif-I season – this has fallen from 8.8% to 6.8% of the cultivable area. Fish ghers are not usually found in this region.
- Polder 43-2F has a significant area (41% of land) under aus, but this has remained unchanged during the BGP period.

Table 10: Land use in the kharif-II season in the Patuakhali zone

Kharif-II crops	Polder 43-1A		Polder 43-2A		Polder 43-2D		Polder 43-2E		Polder 43-2F		Polder 55-2A		Polder 55-2C		Total (weighted)	
	before	now	before	now	before	now	before	now	before	now	before	now	before	now	before	now
Aman Paddy (Local)	80.4	42.5	82.9	64.3	93.7	55.5	72.9	62.9	87.4	43.5	88.1	48.1	88.1	31.3	87.2	48.5
Aman Paddy (HYV)	20.4	56.8	7.6	34.5	5.6	44.5	11.7	37.1	11.1	56.3	7.3	51.9	7.3	68.8	8.8	51.2
Fish / shrimp gher	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Other crops	0.0	0.0	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Total crops	100.7	99.3	92.4	99.3	99.3	100.0	84.6	100.0	98.5	99.8	95.4	100.0	95.4	100.0	96.2	99.8
Fallow	1.4	0.7	7.6	0.7	0.7	0.0	14.6	0.0	1.5	0.2	4.6	0.0	4.6	0.0	3.8	0.2
Total	102.1	100.0	100.0	100.0	100.0	100.0	99.2	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

4. Change in Cropping Intensity

4.1 Calculation of cropping intensity.

Cropping intensity (c.i.) is generally taken to be the total area of all crops grown during one year divided by the area of cultivable land. Thus if all land is used to grow two crops the year, the c.i. is 200%. However this is complicated in the Khulna zone by the significant area being used by fish ghers. In the Khulna zone it is possible to calculate c.i. in three different ways as follows:

- Method A: (crops+gher)/(crops+gher+fallow) - this shows the overall intensity of land use with ghers treated as another crop – which is reasonable as ghers may well be cropped seasonally or converted into crop land. Perennial ghers occupying land in all three seasons would have a c.i. of 300%.
- Method B: crops/(crops+gher+fallow) - this shows the share of crops in overall land use, and effectively ignores ghers as a form of land use. This would seem to be closest to the method used by Satelligence which is the number of crop harvests in one year.
- Method C: crops/(crops+fallow) - this takes fish out of the equation and shows the intensity of land used for crops.

Table 11 compares c.i. calculated using these three methods for the five polders in Khulna. This uses data from the WMG survey and data from the Satelligence report derived from satellite images. Method B gives a lower c.i. but, in terms of change in c.i., these WMG survey results are closest to Sateligence (although polder 31 part is very different as the WMG survey shows a large fall in the gher area in the aman & aus seasons). The overall figure is a weighted average.

Table 10: Methods of calculating cropping intensity

Polder	Method A		Method B		Method C		Satelligence		Change in cropping intensity			
	before	After	before	after	before	after	before	after	A	B	C	Satell.
22	128.8	177.6	107.2	148.5	116.1	161.1	132	171	48.8	41.3	45.0	39
26	173.9	251.3	111.7	158.9	140.7	220.3	114	166	77.4	47.1	79.6	52
29	197.8	245.5	133.2	148.6	166.2	206.8	141	157	47.7	15.4	40.6	16
30	170.4	172.9	155.7	148.8	163.0	160.8	169	179	2.5	-6.9	-2.2	10
31 part	172.0	209.0	104.2	191.1	134.8	200.6	128	162	37.0	86.9	65.8	34
overall	178.3	214.7	132.0	155.2	154.3	188.8	143.9	166.5	36.4	23.2	34.5	22.6

'* overall data is the average for all polders weighted by the relative area of each polder

For the purposes of this report, c.i. has been calculated using method A – i.e. treating fish ghers as another crop.

4.2 Khulna zone cropping intensity

Data on cropping intensity in each of the five WMG survey polders is in Table 12. This shows that overall cropping intensity increased from 178% to 215% - an increase of 36%. Data derived by Satelligence from satellite images gives lower estimates of cropping intensity as this does not seem to take account of land utilised for fish production. The overall increase in c.i. is 36 percentage points using the WMG data and 23 percentage points from the satellite data. Estimates of the c.i. from nearby polders (non-BGP) using satellite images have been used as a control group. Overall these polders have lower c.i. than the BGP polders, but their overall increase in c.i. is 25.5 percentage points, slightly higher that satellite data for the BGP polders – although their overall level of c.i. is lower than for the BGP polders.

It is worth noting that both the WMG survey and Satelligence estimate show that the lowest increase in c.i. was in polder 30.

Table 12: Estimates of cropping intensity for polders in Khulna

	Polder	WMG survey		Satelligence		Change in c.i.	
		before	now	Before	now	WMG	Sat
BGP polders	22	128.8	177.6	132.0	171.0	48.8	39.0
	26	173.9	251.3	114.0	166.0	77.4	52.0
	29	197.8	245.5	141.0	157.0	47.7	16.0
	30	170.4	172.9	169.0	179.0	2.5	10.0
	31-BGP	172.0	209.0	128.0	162.0	37.0	34.0
	Overall*	178.3	214.7	143.9	166.5	36.4	22.6
Control polders	16			86	108		22.0
	17-1			96	128		32.0
	17-2			114	127		13.0
	18/19			79	90		11.0
	20			117	143		26.0
	21			118	161		43.0
	31 non-BGP			125	159		34.0
	Overall*			102.3	127.8		25.5

'* overall data is the average for all polders weighted by the relative area of each polder

4.3 Satkhira (polder 2) cropping intensity

The pilot study covered six WMG in the central catchment area of this polder. Overall cropping intensity in the beel areas of these WMG rose from 141% to 172%, an increase of 31 percentage points. Cropping intensity (including fish ghers) was close to 200% at Hazikhali and Jhyar khal prior to BGP, limiting the scope for further improvement.

Satelligence data for this polder show a lower c.i. and a smaller increase – from 129% to 142%, an increase of 13 percentage points. However the Satelligence data did not include harvests from fish ghers – so effectively these did not contribute to cropping intensity. Moreover the pilot study focused on the area where BGP had been most effective - the beel land in the Amodkhali catchment area. But comparing the Sateligence estimate for the whole of polder 2 with estimates for two control polders on each side of polder 2, shows that polder 2 had a greater increase in c.i.- 13 percentage points compared with 2 percentage points (Table 13) This suggests that Blue Gold may have had a positive impact on the area covered by crops in this polder.

Table 13: Estimates of cropping intensity in Satkhira

	Polder	Pilot study		Satelligence		Change in c.i.	
		before	now	before	now	WMG	Sat
BGP polders	2	141	172	129	142	31	13
Control polders	1			125	117		-8
	6-8			119	129		10
	Overall			122	124		2

'* overall data is the average for all polders weighted by the relative area of each polder

4.4 Patuakhali zone cropping intensity

The WMG study covered seven polders in this zone, and data from polder 43-2B is also included, making a total of eight BGP polders (see Table 14). The overall c.i. for these polders prior to BGP was 181%, and this has increased by 34 percentage points to 214%.

Table 14: Estimates of cropping intensity in the Patuakhali zone

	Polder	WMG data		Satelligence		Change in c.i.	
		before	now	before	now	WMG	Sat
BGP polders	43-1A	205.4	241.1	111.0	193.0	35.7	82.0
	43-2A	184.7	216.9	112.0	215.0	32.2	103.0
	43-2B	155.0	204.0	108.0	204.0	49.0	96.0
	43-2D	176.6	217.8	107.0	220.0	41.2	113.0
	43-2E	166.3	207.1	121.0	205.0	40.8	84.0
	43-2F	194.3	233.7	121.0	195.0	39.4	74.0
	55-2A	183.8	205.4	118.0	196.0	21.5	78.0
	55-2C	183.8	203.9	116.0	201.0	20.0	85.0
	Overall*	180.6	214.3	113.4	204.6	33.7	91.2
Control polders	43-1			112.0	166.0		54.0
	43-2C			107.0	172.0		65.0
	54			103.0	146.0		43.0
	54-AB			113.0	153.0		40.0
	55-2B			120.0	191.0		71.0
	55-2D			113.0	200.0		87.0
	55/2E			120.0	211.0		91.0
	Overall*			113.9	183.7		69.7

'* overall data is the average for all polders weighted by the relative area of each polder

Satelligence data for these same eight polders shows a much larger increase in c.i. (91 percentage points) due to a much lower pre-project estimate of only 113%. Seven nearby non-BGP polders have been used as a control group, with Satelligence data showing a very similar pre-project c.i. of 114%, and a current c.i. of 184% - significantly lower than the 205% in BGP polders. As a result, the 91 percentage point increase recorded in the BGP polders using Satelligence data is significantly higher than the 70 percentage point increase in the control polders. This provides some convincing evidence of the possible impact of BGP in this zone.

4.5 Variability in cropping intensity between WMG

In both the Khulna and Patuakhali zones there is considerable variation in cropping intensity between WMG. In fact there is often more variation in WMG survey data between WMG in a single polder, than from one polder to another. Data in Table 15 shows the average, minimum and maximum c.i. recorded by WMG in each polder. The range in c.i. (the maximum divided by the minimum) was as much as 3.43 (polder 30, pre-BGP) while the range between the average for each polder was only 1.59. Current c.i. data for each polder shows less variation, however 14% of all WMG has recorded a decline in c.i. of as much as 85 percentage points, while 6% of WMG reported no change in c.i. In polder 30, 45% of WMG reported a decline in c.i. with another 5% reporting no change. Around one quarter of WMG in polders 31 and 43-2A recorded a fall or no increase in c.i.

Table 15: Variability of changes in cropping intensity

	Cropping intensity before BGP				Cropping intensity after BGP				Change in c.i.			Percentage of WMG with:		
	average	Max	min	Range	average	max	min	range	Average	max	min	Reduced c.i.	No change	Increased c.i.
22	129	163	100	1.63	178	200	138	1.45	49	80	5	0%	0%	100%
26	174	262	80	3.28	251	299	152	1.97	77	140	-10	7%	0%	93%
29	198	300	100	3.00	245	300	160	1.88	48	170	-40	4%	11%	86%
30	170	240	70	3.43	173	225	110	2.05	3	90	-60	45%	5%	50%
31 part	172	290	125	2.32	200	290	155	1.87	27	105	-20	17%	8%	75%
43-1A	205	280	150	1.87	241	300	180	1.67	41	80	-20	7%	0%	93%
43-2A	185	230	110	2.09	217	280	170	1.65	29	105	-20	24%	0%	76%
43-2D	177	270	130	2.08	218	300	160	1.88	43	95	0	0%	4%	96%
43-2E	166	250	100	2.50	207	230	165	1.39	40	100	-85	8%	8%	83%
43-2F	194	260	110	2.36	234	280	195	1.44	40	125	-60	7%	4%	89%
55-2A	184	205	150	1.37	205	225	190	1.18	22	45	0	0%	15%	85%
55-2C	185	230	130	1.77	204	250	180	1.39	20	85	-20	31%	6%	63%
min	129				173							14%	6%	80%
max	205				251									
range	1.59				1.45									

5. Increase in crop yields

The WMG survey gathered information on the yield of the principal crops. Data from polders in the Khulna zone in Table 16 shows that there has only been limited yield increases for HYV boro and local and HYV aman, but farmers will have achieved a 34% increase in production of these crops by switching from HYV to hybrid seed for boro, and a 50% increase in production by switching from local to HYV aman varieties.

Table 16: Yield of principal crops in Khulna zone (kg per hectare)

	Polder 22		Polder 26		Polder 29		Polder 30		Polder 31		Average		
	before	now	before	Now	before	now	before	now	before	Now	before	now	increase
Boro Paddy (HYV)	4,495	4,150	4,823	5,249	4,598	5,067	5,187	5,138		4,802	4,781	4,877	2%
Boro Paddy (Hybrid)	5,434	5,558	6,768	7,430	5,879	6,862	4,150	6,710			5,558	6,423	16%
Mung bean	823	790			1,092	2,847	1,087	847	1,097	1,122	1,031	1,379	34%
Watermelon	39,520	53,621		54,340	57,633	70,593		60,323	39,520	39,630	45,594	56,894	25%
Aman Paddy (Local)	2,816	3,195	2,901	3,331	3,207	2,908	3,022	3,071	2,526	2,900	2,969	3,095	4%
Aman Paddy (HYV)	4,237	4,751	3,962	4,467	4,181	4,246	3,732	4,726	3,853	4,803	4,183	4,475	7%

There has been a significant increase in yields of all the principal crops in the Patuakhali zone (Table 17).

Table 17: Yield of principal crops in Patuakhali zone (kg per hectare)

	Polder 43-1A		Polder 43-2A		Polder 43-2D		Polder 43-2E		Polder 43-2F		Polder 55-2A		Polder 55-2C		Average		
	before	now	before	now	before	now	before	now	before	now	before	now	before	now	before	now	increase
Boro HYV		4,802			4,742	5,676	3,952	6,521		5,928	3,952	5,849		5,372	4,215	5,691	35%
Mungbean	1,097	1,122	699	1,026	907	1,168	576	1,042	560	1,047	871	1,094	880	1,272	799	1,110	39%
Chilli	1,630	1,908	1,232	1,482	1,598	1,933	879	972	1,846	2,532	1,460	1,762	1,400	1,179	1,435	1,681	17%
Ground-nut	2,371	2,486	2,216	2,524	2,460	3,035	2,075	3,122	2,141	2,507	1,939	2,223	1,976	1,816	2,168	2,531	17%
Keshari	1,227	1,225	1,126	968	1,098	790	1,276	2,618	1,138	914	1,161	1,482	1,193		1,174	1,333	14%
Aman Local	2,526	2,900	2,418	2,945	2,477	2,968	2,157	2,989	2,404	2,865	2,546	2,941	2,229	2,463	2,394	2,867	20%
Aman(HYV)	3,853	4,803	3,846	4,714	3,838	4,977	4,150	5,306	3,870	4,581	4,093	4,963	3,754	5,070	3,915	4,916	26%
Aus (local)	2,386	3,820	2,082	3,023	2,272	2,174	2,174	2,124	2,210	3,532	2,766	3,458	1,793		2,240	3,022	35%
Aus (HYV)	3,837	4,439	3,594	4,167	3,458	4,654	3,952	4,100	3,365	4,007	4,051	4,534	3,112	4,150	3,624	4,293	18%

Crop yield data was gathered from farmers in polders 2 and 43-2B during the pilot study and is shown in Table 18. This data was discussed with BGP agronomists and polder teams, and compared with data from BGP crop cutting and DAE statistics. These yield assumptions were used in the calculation of economic benefits. Compared with the data in Tables 16 and 17 from the WMG survey, the yield assumed for HYV boro in polder 2 was significantly higher, while yields for pulses (keshari and mung bean) and groundnut were significantly lower.

Table 18: Yield assumptions used in the pilot study

		Yield kg per hectare	
		Polder 2	Polder 43-2B
Boro / rabi season	Boro paddy HYV	6,961	
	Keshari (grass pea)		790
	Felon (cow pea)		1,112
	Mung bean local variety		556
	Mung bean HYV		865
	Sesame		593
	Groundnut		1,778
	Sweet potato		9,263
	chilli local variety		556
	chilli HYV		2,470
Kharif I season	Aus paddy local variety		1,853
	Aus paddy HYV		3,952
Kharif II season	Aman paddy local variety		2,470
	Aman paddy HYV	4,042	4,446

6: Factors behind increases in agricultural production

6.1 Link between improved water management and increased cropping intensity

Although it may be expected that WMG reporting reduced water-related constraints to crop production would also report increases in crop areas and so cropping intensity, there is not much of a link between WMG data on improved water management and increased cropping intensity. The two variables of the increase in c.i. and the improvement in water management problem score have been plotted for each WMG on Figure 1, and it can be seen that there is little correlation between the two (the trend line has an R^2 of only 0.11, which implies that almost 90% of variability in the change in c.i. is explained by factors other than improvements in water management).

However if the average improvement in water management problem score for each polder is plotted against the increase in cropping intensity derived from Satelligence data, then there is a much stronger relationship (Figure 2), with those polders with a larger improvement in water management problem scores having a larger increase in cropping intensity. Caution is needed in interpreting this data – water management problem scores are based on the subjective opinions of the interviewed WMG members and it cannot be assumed that the Satelligence estimate of change in cropping intensity is more accurate than the WMG survey just because there is a better correlation with the change in water management problem score.

Figure 1: Improvement in water problem score and increase in cropping intensity from WMG survey

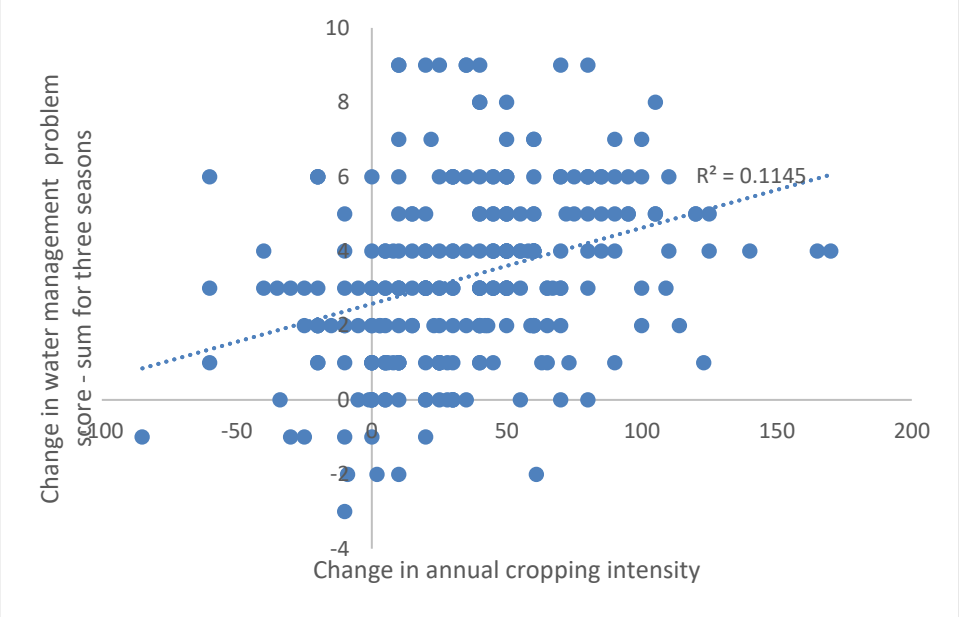
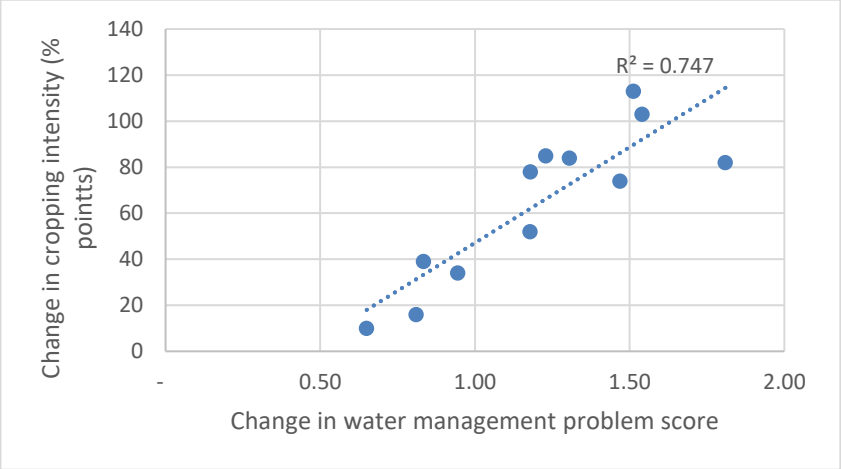


Figure 2: Improvement in water problem score and increase in cropping intensity from Satelligence



There could also be a link between improved water management and increase in areas of high yielding and high value crops. An initial examination of the available data does not show much of a relationship.

6.2 Satkhira – polder 2

The pilot study examined the factors that seemed to determine the adoption (or non-adoption) of aman on beel land of the six sample WMG command areas. These factors were:

- Availability of fallow land in the aman season
- Improved drainage of land in the aman season
- Utilisation of land for fish production
- Land ownership and tenure

Table 19 shows that there were serious constraints to expansion of aman in four of the six WMG commands. In three beels larger land owners were reluctant to convert land from fish gher to aman, and these ghers often obstruct the drainage of other parts of the beel. The profitability of a seasonal fish gher was more or less similar to aman production, and smaller farmers said that they preferred to grow aman for reasons of food security, a supply of straw as animal feed, and utilisation of household labour (reducing the need to migrate out to find work). . Although fish/shrimp gher production was said to be more risky, larger land owners were reported to prefer this to aman production, it being easier to lease out land to a large gher operator than to cultivate it themselves or to sharecrop out.

