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Technical Report 26

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

WMG Survey 2019

BETS

Socioconsult Ltd. for sustainable development

FEMCONSULT

MOTT MACDONALD

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

WMG Survey 2019

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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 is the second in a series of evaluations of the outcomes of BGP 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 changes in farming and farm income resulting from changes in cropping patterns and improved farming practices. This report contains the results of a survey in 2019 that gathered data from all BGP WMG on water management and agriculture.

Improvement in water management

WMG continue to report a reduction in water-related constraints to crop production. These primarily relate to water scarcity (for irrigation) and water logging – with salinity and flooding much less serious. Water scarcity is now slightly more frequently reported than waterlogging. Around one third of WMGs report no improvement in at least one season. But taking the overall average across the three seasons, only 9.4% of WMGs say they have a bad or very bad problem, compared with 58.5% prior to BGP, and only 17% of WMGs say that water management problems have not been reduced. The greatest reduction in water management problems has been in the Patuakhali zone, and the smallest reduction in the Khulna zone.

The vast majority of WMGs (86%) say that water management infrastructure has been improved. Most of the WMG reporting no improvement in infrastructure were in Khulna and also report little or no improvement in water management problems. In some WMGs, water management has got better with the use of private tubewells for irrigation. The most widely (80%) reported improvement in infrastructure was re-excavation and de-silting of khals, but many WMG (30-50%) reported khal cleaning, sluice repairs, new/repaired culverts, better sluice operation and repaired embankments. In general works seem to have been more extensive in Patuakhali than in the other zones, and average expenditure per WMG is higher here. Most of these works were undertaken by BWDB-BGP with WMG support, with WMG themselves mainly being responsible for khal cleaning and better sluice operation. Local government have had an important role in culvert improvement.

Where sluices are not functional there has been little improvement in water management. Overall 12% of WMG report non-functioning sluices, all of them in the Khulna and Satkhira zones. Another 39% of sluices are under control of people outside of WMGs – said to be “influentials” and “politically connected” who operate sluices for their own benefit – usually for gher operation and/or netting wild fish. One WMG reported that these people also cut the embankment to allow water in for ghers, and two others mentioned refusal to allow de-silting of khals. Outside control of sluices is reported on all three zones, but is more likely in Khulna and Satkhira where the fish ghers are located. There has been a significantly greater reduction in water management problems for the 50% of WMG where sluices are under WMG control.

Sustainability: while WMGs appreciated that they will need to take responsibility for the sustainability of improvements in water management, most WMGs said they lacked the required financial resources and that members were not sufficiently interested in providing voluntary work. WMG often saw the continued implementation of BGP activities as the only way of ensuring that the required work would be carried out. The prospects for sustainability were not good where sluices were controlled by outside interests, and also where the works that are needed to make the system fully functional have not been completed.

Changes in crop areas

Since the start of BGP there has been significant changes in land use and cropping. In Khulna the biggest change has been an increase in the area under fish ghers, but the area of paddy has also gone up with

more boro being grown. In Satkhira there has been an even bigger increase in area of fish ghers (the area has doubled), and there has also been an increase in boro paddy. There are virtually no fish ghers in Patuakhali and there has been little change in the area of paddy, but a significant increase in area of non-rice crops, primarily mung bean which has largely replaced keshari (grass pea). In all three zones there has been increases in the total area of both paddy and non-rice crops, but taking the three zones together the increase in area under fish ghers has been greater than the combined increase in paddy and non-rice crops. Although the expansion of fish ghers has not meant a reduction in crop areas at a zone or polder levels (apart from polder 28/2), 23% of the WMGs in the combined Khulna and Satkhira zones have reduced their area under crops while increasing the area of fish gher, with only 5% moving in the opposite direction. This suggests that some switching is taking place from crops to fish.

In all areas there has been a move to more productive types of paddy. In both Khulna and Satkhira (very little is grown in Patuakhali), most boro is now more the productive hybrid type. The only significant areas of aus paddy are in Patuakhali, where there has been a sharp switch from predominantly local varieties to predominantly HYV. Aman is grown in all three zone and there has been a trend towards HYV, although much local aman is still grown in Khulna and Patuakhali. In Satkhira most aman was HYV before the start of BGP.

Regarding non-rice crops, in Khulna the total area is not much changed but there has been a sharp drop in sesame and also mung bean (but not so much was grown here), and increase in more profitable vegetables and watermelon (the latter concentrated in a few polders). Only a small area of non-rice crops are grown in Satkhira, this mainly being vegetables (which have slightly increased, and jute (slightly declined). The main area of non-rice crops is Patuakhali, where their total area has increased from just over half of cultivable land to 85%. The main non-rice used to be keshari, but this has almost disappeared and has been replaced by more profitable mung bean which now accounts for 70% of the area of non-rice crops. Relatively small, but increasing, areas of groundnut, watermelon and chilli are also grown.

Increase in cropping intensity

Overall cropping intensity has increased by 41 percentage points, from 187% to 228%, with a larger increase in Satkhira of 76 percentage points - largely due to expansion of fish ghers in polder 2. Increases in cropping intensity was reported for all polders apart from polder 28/2 (which recorded a fall of 34 percentage points, but which is being absorbed into the urban area of Khulna city) and for 80% of WMG. In Khulna polders that were covered in the 2018 survey are reporting further increases in c.i. this year, with little change for the 2018 survey Patuakhali polders. Compared with the 2018 WMG survey, a smaller proportion of WMGs report a fall in c.i. (8% compared with 14%).

On average WMGs with a greater improvement (reduction) in water management problem scores also have a larger increase in cropping intensity and a bigger increase in area under high yielding and high value crops. However, there is considerable variability about the trend line so the relationship is not strong.

Crop yields

There has been a substantial increase in the productivity of paddy. Apart from a switch to more productive HYV and hybrid varieties, average yields of each type of paddy has increased by around 10% to 25%. However there is a more mixed picture regarding the yields of non-rice crops, with significant falls in yields of some of the key crops including mung bean and sesame. Farmers say that unpredictable weather conditions during the growing season (excessive drought, unexpected and heavy rainfall) have adversely effected non-irrigated rabi crops.

Farmers Field Schools

The outcomes of FFS were discussed with 24 FGD. Participants identified technologies which they had learned about and reported on adoption rates. For crops, new varieties and improved cultivation techniques

have mostly been fairly widely – including by farmers who are not members of FFS. However, a number of pest control methods and environmentally friendly technologies (such as light traps and vermicompost) have low adoption rates, and farmers seem to think that they are either inconvenient or not cost-effective, and maybe not appropriate to their needs. Aquaculture technologies seem to have been more widely adopted. Although BGP has not provided FFS for fish ghers, learning from pond fishery FFS is being applied to gher fisheries. FGD said that training of farmers has directly contributed to expansion of mung bean cultivation in Patuakhali and to an increased area of fish gher in the other two zones.

Farmers problems

Falling market prices for farm production were the problem most frequently identified in FGDs. Participants also spoke of the risings cost of inputs and labour, along with scarcity of seed and labour, and adulteration of fertiliser and pesticides.

Pests and diseases were the second most widely reported problem in FGDs. This is a particular issue given that there has not been much adoption of pest control technologies that were promoted by FFS

Environment and water management: drought was the third most widely reported problem. It is also apparent that unexpected rains in the winter damaged rabi crops.

Changes in land tenure

This survey confirms the trend identified last year, with less land now being farmed by its owner, less being sharecropped, and significantly more via other lease arrangements (mainly annual cash rental). Before BGP, a little more than half of all land was farmed by its owner, now it is less than half.

Farm labour and the role of women

With an increased area of crops, more labour is now being hired. Much male labour has been absorbed in the non-farm sector, so more women now being hired. In Khulna and Satkhira women are now hired for almost all farm operations and have, to some extent, replaced male labour in crops such as paddy. In Patuakhali women are still primarily hired for work in mung beans and other non-rice crops (but they may provide all the hired labour for these crops). Here women provide little or none of the hired labour for paddy.

Women are almost always paid less than men, but in some locations the differential between male and female may have narrowed, at least in relative terms, with female wages increasing at a faster rate.

Increased participation in the workforce has increased the overall workload of women. But women think that, overall, they are now better off – with additional income in their hands leading to greater say in household decision-making.

Increase in farm income

An increased area of crops, improved cropping patterns and increased yields have resulted in increased farm income. Based on model crop budgets for the main crops in each zone, net income for each crop has been calculated for the before project and current situations. Total net income has increased by 86%, with more coming from aquaculture than from crops. However, in relative terms the increase has been higher for paddy and for other crops. The relative increase has also been higher in Patuakhali zone, and lowest in Khulna. All polders except one, polder 28/2 near Khulna city, are shown to have increased net income.

Apart from around six polders which have the lowest increases in farm income, there is no correlation between increase in net income and increased cropping intensity, the area of high yielding and high value crops, or the reduction in water management problem scores. Although farmers say that improved water management increases farm production and income, there may be too much variation within polders for this to show up when comparing the averages for different polders.

Return to BGP investment

The overall annual increase in net farm income is sufficient to cover the total expenditure of BGP within two years. Out of the 22 polders, 13 are able to cover total expenditure within three years – of the nine that do not, seven are in Patuakhali, where the payback period tends to be longer. So, although WMG in Patuakhali benefited from more extensive water infrastructure works, had less problems in terms of sluice operation, and generally reported greater improvements in water management, they had a marginally smaller increase in cropping intensity than Khulna, and generated significantly less net income from crops. Although the percentage increase in net income was higher in Patuakhali than elsewhere the fact that it started from a lower base (as there was no contribution from fish ghers) means it is less in absolute terms and so it takes longer to cover total BGP expenditure.

Recommendations

(a) Completion of water infrastructure works will make an important contribution to sustainability, and BGP should make systems fully operational by the completion of the project. BGP should also make every effort to ensure that sluices are under the full control of WMGs.

(b) Aquaculture ghers: with paddy production now significantly less profitable than fish ghers, BGP should review what it thinks about the move from crop to fish production. FGD should be held to understand about the criteria used by farmers to make this decision and its implications for different groups as well as for water management.

(c) Irrigated non-rice crops: given that non-irrigated crops are having problems with variable weather conditions, more support could be provided to irrigated non-rice crops – such as commercial production of melons and vegetables for the market.

(d) Cropping intensity lessons: to learn lessons, WMGs with very poor (or negative) changes in cropping intensity and areas of high value crops should be identified and the reasons for this documented by BGP polder teams. If needed some discussions could take place with farmers and WMG. A similar exercise could take place with WMGs that have done very well.

(e) Technologies and improved techniques to be promoted via FFS etc. need to be screened to ensure that they meet the needs of farmers and will be profitable to adopt.

(f) Numbers of FFS: a number of successful technologies have been rapidly adopted by farmers who did not attend FFS. This would suggest that fewer FFS are needed to cover a single topic, releasing resources for other topics

(g) Falling crop prices are now farmers' biggest problem. A brief study should document changes in the prices over the last few years at farmgate and in local markets to see if farmers are getting fair prices for their production.

(h) Pest control is another major problem, and FFS have not been so successful here. The major pest and disease problems should be identified and practical solutions should be disseminated via information, training and links to input suppliers.

(i) Labour Contracting Societies are a relatively costly and inefficient method of undertaking works such as re-excavating khals. A much greater amount of sustainable employment would be created by using machines to excavate a greater length of khal and so create more farm employment.

(j) Crop budget validation: feedback from farmers would confirm the validity of crop budgets used in these calculations. In particular farmers could rank crops in terms of yield and net income.

(k) Farmer participation: investment in BGP has had a very rapid payback in terms of increased farm income, but efforts to get a significantly greater contribution from farmers towards the cost of these works is not likely to yield positive results – but farmer participation in sluice gate operation and in cleaning and minor repairs to khals is well worthwhile, and justifies the effort in establishing and supporting WMGs.

1. Introduction

This report is the second in a series of evaluations of the outcomes of BGP 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 changes in farming and farm income resulting from changes in cropping patterns and improved farming practices. These stem from BGP supported interventions in water management and agricultural extension.

This report is the outcome of a survey that aimed to gather data from all 510 BGP WMG BGP via group interviews with representatives of each WMG. This survey primarily gathered quantitative data on water management and agriculture, and was supported by more detailed qualitative FGDs with 25 WMG. Budgets showing the costs and returns for major crops were drawn up for each of the three BGP zones (Khulna, Satkhira and Patuakhali).

The scope of this survey is considerably wider than that of the 2018 survey (Technical Report 25) which only covered 266 of the phase 1 WMG in 12 polders, plus some rapid data gathering in two more phase 1 polders. The 2019 survey covered all three phases of BGP in 22 polders. The survey questionnaire was expanded to cover some additional questions on water management with the objective of gathering more evidence of links between BGP interventions and outcomes.

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 with the objective of draining excess water while improving access to water for irrigation. 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.

Apart from improving conditions for crop production and aquaculture, a few FGDs reported that the quality of water in the khals has now improved ("less polluted") and can sometimes be used for domestic purposes. The availability of fodder for livestock is also said to have improved.

2.2 Water management problems

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) is, as would be expected, the main problem for farmers in the rabi (boro) season, with water logging the main issue in kharif 2 (aman) and a more even division between water scarcity and waterlogging in kharif 1. For the three BGP zones, taking the average for each season, waterlogging is the major issue for WMGs in Satkhira, while water scarcity is number one in Khulna and Patuakhali. Flooding and salinity are much less likely to be the major problem. Comparing the present and pre-project situations, there has not been much change in the type of main problems. Compared with the 2018 WMG outcomes survey, a smaller proportion of WMGs are reporting water scarcity as the principal problem.

Table 1: Principal water management problems

Main problem		rabi	kharif-2	kharif-1	Khula	Satkhira	Patuakhali	All
Before	Waterlogging	13%	78%	32%	37%	59%	41%	41%
	Flooding	1%	3%	1%	1%	1%	2%	1%
	Water scarcity	69%	6%	44%	40%	25%	44%	39%
	Salinity	12%	3%	9%	9%	6%	8%	8%
Now	Waterlogging	12%	71%	20%	33%	54%	29%	34%
	Flooding	1%	1%	0%	1%	1%	0%	1%
	Water scarcity	58%	5%	52%	39%	26%	40%	38%
	Salinity	9%	1%	7%	8%	0%	5%	6%

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

Data on problem for WMG in each polder is in Appendix 2, Table 1. This shows that there is considerable variation between WMGs. Before BGP, salinity is reported as the major problem in polder 47/3 and 47/4 (Patuakhali) and for 31 Part in Khulna, although water scarcity has now become more of an issue in 47/4.

Other water management problems are shown in Table 2. In the rabi season and in the Khulna zone, salinity was, and still is, the main other problem, but this issue seems to have now largely been eliminated in polders 26 and 29, but remains a significant issue in polder 30 (see Appendix 2, Table 2). In the Patuakhali zone, there is no over-riding other problem, but salinity was an issue for polders 47/3 and 47/4, but is now much less significant.

In the 2018, WMG survey a slightly higher proportion of WMG reported that salinity was a continuing other problem, but more now put waterlogging as another problem.

Table 2: Other water management problems

Other problems		Season			Zone			All
		rabi	kharif-2	kharif-1	Khulna	Satkhira	Patuakhali.	
Before	Waterlogging	2%	5%	7%	4%	0%	8%	5%
	Flooding	1%	8%	1%	1%	1%	7%	3%
	Water scarcity	13%	4%	8%	10%	0%	8%	8%
	Salinity	18%	2%	8%	14%	2%	4%	9%
Now	Waterlogging	1%	2%	3%	3%	0%	2%	2%
	Flooding	0%	2%	0%	1%	0%	1%	1%
	Water scarcity	11%	2%	9%	11%	0%	5%	7%
	Salinity	12%	1%	8%	12%	0%	3%	7%
	Other	16%	0%	0%	0%	0%	15%	5%

Percentage of WMG reporting. The percentages for zones are the average number reports for each of three seasons. As many WMG did not report other problems in all seasons (but some WMG reported multiple other problems), the totals in each row do not add up 100%.

Table 3 shows the severity of the problem (ranked 1 to 5) for each season and each zone. In general problems have been reduced compared with the pre-project situation. Overall over half of the seasonal reports from WMGs (56%) say the situation is now good or very good (score of 1 or 2), compared with only 12% in the pre-project situation. This is much the same as in the 2018 survey. The improvement has been greatest in Patuakhali where only 1% of WMG seasons were rated as very good or good before BGP, but now 63% are at this level. WMGs in Khulna registered the lowest improvement – 15% good or very good before, compared with 48% now. Satkhira (the single polder no.2) had a relatively better position prior to BGP (31% good or very good) and now has the highest proportion of WMG seasons in these categories (67%). Data on individual polders is in Annex … Table 3

Table 3: Severity of water management problems

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

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

Data on individual polders in Appendix 2, Tables 3 and 4 shows that in some polders in Khulna, more than half of the seasonal reports of WMGs show that the water management situation had either not changed or got worse. These include polders 25, 27/1, 28/1 (where only 31% of WMG-seasons show an improvement), 28/2 and 34/2. On the other hand, also in Khulna, 82% of WMG-seasons polder 26 reported an improvement, while 94% of WMG/seasons in polders 43/2A and 43/2F (both Patuakhali) reported improvement. Data on the change in water management problem scores by season and zone in shown in Table 4. This shows that the greatest

improvement is reported in the rabi season and least in the kharif 1 season – some WMG report improvement in the rabi season (especially more irrigation), but increased waterlogging in the following kharif-1. One of the WMGs covered in the qualitative interviews (Budharam WMG in polder 55/2C) reported that all land was now fallow in kharif-1 due to water logging – at least partly due to unexpected rainfall as well as inadequate drainage khals. This also effects keshari and sesame in the rabi season, with less of these crops now being grown.

Table 4: Change in severity of seasonal water management problems

		Change in seasonal water management score								% of WMGs improving
		-3	-2	-1	0	1	2	3	4	
season	Rabi	0%	1%	1%	24%	33%	32%	8%	1%	74%
	Kharif-2	0%	0%	3%	25%	36%	28%	7%	1%	71%
	Kharif-1	0%	1%	4%	36%	32%	22%	4%	1%	59%
	Total	0%	1%	3%	29%	33%	27%	6%	1%	68%
zone	Khulna	0%	1%	4%	38%	31%	21%	5%	0%	57%
	Satkhira	0%	2%	2%	31%	32%	27%	4%	2%	66%
	Patuakhali	0%	0%	1%	14%	38%	37%	9%	1%	84%
	Total	0%	1%	3%	29%	33%	27%	6%	1%	68%

Three other WMG, Char Joinkathi Purbo in polder 43/2E, and Tushkhali WMG and Purbo Choto Bighai WMG in polder 43/2A reported increased irrigation and reduced waterlogging in the rabi season (and also in aman) but increased waterlogging and reduced area of aus paddy (and lower yields) in the kharif 1 season due to heavy rainfall and inadequate drainage – drainage improvements have not kept pace with the increase in rainfall at this time of year. Salinity also increased in aus season for Tushkhali WMG.

Compared to the 2018 survey, more WMG-seasons are reported has having no improvement or worsening in terms of water management problem scores. In 2018, 26% of WMG-seasons were in this category – it is now 33%. This may be linked to increased waterlogging in the kharif 1 season.

If the water management problem score is averaged across the three seasons for each WMG, the data moves towards the centre– as very good or poor scores in a single season tend to be offset by less extreme scores for the same WMG in the other seasons. Nevertheless, Table 5 shows much the same pattern of improvement. Before BGP, only 2.0% of WMGs had an overall score of 1 to 2 (good or very good), now 32.5% are in this category, while the proportion reporting the that their water management situation was worse than bad (score of over 4) has fallen from 15.4% to 1.6%

Table 5: Water management problem scores – WMG averages

WM problem score	Before BGP – WMG		Now – WMG	
	number	Percent	number	percent
4 to 5	77	15.4%	8	1.6%
3.5 to 4	216	43.1%	39	7.8%
3 to 3.5	68	13.6%	24	4.8%
2.5 to 3	114	22.8%	148	29.5%
2 to 2.5	16	3.2%	119	23.8%
1 to 2	10	2.0%	163	32.5%
Total	501	100.0%	501	100.0%

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

The average water management scores for each WMG are summarised in Table 6 by season and zone. This shows that there has been a greater improvement in water management (i.e. reduction in the water management

problem score) in the rabi season followed by kharif 2 with the least improvement in kharif-1. The Khulna zone showed relatively little improvement, and WMGs report that they still have higher levels of water management problems than in the other two zones. In Satkhira, the problem score has been relatively low in the rabi season, and this season showed relatively little improvement. Patuakhali showed the greatest improvement, especially in khairif-2 – but this zone has the highest problem scores before the start of the project, so there was the greatest potential for improvement. The overall average improvement is 1.06 – meaning the WMGs have moved up one place on the problem ranking of 1 to 5.

Table 6: Average WMG water management problem score

		Before	Now	Change
Season	Rabi	3.67	2.45	1.22
	Kharif-2	3.45	2.34	1.11
	Kharif-1	3.65	2.79	0.84
Khulna	Rabi	3.72	2.70	1.03
	Kharif-2	3.23	2.50	0.73
	Kharif-1	3.67	2.94	0.73
Satkhira	Rabi	2.86	1.95	0.90
	Kharif-2	3.92	2.83	1.10
	Kharif-1	3.16	2.10	1.06
Patuakhali	Rabi	3.88	2.28	1.61
	Kharif-2	3.61	1.94	1.66
	Kharif-1	3.82	2.82	0.92
Zone	Khulna	3.54	2.71	0.83
	Satkhira	3.31	2.29	1.02
	Patuakhali	3.77	2.33	1.40
Total	All WMG	3.59	2.53	1.06

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

Water management problem scores for individual polders is in Appendix 2, Table 5. This shows considerable variation between polders, with average pre-project scores ranging from 4.05 (polder 47/3) to 3.31 (polders 2 and 28/1). The average improvement in problem scores range from only 0.28 (polder 34/2) to 1.71 (polder 43/1A, and the current water management problem scores range from 2.11 (polder 43/2F) to 3.24 (polder 27/1).