Table 19: Summary of increase in aman area and constraints in expansion of aman

WMG	Percentage of beel area		Land converted from	Constraints to conversion
	Aman area now	Aman area now		
Koilhali	0%	90%	fallow, fish	none, almost all land converted from fallow and fish
Goshkhali	30%	80%	Fallow	none, most land now aman
Hazikhali	11%	15%	Fallow	drainage not effective, obstruction of drainage by a perennial gher
Jhyar khal	0%	0%		Very big gher obstructs drainage
Chellar beel	28%	33%	Fallow	Large landowners prefer fish, ghers obstruct drainage
Darikkha	0%	40%	Fallow	Drainage not yet fully effective

WMG members from polder 2 reported increased crop yields due to improved drainage and/or improved technologies and farming methods introduced by BGP. It is reported that improved drainage has enabled boro to be planted earlier, resulting in higher yields. As a result of farmer field schools (FFS) a number of WMG reported adoption of line sowing of paddy and, in one WMG, 15% to 20% of farmers are reported to be using USG.

6.3 Feedback from farmers in the Khulna zone

FGDs in polders 22, 26, 29 and 30 reported that better water management has contributed to increased crop yields and higher profits. Better water management has allowed increased cultivation of paddy and other crops in the rabi season, and increased areas of HYV aman paddy and aus paddy in the kharif seasons. In polders 26 and 30 better water management is also reported to have contributed to increased areas of fish ghers in the kharif seasons – with off-season vegetables and water melons being grown on the banks of these ghers. Vegetables are now also grown in the aus as well as rabi seasons in polder 29, with okra being particularly profitable. In this polder the sesame that has been replaced by boro (thanks to improved irrigation water supply) was a risky crop due to erratic rains prior to harvest.

Apart from improved water management, FFS from DAE and the TA team has resulted in adoption of line sowing of paddy, improved paddy seedbed management (with lower seed rate), transplanting fewer seedlings per hill, and more judicious use of fertilisers and pesticides, along with better management of pests such as brown plant hopper. All the farmers who attended the various FFS are reported to have adopted these technologies, along with between 10% and 80% of other farmers. In polder 29 farmers have a tradition of producing seed for sale, and an FFS on seed production has helped them improve seed storage and processing.

Farmers in polder 22 reported that the introduction of BR-52, a submergence-tolerant and early maturing variety of aman, has not been very successful as: (i) as an early variety, it very much prone to rat attack; (ii) getting other farmers (who are not growing early varieties) to agree to drain out water prior to an early harvest; (iii) the market price of BR-52 is around 40% lower than other HYVs such as BR 28 or 10 as it is not a well-known variety; and (iv) it is not popular with farm households as it does not keep for long after cooking.

Farmers in FGDs reported that the main problems they face are the high cost of labour during peak periods, and also the need for loans at the right time, the high price of fertiliser and shortages of seed in the aman and rabi seasons. Collective purchase of inputs has been organised by some WMG, but this only covers 10% to 15% of members as this requires farmers to decide and pay in advance for the inputs they need. Farmers in polder 30 also mentioned pest problems, and said the training from BGP in pest management had not been very useful or effective.

6.4 Feedback from farmers in the Patuakhali zone

Polder 43-1A

Farmers report that better water management brought more land under cultivation in different seasons, with farmers are now adopting HYV for different crops. Without having good water management, the adoption of HYVs was not possible, especially in the aman and aus seasons. It was also difficult to cultivate crops during the rabi season, especially on low land.

FFS have taught farmers about line sowing, using less seed in paddy seedbeds, and fewer plants per hill in paddy transplanting. Farmers have also adopted leaf colour charts to guide urea application to guide urea applications to paddy, and some use pest control methods, such as perching, for aman.

Farmers have also been told about the use of irrigation and fertilizer in mungbean cultivation, but do not follow this as they say that they normally get sufficient rain, and yields without fertilizer are not bad. They do not want

to invest any more money in this crop as the risk of rain during harvest can cause a total loss. Major problems in this polder are shortages of seed (with prices being inflated by dealers), along with lack of loans and an increasing shortage of labour as the cropping intensity increases and non-farm employment grows.

Polder 43-2B

WMG members attribute the significant increase in the area off rabi crops to better drainage as sluices have been repaired and khals re-excavated, along with better awareness and knowledge of a range of rabi crops. In Nashaishil the sluice is controlled by fishers and farmers report almost no improvement in water management but, despite this, farmers have switched to growing HYV paddy and a larger area of rabi crops with the knowledge they have obtained from BGP and other sources. In Mushurukathi the main water management improvement seems to have been a better supply of water for the irrigation of melon, with increased knowledge of new crops and technologies being a key factor.

There has been a switch from local to HYV varieties of aman and aus paddy – before BGP almost all the area was planted with local varieties, now a little over half of aman is HYV as is almost all aus paddy (Table 10). This change is attributed to a combination of better drainage (rain water drains away more quickly allowing earlier planting of aman) and knowledge of HYV varieties – along with the availability of seed.

As well as a much larger area of rabi crops being grown, there has been a switch from keshari (grass pea) to mung bean and water melon. Discussions with WMG indicated that much of the improved knowledge came from BGP MFS (Market Field Schools) introducing BR52 (short-duration aman HYV) and improved methods of mung bean cultivation, and FFS introducing line sowing for paddy and mung, improved paddy seedbeds and better use of fertiliser. Information from FFS is reported as being disseminated to other farmers – such as line sowing and IPM for homestead vegetables. Some information has come from other sources – such as ATDP (DAE/USAID project) on mechanisation and use of USG, and seed companies on paddy HYVs.

Polder 43-2D

The two WMGs covered by FGD reported increased production and profitability, with an increase in cropping intensity and introduction of HYVs both contributing. Farmers said that without water management cultivation of HYV aman and different types of rabi crops would not be possible. With more water available for irrigation, farmers say they would like to switch from mung bean to boro paddy as mung is labour intensive, less profitable and there is a high risk of rain damage prior to harvest.

FFS are reported to have been effective regarding: (i) improved seedbed preparation, (ii) spacing of rows and plants for aman paddy and mung bean, (iii) reduced seed rates in paddy seedbeds, (iv) reduced numbers of seedlings (2/3) per hill for paddy transplantation, (v) omission of one line per 8 to 10 lines of mung bean and when transplanting aman - to make fertiliser and pesticide application more effective. These have been adopted by all FFS farmers and 80% of other farmers.

In 2016, BGP Command Area Water Management (CAWM) introduced BR-52 as a submergent tolerant early-maturing variety of aman. The idea was that earlier harvest of paddy would allow earlier cultivation of rabi crops (mung bean & sunflower), as well as higher prices from earlier harvesting. Farmers (around 50) cultivated this variety after getting seed from BGP. However cultivation of BR-52 has now fallen as: (i) as an early variety,25-30% of production was lost to rats; (ii) getting other farmers to agree to drain out water prior to an early harvest; and (iii) the market price of BR-52 is lower than other HYVs such as BR 28 or 10.

Major problems for farmers are shortages of seed and lack of labour in the peak season.

7. Changes in land tenure

Increased crop areas may provide new opportunities for relatively poor households to cultivate land. The pilot study found that, in polder 2, most land was owned by medium and large farmers, but most aman paddy is sharecropped and expansion of this crop in some WMG areas had created new opportunities for poor households to become sharecroppers and so gain access to land to improve their food security – although sharecropping of aman was not particularly profitable for tenants. The only polders covered in the WMG survey to report a significant increase in the area of aman (and even more aus) was polder 31 – and to a lesser extent polder 43-2E. The area under boro increased in polder 26 and 29, and to a lesser extent in polders 30 and 31. Where aman has traditionally been the main rice crop, it would be expected that additional boro cultivation would create opportunities for tenant farmers.

Data from the WMG survey in Table 20 does not show that there has been an increase in sharecropping in these or other polders. In fact there has been a general reduction in sharecropping in all three seasons in most polders. Most land is farmed by its owner, but there is also some fall in owner-operation, while more land is now being farmed under other lease arrangements. This includes mortgaging of land (whereby a tenant obtains the use of land in return for providing a loan to the land-owner – with the land being returned to its owner when the loan is repaid) and cash rental. These forms of tenure may also provide opportunities for land-poor households providing they have access to some capital.

Table 20: Land tenure

	Percentage of crops under different land tenure arrangements (average rabi & kharif II seasons)								
Polder	Owner cultivator			Sharecropper			Other lease		
	before	now	change	before	now	change	before	now	change
22	74	74	0	13	9	-4	8	17	8
26	54	43	-12	25	16	-10	20	42	21
29	52	46	-6	22	13	-9	26	41	16
30	62	64	2	26	25	-1	12	11	-1
31 part	52	52	-1	25	22	-3	22	26	4
43-1A	59	49	-10	18	12	-7	23	39	17
43-2A	64	58	-6	25	20	-6	11	23	12
43-2D	61	52	-9	24	19	-5	15	30	15
43-2E	70	66	-4	17	15	-3	13	20	6
43-2F	56	46	-11	23	8	-15	17	43	26
55-2A	51	45	-5	30	15	-15	19	40	20
55-2C	59	45	-14	25	21	-5	15	34	19

Data for each season is in Appendix 2.

The fall in owner operation could be linked to the decreasing size of land holdings and their increased fragmentation – which together with increased income from non-farm sources and migration to cities, means that farming is becoming less attractive for the smallest land-owners. That said, improvements to the profitability and reliability of some crops in some locations could mean that households who previously leased out land now find it worthwhile to farm themselves. An FGD in polder 22 found that the aman crop is now all owner-cultivated, whereas previously 10% had been sharecropped, and the same trend was apparent in polder 26.

FGD in polder 43-2D reported that there has been a slight increase in mortgaging of land and a fall in sharecropping. Large farmers and those lacking labour may want to lease out land, while improved yields and profitability, and the reduced risk for boro, encourage owner-cultivation.

The pilot study also found that in polder 43-2B, the changes to cropping patterns bought about with support from Blue Gold had not resulted in significant new opportunities for sharecroppers from poorer households. Around 70% to 75% of land is farmed by land-owners, with 5% to 10% sharecropped and 20% on a cash rent and 5% mortgaged.

Calculations for polders 2 and 43-2B found that sharecropping of most crops was not particularly profitable for tenants, which may be reflected by the general move away from sharecropping. Families who do not have sufficient people to cultivate their land, and who lack the financial resources to hire sufficient labour, may lease out some of their land via sharecropping or other leasing system. Poor families who have manpower, but insufficient land, may sharecrop land – preferring this arrangement to cash renting as they would need to pay a cash rent at the start of the year (or season), while rent (crop share) for sharecropped land is not paid until the crop is harvested. Sharecropping also reduces risk – if the crop produces less than expected, then the rental will also be lower. However a cash rent or mortgage tenure should normally generate more income for tenants – and provides greater incentives for tenants to use more labour and other inputs as the resulting additional crop production is not shared with the landlord. That said, cash rents and mortgage costs, as well as the purchase price of land, have all risen substantially (typically doubling) since the start of BGP.

8. Increase in farm income

The pilot study calculated the increase in farm income for polders 2 and 43-2B. This was based on the change in cropping patterns and the net income per hectare for each crop. Details of these calculations are in Appendices 3 and 4.

8.1 Increase in income for polder 2

In polder 2 calculations were based on data from six of the 24 WMG in the Amodkhali catchment. Total annual benefits from the change in cropping pattern alone is calculated in Table 21 to be Tk24.54 million for an area of 811 ha of beel (Tk30,253/ha). The annual benefits on polder 2 are less than half of the investment of Tk51.1 million (total polder development cost divided by 65 WMG and then multiplied by 6). In addition total labour requirement is increased by 9% and hired labour by 18%.

Table 21: Increase in income for six WMG in Amodkhali khal catchment

		Crop area - ha		Net income - Tk m		total labour '000 p-days		hired labour '000 p-days	
		Before BGP	Present	Before BGP	Present	Before BGP	Present	Before BGP	Present
Boro		744	755	100.94	102.49	161.5	164.0	94.7	96.1
Aman		71	306	7.03	30.13	9.4	40.1	4.8	20.6
Jute		0	10	-	0.75	-	1.6	-	0.5
Fish	seasonal	330	321	30.43	29.56	123.7	120.1	-	-
	perennial	54	54	11.78	11.78	36.4	36.4	-	-
	Total	1,200	1,446	150.17	174.71	330.87	362.13	99.47	117.18
increase				16%	24.54	9%	31.26	18%	17.71

The increase in net farm income of almost Tk25 million per year, means that the payback period for the investment in this polder is a little more than two years – even though so far three of the six WMG only have minimal benefits. Data for all 24 WMG could produce a higher estimate as it may well be that more than 50% of WMG have significant benefits. Some of the other polder 2 WMG are reported to be growing increased areas of mustard, and have switched from local to HYV varieties of mustard. There are also reports of beel land being used for vegetables. This has not been included in these calculations.

In addition, FFS have promoted better methods of paddy production. As almost all land grows boro this could have a significant benefit. Attributing a 20% increase in boro yield to FFS technologies along with earlier planting would double total benefits to Tk56.55 million - but there is no evidence that improved technologies and dissemination from FFS have had this much impact. Benefits from improved homestead production have not been quantified, but could well be significant.

8.2 Increase in income for polder 43-2B

The increase in net farm income for polder 43-2B was based on changes in crop areas and the net income per hectare for each of the crops. As in polder 2, no account was taken of an increase in yield of individual crops due to improved water management or adoption of FFS technologies. However the change in crop areas does show a considerable shift of HYVs for a number of different crops – and this shift had increased average yields.

Table 22: Increase in farm income for polder 43-2B

		Crop area ha		Net income Tk m		total labour '000 p-days		hired labour '000 p-d	
		Before	Present	Before	Present	Before	Present	Before BGP	Present
Aman	LV	2370	1297	80.67	44.14	105.37	57.66	35.12	19.22
	HYV	236	1498	14.14	89.65	12.83	81.38	3.50	22.20
Aus	LV	604	50	12.94	1.07	26.87	2.22	8.96	0.74
	HYV	7	863	0.34	26.35	0.36	46.87	0.10	12.78
Rabi	sesame	118	15	2.88	0.38	2.32	0.30	-	-
	s-potato	41	0	5.25	-	8.79	-	-	-
	keshari	610	15	18.62	0.45	10.54	0.25	-	-
	felon	42	69	1.53	2.49	4.38	7.13	-	-
	chilli LV	38	16	2.05	0.85	2.85	1.19	-	-
	chilli HYV	38	62	7.29	11.84	4.21	6.84	-	-
	mung LV	293	136	3.16	1.47	6.40	2.98	4.24	1.97
	mung HYV	99	1497	1.64	24.68	2.70	40.76	1.97	29.66
	w-melon	0	420	-	91.79	-	56.02	-	10.37
	g-nut	158	189	10.18	12.14	13.29	15.85	3.13	3.73
Total		4,653	6,125	160.68	307.30	200.92	319.45	57.01	100.67
increase				91%	146.62	59%	118.53	77%	43.66

The overall increase in annual net farm income is calculated in Table 22. This shows that farm income has almost doubled (increase of 91%), overall employment has risen by 59% and hired labour by 77%. The annual benefit of Tk146.6 million almost matches the estimated BGP cost on the polder development plan of Tk158.8 million – indicating a rapid payback of the project investment – even if all of these benefits are not attributed to BGP.

In fact benefits could be larger as much of the change in cropping pattern has been an increase in the area of mung bean. The crop budget calculations assumed yield of 865 kg per hectare for HYV mung, resulting in this crop not being as profitable as a number of other rabi crops, although it is now the principal crop grown in the rabi season. In particular, mung bean has largely replaced keshari, yet does not seem to be as profitable. Farmers admitted that some of the less popular pulse crops, such as keshari and felon, do appear to be more profitable, but said that mung bean was easier to grow and has a ready market. Yield data from the WMG survey in Table 17 shows an average yield of 1,110 kg per hectare – which would make mung bean production more profitable, resulting in a larger increase in net farm income.

8.3 Increase in income in other polders

Farmers participating in FGD spoke of the increase in income due to the improved water management and other interventions of BGP. The increase in net farm income for these other polders has not been calculated.

In the Khulna zone, the increase in cropping intensity has not been as large as that for Patuakhali zone, but benefits for most polders should be at least as great as that calculated for the polder 2. Polder 2 recorded an increase in c.i. of 31 percentage points, but this was only applied to half of the land of the six sample WMG. Moreover, Khulna zone polders have benefited from a significant increase in the area of profitable high value crops – water melons and vegetables as well as expansion of boro paddy. Polder 30 stands out as not having much of an increase in c.i. – only 2.5 percentage points in the WMG survey, and 10 points using Satelligence data. However this polder has benefited from an increase in the cultivation of high value crops, as has polder

29 – another polder with a relatively small increase in cropping intensity – and where there has also been a large increase in boro (from 12% to 47% of cultivable land). It can therefore be projected that these polders have generated increases in income that more than cover the investment by BGP.

In the Patuakhali zone the increase in cropping intensity is larger and more clear-cut, with land that was previously fallow or used for keshari in the rabi season being cropped with mung bean. Polder 43-1A (like polder 43-2B) also has a significant area of water melon, which would have generated a large increase in farm income, and the payback of the BGP investment would be similar to that on polder 43-2B. The size of benefits in the other polders partly depends on the profitability of mung bean (which is uncertain), although polder 43-2E also had a significant increase (18% of cultivated land) in paddy area. However, even if mung bean does not make much contribution to net farm income, the switch to HYV paddy and increase in yield of HYV paddy should mean that the increase in farm income over the implementation period of BGP is at least equal to the BGP investment in these polders.

9. Demand for labour and changes in the role of women in agriculture

9.1 Demand for labour

More work needs to be done with the expansion of cropping. Farmers are talking of a "labour crisis" in agriculture – with increasing demand for labour on farms as well as increasing opportunities in the non-farm sector – transport jobs linked to improved communications were specifically mentioned. Mechanisation is limited to land cultivation and pumping of water – this mechanisation took place prior to the start of BGP, so there has been no opportunity to offset increased crop areas with increased mechanisation. With increased work locally available, migration to outside jobs may have fallen. Three years ago in polder 2, labour went outside the polder to find work – to cities and towns and to shrimp farms in polder 3. This is now said to have stopped in the Amodkhali catchment area. In polder 43/2B there are not so many reports of reduced out-migration – which is still widespread with men going to cities to find work. In polder 43-2D a larger proportion of farm labour is now hired – up from 15% in 2014 to 30% now.

9.2 Employment of women in agriculture

FGD in polders 2, 22, 29 and 43/2B found that women are undertaking an increasing amount of work in the fields, including wage labour. In polder 2 women now do (and are being are hired for) virtually all tasks in paddy crops. Previously, women only did some specific activities - weeding, seedling preparation, harvesting and threshing. It would be expected that women work (and are employed) to an even greater extent for the horticultural crops grown on higher ground (which has not been affected by improved BGP water management). In 2% to 3% of farms women have taken on management responsibilities in the absence of their husbands.

In polder 22, women now provide about 50% of the labour for aman paddy – in particularly doing 80% of weeding and threshing work. For rabi crops, women provide 80% of the labour. This work is done in addition to their household tasks and care of livestock, but women are reported to be happy to have the extra income – and in some cases men undertake some domestic work.

In polder 29, women now provide about 50% of the labour for the major aman and boro crops – in particularly doing three quarters of the post-harvest work. The amount of work done by women has increased significantly - in 2010 they only provided 10% of labour. This work is done in addition to their household tasks and care of livestock, but women are reported to be happy to have the extra income – and in some cases men undertake some domestic work.

In contrast, in polder 30, men still do 98% of the work for aman and rabi crops. Work on aman and rabi crops in polder 26 is still predominantly male, with women now doing 20% of the work. In polder 26 women do 98% of the work in producing vegetables grown on the banks of ghers, while in polder 30 women do 98% of the harvesting of these vegetables.

In polder 43/2B women are reported to do about 50% of the work for rabi crops – but very little in paddy, where only 5% of hired workers are women. As BGP has supported a major expansion in the area of rabi crops, employment opportunities have considerably increased for women.