Table 7: Change in water management problem scores

Change in score	Number of WMG	Percent of WMG
over 2 (improved)	40	8.0%
1.5 to 2	125	25.0%
1 to 1.5	55	11.0%
0.5 to 1	156	31.1%
0 to 0.5	38	7.6%
0 (no change)	66	13.2%
under 0 (worsened)	21	4.2%
Total	501	100.0%

The distribution of change in water management problem scores is shown in Table 7. This shows that the overall score (for three seasons taken together) did not change for 13% of WMG and actually got worse for 4% - but the vast majority of WMGs (83%) reported an overall improvement.

2.3 Water management infrastructure

This survey gathered further information on the reasons for changes in water management. WMGs were asked about the measures that were taken to improve water management. A small but significant proportion (14% - 72 out of 501) of WMGs reported that no improvement in infrastructure had taken place. This is slightly less than the 17% of WMG that reported no improvement in their water management problem score (Table 7). However, there is a partial mismatch between WMGs reporting no improvement in infrastructure and those reporting a static or worsening water management problem score. Out of the 72 of the "no improvement" WMGs, 27 (38%) report a positive improvement in water management problem scores. For 18 of these WMG, investment in privately operated shallow tubewells has improved the availability of irrigation water. For the 42 WMGs which reported improved infrastructure but with no decrease in water management problem scores, it is more than possible that infrastructure improvements were not effective or were insufficient to bring about improved water management problem scores.

Almost all the WMG reporting "no improvement" in infrastructure are in the Khulna zone (Table 8). Of the WMGs reporting improvements, around 80% report re-excavation and de-silting of khals. A higher proportion of WMGs in Patuakhali report khal re-excavation, cleaning of khals and removal of cross-dams, and repairs to sluices and culverts. But Char Joinkathi Purbo WMG on polder 43/2E said that BGP had not done any remarkable work – improvements in irrigation and drainage had been quite limited and more works were needed. In particular excess rains had resulted in more land being kept fallow during kharif 1. Another FGD in the same polder also reported an increase in fallow land during kharif 1 due to waterlogging.

Embankment repairs figure more prominently in Satkhira. Apart from re-excavation of khals, the range of works carried out in the Khulna zone is more limited – and here 28% of WMG said that there had not been any improvement in water management infrastructure.

Table 8: Improvements in infrastructure

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

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

The main organisations responsible for each type of infrastructure improvement are shown in Table 9. Khal re-excavation (including de-silting) was the main type of work reported and was very largely done using BGP resources, usually with support from the WMG. Khal cleaning (removal of weeds, cross-dams etc) was mostly done by the WMG with their own resources (i.e. voluntary labour), along with other farmers. The same is true of improved operation of sluices. This is an outcome of BGP's work in establishing and strengthening WMGs. Culverts (new and repaired) were primarily done by local government (Union Parishads), as culverts usually cross roads which are a government responsibility. BGP funds for culverts were usually channelled via UPs, and this may be reflected in the data.

Embankment repairs were mainly done by BGP without WMG support. Some works were also carried out by BADC – and may well be underreported in Table 9 as BADC were mentioned in 11 of the 25 qualitative interviews as contributing to water management improvement. The same is also true of other agencies such as LGED (responsible for water management schemes of up to 1,000 ha), ADB (may be funding LGED schemes) and NGOs. Qualitative interviews also mentioned DANIDA.

Table 9: Organisations responsible for infrastructure development

	Khal excavation	Khal cleaning	Culvert	Sluice works	Sluice operation	Embankment
Main organisation						
1 WMG with own resources	4.5%	60.6%	6.9%	7.0%	66.4%	10.8%
2 BWDB-BGP with WMG support	73.1%	0.0%	5.6%	36.8%	15.0%	12.2%
3 BWDB-BGP without WMG support	11.9%	12.6%	16.7%	40.4%	1.9%	56.8%
4 BWDB with no BGP involvement	1.4%	0.0%	2.8%	1.8%	0.0%	2.7%
5 BADC	3.7%	0.0%	11.1%	3.5%	0.0%	0.0%
6 Local government	3.4%	5.5%	54.2%	8.8%	0.0%	14.9%
7 Farmers by themselves	1.7%	21.3%	0.0%	1.8%	16.8%	2.7%
8 Other (LGED, ADB, NGO)	0.3%	0.0%	2.8%	0.0%	0.0%	0.0%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Supporting organisation*						
1 WMG with own resources	2.3%	11.8%	26.4%	5.3%	0.0%	10.8%
2 BWDB-BGP with WMG support	2.5%	4.7%	6.%	3.5%	1.9%	8.1%
3 BWDB-BGP without WMG support	0.3%	0.0%	1.4%	3.5%	0.0%	0.0%
4 BWDB with no BGP involvement	0.8%	0.0%	1.4%	0.0%	0.0%	1.4%
5 BADC	1.7%	0.0%	1.4%	0.0%	0.0%	2.7%
6 Local government	3.4%	7.9%	30.6%	0.0%	2.8%	55.4%
7 Farmers by themselves	6.5%	21.3%	0.0%	8.8%	11.2%	5.4%
Number reporting main organisation	353	127	72	57	107	74

* Percentage of those reporting a main organisation.

Qualitative interviews indicate that sluice operation can be a key factor in improving water management. Often (in eight out of 25 FGD) sluices were controlled by "influentials" who operated them for their own benefit rather than for the wider farming community. These persons are often linked with local government and may want to let water in or out to catch fish (netting fish at the sluice or in the khals) or to let water (often brackish) into large fish/shrimp ghers that they operate. One FGD (Amodkhali WMG) reported a major problem with influential people cutting the embankment to bring in saline water for shrimp culture in ghers. The sluice is not controlled by the WMG, being operated by a team of five people led by the UP Chairman. In this WMG there has only been a relatively small change in cropping patterns, with some more HYV and hybrid paddy, but also more gher area.

Data from the WMG survey in Table 10 shows that in 50% of WMGs sluices are controlled by WMGs (either the WMGs interviewed or another WMG – the sluice may not be located in the WMG command area). However in Khulna, where there is a significant area of fish/shrimp gher. 53% of WMGs say sluices are operated by other people. To a lesser extent this also applied in Satkhira where one third of WMGs report that sluices are operated by other people. In Patuakhali, where there are no fish ghers, almost 80% of WMGs report WMG control of sluices and all WMGs say sluices are functional.

Table 10: Control of sluices

Sluice control by:	Khulna	Satkhira	Patuakhali	Total
WMG interviewed	12%	17%	46%	25%
Another WMG	19%	22%	33%	25%
Other people	53%	33%	21%	39%
not functional	16%	27%	0%	12%
total	100%	100%	100%	100%

Percentage of WMGs reporting (n=501)

Details on individual polders in Appendix 2, Table 6 shows considerable variations in control of sluices. Within Khulna zone, all WMGs in polders 27/1 and 27/2 say that sluices are under the control of WMGs, while in polders 28/1, 28/2 and 25, only 8% to 10% of WMGs report that sluices are under WMG control. Although in Patuakhali, there is generally more control of sluices by WMGs, only in polders 43/2E and 43/2F do all WMGs report sluices under WMG control, and in polder 47/4 61% of WMG report sluices under control of other people.

Having functional sluices and sluices controlled by WMGs is linked to reduced water management problems. Table 11 shows that WMGs where sluices are under the control of WMGs now have lower water management problem scores. There is a large difference in the reduction in water management problems for WMGs where sluices are not functioning (where water management problems have not been much reduced), where sluices are controlled by other people (influentials etc), and where they are controlled by WMGs. Having the WMG in control is clearly linked to better water management, but having a functional sluice is even more important. It should be pointed out that many of the non-functioning sluices cannot be fixed as the bed levels in the rivers outside the polder have got too high. River dredging is beyond the scope of BGP.

Table 11: Sluice control and water management

Sluice control by:	Water management problem score	
	now	change
WMG	2.35	1.39
Another WMG	2.47	1.22
Other people	2.59	0.93
not functional	2.82	0.52

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

2.4 Infrastructure constraints

WMGs report that the main water management issues that continue to constrain agriculture is the failure of khals to allow a sufficient flow of water (either drainage or irrigation) – see Table 12. Siltation of khals is a particular issue in Khulna and also Patuakhali. In Satkhira WMG report that water is not being well drained by the existing khals – sometimes this is due to obstruction of khals by ghers. Qualitative interviews also indicate that, in a few WMG, influential local people or land owners control khals and, for whatever reason, so not want them re-excavated or to remove cross dams put there to net fish. For one WMG there was a conflict between people with higher ground, who wanted to let more water in for irrigation, causing drainage issues for those with lower land.

Table 12: Water infrastructure constraints

	Limiting factor	Khulna	Satkhira	Patuakhali	Total
1	Siltation in khals	31.7%	15.1%	24.1%	25.5%
2	Water not drained by existing khals	8.6%	25.9%	7.1%	9.7%
3	Weed and cross-dams in khals	10.6%	6.0%	19.1%	13.5%
4	Blocked / non-existent culverts	12.2%	6.6%	6.9%	9.1%
5	Non-functional sluice gate	11.7%	9.0%	1.9%	7.2%
6	Sluice gate not operated for farmers	3.7%	0.6%	4.7%	4.0%
7	Broken and damaged embankments	2.6%	1.8%	11.4%	6.6%
8	Competition for irrigation water	2.6%	6.0%	5.9%	4.8%
9	Lack of pumps for irrigation	5.8%	7.2%	10.5%	8.3%
10	Other	10.7%	21.7%	8.4%	11.2%
	Total	100.0%	100.0%	100.0%	100.0%
	Number of limiting factors reported	625	166	622	1468

The WMG survey shows that in Satkhira a high proportion (22%) of constraining factors are in the "other" category. These primarily (70%) relate to non-functioning inlets and outlets (so are similar to non-functioning sluices), as well as pipe culverts, saline intrusion and siltation of rivers outside of the polder. In Patuakhali weeds and cross-dams in khals are a significant factor and there are also more reports of damaged embankments and lack of pumps for irrigation – the latter being beyond the scope of BGP, but could be a topic for further investigation.

These limiting factors may be located inside or outside of the WMG command area. Table 13 shows that about half are inside and the remainder either entirely or partly outside the WMG area – and so not entirely under the possible remit of the WMG.

Table 13: Location of limiting factors

location of limiting factor	Khulna	Satkhira	Patuakhali	Total
Within WMG command	62%	32%	48%	52%
Outside WMG command	17%	55%	14%	20%
Both inside and outside WMG command	21%	13%	38%	28%
total	100%	100%	100%	100%
Number of locations reported	318	78	313	715

Sustainability was discussed in the informal interviews. Most WMGs appreciated that they will need to take some responsibilities for ensuring that improvements to water management are sustainable. However, most WMGs said they lacked the required financial resources and that members were not sufficiently interested in providing voluntary work. Khals will continue to need re-excavation and some WMG saw the continued implementation of BGP activities as the only way of ensuring that such work (and also sluice repairs) would be carried out. The prospects for sustainability were not good where sluices (and sometimes khals) were controlled by outside interests and powerful individuals, and also where the works that are needed to make the system fully functional have not been completed.