Increased opportunities for women to earn cash by working as wage labourers gives them another option to support their families and increase living standards. As women are contributing cash to the household, their status within the family may have improved and they may get a more say in household decisions – especially regarding expenditure of money that they earn. That said, field labour is a low status and poorly paid occupation. Women are not likely to increase their status in the community by undertaking such work, although managing

activities on their own land may improve their status (see box below). Moreover this work tends to be in addition to their domestic duties – with men only taking a slightly larger domestic role when their wives are working. Women are likely to see homestead-based activities (poultry, livestock, fish ponds, homestead vegetables and non-farm work such as tailoring) as being more attractive than wage labour in fields[4]. However in polder 43/2B cattle numbers are reported to be in decline. This is said to be partly due to lack of labour within families – so maybe wage labour is now being seen as a better use of time for women.

Women farmers

Shokina Begum of Uttar Fingri village in the Goshkhali khal WMG command area of polder 2 was previously a housewife – busy with domestic tasks helping her husband. When her husband divorced her, she was helpless, with no resources to earn an income. But she then stared to cultivate land via sharecropping. In the last boro season she cultivated 3 bigha of land in this way, and she is now recognised as a model farmer.

Debi Bachar of Uttar Fingri village is the ultra-poor representative in Goshkhali khal WMG. Previously she was a housewife, but her husband died about 15 years ago. At that time she had two children - one was 5 years old and another was 1 year old. To survive she took on the job of faming the household land, and her main source of income is from agriculture. She has now been trained by Blue Gold. In the last boro season she cultivated 5 bigha of land, doing all the work herself. She is now recognized as a good farmer in the area.

In polders 43-2B and 43-2D women are only hired for harvesting of mung bean – where 85% of workers are female. Although field work is not considered to be a respectable job for women, women appreciate the income they earn. The local tradition of cooking only one in the day helps women balance this work with domestic tasks.

In polder 43-1A a significant amount of watermelon is grown and women do all kinds of work in this crop as well as harvesting mung bean. Women are happy to get this income and adjust their domestic work, cooking lunch for their families early in the morning, or leaving their mothers-in-law to do this task.

9.3 Wages for men and women

With increased demand for labour, wages in both polders have increased relative to the prices of farm products. In polder 2 wages for men in the paddy transplanting and harvesting seasons used to be Tk300 per day (8 hours), and have now risen to Tk500, with wages at other times increasing from Tk200 to Tk350. Women are paid less. In the peak season, wages for a half day (5 to 6 hours) for men are now Tk350-400, while women are paid Tk250-300.

There is sharp difference in wages between the Amodkhali area and the Moheswarkati area to the south. Boro rice cultivation is five times higher in Amodkhali than in Moheswarkati area (and BGP has helped rabi crops expand in Amodkhali). In Amodkhali, men earn Tk500 to Tk700 per day, and women Tk400, whereas in Moheswartkati the male wage is Tk400 to Tk500 and women are paid Tk250 to Tk300.

In polder 22, although men are paid Tk500-550 per day for work in the aman crop, some labour is now hired on an hourly basis with both men and women being paid Tk45-50 per hour. Men and women are paid the same piece rate to carry water melon to the roadside.

In polder 29 men earn more than women – being paid Tk450 to Tk550 per day plus three meals while women get Tk300 with no meals. Mostly women only work a part day (5 to 6 hours) being paid Tk200.

In polders 26 and 30, women are paid little more than half of the male wage (Tk500 per day for men plus three meals in polder 30, Tk250-300 for women with no meals).

[4] This is based on a gender impact assessment carried out for CDSP IV.

In polder 43/2B about 70% of farm labour is done by farm households, with 30% being hired. Typical daily wages for men doing farm work are Tk500 per day – or Tk400 plus two meals which are taken to be worth Tk100. Wages for women are Tk250 to Tk350 per day (or Tk200 plus Tk100 food). Wages are more or less the same all year round as other work is always available. Farmers are increasingly hiring women as they are paid lower wages and, if needed, can also help around the house. Hired labour is often paid by the task, which can mean higher daily earnings. For example, women are paid Tk2 per bed (macha) (plus tea, biscuits and pan) that they prepare prior to planting of watermelon. One woman can make 150 beds per day – so earning Tk300.

Wages for men have doubled over the last three or four years. Earlier women labourers were just given food and a small share of the crop. With cash payments, women's wages have now gone up more than men's. With the great increase in area of mung bean, demand for harvesting labour has greatly increased and women now get one quarter of the crop rather than one sixth. This is the equivalent of increasing wages from Tk200 to Tk300 per day.

10. Other benefits and impacts

10.1 Other changes and benefits in polder 2

In the past excessive seasonal flooding meant that people living near a number of beels used to have to leave their homes and take shelter in schools. Monsoon water levels have now decreased by between 30 cm and 75 cm. As a result, homes no longer flood, roads remain functional, and more land has come under cultivation. Household tasks are now much easier for women. Additional income from farming is being spent on children's education, investment in IGAs, and in improving houses.

10.2 Feedback from FGD in Khulna zone polders

Polder 22

Increased agricultural production has eliminated food insecurity. Out of 165 households in the FGD village, 100 have non-farm incomes, and this combined with farming gives them an improved standard of living. These non-farm occupations include fish trading, small business, transport work and construction, with 10 to 15 people working in the garment sector. However, agriculture is still the main income source, with 70% of income coming from farming. Due to better water management people are now tending to focus more on agriculture, and non-agricultural income has now been reduced.

The additional income from agriculture is being invested and spent on:

- Children's education and better housing
- Investing in agriculture, with a bigger area of capital intensive water melon.

Following FFS on poultry, homestead gardening and pond fisheries, most families are now rearing poultry, livestock and pond fish. All households have poultry and many have adopted new technologies (hazal, separating chick from hen). Pond fisheries are not so popular here. Ponds are small and many of the become dry during the rabi season. About 50% of households own cows and people say that they are now more conscious regarding giving better food and having good housing, but are not so likely to actually invest money on better housing for livestock or for poultry. Most households have homestead gardens, and FFS farmers try to utilized all of the available homestead land for vegetables.

Polder 26

Now there is no food insecurity within the year. Most households still depend on agriculture - only around 30 out of 223 have non-agricultural income, such as small business, fish and vegetable trading and transport work. Ninety percent of income comes from agriculture. People are investing their additional income from farming in:

- Children's education
- Better houses with bathroom, toilet and furniture.
- Poultry and livestock
- Savings

There have been FFS on poultry, homestead gardening and pond fisheries. All households have poultry and many have adopted new technologies (hazal, separating chick from hen). Pond fisheries are not so popular here. Ponds are small. Seasonal and mainly for household use. If people have a gher, they tend to focus on this. About 50% of households own cows and people say that they are now more conscious regarding giving better food and having good housing, but are not so likely to actually invest money on better housing for livestock or for poultry. Most households have homestead gardens, and FFS farmers try to utilized all of the available homestead land for vegetables.

Polder 29

Now there is no food insecurity. Around one third of households HHs have non-agriculture income such as from brick fields, transport and wood and vegetable trading. Livelihoods have improved. Households are investing in livestock, land mortgage, children's education (most of children have private tutors) and better houses.

There have been FFS on poultry, homestead gardening and livestock. All households have poultry and about 50% have cattle, and people say that they are now more conscious regarding giving better food and having good housing, but are not so likely to actually invest money on better housing for livestock or for poultry. There are around 200 fish ponds, mostly for home consumption, but owners of 50 ponds also sell fish. However the main focus is on ghers. Most households have homestead gardens, and FFS farmers try to utilized all of the available homestead land for vegetables.

Polder 30

Agriculture is still the main income source, with 60% of income coming from agriculture. Better farming has eliminated food insecurity. Around 100 out of 279 households in the village have non-agriculture incomes such as small business, fish and vegetable trading, transport and construction work.

Additional income from agriculture is being invested in:

- Children's education (private tutors, admission in better schools far from home - so need more transport expenditure)
- Better houses with bathrooms, toilet and furniture.
- Business.
- Mortgage land
- Savings

There have been FFS on poultry, homestead gardening and livestock. FFS farmers have adopted new poultry technologies (hazal, separating chick from hen). Some of their neighbours have also learnt these technologies.

Pond fishery is not so popular here. The people who have ponds mostly use them to produce fish for home consumption. Ponds are small and many of them become dry during the rabi season. Due to there being gher cultivation. There is less focus on pond fisheries.

10.3 Other changes and impacts in polder 43/2B

Overall household income is reported to have increased by between 50% and 70% since the start of Blue Gold. Despite growth in agriculture, the share of household income coming from the farm sector (including fisheries, livestock and poultry) has fallen from an estimated 80% to 70% due to faster growth in the non-farm sector.

Additional income has been used to:

- Build new houses
- Improve the quality and nutrition of food (more meat/fish/eggs etc.)
- Spend more money for education of children
- Purchase of better clothes
- Increased expenditure on entertainment etc.

There are now no houses with straw roofs and the proportion of households with semi-pucca houses (brick walls and tin roof) have increased from almost none to 10% to 15%. Almost all households have access to electricity (mostly via solar panels). Before BGP in some catchments as few as 25% of households had sanitary latrines, now almost all households have these latrines. Food security is greatly improved - earlier between 30% and 40% of households had problems in getting three meals per day – now only 3% to 10% have such problems.

With more money in the local economy there has been an increase in non-farm enterprises (hotels, local transport, tea stalls, grocery shops etc.). BGP's contribution to the overall economic development of sub-catchment areas in estimated by WMG members to be between 50% and 60%.

10.4 Feedback from FGD in Patuakhali zone polders

Polder : 43/1A

Now that farmers have full aman and rabi cultivation, in a good year they now have enough rice to ensure food security as well as income to meet the other requirements of their families for clothes, education etc. Extra income from agriculture is invested in children's education, improvement of houses and taking leases on land.

Now most families are rearing of poultry, livestock and pond fish. Due to the TA FFS, farmers, especially the FFS farmers, have adopted new technologies for rearing chicks, better food for livestock, and preparing ponds before fish cultivation. However, these sub-sectors are still mainly for household consumption. Within the WMG area, three to four households have taken up each of these activities on a commercial basis. Poultry producers are earning Tk5,000 to Tk10,000 per year, while livestock rearers can sell one or two cows each year, each for Tk20,000 to Tk25,0000.

Three-quarters of households have income from the non-agricultural sector – the main sources being driving auto rickshaws, driving a motorcycle, non-agricultural labour, and working in brickfields.

Men from 75% of landless and marginal and small farm households are likely to work in brick fields. They get Tk50,000 to Tk70,000 six months before the work, while during the six month working period, they can able to earn another Tk50,000 to Tk70,000 depending on their working ability and skills. For these households, 60% of their income comes from non-agricultural work. Men from these households stay at home in the aman season to work on this crop, going to work in brick fields in the rabi and part of the aus seasons. They take leave from brick field and come to home for a week during rabi season at which time they plant rabi crops in the field, with women from their families taking responsibility to harvest the rabi crops. For other households, 30% of income comes from non-agricultural work.

Polder 43-2D

Changes in agriculture have impacted on the living standards and welfare of farm households. Having a good aman season ensures their food security, while having an addition (rabi) crop helps them to improve other aspects of wellbeing. People are likely to spend extra income on:

- Children's education
- Good clothes
- Sanitary latrine with brick walls
- Furniture and fridge
- Better housing
- Gas cylinder and cooker

This WMG is under Patuakhali Sader Upazila and close to the town, so non-farm enterprises and non-farm employment play an important role for farmers and other households. Now 90% household have non-agricultural incomes while around 50% of total income is coming from the non-agriculture sector. Four or five years ago only 50% of households had non-farm income and this only accounted for 30% of total income. Non-agricultural employment includes: driving auto rickshaw and motorcycle, construction worker, small shop, tea steal, hawker, fingerling and vegetable selling/trading (they buy these from Jassore district and sell here), retail vegetable seller (buy from the wholesale market), and wage labour in other non-agriculture sectors

Water management activities didn't have much impact on livestock, poultry and pond aquaculture systems, but better cropping in two season means more fodder for livestock, and less flooding reduces the chance of washing away of the pond.

Learning from FFS helped FFS farmers to increase production of livestock, poultry and pond aquaculture. Some of their neighbouring households also learnt from them and are practising some of the technologies.

In poultry, the most effective technologies that they learnt were: (i) use of hazol for the hen to sit on a clutch of eggs for hatching; and (ii) separate the chicks from the mother hen. Most households in this area rear poultry. FFS farmers are using hazol and separating chicks from hens (20 farmers out of 25 FFS farmers) while they informed that some of their neighbours (30 farmers) also learned about this and have adopted these technologies. Separating the chicks means more cycles of chicks and using hazol helps reduce the loss of hatching eggs. However, they face various diseases every year, and birds die if they are not able to sell them before the disease attack. Although they have learned about vaccination, this service is not available within the village.

Whether using the new technologies or not, the trend is for rural households to have larger numbers of poultry. As well as local poultry, they also are rearing improved varieties such as Sonali. It is now normal for rural households fulfil their household demand and also has regular income from poultry of around Tk5000-Tk7000 per year. Within the WMG area, there are also 3-4 households having larger commercial poultry rearing activities.

Homestead vegetable: new or improved technologies coming from BGP FFS include using different types of land (sunny, half/shade, wet, the roof of the house, trellis over the pond) and preparation of improved mada (beds). There is also a trend of increasing cultivation of homestead vegetables, with FFS farmers doing better than other farmers. Though they have learned so many things about homestead gardening, they do not follow all of them due to lack of land and lack of time. In most cases, they are doing homestead gardening to fulfil their household demand, so they are not interested to keep income-expenditure records and calculations as well as maintain the networking. Some of the families sell their vegetables after fulfil their households demand. Farmers who are cultivating vegetables in the crop field say that the FFS learning also helped them.

In the FFS on pond fisheries farmers learnt about pond preparation, stocking different types of fish in the different level of water, and natural food within the pond, FFS farmers are more likely to follow the learning from FFS but still, their target is to fulfil the household demand. Many of them do not have individual ownership of pond (have share ownership), which negatively influences them to take pond fisheries as a commercial initiative.

For livestock, FFS members learnt about good housing for livestock, vaccination, and special feed for beef fattening. While people who have the ability to make good (healthy) housing for livestock, smallholders are less likely to do this. It is also difficult to make the prescribed/special food for livestock as some of the ingredients are not available within the house, like wheat bran and molasses. Many of households (FFS & non- FFS) rear one or two cows with the target to sell them during the Eid festival. They give them better food but not the prescribed food. However, three or four farmers from the FFS do follow the learning and have good returns from beef fattening.

11. Role of WMG in operation of group savings and credit

The pilot study reviewed WMG credit operations. Only a few WMG in polders 2 and 43/2B operate savings and loan (S&L) schemes. Interviews were held with four WMG which were operating, plan to operate, or had in the past operated, S&L schemes. Access to credit was also discussed with two other WMG., one of which has lent funds to a collective enterprise. Further details for each WMG are in Appendix 5.

11.1. Shalley Paschim O Beradangi WMG (polder 2)

Since August 2016, the WMG has given loans to 143 members – 40% of its total of 335 members. In total 156 loans with a total value of Tk975,000 have been disbursed. Thirteen of the 143 borrowing members have had more than one loan. The average loan size is only Tk6,256. Currently 55 loans are outstanding with a value of Tk317,400 - so 15% of members have running loans. Loans are repaid monthly over 10 months, with an interest charge of 10% flat (i.e.10% of the loan amount).

The savings fund now amounts to Tk207,000, with 333 members having some savings – but the average amount is only Tk622 per member. Around 100 members are making regular savings of Tk20/month, but to get a loan, borrowers need to have savings of at least 10% of the loan amount.

The scheme is managed by WMG secretary with using his own computer. It takes him seven full days per month (84 days/year), and he does not have time to deal with any more borrowers than the current number. The WMG President is involved in selecting borrowers and there is a five-person loan approval committee. The records appear good and have been audited by BWDB. But there have been three bad loans - one of Tk620 (still outstanding), and two of Tk320 (repaid by Secretary from his own pocket). All transactions are in cash, and there is currently Tk55,000 cash in hand – soon to be disbursed as loans.

Virtually all WMG funds are invested in credit. As well as savings this includes WMG entry charges of Tk19,980, profit from an LCS contract of Tk37,640 and a grant of Tk20,000 from DAE. There is only about Tk1000 in the WMG bank account and no funds are available for other WMG activities.

The WMG President and Secretary see the advantages of WMG loans as being: (i) easy to get (no need to go to NGO offices), (ii) interest rate is lower (in fact it is the same as Grameen Bank), and (iii) some flexibility in repayment dates.

11.2. Goshkhali khal WMG (polder 2)

This WMG of 243 members plans to collect savings of Tk20/month from each member, and lend these funds out as loans, charging interest of 5% per month on the balance outstanding (2.5 times more than than NGO-MFIs charge) over a 10 month term. The rationale for this is that sometimes members are not able to get loans for marriage expenses or for crop inputs. Current sources of credit for WMG members include:

- Bank loans – accessed by 25% members – but these are difficult to get due to the paperwork and collateral requirement
- NGO loans – accessed by 75%-80% members. The WMG claims these are weekly repayment so there is little or no grace period. In fact virtually all NGO-MFIs now operate monthly repayments – the same as planned by this WMG
- Crop sales in advance – the bepari (trader) pays the farmer the current market price and charges no interest. These loans cover paddy, jute, and mustard (advance sales to an oilseed mill). In total 30-40% of households sell some of their crops in advance.

- Fertiliser on credit from the shop, with no interest or additional price. But the shop needs to know the farmer, or get an introduction or guarantee by someone they know. All households get fertiliser on credit.

11.3. Dokki Amkhola WMG (polder 43/2B)

This WMG was re-formed by BGP with 159 members. It started credit operations in 2014, so is now in its 4th year.

The S&L scheme has involved 124 members, with 60 to 70 members saving each month – this is now Tk100/month per member. The savings fund is now Tk219,000 (average Tk1,766 per member). Borrowers need to have12 months value of savings (i.e. Tk1,200) before they get a loan.

In total Tk1,102,000 disbursed in 114 loans to 37 households (23% of WMG members). The average loan size is Tk8,956. Currently Tk220,000 is outstanding to 22 borrowers. The WMG has Tk584,000 in loanable funds from savings and interest payments. Loans are repaid in a single lump sum after one year with a 36% interest charge (50% more than NGO-MFIs charge for a seasonal loan).

The WMG Chairman and Cashier manage S&L which takes them 74 person-days per year. They say they give loans to all members who want loans. Most (90%) of members have NGO loans, and 10% have bank loans. Credit from fertiliser dealers is taken by 2-5% of farmers – this adds 5% to the price, and a similar proportion sell paddy in advance – but get 2%-5% lower price. This is not done for other crops.

11.4. Uttar Poschim Goal Bashbunia WMG (polder 43/2B)

This WMG of 173 members started lending three years ago, but stopped after one year. It had a total of Tk200,000 in loan funds (from the admission fee, savings of 90 members, and income from rental of machinery), and 32 loans were taken of between Tk3000 and Tk20,000. These loans were disbursed between August and January and were to be repaid after the rabi harvest, with 3% interest charge for the entire period (well below the market rate). These loans were used from rabi crops and some businesses such as shops.

After loans had been disbursed excessive rain damaged rabi crops, and only Tk100,000 of loans were recovered. The WMG hopes to recover the rest of the loans this year, but will not lend money again after this bad experience. All the work was done by the Cashier, but helped by Chairman and Secretary when they got into problems with loan repayment.

Farmers are now funding rabi crops with loans from NGOs, also from fertiliser and input shops (who charge prices that are 3-4% higher than for cash). NGOs are better at this job as: (i) have legal agreements with borrowers to ensure recovery, and (ii) the manpower to manage monthly loans.

11.5. WMG in Mushurukathi catchment (polder 43/2B)

The President of this WMG of 144 members does not think that lending of WMG funds to members is a good idea as: (i) risk of late payment can cause quarrels in the WMG, and (ii) there is not enough money to give loans to all members. But 25 members have a collective fishery enterprise in a khal that has been funded by the WMG.