3. Changes in crop areas

3.1 Overall land use

Use of cultivated land has been divided for each season into three categories: (i) paddy; (ii) other crops; and (iii) fish/shrimp ghers. Table 14 shows the seasonal land use for each of the three zones. For the Khulna zone in the rabi/boro (winter/dry) season before the project boro paddy and other crops were of almost equal importance, followed by fish ghers, with over one third of land fallow. There has now been considerable expansion in boro, some growth in fish and some decline in other crops, with significantly less fallow land. In the kharif 1 (early monsoon) season fish ghers were, and still are, the main land use, with the area now significantly increased. This, along with some growth in other crops, means that more than half of the land is now cultivated in this season. In the kharif 2 (late monsoon) season, over half the land was used to grow aman paddy. This has now fallen slightly, with a significant increase in area under fish. This growth has continued since the 2018 survey.

Table 14: Seasonal land use

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

Percentage of cultivable land

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

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

Percentage changes in these categories of land use are shown in Table 15.

Table 15: Change in seasonal land use

		Khulna	Satkhira	Patuakhali	Total
Rabi/boro	Paddy	68%	13%	*	50%
	other crops	-19%	-8%	59%	26%
	Fish	43%	41%		43%
	Total	29%	16%	63%	37%
Kharif 1	Paddy	-71%	110%	-23%	-24%
	other crops	40%	22%	-95%	35%
	Fish	42%	130%		56%
	Total	37%	110%	-24%	30%
Khairif 2	Paddy	-15%	1%	5%	-4%
	other crops	33%	*	-100%	34%
	Fish	34%	105%		47%
	Total	4%	48%	5%	8%
Total	Paddy	11%	11%	1%	7%
	other crops	2%	22%	58%	28%
	Fish	39%	106%		50%
	Total	19%	43%	19%	22%

Percentage of cultivable land * only very small areas grown so percentage change is meaningless

Seasonal land use for each polder is shown in Appendix 2, Tables 7 to 9. Within the Khulna and Patuakhali zones there is great variation between polders. In Khulna, polder 22 has (and did) grows very little boro paddy and not much fish, but there has been significant expansion of other crops in the rabi season. Polders 25 and 27/1 had relatively little aman paddy in kharif-2 but grow more boro in the rabi season. These polders, plus 27/2 and 28/1 have larger areas under fish culture.

Although non-rice crops dominate the rabi season in Patuakhali, in polder 47/3 (and to a lesser extent 47/4), there is not such a large area of these crops, nor is there much aus paddy in kharif-1 although, like the other polders, most of the land is used for aman paddy in kharif-2.

As can be see in Table 15, the increase area under fish ghers has increased substantially. There has been an increase of 50% of the cultivable area (CA) spread over three seasons. This is far greater than the increase in area of paddy (7% of CA) and other crops (28% of CA). But in none of the zones has there been a decline in the area of crops while to area of fish increased – suggesting that land has not been switched from crops to fish. The expansion of fish has taken land that was previously fallow. The same applies at the polder level – there is no switching from crops to fish – with the exception of polder 28/2 where there has been a sharp fall in the area under non-rice crops and a much smaller increases in areas under paddy and fish. At the WMG level, such switching of land is more widespread. Table 13 in Appendix 2 shows that in 10 of the 11 polders in Khulna zone, at least some WMGs report decline in area under crops (paddy and other) and an increase in fish gher – implying that land as moved out of crops (in at least one season) and into fish. For the zone as a whole 23% of WMGs report making such a shift. A much smaller number of WMGs (6% for the zone) on 9 of the 11 polders report the opposite – reducing the area under fish while increase the area of crops. In Satkhira zone (polder 2 only), the pattern is similar, with 22% of WMGs reporting switching land from crops to fish ghers, and only 3% moving in the opposite direction. Within each WMG there will be individual farmers switching land – so this may be happening even if it is not shown for data for the WMG as a whole.

3.2 Change in cropping pattern and crop types

For paddy there has been a move from traditional local varieties to modern HYVs and hybrids (Table 16). There are no reports of cultivation of local varieties of boro (these seem to have disappeared in Bangladesh), but there is a move from conventional HYVs to hybrid seeds. This is particularly apparent in the Khulna zone. Only in Patuakhali is a significant area of aus grown, and there has been a dramatic switch from local varieties to HYVs. There has also been a switch from local to HYV in the aman season – less so in Satkhira where HYVs predominated before BGP, and significant (but reduced) areas of local aman continue to be grown in the other two zones.

The area of land occupied by other crops is shown in Table 17. In the Khulna zone, sesame was an important crop, but this and a number of other more minor crops have declined in importance due to a combination of unfavourable growing conditions – with more emphasis being placed on more reliable irrigated boro and on more profitable fish ghers. However, the area of two non-rice crops have expanded – vegetables and water melons – these are profitable and, in particular farmers report that they would like to grow more water melon if they have access to the required irrigation water.

Table 16: Land under different types of paddy

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

Percentage of cultivable land

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

Table 17: Land under other crops

	Khulna		Satkhira		Patuakhali		Total	
	before	now	before	now	before	now	before	now
maize	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0
Mung bean	3.6	1.3	0.0	0.0	12.1	59.1	6.1	21.7
keshari	0.0	0.0	0.0	0.0	22.6	1.2	8.0	0.4
felon	0.0	0.0	0.0	0.0	0.8	0.5	0.3	0.2
sesame	15.1	4.8	0.0	0.0	2.2	0.2	8.7	2.6
groundnut	0.0	0.0	0.0	0.0	4.5	8.2	1.6	2.9
sunflower	0.2	0.0	0.0	0.0	0.2	0.8	0.1	0.3
sweet-potato	0.0	0.0	0.0	0.0	2.9	1.3	1.0	0.4
Jute	0.6	0.1	3.0	2.7	0.0	0.0	0.7	0.4
Chili	0.1	0.1	0.2	0.0	3.7	4.6	1.4	1.7
watermelon	0.2	4.7	0.0	0.0	1.4	5.4	0.6	4.3
vegetable	15.1	22.3	3.5	5.5	0.6	0.8	8.5	12.5
other	6.9	9.4	0.7	1.0	2.6	2.9	4.6	1.6
total	41.9	42.7	7.5	9.1	53.7	85.0	41.7	53.5

Percentage of cultivable land

Areas under other crops in each polder is shown in Appendix 2, Table 11. There is considerable variation between polders within each zone. Although mung bean is an important crop in Patuakhali zone, it only covers 8.1% of the land area in polder 47/3. Similarly, very little sesame was grown in some polders in Khulna zone (25, 26, 27/1, 27/2). Water melon is concentrated is a relatively small number of polders – in polder 22 it covers half of cultivated land, 25% in polder 43/2B and 21% in 43/1A. It is also grown in polders 30 and 31 part, but with only small areas or none at all in the other polders.

Table 12 in Appendix 2 shows, for each polder, the total area of paddy, other crops and fish/shrimp in all three seasons as a percentage of the area of cultivatable land. In all polders the total area of paddy amounts to between 76% and 149% of cultivated land. Although the overall area of paddy has increased by 7%, the increase was as much as 33% (polder 26), with a decrease of 32% in polder 43/2B. A significant area of land is used for fish in Khulna and Satkhira, amounting to close to, or more than, 100% of cultivated land in eight of the 12 polders. The area under fish has generally increased, at least doubling in polders 30, 28/2 and 2, but falling in polder 34/2.

The FGD in Khulna confirmed the decline in non-irrigated rabi. Participants said that this is partly due to excessive rainfall resulting in waterlogging. Farmers say crops such as keshari and sesame are not profitable, and would prefer to focus their efforts on smaller areas where irrigation is now possible and where high value crops such as watermelon can be grown. But letting in more water from outside rivers to expand irrigation can mean that salt is also carried in with this water. Better water management is encouraging some WMGs to switch from rice to fish/shrimp ghers. However, a number of FGDs (7 out of 10 in Khulna) said that sluices were under the control of influential or politically connected people who operated them as they wished with little regard to the needs of farmers. Another FGD (Buramara WMG) reported that two km of khal was controlled by an influential person who would not allow it to be re-excavated.

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

In Satkhira (polder 2) the FGDs confirmed a general switch to hybrid boro and HYV aman paddy and reduction in fallow area in the rabi (boro) and kharif 2 (aman) seasons. This has come about due to better drainage. More timely planting of HYV paddy has increased crop yields. Some FGD reported an increased amount of fallow in the kharif 1 which could be linked to the expansion of boro paddy which tends to overlap into the kharif 1 season. In general, the area of fish ghers have been expanding, although one FGD (Hazikhali Khal WMG) reported less gher and more boro and aman paddy. Better water management and reduced risk of flooding due to repaired embankments have encouraged expansion of ghers as well as paddy.

3.3 Cropping intensity

Cropping intensity has been calculated as the sum of crops and fish ghers in each season divided by the sum of crops, ghers and fallow land. This treats fish ghers as another crop in each season and takes no account of the frequency of fish harvests – so land used as a perennial (year-round) gher would have a 300% cropping intensity. With this approach overall cropping intensity has increased from 187% to 228%, with a larger increase in Satkhira of 76 percentage points - largely due to expansion of fish ghers in polder 2, together with an increase in the area of paddy (Table 18).

Table 18: Cropping intensity

	Rabi /boro season		Kharif 1 season		Kharif 2 season		Cropping intensity		
Zone	before	Now	before	now	before	now	before	now	change
Khulna	65	84	41	57	93	97	199	237	38
Satkhira	85	99	31	66	59	87	176	252	76
Patuakhali	53	87	25	19	95	99	173	205	33
Total	64	87	34	44	89	96	187	228	41

Percentage of cultivable area used in each season

The change in cropping intensity for individual polders is in Table 14 of Appendix 2. This shows current cropping intensities for individual polders ranging from 42% (polder 47/4) to 274% (polder 27/1). Increases in cropping intensity, of up to 81 percentage points, was reported for all polders apart from polder 28/2 which recorded a fall of 34 percentage points, going from 196% to 162%. Polder 28/2 is close to Khulna city and is being absorbed into the expanding urban area. Apart from workers finding better opportunities in the non-farm sector, urban development often disrupts drainage lines and makes it difficult to grow crops on patches of land surrounded by buildings. In this polder there has been 56 percentage point fall in the proportion of land used for non-rice crops, with falls in mung bean, sesame and vegetables. There has not been much increase in areas of paddy or fish to offset these falls. The increase in area of high yielding and high value crops and fish ghers is only 18% of the cultivable area, less than in any of the other polders.

Changes in cropping intensity vary considerably between WMGs. Overall 80% of WMGs report an increase in c.i., 11% no change and 8% decrease. The proportion of WMGs with an increase in c.i. was highest in Satkhira at 92% and lowest in Khulna at 75% (Table 19). Data on individual polders is in Appendix 2, Table 15, and shows that in polders 22, 27/2 and 26 (Khulna zone), all WMGs had an increase in c.i., while in the same zone only 33% of WMG in polder 28/2 increased their ci, while 50% had a decrease.

Table 19: Change in cropping intensity

Zone	Percentage of WMGs with change in cropping intensity			
	increase	No change	decrease	total
Khulna	75%	15%	9%	100%
Satkhira	92%	6%	2%	100%
Patuakhali	84%	7%	10%	100%
Total	80%	11%	8%	100%

DAE calculates cropping intensity as the area of crops divided by the sum of the areas of crops, fish ghers and fallow land. Cropping intensity calculated in this way is lower in Khulna and Satkhira, with a smaller increase (Table 20). However, it does show that, even leaving aside the fish ghers, the area of farm crops has expanded.