The group took Tk65,000 loan from the WMG fund, and invested another Tk75,000 of their own money (Tk3000 each). There is no interest on the loan, but the group will pay 10% of their profit to the WMG. At least Tk50,000 profit is expected – which means the WMG gets Tk5,000 (7.7% of the amount lent). This arrangement does not seem equitable – and could well mean that WMG gets relatively little return. The WMG loan has contributed 46% of the total capital of Tk140,000 and is taking the risk that there may be no profit. The WMG chairman, secretary and cashier are in the fishing group (in total 9 of 12 members of executive committee are members). This seems to be clear conflict of interest.

11.6. Conclusions regarding WMG credit operations

The potential benefits of WMG operating savings and loan (S&L) schemes are:

- This keeps WMG active and members in contact at times when there may be little other happening
- It provides useful credit, that is not available from other sources, and/or at a lower rate of interest
- WMG can be more relaxed and flexible about repayment schedules than professional MFIs. This makes loan repayment less onerous for borrowers.

However, interviews with a few Blue Gold WMG, along with experience from other projects, shows these advantages to be illusionary, and that WMG are not a suitable vehicle for S&L operations. The reality is that:

- With limited funds and only a few people with the time and inclination to manage S&L, only a small proportion of WMG members people get loans, and only a minority make regular savings. Therefore, the WMG membership as a whole is not kept involved in WMG activities.
- Loans amounts are small (relative to loans from NGO-MFIs) which limits their usefulness for borrowers.
- Unlike NGO-MFIs, WMG are not in a position to offer a range of S&L products to meet the varying needs of households.
- WMG interest charges vary – they may be more, less or the same as NGO-MFIs. Charging low interest rates is a subsidy for borrowers at the expense of other members.
- A relaxed approach to repayment will soon result in non-recovery of loans. A relaxed approach to savings collection means relatively little capital is mobilised for lending.

In addition, WMG credit operations:

- Heavily rely on a lot of voluntary work from one or two people – with the risk that this person could become unable or unwilling to continue.
- Virtually all WMG funds are tied up – there is no money for anything else.

WMG are also not suitable vehicles for S&L operations because:

- WMG are too large for all members to know each other and build trust at an individual level – as in a self-help group of about 30 members.
- WMG are too small for full time paid management, or to set in place systems to ensure the maintenance of prudent financial processes. They are also too small to manage the risk of, say, a bad harvest.
- Provision of financial services by community organisations is not a model that has developed and matured in Bangladesh. But the NGO-MFI service provider approach is well developed, with accepted processes and official regulations.
- MFIs mobilise funds from external sources (loans from banks and PKSF) which, together with their own capital, means that credit groups are able to access funds far in excess of their savings.
- In other projects in Bangladesh, WMG sustainability has been undermined by the collapse of their credit programmes, with repayment collection lapsing, and members being unable to access their savings[5].

[5] Report on Microcredit Study, Dewan A.H. Alamgir, Participatory Small Scale Water Resources Project, July 2008

12. Conclusions and recommendations

Improvement in water management

BGP has bought about significant improvements in water management, and there have been a reduction in water-related constraints to crop production. However problems still remain, with a significant proportion of WMGs reporting no improvement, and problem areas remaining within individual WMGs. The most frequently reported principal problem is scarcity of water for irrigation.

Changes in crop areas

In the Khulna zone there has been a significant increase in the land used for paddy – mainly boro. There has also been a modest increase in land used for fish ghers (despite a sharp fall in one polder), and also a modest increase in the area of high value crops and fall in other dryland crops such as sesame.

In polder 2, better drainage in some WMG commands have resulted in an increase in the area of aman paddy. But very little land has been converted from gher to paddy. However this only applies to the beel areas in six WMG of one catchment, and so cannot be taken to represent polder 2 as a whole.

In the eight BGP polders in the Patuakhali zone there is considerable variation between polders. Overall there has been a little growth in in the area paddy, with significant expansion of water melon in two polders. The main expansion has been in dryland rabi crops, mainly mung bean, which has also very largely replaced keshari.

Increase in cropping intensity

The increase in c.i. using data from the WMG survey is higher the Satelligence estimates in the Khulna zone, but lower in Patuakhali. In Khulna Satelligence data for comparison (control) polders have a marginally higher increase in c.i., but in Patuakhali control polders have a significantly smaller increase in c.i. than BGP polders. Data for polder 2 in Satkhira from Satelligence shows a small (13 point) in c.i., but this is greater than surrounding polders.

There appears to be a link between the reduction in the severity of water-related constraints in each polder and data from Satelligence on the increase in cropping intensity.

Feedback from farmers on outcomes of BGP interventions

Better water management has allowed increased cultivation of paddy and dryland rabi crops, and a switch to HYV paddy. But rabi crops (apart from water melon and vegetables) are often seen as more risky and less profitable than boro – so the latter is preferred where irrigation is available. In polders 26 and 30 better water management is also reported to have contributed to increased areas of fish ghers in the kharif seasons.

FFS have resulted in adoption of improved methods of crop cultivation – some of which have dissemination to other farmers. However not all innovations have been effective. Farmers in FGDs reported that the main problems they face are the high cost of labour during peak periods and shortages of seed, along with the need for loans at the right time and the high price of fertiliser.

Changes in land tenure

In polder 2, expansion of aman created new opportunities for poor households to gain access to land via sharecropping and so improve their food security. However data from the WMG survey shows a general reduction in sharecropping in most polders. Most land is farmed by its owner, but there is also some fall in owner-operation. More land is now being farmed under other lease arrangements (mortgaging and cash rental). Sharecropping of most crops is not particularly profitable for tenants, and a cash rent or mortgage provides greater incentives for tenants.

Increase in farm income

The pilot study calculated the increase in farm income for polders 2 and 43-2B . This was sufficient to cover the BGP investment in these polders over little more than two years in polder 2 and one year in polder 43-2B. The polders in the Khulna zone have benefited from a significant increase in the area of profitable high value crops – water melons and vegetables as well as expansion of boro paddy. It can therefore be projected that these polders have generated increases in income that more than cover the investment by BGP.

In the Patuakhali zone the increase in cropping intensity is larger and more clear-cut. But only two polders (43-2B and 43-1A) have significant areas of water melon, which would have generated a large increase in farm income. The size of benefits in the other polders partly depends on the profitability of mung bean, a crop which has enormously expanded, but may not be all that profitable. However, apart from this crop, the switch to HYV paddy and increase in yield of HYV paddy should mean that the increase in farm income over the implementation period of BGP is at least equal to the BGP investment in these polders.

Demand for labour and role of women

More work needs to be done with the expansion of cropping. Farmers are talking of a "labour crisis" in agriculture – with increasing demand for labour on farms as well as increasing opportunities in the non-farm sector. In some polders an increasing proportion of farm labour is being hired and, in places, the increasing demand for farm labour has reduced out-migration to find work elsewhere.

With an increasing shortage of labour women are undertaking an increasing amount of work in the fields, including wage labour. However the amount of work done by women varies considerable between polders (and possibly between locations within a polder – but we have no information on this). Increased opportunities for women to earn cash by working as wage labourers may be empowering at the household level. That said, field labour is a low status and poorly paid occupation. Moreover this work tends to be in addition to their domestic duties – with men only taking a slightly larger domestic role when their wives are working.

With increasing demand for labour wages have increased – doubling over the last three or four years in some polders. In general women are still paid significantly less than men, although in polder 22 some work is now being paid on an hourly basis with the same rate for men and women, and in some other locations changes in piece work rates suggest that that the differential may have been slightly reduced.

Other benefits and impacts

Increased paddy production has eliminated (or greatly reduced) food insecurity, while high value and other rabi crops provide a cash income. There is a general trend for more households to have non-farm incomes, but agriculture usually remains the major source of income in most villages. Improvements in agriculture have meant an increased focus on this sector. Additional farm income is spent on children's education, improved housing and sanitation, and invested in farming – including land leases, livestock and high value crops. People are also saving more.

Households also report positive impacts from BGP FFS on poultry, livestock, pond fisheries and homestead gardens. All households have poultry and FFS members (and some other households) have adopted improved methods, although lack of access to vaccination has not reduced the disease risk. Not all households have cattle and there seems some reluctance to invest in improved housing, while materials for improved feeds may not be available. The same applies to fish ponds, which may be in shared ownership, small, seasonal and only produce fish for home consumption. However most households have homestead gardens and FFS provided some useful learning which has also been applied to vegetables grown on a commercial scale in the field.

Role of WMG in operation of group savings and credit

Savings and loans schemes are operated by a limited number of WMGs. Some of these WMGs seem to operate them successfully in terms of maintaining records and recovering loans, although one had not been able to recover loans after a crop failure. However, WMG lack the resources in terms of capital and the time of volunteer members to provide loans to all of their members, and loans are quite small – and so of limited value in funding investments. Lending to a group enterprise can result in conflict of interest within the WMG. These activities also divert WMG management and financial resources away from water management issues – which should be the focal point for WMG.

Recommendations:

Further analysis of WMG survey data alongside other sources of information – such as participatory monitoring and the WMG tracker – could provide further insights into the factors driving WMG performance and outcomes. Further analysis of cropping pattern and water management information could different farming system clusters within individual polders – with different water management priorities.

Further information is needed on the profitability of mung bean to understand why it has expanded so much and if it is a crop worth supporting. It would also be useful to have more information on the relative profitability of fish ghers and paddy to understand why ghers may be expanding in some locations and contracting in others.

A further round of data collection from WMGs should be planned, which would include the polders not covered in this survey, the whole of polder 2 as well as the polders covered in this survey.

Impact on women – a more in-depth investigation of the impacts of the changes bought about by BGP on women, including their roles in WMG and other institutions related to Blue Gold.

Improved farming practices: more information is needed on the outcomes of FFS for field crops, including the dissemination of technologies to farmers who did not attend FFS. The survey carried out by DAE does not provide sufficient information on this topic. A methodology for such a survey should first be tested on a pilot scale.

WMG lending operations are not a good idea for WMGs and are of little benefit to their members. WMG should be discouraged from undertaking this activity.

Appendix 1: Methodology

The Study was conducted by the MRL team along with a consultant Economic Analyst (Edward Mallorie) in response to the request from the 2017 Annual Review Mission to obtain information based on data that can be readily collected from Water Management Groups and project field staff. The study was conducted in two parts. In the first part, a pilot study was conducted in the polder 2 in Satkhira and polder 43/2B in Patuakhali. The final study was then designed for another 12 polders, based on the findings of the pilot study.

Methodology for the Pilot Study

In May 2018, the polder teams [6] conducted several Group Discussions (GDs) in the Polder 2, Polder2 Extension and in Polder 43/2B to collect primary information on the polders and to explore the economic changes and increased income for farming communities resulting from Blue Gold interventions. Additional data and information was collected during visits to the polders in May by the consultant M&E Expert (Dr. Sharmin Afroz). The Economic Analyst and M&E Expert visited both polders again in May for more clarification of the collected data and further GDs to expand on the data collected and to fill gaps in the information.

During the visit of the consultants to polder 2, the Amodkhali catchment area was selected for investigation as this was the catchment that had benefited at that time from the improved drainage of Amodkhali khal. There are 24 WMG in the catchment. Data was collected from six of the 24 WMGs selected on the basis of expectations that high, medium and low proportions of beel land had been converted into aman following improved drainage – with two WMG being selected in each of these categories. A GD was held during a visit to each WMG.

The polder 43/2B, of around 3,158 ha, has 28 WMG divided into six sluice catchment areas. The polder is considerably smaller than polder 2 – indeed it is smaller than the Amodkhali khal catchment area of polder 2 which covers 4,323 ha. A total six GDs was conducted during the field visit of the consultants. One GD was conducted for each sluice catchment with representatives from different WMGs from each catchment. At the end of the field visits to polders 2 and 43-2B a de-briefing meeting was held with members of the BGP polder teams. On return to Dhaka a workshop was held with the BGP headquarters team to obtain their feedback.

Based on the findings of the pilot study of the two polders (polder 2 from Satkhira zone and polder 43/2B from Patuakhali zone), an interim report was produced in June 2018 with estimates of changes in cropping patterns, and calculations of changes in profitability and farm income, along with suggestions for further data gathering to rapidly assess benefits in other polders of BGP. There was also a brief review of WMG credit activities.

Based on the findings, the study team and the management of BGP program decided on a second phase study to understand the economic changes in the polders that were going to phase out in the year 2018 (polder 22, 26, 29, 30, 43/1A, 43/2D, 43/2E and 43/2F) and by June 2019 (polder 31 Part, 43/2A, 43/2B, 55/2A, 55/2C and 2 & 2 Ext.)[i]. These are the older phase 1 & 2 polders of BGP and have had more interventions compared to the new polders (phase-3). However, as the pilot study took place in the polder 2 and 43/2B, it was decided that these two polders will not be included for data collection in the final study as there was already some information on these polders, and time and resources for data collection were limited. In addition, it also decided that the final study also will not further explore the lending operations and credit activities of WMGs as from the findings of pilot study was enough to make a recommendations regarding this issue.

[6] SK Mohibullah and Shagadat Hossain in Satkhira. Md. Shaifullah and Shamim Ahamed Yousuf in Patuakhali

Methodology for the main study

The pilot study showed that there were large variations in results between WMGs, so it was decided that data should be collected from each WMG covering changes since the start of BGP for a limited number of key indicators. The name of the polders, location and number of WMGs in each polder are given in Table 1. In total information was collected from 266 WMGs against a plan for 268 – data was not collected from two WMGs (one each in polders 43-2A and 55-2A) that has ceased to function due to internal management issues.

Table 1: Name of the polder, location and number of WMGs covered in each polder

Polder	*District*	*Upazila*	*No. of WMG*
PHASE-1			
22	Khulna	Paikgacha	12
26	Khulna	Dumuria	15
29	Khulna	Dumuria, Batiaghata	56
30	Khulna	Batiaghata	40
43/1A	Barguna	Amtali	12
43/2D	Patuakhali	Patuakhali Sadar	28
42/2E	Patuakhali	Patuakhali Sadar	12
43/2F	Barguna	Amtali	27
PHASE-2			
31 Part	Khulna	Batiaghata	12
43/2A	Patuakhali	Patuakhali Sadar	21
55/2A	Patuakhali	Patuakhali Sadar, Bauphal, Dashmina, Galachipa	13
55/2C	Patuakhali	Dashmina, Galachipa	16
Total			266

The data was collected through group discussion (GD) with six-eight persons from the WMG area. The Blue Gold study team prepared a structured questionnaire which was completed during the GD. The questionnaire mainly covers the information related to water management, changes in land use in different seasons and land tenure arrangements in different seasons.

A firm (Socioconsult Ltd) was hired for collecting data. The firm was supervised and guided by the study team and zonal teams. The survey team comprised eight experienced enumerators and a coordinator who coordinated all logistical and technical arrangements for the GD survey. Before going to data collection, there was one day training session on the questionnaire for the enumerators, coordinator and data entry operator. A responsible Blue Gold team member supervised as resource persons in the training session. In the training, there was a detail discussion on the objective and methodology of the study, detail discussion on each question of the questionnaire, work plan and roles and responsibilities of the team members of the data collection.

The enumerators selected 6-8 participants for GD meeting with help of Blue Gold zonal teams. It is important to note that among the participants, two-third members were selected from WMG members, with one or two being women. The enumerators made all efforts to have a friendly and open-minded interaction with the participants. The enumerators recorded the data only after being fully satisfied. All questions were asked one by one, and data filled in on the spot. Moreover, the survey coordinator was in the field to oversee and guide the enumerators. He also checked the quality of the collected data. He reviewed the filled-in questionnaire with the enumerators, and provided feedback to the enumerators at field level.

In addition to the 266 GDs, eight FGDs (four FGDs in Khulna and four FGDs in Patuakhali) were conducted by Dr. Sharmin Afroz to explore the in-depth opinions regarding the changes of water management and land use, crop productivity, land tenure, labour and gender aspects, and impacts on agriculture and changes in other sectors. In each FGD, there were 8 to 10 participants, of whom 2 to 3 were women.

Figure 1 shows the timeline of implementation of the different activities of the final study. The findings of this study aim to understand the outcomes of Blue Gold, as well as the benefits for coastal farming communities resulting from Blue Gold Program interventions.

Figure 1: Timeline of Implementation of the different activities of the final study

Activities	Aug. 2018	Sept. 2018				Oct. 2018	
	W1	W2	W3	W4	W5	W6	W7-W8
Phase 1. Inception and Design Phase							
• Translation of the questionnaire into Bangla • Recruitment of the field staff • Training of the survey coordinator, enumerators and data entry operator • Finalization of the questionnaire	■						
Phase 2. Field Phase							
• Data collection from fields through administering the GD Checklist • Field visits by the Survey Coordinator for supervision and monitoring of data collection activities • Prepare the checklist for FGD • Conduct FGDs		■	■	■			
Phase 3. Submission of Data							
• Data Entry format design in Excel			■				
• Data Entry on electronic format in Excel				■	■		
• Data Cleaning					■		
• Submission of data on electronic format in Excel • Writing information from FGDs						■	
Phase 4. Report writing							
• Data analysis and report writing							■

It is important to recognise limitations in the data collection method used. A small number of participants in each GD had to provide information on the results for the entire WMG command area covering 200 or more households. They also had to recall the situation four or five years ago before the start of BGP interventions. This meant that the questions needed to be simple, straightforward and easy to answer. On the other hand, by conducting a complete census of all WMGs, there were no sampling errors or biases and the full range of results for all WMG were obtained. This makes it possible to identify all WMGs that fall into certain categories. Data on cropping intensity has been compared and verified with data from satellite image interpretation carried out by Satelligence for BGP.

Appendix 2: Data from the WMG survey

Table 1: Water-related constraints by season – pre-project

Polder	Season	Main problem				Other problem				
		Waterlogging	Flooding	Water scarcity	Salinity	Waterlogging	Flooding	Water scarcity	Salinity	Other (iron)
22	rabi	0%	0%	100%	0%	0%	0%	0%	83%	8%
	kh-II	67%	0%	8%	0%	8%	0%	25%	0%	0%
	kh-I	8%	0%	42%	42%	0%	0%	17%	8%	0%
26	rabi	0%	0%	80%	7%	0%	0%	7%	27%	0%
	kh-II	73%	13%	7%	0%	0%	13%	0%	7%	0%
	kh-I	20%	0%	53%	0%	0%	0%	0%	20%	0%
29	rabi	0%	0%	79%	16%	0%	2%	11%	39%	0%
	kh-II	32%	4%	13%	0%	2%	0%	4%	0%	0%
	kh-I	20%	0%	43%	7%	2%	0%	4%	9%	0%
30	rabi	0%	0%	63%	38%	0%	0%	30%	43%	0%
	kh-II	65%	5%	8%	3%	8%	0%	5%	3%	0%
	kh-I	10%	0%	45%	13%	0%	0%	10%	23%	0%
31	rabi	0%	0%	25%	75%	0%	0%	58%	25%	0%
	kh-II	75%	8%	0%	8%	0%	0%	0%	8%	0%
	kh-I	0%	0%	25%	58%	8%	0%	33%	8%	0%
43-1A	rabi	0%	0%	86%	0%	0%	0%	0%	7%	0%
	kh-II	79%	0%	7%	0%	7%	7%	0%	0%	0%
	kh-I	36%	0%	57%	0%	21%	0%	0%	0%	0%
43-2A	rabi	0%	10%	86%	5%	0%	5%	0%	5%	0%
	kh-II	86%	5%	10%	0%	0%	24%	0%	0%	0%
	kh-I	48%	5%	48%	0%	10%	10%	0%	0%	0%
43-2D	rabi	0%	0%	96%	0%	0%	0%	0%	0%	0%
	kh-II	86%	4%	11%	0%	11%	7%	7%	0%	0%
	kh-I	25%	0%	68%	0%	21%	0%	7%	0%	0%
43-2E	rabi	0%	8%	75%	8%	0%	0%	0%	8%	0%
	kh-II	83%	17%	0%	0%	17%	17%	0%	0%	0%
	kh-I	25%	8%	17%	17%	25%	8%	0%	0%	0%
43-2F	rabi	0%	0%	93%	7%	0%	7%	7%	0%	0%
	kh-II	89%	0%	4%	0%	4%	26%	15%	0%	0%
	kh-I	37%	4%	56%	4%	37%	0%	0%	7%	0%
55-2A	rabi	0%	0%	100%	0%	0%	0%	0%	0%	0%
	kh-II	92%	0%	8%	0%	8%	23%	0%	8%	0%
	kh-I	69%	0%	23%	0%	15%	8%	8%	0%	0%
55-2C	rabi	0%	0%	100%	0%	0%	0%	0%	0%	0%
	kh-II	88%	0%	13%	0%	6%	6%	0%	0%	0%
	kh-I	38%	0%	44%	0%	19%	0%	0%	6%	0%
-	total	32%	2%	45%	8%	6%	4%	7%	11%	0%

Table 2: Water-related constraints by season – current situation

Polder	Season	Main problem				Other problem				
		Waterlogging	Flooding	Water scarcity	Salinity	Waterlogging	Flooding	Water scarcity	Salinity	Other (iron)
22	rabi	0%	0%	92%	8%	0%	0%	8%	67%	8%
	kh-II	50%	0%	17%	0%	8%	0%	25%	0%	0%
	kh-I	8%	0%	42%	42%	0%	0%	17%	8%	0%
26	rabi	0%	0%	80%	0%	0%	0%	0%	7%	0%
	kh-II	67%	0%	7%	0%	0%	0%	0%	0%	0%
	kh-I	20%	0%	53%	0%	0%	0%	0%	0%	0%
29	rabi	0%	0%	86%	9%	0%	0%	7%	38%	2%
	kh-II	45%	0%	23%	0%	2%	0%	4%	0%	0%
	kh-I	20%	0%	45%	7%	4%	0%	4%	7%	0%
30	rabi	0%	0%	73%	28%	0%	0%	25%	55%	0%
	kh-II	68%	0%	10%	3%	5%	0%	8%	5%	0%
	kh-I	10%	0%	38%	20%	0%	0%	18%	23%	0%
31	rabi	0%	0%	25%	67%	0%	0%	58%	17%	0%
	kh-II	67%	0%	0%	17%	8%	0%	0%	0%	0%
	kh-I	0%	0%	25%	58%	8%	0%	33%	8%	0%
43-1A	rabi	0%	0%	93%	0%	0%	0%	0%	7%	0%
	kh-II	64%	0%	7%	0%	7%	7%	0%	0%	0%
	kh-I	7%	0%	64%	0%	14%	0%	0%	0%	0%
43-2A	rabi	0%	10%	86%	0%	0%	5%	5%	5%	0%
	kh-II	81%	5%	14%	0%	0%	14%	5%	0%	0%
	kh-I	38%	5%	57%	0%	10%	10%	0%	0%	0%
43-2D	rabi	0%	0%	89%	0%	0%	0%	0%	0%	0%
	kh-II	75%	4%	11%	0%	11%	7%	7%	0%	0%
	kh-I	7%	0%	75%	0%	25%	0%	0%	0%	0%
43-2E	rabi	0%	0%	100%	0%	0%	0%	0%	0%	0%
	kh-II	67%	8%	0%	0%	8%	8%	8%	0%	0%
	kh-I	25%	8%	33%	0%	25%	0%	8%	0%	0%
43-2F	rabi	0%	0%	93%	7%	0%	11%	7%	7%	0%
	kh-II	78%	0%	0%	0%	4%	22%	15%	4%	0%
	kh-I	22%	0%	74%	0%	41%	4%	0%	7%	0%
55-2A	rabi	0%	0%	100%	0%	0%	0%	0%	0%	0%
	kh-II	77%	0%	8%	0%	8%	23%	0%	8%	0%
	kh-I	54%	0%	31%	0%	15%	8%	15%	0%	0%
55-2C	rabi	0%	0%	100%	0%	0%	6%	0%	6%	0%
	kh-II	69%	6%	19%	0%	6%	6%	0%	0%	0%
	kh-I	31%	6%	38%	6%	25%	0%	0%	0%	0%
	total	28%	1%	49%	7%	6%	3%	7%	10%	0%

Table 3: Severity of water-related problems by season

Polder	Season	pre-project situation						Current situation					
		1	2	3	4	5	Severity score	1	2	3	4	5	Severity score
22	rabi	0%	0%	0%	67%	33%	4.3	0%	0%	58%	42%	0%	3.4
22	kh-II	0%	25%	42%	33%	0%	3.1	17%	58%	25%	0%	0%	2.1
22	kh-I	0%	8%	25%	42%	25%	3.8	0%	25%	25%	50%	0%	3.3
26	rabi	0%	7%	20%	60%	13%	3.8	0%	60%	40%	0%	0%	2.4
26	kh-II	0%	13%	33%	47%	7%	3.5	0%	80%	13%	7%	0%	2.3
26	kh-I	0%	7%	20%	47%	27%	3.9	0%	13%	73%	13%	0%	3.0
29	rabi	0%	11%	18%	54%	18%	3.8	0%	29%	54%	18%	0%	2.9
29	kh-II	2%	30%	48%	20%	0%	2.9	5%	79%	13%	2%	0%	2.1
29	kh-I	0%	9%	41%	36%	14%	3.6	0%	25%	63%	11%	0%	2.8
30	rabi	0%	0%	18%	53%	30%	4.1	3%	10%	50%	33%	5%	3.3
30	kh-II	5%	43%	30%	20%	3%	2.7	25%	58%	18%	0%	0%	1.9
30	kh-I	0%	10%	23%	23%	38%	3.7	0%	15%	28%	28%	23%	3.4
31	rabi	0%	0%	17%	50%	33%	4.2	17%	25%	33%	25%	0%	2.7
31	kh-II	0%	33%	58%	8%	0%	2.8	33%	50%	17%	0%	0%	1.8
31	kh-I	0%	8%	42%	8%	42%	3.8	0%	8%	58%	17%	17%	3.4
43-1A	rabi	0%	0%	29%	57%	14%	3.9	36%	57%	7%	0%	0%	1.7
43-1A	kh-II	0%	0%	36%	50%	14%	3.8	36%	43%	21%	0%	0%	1.9
43-1A	kh-I	0%	0%	29%	64%	7%	3.8	14%	43%	29%	14%	0%	2.4
43-2A	rabi	0%	0%	33%	52%	14%	3.8	24%	57%	19%	0%	0%	2.0
43-2A	kh-II	0%	5%	33%	43%	19%	3.8	10%	71%	19%	0%	0%	2.1
43-2A	kh-I	0%	0%	19%	67%	14%	4.0	5%	33%	43%	10%	10%	2.9
43-2D	rabi	0%	4%	25%	54%	18%	3.9	14%	68%	18%	0%	0%	2.0
43-2D	kh-II	0%	0%	36%	50%	14%	3.8	11%	61%	25%	4%	0%	2.2
43-2D	kh-I	0%	0%	21%	68%	7%	3.7	4%	50%	21%	18%	4%	2.6
43-2E	rabi	0%	0%	33%	25%	42%	4.1	17%	50%	17%	17%	0%	2.3
43-2E	kh-II	0%	0%	50%	42%	8%	3.6	25%	58%	8%	0%	8%	2.1
43-2E	kh-I	0%	8%	17%	50%	8%	3.1	8%	25%	17%	33%	0%	2.4
43-2F	rabi	0%	0%	33%	59%	7%	3.7	0%	85%	11%	4%	0%	2.2
43-2F	kh-II	0%	0%	52%	37%	11%	3.6	0%	89%	11%	0%	0%	2.1
43-2F	kh-I	0%	0%	33%	59%	7%	3.7	0%	70%	22%	7%	0%	2.4
55-2A	rabi	0%	0%	46%	31%	23%	3.8	15%	31%	54%	0%	0%	2.4
55-2A	kh-II	0%	0%	38%	38%	23%	3.8	8%	31%	46%	15%	0%	2.7
55-2A	kh-I	0%	0%	31%	38%	23%	3.6	8%	8%	69%	8%	0%	2.6
55-2C	rabi	0%	6%	19%	63%	13%	3.8	13%	63%	13%	13%	0%	2.3
55-2C	kh-II	0%	0%	31%	63%	6%	3.8	0%	69%	25%	6%	0%	2.4
55-2C	kh-I	0%	6%	44%	50%	0%	3.4	6%	44%	25%	25%	0%	2.7
-	total	0%	8%	31%	44%	15%	3.6	8%	47%	31%	11%	2%	2.5

Score: 1 = very good, 2=good (i.e. no problem), 3-=average, 4=bad, 5=very bad. Severity score is the average of these over three season

Table 4: Land tenure by season

		Percentage of crop area under different tenure arrangements								
Season	Polder	Owner cultivator			Sharecropper			Other lease		
		before	now	change	before	now	change	before	now	change
Rabi/boro	22	72	74	1	13	9	-4	6	17	11
	26	53	43	-10	25	16	-10	22	42	20
	29	50	46	-4	23	12	-11	25	42	16
	30	58	59	1	28	28	1	14	13	-2
	31	52	52	0	24	23	-2	24	26	2
	43-1A	59	50	-9	19	11	-8	23	39	17
	43-2A	63	57	-6	27	19	-7	11	24	13
	43-2D	61	52	-9	24	19	-5	15	29	14
	43-2E	70	66	-5	17	14	-3	13	20	8
	43-2F	57	47	-11	23	8	-15	16	42	26
	55-2A	51	45	-7	29	15	-14	20	40	20
	55-2C	59	45	-14	25	21	-5	15	34	19
Kharif II	22	76	74	-2	14	10	-4	10	16	6
	26	56	43	-13	26	16	-10	19	42	23
	29	54	46	-8	20	13	-7	26	41	15
	30	66	69	3	24	22	-2	10	10	0
	31	53	52	-1	26	21	-5	21	27	6
	43-1A	60	48	-11	18	12	-6	23	39	17
	43-2A	65	58	-6	24	20	-4	12	22	10
	43-2D	60	51	-10	24	18	-6	15	31	16
	43-2E	69	66	-3	18	15	-3	14	19	5
	43-2F	56	44	-11	23	8	-14	18	44	26
	55-2A	50	46	-4	31	15	-16	18	39	20
	55-2C	59	45	-14	25	21	-5	15	34	19
Kharif I	22	87	85	-2	8	3	-6	5	13	8
	26	58	46	-12	10	5	-6	32	49	18
	29	59	49	-9	11	6	-5	30	44	14
	30	75	71	-4	5	7	1	10	13	3
	31	66	62	-4	3	4	0	23	35	12
	43-1A	55	48	-7	17	12	-4	21	39	18
	43-2A	54	52	-2	23	16	-7	9	18	9
	43-2D	41	44	2	11	8	-2	9	16	7
	43-2E	25	37	13	5	10	5	4	12	8
	43-2F	56	51	-5	19	8	-11	18	37	19
	55-2A	24	32	7	14	10	-4	8	28	20
	55-2C	36	29	-7	8	8	0	6	19	13

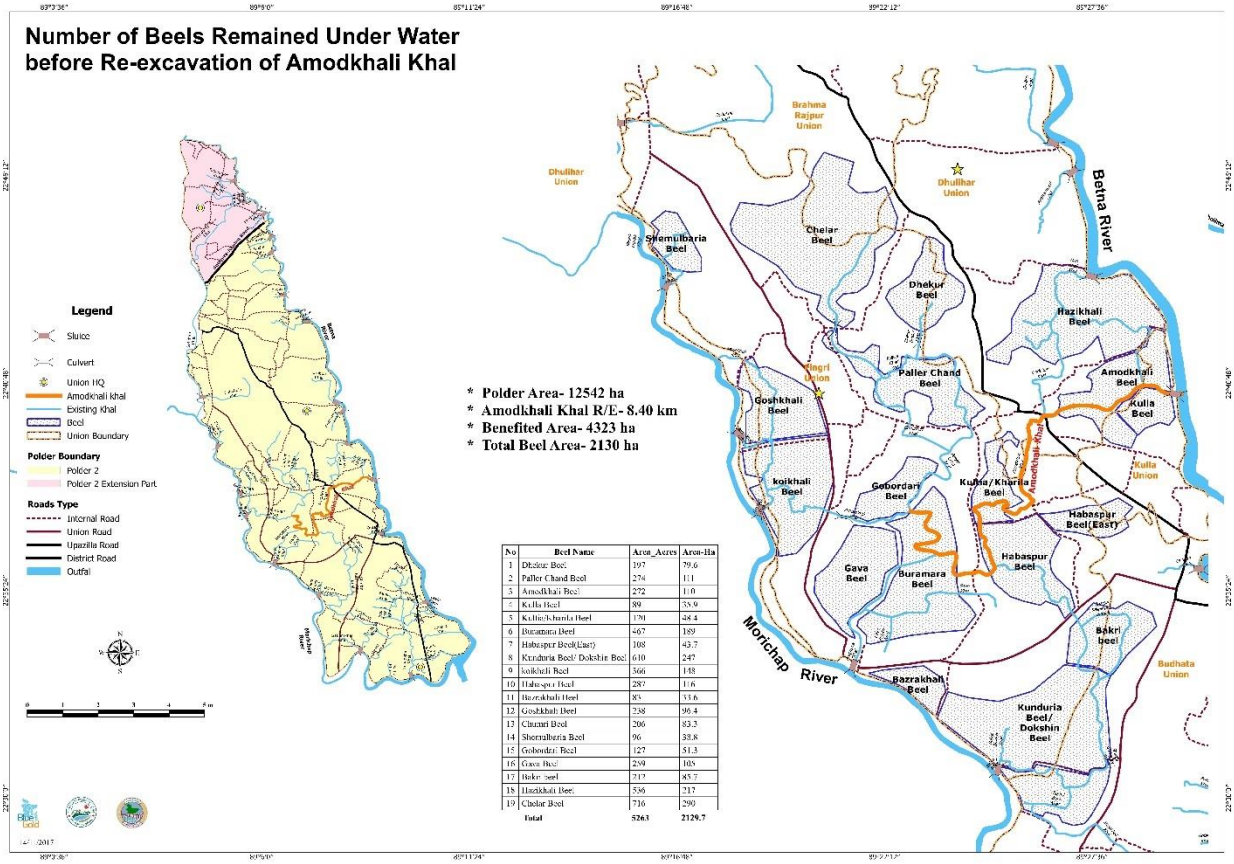
Appendix 3: Polder 2: changes in farming systems and farm income

1. Introduction

Polder 2 is a large polder of 12,600 ha. Over the last 20 years farming here has been increasingly affected by siltation of the rivers (Betna and Morichap) that drain the polder, running along its east and west boundaries. Apart from the lower reach of the Betna, these rivers are now effectively dead and no longer drain the northern half of the polder. Drainage khals within the polder have also silted up. As a result, aman paddy can no longer be grown in the in low-lying areas of the polder, much of which is now used for aquaculture in the aman season followed by boro paddy in the dry season. In places some land has now been converted to year-round fish production ghers – often producing brackish-water shrimp along with fresh water fish.

However there is still potential to drain water to the lower part of the Betna on the eastern side of the polder. A key khal in the centre of the polder, Amodkhali khal, has been re-excavated to drain water through the Amodkhali sluice into the Betna river. This catchment covers the full width of the centre of the polder, amounting to 4,323 ha, over a third of the total area of the polder. Land on the western side of the catchment previously drained to the east into the Morichap river, while on the north eastern side some land would have originally drained into the Betna via another sluice upstream of Amodkhali sluice, but this is no longer possible due to siltation of this part of the Betna river.

Figure 1: Beels in the Amodkhali khal catchment



No	Beel Name	Area_Acres	Area-Ha
1	Dhulia Beel	197	79.6
2	Paller Chand Beel	274	111
3	Amodkhali Beel	272	110
4	Kulia Beel	89	35.9
5	Kulia/Khuria Beel	170	68.4
6	Buramara Beel	467	189
7	Habaspur Beel(East)	108	43.7
8	Kunduria Beel/ Dokshin Beel	610	247
9	koikhali Beel	366	148
10	Habaspur Beel	287	116
11	Razzakhali Beel	85	34.6
12	Goshkhali Beel	238	96.4
13	Chazari Beel	206	83.3
14	Shemulbaria Beel	96	38.8
15	Gobordri Beel	127	51.3
16	Gava Beel	259	105
17	Bakri beel	217	87.7
18	Hazikhali Beel	536	217
19	Chelar Beel	716	290
	Total	526.3	2129.7

Within this enlarged Amodkhali catchment area there are 19 low lying depressions known as beels. These areas cover a total of 2,130 hectares, 49% of the total area of the catchment. It is this land where aman production has been severely constrained by poor drainage, and which will benefit from the improved drainage of Amodkhali khal. There are 24 WMG in the catchment – beels overlap with different WMG, and some WMG commands have land in more than one beel.

During the field visit in May 2018, data was collected from a sample of six of the 24 WMG. These were selected on the basis of expectations that high, medium and low proportions of beel land had been converted into aman following improved drainage – with two WMG being selected in each of these categories.

2. Change in land use

Table 1 shows changes in the use of land in beels for the six sample WMG. Of the six WMG, one (Koikhali khal) has been able to convert 90% of beel land to aman – previously this was 30% used for seasonal fish ghers and 70% was fallow. Now all the fallow land and most of the fish ghers have been converted to aman. Two more of the six WMG reported a substantial increase in aman cultivation – in the order of 40% to 50% of the beel area. Goshkhali khal WMG reported that, with better drainage, the area of aman was increased from 30% to 80% of the beel area, with a commensurate reduction in the area of fallow land. Some jute is also now grown. After Amodkhali khal was re-excavated, all of the beel area of Darikkha WMG was planted with aman. This area had previously been fallow in the aman season. However the crop was flooded and submerged, and 60% of the area failed to produce a harvest. A small part of this land was then used as a seasonal fish gher. As further re-excavation of Amodkhali khal is now taking place, farmers are keen to try and grow aman in this coming season.

Table 1: Change in land use in beels

WMG		Koikhali	Goshkhali	Hazikhali	Jhyar khal	Chellar	Darikkha
Total area	ha	191.2	138.3	205.8		84.3	195.7
Beel area	ha	114.7	101.2	175.4	170.0	74.2	175.4
Pre-project							
Boro	Boro	90%	100%	69.2%	99.0%	100.0%	100.0%
	Fish	0%		30.8%[2]			
	Fallow	10%			1.0%		
Aman	Aman	0%	30%	11.5%		28.0%	0.0%
	Fish	30%	5%	84.6%	99.0%	38.0%	0.0%
	Jute	0%	0%				0.0%
	fallow	70%	65%	3.8%	1.0%	35.0%	100.0%
Cropping intensity		120%	135%	196%	198%	165%	100%
Now							
Boro	Boro	100%	100%	69.2%	99.0%	100.0%	100.0%
	Fish			30.8%			
	Fallow	0%			1.0%		
Aman	Aman	90%	80%	15.4%		33.0%	40.0%
	Fish	10%	5%	84.6%	99.0%	38.0%	7.7%
	Jute	0%	10%[1]				
	fallow	0%	5%	0.0%	1.0%	29.0%	52.3%[3]
Cropping intensity		200%	195%	200%	198%	171%	148%
Increase in aman		90%	50%	4%	0%	5%	40%

[1] Some jute may be grown prior to planting aman, so the area of fallow land may be greater than that shown.
[2] This area is year-round fish/shrimp gher
[3] This land was planted with aman, but the crop failed after flooding.

The remaining three sample WMG reported growing aman on no more than 5% of their beel area. Chellar beel khal WMG has expanded their area of aman from 28% to 33% of beel land, and Hazikhali WMG has expanded the area of aman from 11.5% to 15.4% of the beel area. But Jhyar khal still grows no aman at all on its beel land. Cropping intensity (including fish ghers) was close to 200% at Hazikhali and Jhyar khal prior to BGP, limiting the scope for further improvement.

Factors that determine the adoption (or non-adoption) of aman on beel land of these WMG command areas are:

- Availability of fallow land in the aman season
- Improved drainage of land in the aman season
- Utilisation of land for fish production
- Land ownership and tenure

Fallow land: before drainage improvement, all beel land in one (Darikkha) of the six WMG was fallow in the aman season, while two WMG (Koikhali and Goshkhali) had about two-thirds was fallow, and a fourth WMG had one third of its beel land fallow. This land is potentially available for cultivation of aman, and at Koikhali and Goshkhali WMGs, all, or almost all, of this land has been converted to aman. At the other two WMGs conversion has been constrained by other factors.

Improved drainage – the reason why more land was not used for aman as Darikkha is that drainage improvements are not yet fully effective – although all the beel land was planted with aman, it was flooded and 60% failed to produce a harvest. Waterlogging is still said to be the main problem for Hazikhali WMG – both delaying the planting of boro and damaging aman.