Table 20: Cropping intensity (DAE method)

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

The overall changes of cropping intensity in the Khulna and Patuakhali zones are similar to those reported in the 2018 WMG survey, with increases of 36.4 percentage points for Khulna in 2018, compared with 37.8 in this survey. In Patuakhali the figures are 33.7 for 2018 and 32.7 in 2019. Note that this survey covers a larger number of polders in each zone than the 2018 survey, which did not have a figure at all for Satkhira. Although the change in c.i. in Khulna and Patuakhali is similar, the 2019 survey has a higher figure for both pre-project and current c.i. in Khulna where the 2018 survey went from 178% to 215%, while now it is 199% to 237%. This is due to inclusion of new polders in the current survey with higher c.i. In Patuakhali the opposite applies – in 2018 the figures were 181% to 214%, and now they are 173% to 205%, as the additional polders have a relatively low c.i.

Cropping intensity for the five polders in Khulna that were covered in the previous survey has now increased over the 2018 figure – showing a continuing rise in c.i. Data for the eight polders in Patuakhali do not show such a continuing increases in c.i. In both Khulna and Patuakhali fewer WMGs report having reduced c.i. than they did in the previous survey – reducing from 14% to 8% despite some polders that only now included in the survey having significant numbers of WMG with declining c.i. (50% for polder 28/2, and 21% for 34/2).

3.4 Link between water management and cropping intensity

There appears to be a link between a reduction in water management problem scores and an increase in cropping intensity. This suggests that improvements in water management may lead to increases in crop areas. Table 21 shows that the 87 WMG where water management problems were unchanged or increased had, on average, an increase in cropping intensity (c.i.) of only 11.6 percentage points, while the 38 WMG where overall water management problem scores increased by under 0.5 had an average increase in c.i. of 19.3. In contrast, the 40 WMG where water management problem scores increased by more than 2.0 had an average increase in c.i. of 74.8 percentage points. There was a similar pattern with changes in the area of high yielding and high value crops[1].

Polder 28/2 was the only polder where cropping intensity declined – a fall of 34 percentage points. This polder also recorded a low reduction in water management problem score – only 0.56, compared with an overall BG average of 1.06, but other polders improved even less, including 28/1 (0.44) and 34/2 (0.28).

Although Table 21 suggests a relationship between improvement in water management problem scores and cropping intensity, a linear regression analysis shows that this link is not strong – the R^2 is only 0.1735 showing that only 17% of the variation in c.i. can be explained by changes in the water management problem scores. The WMG recording the greatest drop in c.i. (150 percentage points) had an improvement in water management problem score of 2.0, while the WMG with the greatest increase in c.i. (280 percentage points) had a smaller

[1] HYV and hybrid paddy, chilli, watermelon, and vegetables.

improvement in water management problem score of 1.7. This shows that there can be a very large range in outcomes (as measured by c.i.) for WMG with similar changes in water management scores.

Table 21: Changes in water management and cropping

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

'* improvement (reduction) in water management problem score

[1] Change in terms of percent of cultivable land

A similar analysis done in the 2018 survey report also concluded that the link was weak, and with a smaller number of WMGs, the regression equation had a lower R^2 of 0.11.

4. Crop yields

There has been a substantial increase in the productivity of paddy (Table 22). Apart from a switch to more productive HYV and hybrid varieties, average yields of each type of paddy has increased by around 10% to 25%. However, there is a more mixed picture regarding the yields of non-rice crops, with significant falls in yields of some of the key crops including mung bean[2] and sesame. During the FGD qualitative interviews farmers reported that unpredictable weather conditions during the growing season (excessive drought, unexpected and heavy rainfall) have adversely effected non-irrigated rabi crops. Data on aquaculture yields needs to be used with caution as seasonal yield data may not reflect the annual productivity of ghers.

Table 22: Average crop yield

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

The proportion of WMGs reporting increased, decreased or no change in crop yields is shown in Table 23. This only covers WMGs that reported yields both before BGP and at the present time, so WMGs that no longer grow the crop or who have only recently started to grow the crop are excluded. The table also shows the number of WMGs that have reported yield changes – for a number of non-rice crops that are not widely grown, only a few WMG have provided yield data which may therefore not be truly representative. Data in Table 21 on yields of crops such as maize, sunflower and felon only comes from a few WMG and so may not represent average yields.

Compared with the 2018 survey, the increase in yield for paddy reported in this survey is more modest (apart from for aman in Patuakhali. The 2018 survey also reported significant yield increases for most non-rice crops while this survey shows yield declines for a number of these crops.

[2] Many farmers have adopted modern, high yielding types of mung bean, especially BARI-6. However these improved types inter-breed with older local types, so much mung bean is of a semi-improved type. For this rason this report has not tried to differentiate between modern and local varieties of mung bean, and farmers report that, despite adopting improved varieties, overall yields have fallen.

Table 23: Change in crop yield

		Percentage of WMG reporting change in yield				no. WMG reporting
		Increase	no change	decrease	total	
Paddy	boro HYV	84%	7%	9%	100%	211
	boro hybrid	85%	4%	10%	100%	137
	aman local	76%	9%	15%	100%	336
	aman HYV	89%	6%	6%	100%	267
	aus local	83%	0%	17%	100%	24
	aus HYV	93%	5%	2%	100%	58
Other crops	maize	75%	0%	25%	100%	4
	mung bean	38%	6%	56%	100%	136
	Keshari	38%	21%	41%	100%	39
	felon	50%	13%	38%	100%	8
	sesame	22%	10%	67%	100%	58
	groundnut	58%	11%	30%	100%	115
	sunflower	100%	0%	0%	100%	3
	sweet-potato	40%	13%	48%	100%	40
	jute	50%	17%	33%	100%	24
	chilli	71%	9%	20%	100%	120
	watermelon	46%	0%	54%	100%	13
	vegetable	100%	0%	0%	100%	1
Aquaculture	rabi	61%	17%	22%	100%	142
	kharif-2	77%	9%	14%	100%	234
	kharif-1	66%	21%	13%	100%	173

Data on crop yields and percentages of WMGs reporting changes in each zone are in Appendix 2, Tables 16 and 17. This shows that boro yields are slightly higher in Satkhira and HYV aman in Patuakhali – but the differences between zones is quite small. In general, a higher proportion of WMGs reported increases in yields of boro and aman in Patuakhali than in the other two zones

5. Technology adoption and production constraints

5.1 Farmers' Field Schools

The informal interviews with 24[3] FGDs discussed the outcomes of Farmers' Field Schools (FFS). FGD participants were able to list a number of improved methods and technologies that were introduced and disseminated through FFS. Adoption rates were usually (but not always) somewhat lower for other (non-FFS) WMG members and lower again for other farmers – typically with a drop of 5% to 20% from FFS to WMG and the same from WMG to other farmers. In some cases, other farmers did not adopt at all – but this would be for technologies with relatively low adoption rates for FFS and WMG members.

Out of around 22 different crop-related technologies identified by FGD participants, 14 were reported by at least 3 FGD. Adoption rates for these 14 technologies are shown in Table 24. Although pheromone traps were quite well adopted (but only reported in three WMG), other pest control methods, light traps and organic pesticides, along with vermicompost, were not much adopted. The most widely cited reason for non-adoption was "lack of awareness" which could suggest a failure in training – the participant was not made aware of the technology. However, it is more likely to be that participants did not feel that the technology was relevant to their situation or needs. Light traps were also said to be too costly and, along with organic pesticides and vermicompost, "not convenient" or "difficult" which may relate to a high labour requirement. Leaf colour charts were not thought to add much to farmers' existing experience.

Table 24: Adoption of crop-related technologies

Technology	Percent FGD with adoption rate[1]			no. of FGD
	high	medium	low	
Improved seeds & varieties	91%	5%	5%	22
Pulse cultivation	80%	20%	0%	5
Seedbed preparation	74%	22%	4%	23
Line sowing	74%	22%	4%	23
Balanced fertiliser	70%	30%	0%	10
Pheremone trap	67%	33%	0%	3
Seed preservation	64%	27%	9%	11
Perching branches for birds	48%	24%	29%	21
Logo sowing method[2]	37%	47%	16%	19
Leaf colour chart	17%	17%	67%	6
Pest control methods	14%	43%	43%	7
Organic pesticides	13%	0%	88%	8
Light trap	8%	15%	77%	13
Vermicompost	0%	0%	100%	3

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

In Khulna and Satkhira zones (but not in polder 30), FFS also covered fishery technologies. Adoption rates for these technologies are shown in Table 25. In general adoption rates were higher than for crop-related technologies. Some FGD say that FFS have directly encouraged expansion of mung bean in FFS in Patuakhali and fish ghers in Khulna. However it should be pointed out that BGP FFS for fisheries were targeted at operators

[3] One of the 25 FGD did not have any FFS

of small fish ponds, not the much larger ghers. However the FGD clearly saw these FFS as supporting gher production. For example, an FFS topic on preparation of fish ponds prior to stocking was identified in FGDs as "gher preparation".

Table 25: Adoption of aquaculture technologies

Technology	Percent FGD with adoption rate[1]			no. of FGD
	high	medium	low	
Improved fingerlings/spawn	92%	8%	0%	12
Balanced fertiliser for fish	90%	10%	0%	10
Liming fish ponds and ghers	90%	10%	0%	10
Netting to monitor growth	75%	13%	13%	8
Gher / pond preparation	67%	0%	33%	3
Aquatic food	60%	40%	0%	5

[1] Adoption rates for FFS members were categorised as; (i) high – over 61% adopting; (ii) medium – 60% to 31% adopting; and (iii) low – 30% or fewer adopting.

5.2 Farmers' problems

The 25 FGD involved in the qualitative interviews were asked about the major problems that they now face in farming. These problems are shown in Table 26 and are dominated by economic issues – the falling price of farm products and the increasing cost of labour and farm inputs. At one FGD participants wondered how much longer they will be able to continue to farm. In total 22 out of the 25 FGDs (88%) said that falling market prices were an increasing problem – and the other three FGDs all said they had marketing problems, which may amount to the same thing. Last year farmers were benefitting from a spike in paddy prices following poor harvest in the preceding year. This encouraged increased paddy production, and the market may well now be over supplied. Farmers no longer think that paddy is such a profitable crop. The rapid expansion of mung bean production may also have had an impact on market prices.

Table 26: Farmers' problems

Problem	increasing	decreasing	% of FGDs[1]
Fall in market price	22	0	88%
Marketing problems	11	0	44%
Labour crisis and high wages	20	0	80%
Increased price of inputs	12	0	48%
Seed availability	10	2	48%
Limited availability of fish spawn	2	0	8%
Adulterated fertiliser / pesticide	9	0	36%
Crisis of modern agric equipment	1	0	4%
Difficult to get loan	6	0	24%
Financial problems	2	0	8%
Lack of technical knowledge	2	1	12%
Pests and diseases	15	1	64%
Shrimp disease	3	0	12%
Rats	10	0	40%
Salinity	0	2	8%
Waterlogging	1	0	4%
Drought	14	0	56%
Natural calamities	2	0	8%
Excess rainfall	1	0	4%

[1] number of FGDs reporting increasing or decreasing problem as percent of the 25 FGDs.