Utilisation for fish production: in the aman season, most (over 85%) beel land for two of WMG (Hazikhali and Jhyar Khal) is occupied by fish production ghers, with ghers also occupying a substantial proportion (30%+) at Koikhali and Chellar. At current (relatively high) paddy prices, aman production may be as profitable as a seasonal fish gher, but even if farmers think fish is more profitable (as at Koilkhali WMG), they still say they would like to convert land from fish ghers due to (i) increased paddy production improves household food security; (ii) paddy straw is highly valued as a livestock feed (and per hectare is worth around 40% of the value of grain); (iii) aman paddy creates work for them and reduces the need to migrate out of the area to find work; and (iv) farmers see fish (and especially shrimp and prawn production) as risky due to threat of disease outbreaks and fluctuations in market prices. However only at Koikahli has beel land been converted from fish ghers to aman paddy. Expansion of aman at four other WMG commands has only been via conversion of fallow land, with land occupied by ghers being unchanged. The non-conversion of land from ghers to aman is linked to land ownership and tenure.

Land ownership and tenure: beel land in two WMG commands (Chellar beel and Jhyar khal) is dominated by large landowners and/or large gher operators. The 600 bigha (80 ha) of Chellar beel is basically in the hands of large Hindu landowners, with 300 bigha owned by three families and another 100 bigha owned by only 10 households. Households with larger land holdings are less interested in improving food security, increasing their supply of straw for fodder, or creating more work during the aman season. For these households it easier to lease out their land for fish production. In Chellar beel there are only 20 gher operators for a total of 225 bigha – over 11 bigha each on average. Although aman production takes place on 35% of beel land, this has only increased by 5 percentage points since BGP improved Amodkhali khal as large ghers make drainage of much of the beel difficult.

Gher operation is even more concentrated in the command area of Jhyar khal WMG, where 960 of the total area of 1260 bigha (168 ha) has been leased to one person who invested a considerable sum in building a dyke around the gher in exchange for a five year lease. Even when this lease expires, it is unlikely that the gher operator will relinquish this land – which is mostly owned by larger land owners. Seasonal fish production also

takes place on almost all of the other 300 bigha in this beel, but this mostly in the hands of owners of this land. However it would be difficult to convert any land to aman as the large gher blocks drainage lines.

Although land ownership in the command area of Hazikhali WMG is not dominated by large land owners (only 5% of households own over 7 bigha =0.93 ha), perennial shrimp/fish production takes place on 31% of beel which creates drainage problems elsewhere. This, and the limited effectiveness, so far, of the re-excavation of Amodkhali khal have limited the expansion of aman to the 4 percentage points of land that was fallow – no fish ghers were converted.

Table 2: Summary of increase in aman area and constraints in expansion of aman

WMG	Percentage of beel area		Land converted from	Constraints to conversion
	Aman area now	Increase in aman		
Koilhali	90%	90%	fallow, fish	none, almost all land converted
Goshkhali	80%	50%	fallow	none, most land now aman
Hazikhali	15%	4%	fallow	drainage not effective, obstruction of perennial gher
Jhyar khal	0%	0%		Very big gher obstructs drainage
Chellar beel	33%	5%	fallow	Large landowners prefer fish, ghers obstruct drainage
Darikkha	40%	40%	fallow	Drainage not yet fully effective

3. Increase in farm income.

The increase in farm income that can be attributed to Blue Gold activities in the Amodkhali khal catchment of polder 2 may include:

- Change in cropping patterns due to improved drainage of beels – in particular expansion of aman, but also small increases in the area of boro and jute. This expansion will generate additional farm income, against which reduction in income from fish due to a reduction in the area of ghers. Virtually all aman and boro are HYV varieties, so there is no potential to improve productivity by switching from local varieties to HYV.
- Increased crop yields (and possible reduced costs) due to improved drainage and/or improved technologies and farming methods introduced by BGP. It is reported that improved drainage has enabled boro to be planted earlier, resulting in higher yields. A number of WMG report adoption of line sowing of paddy and, in one WMG, 15% to 20% of farmers are reported to be using USG.
- Increased income from homestead activities – vegetable gardens, poultry, livestock and small fish ponds – due to improved technologies and farming methods introduced by BGP. Farmers Field Schools (FFS) for homestead vegetables have introduced bed, pot and climbing vegetable production, and one WMG said that production had doubled. Similar increases are also reported for backyard poultry, with wide spread adoption of hazil (improved nesting pots for brooding hens) and vaccination. Another WMG said that, after FFS training, every homestead now grows vegetables for their own consumption. Previously poor drainage prevented vegetable production at some homesteads. Many more households now have cattle and poultry.

The increase in income due to change in cropping patterns alone has been calculated by using the net income per hectare for different crops and fish ghers derived from crop budgets (see Attachment A of this Appendix) multiplied by the areas of each crop and fish gher area before BGP and at the present time.

Table 3 shows income, costs and net income per hectare for crops and fish ghers in beel land in the Amodkhali catchment area. This shows that paddy production is slightly more profitable than fish – however the difference is not great and could easily be reversed if local production conditions favour fish more than paddy or if relative paddy and fish prices change.

Table 3: Costs and income for different land uses

		Boro	Aman	Jute	Seasonal fish	Perennial fish
Gross income	Tk per ha	225,649	131,546	151,942	163,918	306,879
Costs	Tk per ha	89,968	33,046	77,468	71,855	88,695
Net income	Tk per ha	135,682	98,501	74,474	92,064	218,183
Hired labour	days per ha	127	67	45		
HH labour	days per ha	90	64	112		

Labour is not shown for fish enterprises as much time is spent guarding ponds and data is not comparable with that for paddy.
Net income is before household labour costs

Based on data from six of the 24 WMG in the Amodkhali catchment on polder 2, total annual benefits from the change in cropping pattern alone is calculated in Table 4 to be Tk24.54 million for an area of 811 ha of beel (Tk30,253/ha). The annual benefits on polder 2 are less than half of the investment of Tk51.1 million (total polder development cost divided by 65 WMG and then multiplied by 6 - an estimate for the Amodkhali khal catchment alone would be useful).

Table 4: Increase in income for six WMG in Amodkhali khal catchment

		Crop area ha		Net income Tk m		total labour '000 p-days		hired labour '000 p-days	
		Before BGP	Present	Before BGP	Present	Before BGP	Present	Before BGP	Present
Boro		744	755	100.94	102.49	161.5	164.0	94.7	96.1
Aman		71	306	7.03	30.13	9.4	40.1	4.8	20.6
Jute		0	10	-	0.75	-	1.6	-	0.5
Fish	seasonal	330	321	30.43	29.56	123.7	120.1	-	-
	perrenial	54	54	11.78	11.78	36.4	36.4	-	-
	total	1,200	1,446	150.17	174.71	330.87	362.13	99.47	117.18
increase				16%	24.54	9%	31.26	18%	17.71

In addition total labour requirement is increased by 9% and hired labour by 18%.

This means that the payback period for the investment in this polder is a little more than two years – even though so far three of the six WMG only have minimal benefits. Data for all 24 WMG could produce a higher estimate as it may well be that more than 50% of WMG have significant benefits. Some of the other polder 2 WMG are reported to be growing increased areas of mustard, and have switched from local to HYV varieties of mustard. There are also reports of beel land being used for vegetables. This has not been included in these calculations.

In addition, FFS have promoted better methods of paddy production. As almost all land grows boro this could have a significant benefit. Attributing a 20% increase in boro yield to FFS technologies along with earlier planting would double total benefits to Tk56.55 million - but there is no evidence that improved technologies and dissemination from FFS have had this much impact. Benefits from improved homestead production have not been quantified, but could well be significant.

4. Land tenure

Compared to many other districts, more land in Satkhira is in the hands of larger landowners, and information from the BGP polder team suggests that as much as 70% of land in polder 2 is owed by large farmers, with another 20% by medium farmers[7].

[7] 20% of farm households are large farms, 50% medium, 20% small and 10% marginal. Compared with other parts of Bangladesh, this is a very high proportion of large and medium holdings. This data needs further checking.

Data from five WMG[8] in Table 5. This shows that a higher proportion of aman land is sharecropped than for boro. This is the reverse of the normal pattern in Bangladesh where boro is more likely to be sharecropped than aman. Historically, aman has been the main paddy season during which households aimed to produce rice for family consumption. Boro was an additional crop and, being more expensive to grow, land may be leased out in this season by households who do not need the additional paddy. In polder 2, boro has become the principal paddy crop which provides rice for household food consumption. Aman is now an additional crop, and may be seem as being more risky than boro, and therefore land owners are more inclined to lease out land to grow aman.

Table 5: Land tenure arrangements for paddy

Crop	Cultivated by	Percentage of land				
		Koikhali khal	Goshkhali	Hazikhali	Chellar	Darikkha
Boro	owner	80%	90%	70.0%		77.0%
	sharecropper	10%	10%	30.0%		23.0%
	renter	10%				
Aman	owner	30%	47%	50.0%	30.0%	30.0%
	sharecropper	50%	53%	50.0%	70.0%	70.0%
	renter	20%				

Sharecroppers for aman provide all inputs and labour and give half of their crop (prior to threshing) to the landlord, but for boro the landlord pays the irrigation cost. This means that the net income per hectare for sharecroppers is much lower than for owner-cultivators. Net income accruing to sharecroppers and to their landlords is shown in Table 6.

This table shows that net income for sharecroppers is about one third of that for owner-operators, with landlords getting two-thirds of net income (before deducting any charge for household labour). Landlords who sharecrop out land for aman production earn significantly more than if they had leased the land for seasonal fish production at a rent of Tk5,000 per bigha (=Tk37,424 per hectare). However field interviews suggested that many landowners continue to lease land to gher operators – maybe because they prefer a cash rent paid in advance to having to deal with bundles of unthreshed paddy – even if this is more valuable. The improvements in drainage have only just happened, and landlords' preference to lease out to gher operators may change over time as they realise that sharecropping to aman cultivators can earn them more money.

Table 6: Net income for sharecroppers and landlords

		Boro	Aman
Gross income	Tk per ha	112825	65773
Costs	Tk per ha	64894	33046
Net income for sharecropper	Tk per ha	47931	32728
Hired labour	days per ha	112	67
HH labour	days per ha	86	49
Net income as % of owner-operator		35%	33%
Income for landlord		87,750	65,773
Seasonal fish lease charge			37,424

Much land in some beels is leased for seasonal fish and shrimp production. Such leasing is on the basis of a cash rent and can be for a single season (so land is available for the land-owner to produce boro) or for the entire year. In Jhyar khal WMG the cash rent for one season is relatively low (Tk3000/bigha), but 960 bigha of

[8] Jhar khal WMG is excluded as no aman is grown here.

beel has been rented for five years to one person who has made a considerable investment in a dyke in order to use this land as a gher. As part of this agreement, the gher operator has to ensure that land is ready for land owners to plant boro, pumping out residual water if needed. In other beels much gher land is rented for 12 months. Annual cash rental is increasing in Koikhali beel – and is Tk10-12,000 per bigha, double the amount for a single season. Hazikhali was the only WMG where some land was used for year-round ghers, but operators of seasonal ghers may still take 12 month leases (Tk9,000-10,000/bg) and may then sharecrop out land for the boro season. In Chellar beel, seasonal gher operators take one-year leases for Tk10,000/bigha and produce boro rice themselves. It is reported that leasing costs have increased by 50% or more over the last three years.

Most of the aman crop is being grown by sharecroppers. Households leasing in land for paddy production tend to own only a small area of cultivable land – or maybe none at all – and so need more land to produce enough rice to ensure household food security. Such households are relatively poor – so improved drainage is generating new opportunities for poor households to grow paddy. Table 7 shows that net income from sharecropped aman and boro has increased by Tk5.16 million. This is an increase of 79%, considerably more than the increase of 16% in overall net income (Table 3).

Table 7: Net income for sharecroppers

		Koikhali khal	Goshkhali	Hazikhali	Chellar	Darikkha	total
Before BGP Tk'000	Boro	990	485	1,746	-	1,934	5,155
	Aman	-	527	331	476	-	1,334
	total	990	1,012	2,078	476	1,934	6,489
Now Tk'000	Boro	1,100	485	1,746	-	1,934	5,265
	Aman	2,365	1,405	442	561	1,608	6,380
	total	3,465	1,890	2,188	561	3,542	11,645
Increase in net income		2,475	878	110	85	1,608	5,156
		250%	87%	5%	18%	83%	79%

To assess the impact of changes in net income for poor households a model of a typical marginal farmer has been used (Table 8). This farmer cultivates up to 0.2 ha (1.5 bigha) of his own land in the beel plus up to 0.4 ha (3 bigha) of sharecropped land. The percentage of the 0.2 ha of own land actually cultivated with boro and aman is the proportion of total beel land used for these crops (Table 1). The percentage of the 0.4 ha of sharecropped land actually cropped is the proportion of total beel land used for these crops (Table 1) multiplied by the percentage of crop area that is sharecropped.

Table 8: Change in net income for model marginal farmer

		Koikhali khal	Goshkhali	Hazikhali	Jhyar khal	Chellar	Darikkha
Area before							
Own	boro	0.18	0.20	0.14	0.20	0.20	0.20
	aman	0.00	0.06	0.02	0.00	0.06	0.00
sharecrop	boro	0.04	0.04	0.08	0.00	0.00	0.09
	aman	0.00	0.06	0.02	0.00	0.08	0.00
Area now							
Own	boro	0.20	0.20	0.14	0.20	0.20	0.20
	aman	0.18	0.16	0.03	0.00	0.07	0.08
sharecrop	boro	0.04	0.04	0.08	0.00	0.00	0.09
	aman	0.18	0.17	0.03	0.00	0.09	0.11
Before GM Tk'000							
Own	boro	24.42	27.14	18.79	26.86	27.14	27.14
	aman	-	5.91	2.27	-	5.52	-
sharecrop	boro	1.73	1.92	3.98	-	-	4.41
	aman	-	2.08	0.76	-	2.57	-
total		26.15	37.05	25.80	26.86	35.22	31.55
Now GM Tk'000							
Own	boro	27.14	27.14	18.79	26.86	27.14	27.14
	aman	17.73	15.76	3.03	-	6.50	7.88
sharecrop	boro	1.92	1.92	3.98	-	-	4.41
	aman	5.89	5.55	1.01	-	3.02	3.67
total		52.67	50.36	26.81	26.86	36.66	43.09
Increase		101%	36%	4%	0%	4%	37%

Net income for these marginal farmer models has doubled for Kiolkhali khal WMG (where aman area increased by 90% of the beel area) and over one third for Goshkhali and Chellar WMGs (where the aman area has increased by 40-50% of the beel area). Although the area of sharecropping has increased, far more income is generated from crops on owned land. This analysis does not take account of the fact that these households are likely to own higher land as well as beel land, and ignores any contribution from homestead farm activities (vegetables, fruit, poultry, livestock and small fish ponds).

5. Other changes and benefits in polder 2

In the past excessive seasonal flooding meant that people living near a number of beels used to have to leave their homes and take shelter in schools. Monsoon water levels have now decreased by between 30 cm and 75 cm. As a result, homes no longer flood, roads remain functional, and more land has come under cultivation. Household tasks are now much easier for women. Additional income from farming is being spent on children's education, investment in IGAs, and in improving houses. BGP also provided women with training on tailoring and handicrafts, although earnings from tailoring are reported to be less than expected.

Attachment A: Calculations for Polder 2

Crop budgets

Crop name	Boro BR28			Aman HYV		
Unit of land	Bigha			Bigha		
	Quantity	Price	Cost	Quantity	Price	Cost
Input cost						
Seed/seedling (kg/number)	4.00	60.00	240.00	3.00	50.00	150.00
Urea (kg)	40	17.00	680.00	20	17.00	340.00
DAP (Kg)	0	28.00	0.00			0.00
TSP (kg)	30	27.00	810.00	15	27.00	405.00
MP (kg)	20	17.00	340.00	0	17.00	0.00
Zinc (kg)	2	180	360.00			0.00
Gypsum (kg)	8	25.00	200.00			0.00
Insecticide (kg)	0.7	1200.00	840.00	0.10	600.00	60.00
Fungicide (ml)				100.00	2.00	200.00
Irrigation (time/hours)[2]	sum		2650.00			0.00
Machinery (hire)						
Land preparation (times)	1	600.00	600.00	2	180	360.00
Threshing machine	1	300.00	300.00			0.00
Threshing (maund)[3]						
Labour (hired & family)[7]						
Seedling production (days)	3	h'hold	0.00	2	h'hold	0.00
Land preparation (days)	0	500.00	0.00	1	h'hold	0.00
Land leveling (days with cattle)						0.00
Planting/transplanting (#)	4	500.00	2000.00	4	500.00	2000.00
Fertilization (days)	2	h'hold	0.00	1	h'hold	0.00
Weeding/earthing up (#)	4	150.00	600.00	2	150.00	300.00
Irrigation (days)	4	h'hold	0.00			0.00
Pesticide application (day)	2	h'hold	0.00	0.5	h'hold	0.00
Harvesting (day/share)[4]	5	200.00	1000.00	3	200.00	600.00
carrying	2	500.00	1000.00	1	h'hold	0.00
Threshing/winnowing[4]	2	200	400.00	3	h'hold	0.00
Total Cost			12020.00			4415.00
Yield						
Main product (kg)	930	22.92	21312.50	540	22.92	12375.00
By-product (kg/Number)	930.0	9.50	8835.00	540	9.63	5200
Gross Returns			**30147.50**			**17575.00**
Net Returns			18127.50			13160.00

Total labour input

		Boro	Aman
Hired labour	days per bigha	17	9
family labour	days per bigha	11	9
total		28	
Net income per day of family labour	Tk per day	1648	1548

Fish production budgets

System type	year-round shrimp/fish			seasonal fish		
Unit of land	Bigha			Bigha		
	Quantity	Price	Cost	Quantity	Price	Cost
Input cost						
Prawn /shrimp fingerings			7500	1000	2	2000
Fish fingerlings			incl	40 kg	150	6000
Feed and lime			2000			
Gher maintenance			1750			1000
Other costs			600			600
Total costs			11850			9600
Yield						
Fish kg	55	110	6000	40	110	4400
Prawn/shrimp kg	70	500	35000	35	500	17500
Gross Returns			41000			21900
Net Returns			29150			12300
Total labour input						
family	90.0			50		
Net return per day of family labour			324			246

Note: one bigha = 33 decimals = 0.33 acre = 0.1336 ha.

Land use in polder 2

Catchment		Nashaishil	Masuakhali	Musturukathi	Amkola	Badura	Bauria	total
Gross area	ha	191.2	138.3	205.8		84.3	195.7	
Beel area	ha	114.7	101.2	175.4	170.0	74.2	175.4	811.1
Pre-project								
Aman	LV	90.0%	95.0%	90.0%	90.0%	100.0%	100.0%	90.9%
	HYV	10.0%	5.0%	20.0%	10.0%	0.0%	0.0%	9.1%
Aus	LV	100.0%	100.0%	95.0%	100.0%	100.0%	100.0%	98.9%
	HYV	0.0%	0.0%	5.0%	0.0%	0.0%	0.0%	1.1%
Rabi	sesame	17.0%	10.0%	10.0%				8.2%
	s-potato		5.0%	10.0%				2.8%
	keshari		40.0%	30.0%	80.0%	100.0%	75.0%	42.5%
	felon	4.0%	5.0%	5.0%				2.9%
	chilli LV	2.0%	2.5%	5.0%	2.0%		2.5%	2.6%
	chilli HYV	2.0%	2.5%	5.0%	2.0%		2.5%	2.6%
	mung LV	43.0%	19.0%	19.0%	6.0%		7.0%	20.4%
	mung HYV	15.0%	6.0%	6.0%	2.0%		3.0%	6.9%
	w-melon							0.0%
	g-nut	17.0%	10.0%	10.0%	8.0%		10.0%	11.0%
	total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Now								
Aman	LV	40.0%	65.0%	20.0%	42.0%	50.0%	90.0%	46.4%
	HYV	60.0%	35.0%	80.0%	58.0%	50.0%	10.0%	53.6%
Aus	LV	0.0%	10.0%	5.0%	40.0%	40.0%	0.0%	5.5%
	HYV	100.0%	90.0%	95.0%	60.0%	60.0%	100.0%	94.5%
Rabi	sesame	2.5%						0.6%
	s-potato							0.0%
	keshari				2.0%	2.0%	1.0%	0.6%
	felon	2.5%	5.0%	5.0%				2.8%
	chilli LV	1.0%		1.0%	0.5%	0.5%	0.5%	0.7%
	chilli HYV	4.0%		4.0%	1.5%	2.5%	1.5%	2.5%
	mung LV	5.0%	5.0%	4.0%	9.0%	5.0%	5.0%	5.6%
	mung HYV	65.0%	70.0%	36.0%	79.0%	65.0%	67.0%	61.9%
	w-melon	10.0%	10.0%	40.0%	8.0%	15.0%	20.0%	17.4%
	g-nut	10.0%	10.0%	10.0%		10.0%	5.0%	7.8%
	total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Appendix 4: Polder 43/2B: changes in farming systems and farm income

1. Introduction

Improved drainage and water management of this polder in Patuakhali district aims to allow cultivation of rabi crop (i.e. non-rice dry-season crops). In contrast to polder 2, very little boro paddy is grown here as the groundwater is saline and cannot be used for irrigation. However, unlike polder 2, water in rivers outside the polder is fresh and can be used for irrigation (at least in parts of the polder). Improved sluices, inlets and khals help to provide limited irrigation using this water for crops of water melon, chilli and a small but growing area of boro paddy.

The polder, of around 3,158 ha, has 28 WMG and is divided into six sluice catchment areas. The polder is considerably smaller than polder 2 – indeed it is smaller than the Amodkhali khal catchment area of polder 2 which covers 4,323 ha.

2. Change in crop area

Following implementation of BGP, the area of crops has increased, with a significant increase in the overall cropping intensity from 155% to 204% (Table 1). Aman paddy is the principal crop, with its area increasing in two of the sub-catchments due to improved drainage. There has also been a small increase in the total area of aus paddy (said to be at least partly due to the current high market price for paddy), but the major increase has been in rabi crops, with the area increasing from 48% to 81% of cultivable land. However in the Bauria sub-catchment rabi crops are no longer grown as the embankment here has failed and the land is regularly flooded with tidal water.

Table 1: Seasonal crop area

Sub-catchment	Nashaishil	Masuakhali	Musturukathi	Amkola	Badura	Bauria	total
Area ha	648	598	696	607	270	339	3158
Before BGP							
aman	95%	50%	80%	100%	100%	100%	87%
aus	42%	15%	20%	5%	10%	25%	20%
rabi	60%	50%	40%	53%	20%	50%	48%
total (ci)	197%	115%	140%	158%	130%	175%	155%
After BGP							
aman	95%	75%	95%	100%	100%	100%	93%
aus	42%	20%	35%	5%	15%	75%	30%
rabi	100%	83%	90%	92%	80%	0%	81%
total (ci)	237%	178%	220%	197%	195%	175%	204%

WMG members in these catchments attribute these improvements to better drainage as sluices have been repaired and khals re-excavated, along with better awareness and knowledge of a range of rabi crops. In Nashaishil the sluice is controlled by fishers and farmers report almost no improvement in water management but, despite this, farmers have switched to growing HYV paddy and a larger area of rabi crops with the knowledge they have obtained from BGP and other sources. In Mushurukathi the main water management improvement seems to have been a better supply of water for the irrigation of melon, with increased knowledge of new crops and technologies being a key factor.

There has been a switch from local to HYV varieties of aman and aus paddy – before BGP almost all the area was planted with local varieties, now a little over half of aman is HYV as is almost all aus paddy (Table 2). This change is attributed to a combination of better drainage (rain water drains away more quickly allowing earlier planting of aman) and knowledge of HYV varieties – along with the availability of seed.

Table 2: Share of HYV and local varieties of paddy

Catchment		Nashaishil	Masuakhali	Musturukathi	Amkola	Badura	Bauria	total
Pre-project								
Aman	LV	90.0%	95.0%	90.0%	90.0%	100.0%	100.0%	90.9%
	HYV	10.0%	5.0%	20.0%	10.0%	0.0%	0.0%	9.1%
Aus	LV	100.0%	100.0%	95.0%	100.0%	100.0%	100.0%	98.9%
	HYV	0.0%	0.0%	5.0%	0.0%	0.0%	0.0%	1.1%
Current								
Aman	LV	40.0%	65.0%	20.0%	42.0%	50.0%	90.0%[1]	46.4%
	HYV	60.0%	35.0%	80.0%	58.0%	50.0%	10.0%	53.6%
Aus	LV	0.0%	10.0%	5.0%	40.0%	40.0%	0.0%	5.5%
	HYV	100.0%	90.0%	95.0%	60.0%	60.0%	100.0%	94.5%

[1] In the Bauria sub-catchment, farmers report that they now grow HYV aman, however the yield is very low and comparable with LV aman.

As well as a much larger area of rabi crops being grown, there has been a switch from keshari (grass pea) to mung bean and water melon (Table 3). Although the share in the total area of rabi crops has fallen for felon (cow pea), chilli and groundnuts, the actual area of these crops has increased as there has been a large increase in the total area of rabi crops (Table 3).

Table 3: Rabi crops

	Percentage of total area of rabi crops		Percentage of total cultivable area	
	before BGP	now	before BGP	now
sesame	8.2%	0.6%	3.9%	0.5%
sweet-potato	2.8%	0.0%	1.4%	0.0%
keshari (grass pea)	42.5%	0.6%	20.3%	0.5%
felon (cow pea)	2.9%	2.8%	1.4%	2.3%
chilli	5.3%	3.2%	2.5%	2.6%
mung	27.3%	67.5%	13.1%	54.4%
watermelon	0.0%	17.4%	0.0%	14.0%
groundnut	11.0%	7.8%	5.3%	6.3%
total	100.0%	100.0%	47.9%	80.6%

This change in cropping pattern has been driven by a combination of improved water management (better drainage and availability of irrigation water), awareness and knowledge of new crops (paddy HYV, improved varieties of mung bean, water melon) and financial incentives. Discussions with WMG indicated that much of the improved knowledge came from BGP – with MFS (Market Field Schools) introducing BR52 (short-duration aman HYV) and improved methods of mung bean cultivation, and FFS introducing line sowing for paddy and mung, improved paddy seedbeds and better use of fertiliser. Information from FFS is reported as being disseminated to other farmers – such as line sowing and IPM for homestead vegetables. Some information has

come from other sources – such as ATDP (DAE/USAID project) on mechanisation and use of USG, and seed companies on paddy HYVs.

3. Increase in farm income

The increase in farm income attributed to this change in cropping patterns has been calculated using crop budgets to calculate the net income per hectare. This net income is then multiplied by crop areas before BGP and at the present time to calculate the change in total net income. These calculations take account of increased crop yields resulting from a switch from local to HYVs for paddy, mung bean and chilli, but otherwise yields are assumed to be unchanged – which may not reflect the adoption of improved methods for other crops. A summary of crop budgets, including crop yield assumptions, are in Table 4 with details in Attachment A of this Appendix. It is worth noting that straw is much less valuable than in polder 2, only amounting to 2% or 3% of the value of grain. This reflects limited demand from livestock producers who have grazing available on fallow land.

Table 4: Summary of crop budgets

	Yield	Total cost[1]	Gross returns	Net income[1]	Net income[2]	Labour - hired	Labour - family
	kg/ha	Tk/ha	Tk/ha	Tk/ha	Tk/ha	days/ha	days/ha
Aman LV	2,470	16,821	50,857	34,037	22,181	15	30
Aman HYV	4,446	19,414	79,272	59,858	44,050	15	40
Aus LV	1,853	16,728	38,143	21,415	9,559	15	30
Aus HYV	3,952	19,649	70,464	50,815	35,007	15	40
Keshari	790	2,174	32,723	30,549	23,633	-	17
Felon	1,112	10,078	46,313	36,235	5,261	-	104
Mung LV	556	18,135	28,945	10,810	7,846	14	7
Mung HYV	865	23,141	39,623	16,482	13,518	20	7
Sesame	593	5,125	29,640	24,515	16,611	-	20
Groundnut	1,778	24,601	88,920	64,319	38,631	20	64
Sweet potato	9,263	9,894	138,938	129,044	42,594	-	216
Water-melon	3,705	77,854	296,400	218,546	175,074	25	109
chilli LV	556	9,590	63,680	54,090	23,956	-	75
chilli HYV	2,470	54,525	247,000	192,475	148,015	-	111

[1] Total cost and net income excluding cost of family labour

[2] Net income after deducting a notional cost of family labour of Tk400 per day.

From the crop budget calculations, it would seem that mung bean is not particularly profitable compared to a number of other rabi crops, yet its area has substantially increased and it is now the principal crop grown in the rabi season. In particular, mung has largely replaced keshari, yet does not seem to be as profitable. Farmers admitted that some of the less popular pulse crops, such as keshari and felon, do appear to be more profitable, but said that, a number of factors have made mung more attractive. First, keshari is sown by broadcasting seed into the standing aman crop and felon is sown shortly after the aman harvest. At this time, much land may be

too wet to allow land preparation (for felon) and seed sowing. There are also significant risks of these crops being damaged by late rains after the aman harvest. Mung beans are sown in January and February when land will be drier and easier to prepare, so larger areas can be sown. In addition, there is a ready market for large volumes of mung bean, while keshari and felon are largely grown for home consumption and only have a limited market. This issue needs further investigation.

The overall increase in annual net farm income is calculated in Table 5. This shows that farm income has almost doubled (increase of 91%), overall employment has risen by 59% and hired labour by 77%. The annual benefit of Tk146.6 million almost matches the estimated BGP cost on the polder development plan of Tk158.8 million – indicating a rapid payback of the project investment – even if all of these benefits are not attributed to BGP.

Table 5: Increase in farm income and employment

		Crop area ha		Net income Tk m		total labour '000 p-days		hired labour '000 p-d	
		Before	Present	Before	Present	Before	Present	Before BGP	Present
Aman	LV	2370	1297	80.67	44.14	105.37	57.66	35.12	19.22
	HYV	236	1498	14.14	89.65	12.83	81.38	3.50	22.20
Aus	LV	604	50	12.94	1.07	26.87	2.22	8.96	0.74
	HYV	7	863	0.34	26.35	0.36	46.87	0.10	12.78
Rabi	sesame	118	15	2.88	0.38	2.32	0.30	-	-
	s-potato	41	0	5.25	-	8.79	-	-	-
	keshari	610	15	18.62	0.45	10.54	0.25	-	-
	felon	42	69	1.53	2.49	4.38	7.13	-	-
	chilli LV	38	16	2.05	0.85	2.85	1.19	-	-
	chilli HYV	38	62	7.29	11.84	4.21	6.84	-	-
	mung LV	293	136	3.16	1.47	6.40	2.98	4.24	1.97
	mung HYV	99	1497	1.64	24.68	2.70	40.76	1.97	29.66
	w-melon	0	420	-	91.79	-	56.02	-	10.37
	g-nut	158	189	10.18	12.14	13.29	15.85	3.13	3.73
Total		4,653	6,125	160.68	307.30	200.92	319.45	57.01	100.67
increase				91%	146.62	59%	118.53	77%	43.66

Out of the increase in farm income of Tk146.6 million, almost two-thirds (63%) comes from watermelon. Although mung bean accounts for 84% of the increased area of crops, it only contributes 15% to the increase in farm income – due to the apparent low profitability of this crop. The increase in farm income has also been calculated in Attachment B using crop area data from DAE. This gives a slightly lower increase in farm income – but still easily justifies the investment by Blue Gold.

These calculations also do not take any account of improvements in homestead production of vegetables, poultry, livestock and small fish ponds. It is reported that almost every homestead now produces vegetables and backyard poultry. Homestead vegetable production has increased by between 30% and 60%, and local

poultry production has increased by at least 20% to 25%. In one catchment (Badura) it was reported that, after poultry FFS, production increased by 60% to 70% but due a shortage of Poultry Workers to continue vaccinating birds, diseases have now re-emerged and the overall increase in poultry production has dropped back to 25%.

Overall farming has become more market orientated, with farmers producing crops according to market demand – mung bean and watermelon are good examples of this. Some WMG members are participating in collective purchase of inputs and sale of outputs – and so getting better prices. In one WMG 40 to 50 farmers are collectively buying pesticides, paying cash in advance and getting a 10% reduction on the normal price. Farmers who do not have cash can buy on credit through dealers who will add 5% to the price in return for credit (so they pay 15% more than those who buy collectively).

4. Land tenure

In the six catchments, households owning less than 0.2 ha of land (classified as being landless) make up between 25% and 70% of households, while marginal and small farmers (0.2 to 1.0 ha of land) account for between 20% and 63% of households, with medium and large farmers being 5% to 15% of households. Overall about 41% of households are landless, 48% marginal and small farmers and 11% are medium and large farmers

Unlike in polder 2, the changes to cropping patterns bought about with support from Blue Gold in polder 43/2B have not resulted in significant new opportunities for sharecroppers from poorer households. Around 70% to 75% of land is farmed by land-owners, with 5% to 10% sharecropped and 20% on a cash rent and 5% mortgaged. However the terms of sharecropping are different to those prevalent in polder 2 (and also in much of the rest of Bangladesh). There are two main sharecropping systems. In the first of these, rather than the tenant paying for all production costs and giving half of the crop the land owner, sharecroppers in polder 43/2B only pay half of production costs (inputs and machinery hire), the other half coming from the landlord – who still gets half the crop. If the landlord does not contribute 50% of production costs, then the tenant can deduct this from the value of the landlord's crop share. In the other sharecropping system, the tenant pays all production costs, but only gives the landlord one third of the crop. In seems the first system may be more common for paddy and the second for rabi crops.

Families who do not have sufficient people to cultivate their land, and who lack the financial resources to hire sufficient labour, may lease out some of their land via sharecropping. Poor families who have manpower, but insufficient land, may sharecrop land – preferring this arrangement to cash renting as they would need to pay a cash rent at the start of the year (or season), while rent (crop share) for sharecropped land is not paid until the crop is harvested. Sharecropping also reduces risk – if the crop produces less than expected, then the rental will also be lower.

More valuable rabi crops, such as watermelon or vegetables, may more usually be grown on land that is rented for a fixed sum, and usually for one year. Cash rents in polder 43/2B were in the range of Tk12,000 to Tk20,000 per acre per year (rents have doubled since the start of BGP)[9].

Table 6 compares net income per hectare (before family labour costs) for: (i) an owner operator, (ii) a tenant paying cash rent, (iii) a sharecropper with the landlord paying half of input costs and receiving half of the crop, and (iv) a sharecropper with the landlord receiving one third of the crop. These calculations show that, for tenant farmers, cash rental is considerable more profitable than sharecropping for high value crops, but results in a loss for tenants growing mung bean. Sharecropping is more profitable to cash rental for the less productive rabi crops and LV paddy. With the exception of mung bean, sharecroppers giving one third of their crop to landlords, earn more than those whose landlords contribute 50% of input costs but take 50% of the crop.

[9] Land prices in both polders have at least doubled in the last 3 to 4 years.

Table 6: Net income for different tenancy systems

	Net income Tk per hectare				Percent of net income for owner[4]		
	Owner	Cash rent[1]	S-crop A[2]	S-crop B[3]	Cash rent	S-crop A	S-crop B
Aman LV	34,037	14,277	13,313	17,208	42%	39%	51%
Aman HYV	59,858	40,098	26,224	33,656	67%	44%	56%
Aus LV	21,415	1,655	7,002	8,793	8%	33%	41%
Aus HYV	50,815	31,055	21,703	27,525	61%	43%	54%
Keshari	30,549	10,789	15,274	19,641	35%	50%	64%
Felon	36,235	16,475	18,117	20,797	45%	50%	57%
Mung LV	10,810	(8,950)	1,787	1,254	-83%	17%	12%
Mung HYV	16,482	(3,278)	3,288	3,419	-20%	20%	21%
Sesame	24,515	4,755	12,257	14,734	19%	50%	60%
G-nut	64,319	44,559	28,948	34,975	69%	45%	54%
s-potato	129,044	109,284	64,522	82,731	85%	50%	64%
w-melon	218,546	198,786	105,259	119,746	91%	48%	55%
chilli LV	54,090	34,330	27,045	32,956	63%	50%	61%
chilli HYV	192,475	172,715	96,237	110,553	90%	50%	57%

[1] Cash rent is tenant farmer paying Tk19,760 cash rent per hectare for one crop
[2] S-crop A is sharecropper with landlord paying 50% of input costs and receiving 50% of the crop as rent
[3] S-crop B is sharecropper with landlord receiving one third of the crop as rent
[4] Percentage of the net income for an owner-operator that is obtained by different tenancy arrangements.

The major change in cropping patterns that has come about with BGP has been increased areas of mung bean and watermelon. Mung bean does not seem to generate much, if any, profit for tenants and sharecroppers, while watermelon, if grown by tenants, will tend to be grown by business-orientated tenants, with the capital to both pay an initial cash rent and cover production costs. BGP has therefore not resulted in many new opportunities for farmers with little or no land resources – although it is reported that some poor households are using savings (and maybe loans) to mortgage in land for crop production.

5. Other changes and impacts in polder 43/2B

Overall household income is reported to have increased by between 50% and 70% since the start of Blue Gold. Despite growth in agriculture, the share of household income coming from the farm sector (including fisheries, livestock and poultry) has fallen from an estimated 80% to 70% due to faster growth in the non-farm sector.

Additional income has been used to:

- Build new houses
- Improve the quality and nutrition of food (more meat/fish/eggs etc.)
- Spend more money for education of children
- Purchase of better clothes
- Increased expenditure on entertainment etc.

There are now no houses with straw roofs and the proportion of households with semi-pucca houses (brick walls and tin roof) have increased from almost none to 10% to 15%. Almost all households have access to electricity (mostly via solar panels). Before BGP in some catchments as few as 25% of households had sanitary latrines,

now almost all households have these latrines. Food security is greatly improved - earlier between 30% and 40% of households had problems in getting three meals per day – now only 3% to 10% have such problems.

With more money in the local economy there has been an increase in non-farm enterprises (hotels, local transport, tea stalls, grocery shops etc.). BGP's contribution to the overall economic development of sub-catchment areas in estimated by WMG members to be between 50% and 60%.