Another set of problems relate to labour shortages, higher wages and increasing production costs. Intensification of farming and growing opportunities in the non-farm sector has pushed up wages, and increased the participation of women in farm work. FGDs also reported problems with the availability of inputs – especially seed, adulterated fertiliser and pesticides, and lack of access to modern farm equipment. Almost one quarter of FGDs report difficulties in getting loans, but relatively few say that they lack technical knowledge – but they have been getting considerable help from BGP. Pests and diseases are reported as a problem by 64% of FGD – second only to the number reporting a fall in market prices. A significant number of FGD reported increasing damage by rats and shrimp disease is another problem. Pests and diseases are a particular issue for the future given that there has not been much adoption of control technologies from FFS.

A further set of problems relate to the environment and water management. Over half of FGDs report that drought is a problem – placing this problem in third place in terms of the number of FGDs reporting. However very few FGDs reported problems with salinity, waterlogging and excess rainfall – which is a little surprising given that many have said unexpected rains in the winter have damaged rabi crops. FGDs have already reported on water management problems (see above) and it may be that they did not feel the need to repeat this here. Nevertheless, it is useful to have water management issues placed in the context of the wider range of problems that farmers face.

6. Changes in land tenure

WMGs report (Table 2) that less land is now being farmed by its owner and less is being sharecropped, with a significant increase in other lease arrangements (mainly annual cash rental). This pattern is followed in all three zones and in most seasons. In Satkhira there has been a smaller decline in cultivation by owners, and Khulna has seemed a slightly smaller drop in sharecropping and increase in other types of leasing. Although land for fish ghers is often rented in by large operators, there has also been an increase in cash rental in Patuakhali, where there are no ghers. A similar trend was observed in the 2018 WMG survey.

Table 27: Land tenure

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

Average percentage of land under different tenure arrangements

Data on land tenure for individual polders is in Table 18 of Appendix 2. This shows that there is more variation between polders than between zones in Table 27, but the overall direction of change is similar on most polders – less owner cultivation and sharecropping, and more cash rental.

The FGDs showed a mixed picture. At a few locations less land is being leased out or sharecropped as land owners now want to grow highly profitable crops such as watermelon on newly irrigated/drained land. But in most of the locations much more land is now being leased (in line with the WMG survey data) as farming has now become more profitable for tenants. Where improvements in water management have been constrained, there may not be much increase in the amount of land being leased out (Hazikhali Khal WMG in polder 2). One WMG reported that the amount of land being let on cash rental had fallen but more land was being sharecropped in the rabi season (as it was more profitable for tenants than cash rental), but less was now sharecropped in kharif as aman production had become unprofitable. At other WMGs, there were large increases with the amount of land being leased out for cash rents. In general people who rent or sharecrop in land are farmers with limited land holdings (landless, marginal and small farmers), but who have labour available within their families. But at some locations in Khulna and Satkhira land is being rented in by larger farmers and businessmen for fish/shrimp ghers, along with vegetables and paddy.

Cash rents have risen significantly during the BGP period – often by multiple times. Typical annual rent per acre reported in FGD in Khulna were around Tk20,000 - lower in polder 30, but up to Tk50,000 in polder 29. In Satkhira rents were higher – typically around Tk30,000, while Patuakhali Tk13,000 were typical – lower but fish ghers are not a land use option here.

7. Farm labour and the role of women in agriculture

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

Women are almost always paid less than men – typically being paid between half and 80% of the male wage. Only in a few instances for tasks such as weeding of paddy, are equal wages paid. Some FGDs report that the differential between male and female has narrowed, at least in relative terms, with female wages doubling since the start of BGP, while male wages have only gone up 50%.

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

8. Economic returns

8.1 Increase in farm income

An increased area of crops, improved cropping patterns and increased yields should have resulted in increased farm income. This increase in income has been calculated based on budgets for the main crops in each zone and using cropping patterns and yields derived from WMG survey data. Detailed crop budgets are in Appendix 3, Attachment A. These budgets were drawn up prior to collection of WMG survey data and yields have been subsequently adjusted in the crop budget to (i) be in line with those from the WMG survey, and (ii) to reflect what farmers tell us about the relative profitability of crops.

Crop budgets are based on the current situation, and to incorporate yield increases net income "before BGP" has been estimated. This deducts approximately half of the value of the yield increase reported in the BGP survey to arrive at a before BGP net income. This is on the assumption that, without BGP interventions, yields would have increased by about 50% of the reported increase. Where the WMG survey shows that crop yields have decreased (as with a number of non-rice crops) it is assumed that there has been zero yield increase. This means that the yield decrease is not attributed to BGP on the assumption that it is caused by external factors such as the weather. In fact, BGP interventions may have moderated the size of the yield decrease. Before BGP net income for each crop has been estimated by deducting the gross value of the yield decrease less 20% for reduced production costs (as lower yielding crops would have lower harvesting and marketing costs, and may use less inputs).

The cropping pattern in the current and pre-project situation are taken from the WMG survey data for each polder. In each zone crops that are not widely grown have been left out – with their area added to a similar more widely grown crop – for example, in Patuakhali the small area of felon (a pulse) has been added on to the area of much more widely grown keshari. Net income from fish ghers has been calculated on a seasonal basis with the net income gher budgets adjusted for a four month season (thus net income for gher system with an eight month production period has been divided by two to give two four month seasons). The actual area of individual crops for each polder has been calculated by applying the cropping pattern to the total cultivable area of all WMG commands in each polder. These crop areas and the net income per acre for each crop are used to give the total net farm income in each polder, before BGP and for the current situation.

Table 28 shows that net farm income has almost doubled, and that more comes from aquaculture than from crops – and aquaculture contributes over half the increase in farm income. However, in relative terms the increase has been higher for paddy and for other crops. The relative increase has also been higher in Patuakhali zone, and lowest in Khulna.

Table 28: Total net farm income

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

Table 6 in Appendix 3 gives this data for each polder. Although polders in the Patuakhali zone tend to have smaller increases in net income, polder 28/2 in Khulna stands out as having no increase in farm income. This polder reported a significant reduction in cropping intensity (34 percentage points). However apart from this and five other polders which have the lowest increases in farm income, there is no correlation between increase in net income and increased cropping intensity, the area of high yielding and high value crops, or the reduction

in water management problem scores (Table 29). However farmers in the FGDs repeatedly said that improved water management had allowed them to crop more intensively, grow more valuable crops (including fish ghers) and get improved crop yields. There may be too much variation within polders for this to show up when comparing the averages for different polders.

Table 29: Increase in farm income and performance indicators

Increase in farm income	No. of polder	Average change in			
		Increase in farm income	cropping intensity	HYVC + fish ghers	WM Problem score
over 160%	4	349%	33.9	76.0	1.1
120-160%	5	146%	37.5	68.0	1.1
90-120%	3	100%	62.5	107.2	1.4
60-90%	4	79%	44.1	63.2	1.4
30-90%	4	44%	34.9	41.7	0.7
under 30%	2	8%	-9.2	22.1	0.4

The increase in farm income calculated in the 2018 survey report for one catchment in polder 2 and for polder 43/2B was significantly lower than that in this survey. This is at least partly due to calculations in 2018 not taking account of increased crop yield.

8.2 Return to the investment in BGP

The increase in net farm income can be compared with expenditure of project funds to see if benefits (in terms of increased farm income) is sufficient to justify the investment in BGP. Cumulative expenditure of BGP funds by BWDB on water management infrastructure and by DAE on its FFS is shown in Table 30. BWDB expenditure is to June 2019, and DAE expenditure is to June 2018. Given the timing of this survey, expenditure data to June or December 2018 is appropriate for comparison with benefits to date. In terms of average expenditure per WMG, more has been spent in Patuakhali than in the other two zones, reflecting the more extensive works reported in Table 8.

Table 30: Cumulative expenditure by BWDB and DAE

Zone	Million Taka			
	BWDB	DAE	Total	Avg per WMG
Khulna	1,254.10	19.66	1,273.76	4.90
Satkhira	352.85	9.00	361.85	5.74
Patuakhali	1,415.06	30.07	1,445.13	8.12
Total	3,022.02	58.73	3,080.75	6.15

Table 31 shows the payback period required for the increase in annual net farm income to equal the cumulative project expenditure to date. Column A is the payback period for BWDB and DAE expenditure only. Column B is the payback period for total BGP expenditure assuming that DAE and BWDB expenditure are 35% of cumulative total BGP expenditure including the TA team etc. (35% is approximately correct for the end of 2018). Taking column A (BWDB and DAE expenditure only) the payback period is very short – less than six months for all polders taken together. Even if only part of the increase in net income were to be attributed to BGP interventions, the payback period would still be very acceptable.

This approach in measuring the viability of the BGP investment in terms of payback is crude. It takes no account of complementary investments in water management using other resources (such as BADC) or the voluntary labour contributed by farmers. No account has been taken of increases in income derived from BGP interventions in homestead agriculture. A full economic analysis of the project would adjust input and output prices to reflect their real value to the economy. However, BGP is generating very rapid returns and if the increase in farm income covers project investment costs in a few years, it is fairly certain that a full economic

analysis, where benefits are accrued over a 20 or 30 year period, would give positive results, with an acceptable economic internal rate of return.

Table 29: Payback period for project investment

	Payback period (years) A	B
Khulna	0.26	0.74
Satkhira	0.46	1.30
Patuakhali	1.14	3.27
Total	0.44	1.26

The payback period for each polder has been calculated and is in Table 8 of Appendix 3. Taking "case B" – including all BGP costs, almost all polders in Khulna have a payback period of less than two years (and many less than one year). Exceptions are polder 28/2 (where there is no (or almost no) increase in farm income) and polder 34/2. The payback for Polder 28/1 is under three years. Polder 2 in Satkhira has a payback period of under two years, but most of the Patuakhali polders are in excess of five years, apart from 43/1A, 43/2B (both under 2 years) and 55/2C (under 3 years).

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

8.3 Increase in employment

Farm employment

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

Table 30 shows the total labour used in crop production and gher aquaculture in each of the three zones. The total labour requirement is now estimated to be 15.4 million person-days, an increase of around 50% on the pre-project situation. Paddy production absorbs over half of this labour, followed by fish / shrimp aquaculture and then non-rice crops. The table also shows how much labour is hired (men and women) and how much comes from men and women members of farm households.

Table 31 shows the share of each of these four sources of workers in the total supply of labour for the three subsectors (paddy, non-rice crops and aquaculture) in each zone. Over half (57%) of labour is hired and 43% comes from farm households. Paddy production uses a slightly higher proportion of hired labour than the other sub-sectors. With increasing shortages of male workers there has been a four-fold increase in the number of days provided by hired female workers. Women (including those from farm households) provide 63% of labour for non-rice crops. There is data on labour inputs for each polder in Appendix 3.

Table 30: Labour inputs for crops and aquaculture

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

Thousand person-days

Implications for Labour Contracting Societies

The increase in employment of hired farm labour of 3.17 million person-days (1.11 million male, 2.07 million female) per year far exceeds the cumulative employment of LCS labour by BGP over the last six years – estimated at 0.98 million days (62% male, 38% female)[4]. In total 32% of BGP expenditure on embankment and khal earthworks has been via LCS. BWDB rate schedules show that the cost of works done by manual labour are about double that done by machine, so the total volume of work could have been expanded by 32% if mechanised methods had been used instead of LCS. This would create at least as much additional work on farms every year for poor people seeking paid employment. Moreover using machinery will be more efficient in terms of speed and quality of work and avoids the management and administrative effort needed for implementation of LCS.