Attachment A: Calculations for polder 43//2B

Crop budgets

Crop name	Aman LV	Aman HYV	Aus LV	Aus HYV	Keshari	Mung LV	Mung HYV
Unit of land	acre	acre	acre	acre	acre	acre	acre
Inputs							
Seed/seedling (kg/number)	10	10	10	10	11	8	10
Urea (kg)	20	30	20	30			
TSP (kg)		10		15			
MP (kg)				10			
Insecticide (sum/times)	1	1	1	1		1	1
Machinery (hire)							
Land preparation (times)	3	3	3	3		1	1
Labour (hired & family)							
Seedling production (days)	2	2	2	2			
Land preparation (days)	1	1	1	1			
Planting/transplanting	6	6	6	6		1	1
Fertilization (days)	0.5	0.5	0.5	0.5			
Pesticide application (day)	0.5	1	0.5	1		1	1
Harvesting (day/share)	8	10	8	10	4	6	8
Threshing/winnowing	1	2	1	2	3	1	1
Marketing							
Transport to local market (kg)	300	540	225	480		225	350
Total Cost							
Yield							
Main product (kg)	1000	1800	750	1600	320	225	350
By-product (kg)	1000	1800	750	1600	640		
Unit prices							
Input prices							
Seed/seedling (Tk/unt)	40.00	40.00	40.00	40.00	80.00	104.17	91.67
Urea (Tk/kg)	18.00	18.00	18.00	18.00	18.00	18.00	18.00
TSP (Tk/kg)	26.00	26.00	26.00	26.00	26.00	26.00	26.00
MP (Tk/kg)	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Zinc (Tk/kg)	120.00	120.00	120.00	120.00	120.00	120.00	120.00
Insecticide (Tk/kg or lump sum)	500.00	1,000.00	500.00	1,000.00		800.00	1,600.00
Machinery (hire rates)							
Land preparation (Tk/times)	800.00	800.00	800.00	800.00		2666.67	2666.67
Labour wages Tk/day							
Planting/transplanting	500.00	500.00	500.00	500.00			
Harvesting						1/4 Crop	1/4 Crop

Marketing charges							
Transport to local market (Tk/kg)	0.50	0.50	0.50	0.50		0.50	0.50
Value of output							
Main product (Tk/kg)	20.00	17.50	20.00	17.50	40.00	52.08	45.83
By-product (Tk/kg)	0.59	0.33	0.59	0.33	0.70		

Crop name	Aman LV	Aman HYV	Aus LV	Aus HYV	Keshari	Mung LV	Mung HYV
Unit of land	acre	acre	acre	acre	acre	acre	acre
Cost per acre							
Input cost							
Seed/seedling	400	400	400	400	880	833	917
Urea	360	540	360	540	0	0	0
TSP	0	260	0	390	0	0	0
MP	0	0	0	150	0	0	0
Zinc	0	0	0	0	0	0	0
Insecticide	500	1000	500	1000	0	800	1600
Machinery (hire) cost							
Land preparation	2400	2400	2400	2400	0	2667	2667
Labour (hired) cost							
Planting/transplanting	3000	3000	3000	3000	0	0	0
Harvesting	0	0	0	0	0	2930	4010
Marketing cost							
Transport to local market	150	270	113	240	0	113	175
Total Cost	6810	7870	6773	8120	880	7342	9369
Income							
Main product	20000	31500	15000	28000	12800	11719	16042
By-product	590	594	443	528	448	0	0
Gross Returns	20590	32094	15443	28528	13248	11719	16042
percent straw	3.0%	1.9%	3.0%	1.9%			
Net Returns	13780	24224	8670	20408	12368	4377	6673
Total labour input							
hired	6	6	6	6		6	8
family	12	16	12	16	7	3	3
total	18	22	18	22	7	9	11
Net return per day of family labour	1148	1514	723	1276	1767	1459	2224
percent family	67%	73%	67%	73%	100%	34%	27%

Crop name	Felon	Sesame	G-nut	s-potato	w-melon	chilli LV	chilli HYV
Unit of land	acre	acre	acre	acre	acre	acre	acre
Inputs							
Seed/seedling (kg/number)	10	2.5	40	10	0.20	0.25	0.15
Urea (kg)		10			100	15	25
TSP (kg)					70	10	38
MP (kg)					10		13
Zinc (kg)					4		
Insecticide (sum/times)	3			1	1		1
Fungicide (ml)			1				1
Machinery (hire)							
Land preparation (times)	1	1	1	1	1	1	1
Irrigation (times)					1		2
Labour (hired & family)							
Seedling production (days)					1	1	1
Land preparation (days)	1	1	1		10	1	1
Planting/transplanting	10		10	75		10	10
Fertilization (days)					20	1	2
Weeding/earthing up	10		12			10	15
Irrigation (days)					10		0
Pesticide application (day)	1		1		5	1	1
Harvesting (day/share)	15	5	8	13	8	7	15
Threshing/winnowing	5	2	2				0
Marketing							
Transport to local market (kg)		240	720			225	1000
Total Cost							
Yield							
Main product (kg)	450	240	720	3750	1500	225	1000
By-product (kg)							

Crop name	Felon	Sesame	G-nut	s-potato	w-melon	chilli LV	chilli HYV
Unit of land	acre	acre	acre	acre	acre	acre	acre
Unit prices							
Input prices							
Seed/seedling (Tk/unt)	50.00	70.00	100.00	45.00	25,000.00	1,000.00	20,000.00
Urea (Tk/kg)	18.00	18.00	18.00	18.00	18.00	18.00	18.00
TSP (Tk/kg)	26.00	26.00	26.00	26.00	26.00	26.00	26.00
MP (Tk/kg)	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Zinc (Tk/kg)	120.00	120.00	120.00	120.00	120.00	120.00	120.00
Insecticide (Tk/kg or lump sum)	26.67	-	750.00	-	8,020.00	750.00	1,500.00
Fungicide (lump sum)		-					480.00
Machinery (hire rates)							
Land preparation (Tk/times)	3500.00	1600.00	3000.00	3555.56	6000.00	3000.00	3000.00
Irrigation (Tk/unit)					5000.00		6000.00
Labour wages Tk/day							
Planting/transplanting					325.00		
Harvesting			325.00				
Marketing charges							
Transport to local market (Tk/kg)		0.50	0.50			0.50	0.50
Value of output							
Main product (Tk/kg)	41.67	50.00	50.00	15.00	80.00	114.58	100.00

Crop name	Felon	Sesame	G-nut	s-potato	w-melon	chilli LV	chilli HYV
Unit of land	acre	acre	acre	acre	acre	acre	acre
Cost per acre							
Input cost							
Seed/seedling	500	175	4000	450	5000	250	3000
Urea	0	180	0	0	1800	270	450
TSP	0	0	0	0	1820	260	988
MP	0	0	0	0	150	0	195
Zinc	0	0	0	0	480	0	0
Insecticide	80	0	0	0	8020	0	1500
Fungicide	0	0	0	0	0	0	480
Machinery (hire) cost							
Land preparation	3500	1600	3000	3556	6000	3000	3000
Irrigation (	0	0	0	0	5000	0	12000
Labour (hired) cost							
Planting/transplanting	0	0	0	0	3250	0	0
Harvesting	0	0	2600	0	0	0	0
Marketing cost							
Transport to local market	0	120	360	0	0	113	500
Total Cost	4080	2075	9960	4006	31520	3893	22113
Income							
Main product	18750	12000	36000	56250	120000	25781	100000
By-product	0	0	0	0	0	0	0
Gross Returns	18750	12000	36000	56250	120000	25781	100000
percent straw							
Net Returns	14670	9925	26040	52244	88480	21889	77887
Total labour input							
hired			8		10		
family	42	8	26	88	44	31	45
total	42	8	34	88	54	31	45
Net return per day of family labour	349	1241	1002	597	2011	718	1731

Attachment B: Benefits in polder 43/2B derived from DAE data

The increase in farm income for polder 43/2B has also been calculated using DAE data on crop areas. This data comes via BGP Technical Report 22 which has data for each polder based on the best match of surrounding DAE blocks.

These calculations are based on the change in cropping area between 2013-14 and 2016-17. It is debateable whether this covers the period over which change has taken place that can be attributed to Blue Gold. Although benefits from FFS and agricultural extension may have started from 2013-14, water management improvements may have only had an impact in the last year or so. The data on crop area shows a steady change over the entire five year period – but with the biggest switch from local to HYV aman between 2012-13 and 2013-14.

The crops areas are also rather different from those reported by WMG. In particular there is a large and growing area of rabi vegetables (such as cabbage and cauliflower).

DAE data

	2012-13	2013-14	2014-15	2015-16	2016-17
Crop area – hectares					
Boro	5	7	9	9.5	12
T aman HYV	1340	1860	2250	2410	2535
T aman LV	2295	1775	1385	1225	1100
Horticulture rabi	1083	1208	1300	1449	1521
Horticulture Kharif-I	48	60	70	80	86
Horticulture Kharif-II	33	41	54	63	73
Mung bean	600	600	755	780	825
Keshari	340	300	230	120	100
Felon	200	190	150	130	120
Ground nut	350	360	412	419	445
Spices	370	360	345	330	328
Watermelon	530	650	740	840	930
total crop area ha	7194	7411	7700	7855.5	8075
Cultivated area ha	3708	3706	3756	3723	3704
Cropping intensity %	194	200	205	211	218
Yield ton/ha					
Boro	6	6	6.2	6.53	65
T aman HYV	4.72	4.97	5.09	5.29	5.5
T aman LV	3.38	3.55	3.67	3.56	4
Mung bean	0.8	0.9	1.1	1.2	1.2
Keshari	1.04	1.08	1.24	1.5	1.5
Felon	1.61	1.61	1.8	2	2
Ground nut	1.85	1.95	2.1	2.5	2.5
Spices	1.59	1.7	1.8	2	2
Watermelon	18.7	29.4	32	34.7	35

Crop area as percentage of cultivated area

	2012-13	2013-14	2014-15	2015-16	2016-17
Boro	0.1%	0.2%	0.2%	0.3%	0.3%
T aman HYV	36.1%	50.2%	59.9%	64.7%	68.4%
T aman LV	61.9%	47.9%	36.9%	32.9%	29.7%
Horticulture rabi	29.2%	32.6%	34.6%	38.9%	41.1%
Horticulture Kharif-I	1.3%	1.6%	1.9%	2.1%	2.3%
Horticulture Kharif-II	0.9%	1.1%	1.4%	1.7%	2.0%
Mung bean	16.2%	16.2%	20.1%	21.0%	22.3%
Keshari	9.2%	8.1%	6.1%	3.2%	2.7%
Felon	5.4%	5.1%	4.0%	3.5%	3.2%
Ground nut	9.4%	9.7%	11.0%	11.3%	12.0%
Spices	10.0%	9.7%	9.2%	8.9%	8.9%
Watermelon	14.3%	17.5%	19.7%	22.6%	25.1%
total	194.0%	200.0%	205.0%	211.0%	218.0%

Change 2013-14 to 2016-17

	% of cult area	hectares	GM Tk/ha[1]	Total GM Tk
Boro	0.1%	4	59,833	242,423
T aman HYV	18.2%	547	59,833	32,743,457
T aman LV	-18.2%	-546	34,037	- 18,589,266
Horticulture rabi	8.5%	254	192,381	48,838,402
Horticulture K-I	0.7%	21	192,381	4,054,537
Horticulture K-II	0.9%	26	192,381	4,988,305
Mung bean	6.1%	182	16,482	3,006,484
Keshari	-5.4%	-162	30,549	- 4,945,617
Felon	-1.9%	-57	36,235	- 2,052,219
Ground nut	2.3%	69	64,319	4,434,783
Spices	-0.9%	-26	192,381	- 4,965,179
Watermelon	7.6%	227	218,546	49,603,044
total	18.0%	540		117,359,154

[1] GM = gross margin (net income) derived from crop budgets

These calculations show a total increase in crop net income (gross margin) of Tk117.4 million. This is less than the Tk146.6 million increase in net income calculated using the crop area data from WMG (see main report) – but still enough to more than justify the investment by Blue Gold of Tk159 million. Moreover these calculations do not take account of the increase in crop yields – which over the period 2013-14 to 2016-17 are around 10% for paddy and 20% to 30% for other crops.

Appendix 5: Information from WMG on credit

Goshkhali khal WMG – polder 2

- No collection of savings yet, but plan to do so in future. WMG plans to collect Tk20 per month from each member, use this money to lend out @ 5% per month on the balance outstanding, with a 10 month loan term. Sometimes members do not have loans for marriages and crop inputs
- Bank loans: 25% of members have bank loans, repay after one year, interest Tk3200 for Tk40,000 loan, but difficult to get. Forms need to be filled, takes 2-3 weeks to approve loans, but no bribes. But need land documents and 2 guarantors.
- NGOs – weekly repayment (GB, ASA, BRAC) for under Tk50,000 loans, get a loan in one week, (ASA 1 day). Around 60% of people in meeting have NGO loans (75%-80% of all members). Disadvantage of no grace period. Unaware of seasonal loans from PKSF NGOs.
- Ekti bari – repay after one year. One man had loan Tk70,000 - interest after one year will be Tk1300. But only 20 households out of 450 have loans. One group of 30 in each ward.
- BRDB - none
- Mohajan (money lenders) – none (they say).
- Crop sales in advance – but bepari pays the full market price and charges no interest. These sales are for paddy, jute, and mustard (credit from the mill), 30-40% of households sell some of crop in advance. But this is not for vegetables.
- Fertiliser on credit from shop, no interest. But shop needs to know them – have been a customer 1 or 2 times before. Or introduced and guaranteed by someone they know. 100% of households get fertiliser on credit.
- Milk sales in advance, BRAC, Milk Vita and dealers will pay in advance if the farmers have a problem, but sometimes pay only Tk32/kg, full price in local market is Tk40. But most producers do not do this.

Hazikhali WMG – polder 2

- 60% have bank loans – branch is only 2 km away, used by fish farmers.
- 80% use MFI/NGO,
- Many households take fingerling supplier credit but pay a higher price - Tk300 per 1000 for cash, or Tk400/1000 with loan for 3 months - 50% of fingerlings are supplied in this way.
- Shrimp sale in advance – only 5% of producers, but price will be lower (Tk50 less per kg).

Shalley Paschim O Beradangi WMG – polder 2

This is one of two polder-2 WMGs now operating a micro-credit programme.

Meeting with President and Secretary of WMG

WMG formed November 2014. Now have 335 members.

WMG funds:

- Tk60 admission (20+20+20) x 333 members at start
- 2015 LCS contract of Tk1,300,000, 5% of this to WMG O&M fund = Tk37640
- DAE Tk20,000 grant

Savings

- Three months after formation, start savings with a few people, but no proper books.
- In January 2016 got proper books and 40-50 members were saving x Tk20 per month (but not all members save every month).

- 95-105 members are now regular savers including the 55 current borrowers, but 333 members have some savings balance with the WMG.
- Total Tk225,410 collected as savings less Tk18340 withdrawn = Tk207,000 current savings balance.
- 6% interest on savings.

Loans

- Loan start in August 2016. Tk79380 in WMG savings then. Then withdraw Tk117,000 from bank. At this time 27 farmers took loans of Tk3000-5000.
- The loan term is 10 months. For loan of Tk5,000 repay 10 x Tk550 = Tk5500.
- To date 143 people have had loans, 10 people 2 loans, 3 have had 3 loans. Total Tk975,000 disbursed to date in about 156 loans = average Tk6256.
- Current loans = 55, with Tk317,400 outstanding = average Tk5771
- Loan size is now Tk5000-25,000.
- Used for poultry, boro, livestock. All are used for agriculture.
- More people want loans, but funds are limited
- Although more people want loans, giving bigger loans to fewer people is less work. People now get bigger loans from NGOs.
- Three problem borrowers, one still owes Tk620, others adjusted against their savings + Tk320 each from Secretary's own pocket. Defaulters had loans from other sources – were over borrowed.
- Advantages of WMG loans: (i) easy to get (with BRAC etc need to go to their offices – so travel cost), (ii) interest rate is lower, (iii) some flexibility in repayment dates.

Management

- WMG Secretary manages the scheme and keeps all records. He is madrassa-educated and has no formal certificates.
- Keep records in ledger books and on a computer.
- Bought computer for children in 2013. School teacher showed him how to use it and still provides advice if needed.
- Monthly meetings at 4 locations. Also collect in person if members miss a meeting.
- From 3rd to 9th each month Secretary is busy with the programme for at least 8 hours per day. Nobody else helps.
- Not paid any salary. Usually a small shortfall in cash collected – that he makes up.
- Loanee selection is by President and Secretary – based on past loan record, personal reputation, plus guarantor if needed. Need to have savings of 10% of the loan amount.
- There is a loan committee with 5 persons including the Secretary and President. Loan proposals are reviewed at a meeting on the 7th of each month, but committee will agree with the Secretary and President. There was an audit committee active at time of audit, and O&M committee active at the time of this work.
- No help from BGP in this area.
- Audit – for the first time in November 2017 – no problem, told they were one of the best WMG.
- The Secretary is currently holding Tk55000 in cash. This will soon be lent out. Bank balance is only about Tk1000.

Only 16% of members now have loans, only 43% of members have ever had loans.

The fact that 143 members have had loans but only 55 are now running, suggests that many people may not find them useful, and/or resource and management constraints limit the number of loans that can be provided at any one time.

Heavily rely on a lot of voluntary work from one person – risk if this person is ever unable or unwilling to continue.

Savings are very small – only Tk622 per member (333 members). Not much use as a source of funds for lending – but there is no other source. Still only contributing Tk20 per month.

Apart from lower interest and easier access, no real advantage over conventional microcredit.

Virtually all WMG funds are tied up in this – no money for anything else.

Dokki Amkhola WMG – polder 43/2B

WMG was formed 2006 under IPSWAM and re-formed by BGP, 207 households in catchment. 159 households joined WMG at start of BGP

Started credit scheme in 2014 – now in 4th year. 124 doing savings and loans.

WMG admission fee – Tk60/household,

Savings were Tk20/month per member at the start, but last year increased to Tk100/month. Out of 124 hh, each month 60-70 households make savings. Total of Tk219,000 in the savings fund now (average of Tk1,766 for 124 HH).

Current loans = 22. Total households covered by loans = 37 households.

Loan size – start in year 1 with Tk5,000 for 19 households (HH) = Tk156,000, year 2 Tk8000 for 22 HH = Tk196,000, Year 3 Tk8000 to Tk10,000 for 36 HH = Tk304,000, 4th year 37 HH = total Tk365,000 – 15 now repaid, 22 running with Tk220,000 principal o/s, plus Tk77,000 interest. Up to 4th year all loans were disbursed in June. Now think will disburse 2 times per year.

For this year may give loans of Tk10,000-20,000 to about 40-50 HH (Tk500,000 in total).

Need to have 12 months' worth of savings before get loan.

Interest – loan of Tk10,000, repay Tk13,600 after one year (=36%) – one time repayment after 12 months. Repayments are placed in the WMG bank account.

Now have Tk584,000 capital in total. Give loans to all that want it. The grant of Tk20,000 from DAE is in a different bank account.

Calculated interest income

	loans	amount TK	avg loan Tk	interest Tk
year 1	19	156000	8211	56160
2	22	196000	8909	70560
3	36	304000	8444	109440
4	37	365000	9865	131400
total	114	1021000	8956	367560

This amount of interest, plus savings of Tk219,000, is about equal to the Tk584,000 capital reported by the WMG. However the interest rate of 36% is quite high and more than allowed by current MF regulations – PKSF partner NGOs charge 2% per month for seasonal loans. This table also shows little growth in the average size of loans – the increasing capital has been used to give a larger number of loans.

Two persons look after loan activities – Chairman and Cashier. Disbursement takes them 3 full days in one month each year, updating documents takes 7 days per year, in the repayment month they work 15 days (with 5 to 6 WMG members coming with them to visit each loanee HH). Savings are collected in the monthly

meeting and then taken to the bank – this takes 2 person-days per month. In total this amounts to 74 person-days per year for the Chairman and Cashier.

WMG loans used for goats, poultry, boro, fish and other agricultural activities

Other sources of credit:

- 10-15% of HH have bank loans (need land certificates),
- 90% of HH have loans from NGOs.
- Fertiliser credit for 2-5% of farmers – this adds 5% to the price.
- Selling paddy crop in advance – but get 2%-5% lower price, for only a few farmers (2-5%). This is not done for other crops

Mushurukathi sluice – polder 43/2B

No loaning WMGs in this meeting. They do not think it will be good to do this as the risk of late payment can cause quarrels in the WMG, and there is not enough money to give loans to all members.

25 farmers doing collective fisheries (this was said to be a better idea than a lending programme)

- took Tk65,000 loan from WMG fund, plus Tk75,000 of own money (Tk3000 each)
- growing fish for 9 months in a section of khal of 65-70 decimals.
- No lease is paid as WMG owns the khal.
- Will pay 10% of profit to WMG, but no interest on the loan. Minimum of Tk50,000 profit is expected.
- Spent Tk35-40,000 on dyke this year (will last 5 years) which reduces the potential profit.
- Vegetables grown on dyke will earn Tk10-12,000 – but this is not included in profit for WMG, but pays the 3 members who work in the pond.
- WMG chairman, secretary and cashier are in the fishing group (in total 9 of 12 members of executive committee are members).
- WMG has 144 members, 240 total HH.

Uttar Poschim Goal Bashbunia WMG = polder 43/2B

173 members – 220 total HH

Credit programme

- 3 years ago started loan activities, but stopped after one year.
- First loans were disbursed in August continuing to January, and all were to be repaid after the rabi harvest. Borrowers were to pay 3% interest for whole period regardless of length of the loan.
- 32 loans were taken of Tk3000 to Tk20,000 (3-4 were of Tk20,000). There was a total of Tk200,000 in loan fund made up of the admission fee, savings of about 90 members @ Tk20/month, and income from rental of machinery that DAE gave the WMG (2 power tillers, 1 thresher, 2 pumps).
- Loans were used for rabi crops and some businesses (e.g. shop).
- After loans had been disbursed excessive rain damaged rabi crops. Only Tk100,000 of loans were recovered.
- Hope to recover the rest of the loans this year. But will not lend money again after this bad experience.
- All the work was done by the Cashier, but helped by Chairman and Secretary when got into problems with loan repayment.
- Farmers are now funding rabi crops with loans from NGOs, also from fertiliser and input shops (who charge prices that are 3-4% higher than for cash).

- NGOs have legal agreements with borrowers to ensure recovery, and the manpower to manage monthly loans that the WMG does not have. Knows that some NGOs give seasonal loans.

[i] Among the 22 polders of the Blue Gold program, Phase-1 polders includes polder -22, 26, 29, 30, 43/1A, 43/2D, 43/2E and 43/2F, Phase -2 polders includes polders- 31 Part, 43/2A, 43/2B, 55/2A, 55/2C and 2 &2 Ext. and Phase -2 polders includes polders-25, 27/1, 27/2, 28/1, 28/2, 34/2 Part, 47/3 and 47/4