LCS were justified when use of manual labour was less costly than using machines, and when there were few rural employment opportunities, especially for ultra-poor women. Now that Bangladesh is a middle income country this is no longer true, and manual earthwork is of low status and physically demanding work for women.

[4] Calculated from BG data on expenditure on male and female LCS group contracts, assuming that 30% of contract value is absorbed by taxes and management costs and that LCS members (men and women) get total remuneration of Tk300 per day worked. In practice much work contracted by female LCS may be sub-contracted to men – and both male and female LCS may use some machinery.

Table 31: Labour inputs – share by source of labour

		paddy		other crops		fish / shrimp		total	
		before	now	before	now	before	now	before	now
Khulna	hired men	48%	44%	27%	26%	44%	43%	44%	42%
	hired woman	6%	14%	12%	23%	0%	8%	4%	13%
	HH men	36%	31%	38%	26%	46%	39%	40%	34%
	HH women	11%	11%	23%	24%	10%	10%	12%	12%
	total	100%	100%	100%	100%	100%	100%	100%	100%
Satkhira	hired men	43%	37%	31%	26%	39%	25%	41%	31%
	hired woman	15%	25%	17%	22%	10%	46%	14%	35%
	HH men	30%	25%	38%	36%	41%	23%	34%	25%
	HH women	12%	12%	15%	16%	9%	6%	12%	9%
	total	100%	100%	100%	100%	100%	100%	100%	100%
Patuakhali	hired men	61%	63%	24%	6%	0%	0%	51%	42%
	hired woman	0%	0%	14%	41%	0%	0%	4%	14%
	HH men	31%	28%	35%	23%	0%	0%	32%	26%
	HH women	8%	9%	26%	30%	0%	0%	13%	17%
	total	100%	100%	100%	100%	0%	0%	100%	100%
total	hired men	53%	51%	25%	13%	43%	37%	46%	40%
	hired woman	5%	10%	14%	35%	2%	20%	6%	17%
	HH men	33%	29%	37%	25%	45%	34%	36%	30%
	HH women	10%	11%	24%	28%	10%	9%	12%	13%
	total	100%	100%	100%	100%	100%	100%	100%	100%

9. Conclusions and recommendations

Improvement in water management

WMG continue to report a reduction in water-related constraints to crop production, and the vast majority of WMGs (86%) say that water management infrastructure has been improved. But where sluices are not functional there has been little improvement in water management, and having sluices under the control of non-WMG actors limits water management benefits. In Khulna and Satkhira that are quite a number of instances of conflict between WMG (representing farmers) and influential groups or individuals who want to operate sluices and khals, and may even cut embankments, in order to operate fish/shrimp ghers and/or catch fish.

Sustainability: while WMGs appreciated that they will need to take responsibility for the sustainability of improvements in water management, most WMGs said they lacked the required financial resources and that members were not sufficiently interested in providing voluntary work. WMG often saw the continued implementation of BGP activities as the only way of ensuring that the required work would be carried out. The prospects for sustainability were not at all good where sluices were controlled by outside interests, and also where the works that are needed to make the system fully functional have not been completed.

Recommendation: completion of water infrastructure works will make an important contribution to sustainability, and BGP should make systems fully operational by the completion of the project. BGP should also make every effort to ensure that sluices are under the full control of WMGs.

Changes in crop areas

Since the start of BGP there has been significant changes in land use and cropping. In Khulna and Satkhira, the biggest change has been an increase in the area under fish ghers, but there have also been increases in the area of paddy (mainly boro which is now predominant of the hybrid type). In Patuakhali, there has been little change in the area of paddy, but significant increase in area of non-rice crops, primarily mung bean. Taking the three zones together the increase in area under fish ghers has been greater than the combined increase in paddy and non-rice crops. Although the expansion of fish ghers has not meant a reduction in crop areas at a zone or polder levels (apart from polder 28/2), 23% of the WMGs in the combined Khulna and Satkhira zones have reduced their area under crops while increasing the area of fish gher, with only 5% moving in the opposite direction.

Although BGP aims to increase income from all types of farm enterprises, including aquaculture, the project has promoted the idea that improved drainage will allow farmers to convert land from fish ghers to paddy and maybe other crops. The thinking behind this is that fish/shrimp ghers tend to be in the hands of large operators. Moving land back into crops provides an opportunity for small landowners and also for poor households to sharecrop. Small farmers in Satkhira interviewed for the 2018 WMG survey said that small farmers preferred to grow rice rather than fish, as they got food for their families and straw to feed animals. WMGs visited also said land to grow aman was being sharecropped to landless poor households – as landowners got sufficient paddy from a boro crop. At the time paddy prices were high and there was little difference in the profitability of paddy or fish/shrimp.

The situation has now changed, with paddy prices falling and crop budgets now show that, on a per season basis, that ghers are more profitable than paddy. The areas of ghers in Khulna and, especially, Satkhira, have increased substantially. However, the area under crops has also increased, although not as much. Apart from polder 28/2 (where cropping intensity has significantly fallen) crop areas have increased on all polders, but at the WMG level the picture is different and 23% of WMGs in the Khulna and Satkhira zones have reduced their crop areas while increasing the area under fish. Farmers in FGDs said that paddy production had become

unprofitable and that they may switch to fish. Cash rents have risen and in parts of Khulna zone and in Satkhira zone would seem to make it more profitable to lease land to gher operators than to use it to grow crops.

Recommendation: under these circumstances, BGP should review what it thinks about the move from crop to fish production. It would be useful to know more about the criteria used by farmers to make this decision and its implications for small and landless farmers, farm labourers and women as well as for water management. FGD, using appropriate checklists could be held at WMG with different cropping patterns and where land is, or is not, being switched from crops into fish ghers.

Recommendation: given the current poor returns to paddy, and problems that non-irrigated crops are having with variable weather conditions, it may be useful to provide more support to irrigated non-rice crops – such as melons and vegetables (and maybe fruit on higher ground), and place less emphasis on crops such as mungbean and sesame. Melons and vegetables can be more profitable than fish ghers, and a value chain approach could provide support from production to market. It seems much of the support that BG has so far provided has focused on homestead production to improve family nutrition rather than commercial production for the market.

Increase in cropping intensity

Overall cropping intensity has increased by 41 percentage points, from 187% to 228%, with a larger increase in Satkhira of 76 percentage points - largely due to expansion of fish ghers in polder 2. Increases in cropping intensity was reported for all polders apart from polder 28/2 (being absorbed into Khulna city) and for 80% of WMG. In Khulna polders that were covered in the 2018 survey are reporting further increases in c.i. this year, with little change for the Patuakhali polders. Compared with the 2018 WMG survey, a smaller proportion of WMGs report a fall in c.i. (8% compared with 14%).

On average WMGs with a greater improvement (reduction) in water management problem scores also have a larger increase in cropping intensity and a bigger increase in area under high yielding and high value crops. However, there is considerable variability about the trend line so the relationship is not strong.

Recommendation: using data from this survey WMGs with very poor (or negative) changes in cropping intensity and areas of high value crops should be identified and the reasons for this also need to be documented by BGP polder teams. If needed some discussions could take place with farmers and WMG. A similar exercise could take place with WMGs that have done very well. This will help to identify the exogenous factors that are needed to consider for future steps – for instance the fact that polder 28/2 is in an area that is becoming urbanised. The outcome of this investigation would be a brief lessons learned paper on what works and what does not work.

Farmers Field Schools

For crops, new varieties and improved cultivation techniques have mostly been fairly widely – including by farmers who are not members of FFS. However, a number of pest control methods and environmentally friendly technologies have low adoption rates, and farmers seem to think that they are either inconvenient or not cost-effective, and maybe not appropriate to their needs. Aquaculture technologies seem to have been more widely adopted for gher production, despite the fact that the technologies were meant for aquaculture in small ponds. FGD said that this training has directly contributed to expansion of mung bean cultivation in Patuakhali and to an increased area of fish gher in the other two zones.

Recommendation: technologies and improved techniques need to be screened to ensure that they meet the needs of farmers and will be profitable to adopt. There are examples in Bangladesh of vermicompost being highly successful, but usually it is not – suggesting that it will only catch on under a specific set of circumstances.

Recommendation: a number of successful technologies have been rapidly adopted by farmers who did not attend FFS. This suggests that either farmers already knew of the technology or got to hear of it from other sources; or (hopefully) FFS messages and knowledge rapidly disseminated to other farmers aided by field days

and other BGP activities aimed at disseminating knowledge to a wider audience. In either case it would be useful to reconsider the number of FFS that are needed to transfer an improved technology. Maybe a single FFS could include farmers from neighbouring WMGs, which would allow additional FFS to be established to cover a wider range of topics.

Farmers problems

Falling market prices for farm production were the problem most frequently identified in FGDs. Participants also spoke of the risings costs of inputs and labour, along with scarcity of seed and labour, and alteration of fertiliser and pesticides. The falling price of farm products and the increasing cost of labour and farm inputs – something that farmers have faced, and still face, the world over as farm production keeps ahead of population growth and new technologies drive down production costs. There is no evidence that farmers are being denied a fair share of the market price or that they are being exploited by traders and middlemen. A number of studies have investigated the markets for rice, vegetables and fish and have concluded that markets operate efficiently and that farmers get a fair price. The problem at the moment seems to be that the market is over-supplied and government intervention buying has not been able to stabilise prices.

Recommendation: A brief study be undertaken to document changes in the prices of key farm products over the last few years at farmgate and at local and wholesale markets, and to see if farmers are now no longer getting fair prices for their production. Value chain solutions may be appropriate to help farmers overcome market-related barriers, including switching to products with better market prospects.

Pests and diseases were the second most widely reported problem in FGDs. This is a particular issue given that there has not been much adoption of pest control technologies that were promoted by FFS. The same problem was identified as the principal (indeed virtually the only) problem faced by farmers in CDSP IV.

Recommendation: the major pest and disease problems should be identified, and their impact assessed. Practical solutions to these problems, that fit with farmers resources (especially labour) and that are proven to be effective should be disseminated via information, training and links to input suppliers. The contents of FFS should be planned around this, rather than around technologies that are seen as being environmentally friendly.

Environment and water management: drought was the third most widely reported problem. It is also apparent that unexpected rains in the winter damaged rabi crops. It is easy to say that such apparent changes in weather patterns are caused by climate change, but it is likely that such disruption to the monsoon and unexpected rainfall is due to atmospheric pollution rather than global warming[5]. That is not to say that this is not a serious problem requiring mitigation ad adaptation. It also appears that farmers are moving towards irrigated winter crops (boro paddy, water melon, vegetables) as well as aquaculture. This may be partly in response to unreliable rainfall, but they are also taking advantage of market opportunities and higher levels of profit for water melons, vegetables and fish/shrimp.

Changes in land tenure

This survey confirms the trend identified last year, with less land now being farmed by its owner, less being sharecropped, and significantly more via other lease arrangements (mainly annual cash rental). The decline in owner cultivation can be attributed to the increase in off-farm occupations, with some households leasing out their land to enable them to focus on non-farm work. The decline in sharecropping reflects its inefficiency in terms of providing incentives to tenants to maximise productivity – as the output resulting from additional labour (and usually inputs) provided by tenants has to be split with the landlord. While sharecropping has the advantage for tenants of needing less initial capital, with the landlord sharing the risk, the increasing value of

[5] Atmospheric Brown Clouds: Regional Assessment Report with Focus on Asia. United Nations Environment Programme 2008.

labour means it is often less attractive to tenants. Before BGP, a little more than half of all land was farmed by its owner, now it is less than half.

Farm labour and the role of women

With an increased area of crops, more labour is now being hired. Much male labour has been absorbed in the non-farm sector, so many more women now work as hired labour (estimated at 2.6 million person-days per year, a four-fold increase over the pre-project level). In Khulna and Satkhira women are now hired for almost all farm operations and have, to some extent, replaced male labour in crops such as paddy. In Patuakhali women are still primarily hired for work in mung beans and other non-rice crops (but they may provide all the hired labour for these crops). Here women provide little or none of the hired labour for paddy.

Women are almost always paid less than men, but in some locations the differential between male and female may have narrowed, at least in relative terms, with female wages increasing at a faster rate.

Increased participation in the workforce has increased the overall workload of women. But women think that, overall, they are now better off – with income in their hands leading to greater say in household decision-making.

Recommendation: expansion of agriculture and aquaculture supported by BGP will have increased employment for poor women to a much greater extent than the employment they have had from BGP funded LCS. Such LCS are also a relatively costly and inefficient method of undertaking works such as re-excavating khals. More sustainable employment would be created by using machines to excavate a greater length of khal and so creating more farm employment.

Increase in farm income

An increased area of crops, improved cropping patterns and increased yields have resulted in increased farm income. Based on model crop budgets for the main crops in each zone, net income for each crop has been calculated for the before project and current situations. Total net income has increased by 86%, with more coming from aquaculture than from crops. All polders except one, polder 28/2 in Khulna, are shown to have increased net income.

Apart from six polders with the lowest increases in farm income, there is no correlation between increase in net income and increased cropping intensity, the area of high yielding and high value crops, or the reduction in water management problem scores. Although farmers say that improved water management increases farm production and income, there may be too much variation within polders for this to show up when comparing the averages for different polders.

Recommendation: it would be useful to get some feedback from farmers to confirm the validity of crop budgets used in these calculations. In particular farmers could rank crops in terms of yield and net income (after allowing for the value of household labour).

Return to BGP investment

The annual increase in net farm income is sufficient to cover the total expenditure of BGP (including the TA team) within two years. Out of the 22 polders, 13 are able to cover total expenditure within three years – of the nine that do not, seven are in Patuakhali. So, although WMG in Patuakhali benefited from more extensive water infrastructure works, had less problems in terms of sluice operation, and generally reported greater improvements in water management, they had a marginally smaller increase in cropping intensity than Khulna, and generated significantly less net income from crops. Although the percentage increase in net income was higher in Patuakhali than elsewhere the fact that it started from a lower base (as there was no contribution from fish ghers) means the increase in income is less in absolute terms and so it takes longer to cover total BGP expenditure.

In 13 out of 22 polders it would take less than one year for the increase in net farm income to cover the direct cost of all water management infrastructure works. With such a fast return, is it not reasonable to expect the farmers to pay for the cost of these improvements in water management? Farmers are ready to invest in what they see as private assets such as irrigation pumps and tubewells, but not in collective assets such as khals and sluice gates. For such collective assets there are practical problems in cost recovery – not all farmers benefit equally from a water management investment and it is very difficult to align water charges with benefits – especially for drainage services. Tenant farmers may not want to participate, while landlords who have leased out their land may take the same view. It is very difficult for a WMG to get 100% participation in cost recovery efforts, and avoid free riding by some farmers / landowners.

In addition these assets are legally owned by the government, with public agencies (primarily BWDB) being the authorised institutions for construction and rehabilitation. Farmers accept this and see communal water management infrastructure is seen as a public responsibility – the government (and donors) have paid in the past, and BGP continues to do so. Efforts across South Asia for greater participation by farmers in water management (often termed privatisation) tend to be viewed by farmers as an attempt by governments to avoid public expenditure on public assets and on support for farmers.

Recommendation: efforts to get a significantly greater contribution from farmers towards the cost of these works is not likely to yield positive results – but farmer participation in sluice gate operation and in cleaning and minor repairs to khals is well worthwhile, and justifies the effort in establishing and supporting WMGs.

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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 designed to conduct a yearly survey in 2018, 2019 and 2020 with water management groups (WMGs) of BGP. Before going to a full phase survey in 2018, a pilot study was conducted in the polder 2 in Satkhira and polder 43/2B in Patuakhali from the polders of phasing out 1 and 2. Based on the findings of the pilot survey, WMG survey, 2018 was conducted rest of 12 polders of phasing out 1 and 2 polders with 269 WMGs. For detailed methodology of the pilot study and WMG survey 2018, please see Technical Report 25. Methodology for WMG survey 2019 is described below

Methodology for WMG survey 2019

During the WMG survey, 2018, It was decided that WMG survey, 2019 will be conducted in all 22 polders with all 509 registered WMGs. 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 with a revised questionnaire of WMG survey, 2018.

The name of the polders, location and number of WMGs in each polder are given in Table 1. In total information was collected from 501 WMGs against a plan for 510 (509 registered WMGs + One WMG applied for registration.) – data was not collected from a total of nine WMGs. Out of nine, three WMGs were not included as (one each in polder 34/2 part, 43/2A and 55/2A) that have ceased to function due to internal management issues. On the other hand, six WMGs of polder 43/2B experienced severe problems of crop production due to embankment erosion and failure of the sluice. So, we decided not to interview these six WMGs.

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

Polder	District	Upazila	Area (ha)	No. of HH	Total no of WMG	No of interviewed WMGs
Phase -1 (June 2018)						
22	Khulna	Paikgachha	1,630	2,133	12	12
26	Khulna	Dumuria	2,696	3,962	15	15
29	Khulna	Dumuria, Batiaghata	8,218	12,348	56	56
30	Khulna	Batiaghata	6,396	8,233	40	40
43/1A	Barguna	Amtali	2,675	5,129	14	14
43/2D	Patuakhali	Patuakhali Sadar	6,500	10,622	28	28
43/2E	Patuakhali	Patuakhali Sadar	1,650	2,317	12	12
43/2F	Barguna	Amtali	4,453	6,639	27	27
Sub total			**34,218**	**51,383**	**204**	**204**
Phase -2 (June 2019)						
31 Part	Khulna	Batiaghata	4,848	4,196	12	12
43/2A	Patuakhali	Patuakhali Sadar	5,182	8,434	21	20
43/2B	Barguna & Patuakhali	Galachipa, Patuakhali Sadar, Amtali	5,460	8,885	28	22
55/2A	Patuakhali	Patuakhali Sadar, Bauphal, Dashmina, Galachipa	7,166	13,966	14	13
55/2C	Patuakhali	Dashmina, Galachipa	6,275	10,173	16	16
2 & 2 ext*	Satkhira	Satkhira Sadar, Assasuni	11,230	25,077	64	64
	Satkhira	satkhira Sadar	1,370	3,052		
Sub total			**41,531**	**73,783**	**155**	**147**

Polder	District	Upazila	Area (ha)	No. of HH	Total no of WMG	No of interviewed WMGs
Phase -3 (June 2020)						
25	Khulna	Dumuria, Fultala	17,400	30,197	61	61
27/1	Khulna	Dumuria	3,765	4,071	15	15
27/2	Khulna	Dumuria	495	535	6	6
28/1	Khulna	Dumuria	5,600	5,012	12	12
28/2	Khulna	Dumuria	2,590	7,628	12	12
34/2 Part	Khulna	Batiaghata	4,900	11,227	19	18
47/3	Patuakhali	Kalapara	2,025	3,637	8	8
47/4	Patuakhali	Kalapara	6,600	11,853	18	18
Sub total			**43,375**	**74,160**	**151**	**150**
Grand Total			**119,124**	**1,999,326**	**510**	**501**

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 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 collect data, there was a day-long 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, a detail discussion on each question of the questionnaires and checklist, work plan and roles and responsibilities of the team members of the data collection.

The enumerators selected 6-8 participants for GD meeting with the 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.

During the pilot study in 2018, crop budget was collected for the main crops of polder 2 and 43/2B and based on that we calculated the profitability of land. In the WMG survey, 2018, crop budget was not collected. We had to make an estimate of the profitability of land of Khulna and Patuakhali. So, during the WMG survey 2019, it was decided that a zone-wise crop budget will be collected based on the findings (main crops) of WMG survey, 2018. Therefore, crop budget for the main crops of Khulna, Patuakhali and Satkhira zone was collected.

In addition to the 500 GDs, 25 FGDs (Ten FGDs in Khulna and Ten FGDs in Patuakhali and five FGDs in Sathkhira) were conducted 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. A checklist was prepared to guide the FGDs. In each FGD, there were 8 to 10 participants, of whom 2 to 3 were women.

With 500 WMGs to see the overall outcomes of BGP, 26 community-led water management (CAWM) WMGs also interviewed through a different questionnaire that focuses on the outputs and outcomes of the CAWM interventions. All the CAWM WMGs were not included here as we wanted to see the outcomes of CAWM. So, the 26 WMGs that got the CAWM interventions by mid of 2018 have been selected for this survey to see how

they are doing after a year without CAWM interventions. These 26 WMGs also were interviewed with the WMG survey 2019.

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.

Month	April		May				June				July				August				September				October				November
Phase 1. Designing Phase	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1
Revised questionnaire																											
Revised checklist																											
Revised crop budget																											
Recruitment of the field staff																											
Training the enumerators																											
Phase 2. Data Collection Phase																											
Data collection							vac.																				
Revised crop budget																											
Phase 3. Submission of Data																											
Data entry format design in Excel																											
Data entry																vac.											
Data Cleaning																											
Submission of data on electronic format																											
Phase 3: Data Analysis and Reporting																											
Data analysis																											
Report writing																											

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

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.

Appendix 2: Data from the WMG survey

Table 1: Principal water management problems

		Main problem before				Main problem now			
		Waterlogging	Flooding	Water scarcity	Salinity	Waterlogging	Flooding	Water scarcity	Salinity
Polder	22	25%	0%	50%	14%	25%	3%	50%	11%
	25	63%	0%	25%	4%	56%	0%	22%	4%
	26	31%	4%	47%	2%	22%	4%	47%	0%
	29	18%	1%	43%	8%	26%	2%	38%	6%
	30	25%	2%	39%	18%	20%	0%	43%	20%
	31P	25%	3%	17%	47%	17%	0%	25%	31%
	27/1	31%	2%	62%	0%	29%	0%	67%	0%
	27/2	33%	0%	56%	0%	17%	0%	61%	0%
	28/1	44%	0%	47%	0%	33%	0%	53%	0%
	28/2	42%	0%	53%	0%	36%	0%	50%	3%
	34/2	49%	0%	46%	5%	42%	0%	46%	5%
	2	59%	1%	25%	6%	54%	1%	26%	0%
	43/1A	38%	0%	50%	0%	19%	0%	43%	0%
	43/2A	44%	6%	48%	2%	25%	2%	51%	0%
	43/2B	45%	3%	44%	3%	23%	0%	42%	0%
	43/2D	37%	1%	56%	0%	26%	0%	38%	0%
	43/2E	36%	11%	31%	8%	31%	0%	44%	0%
	43/2F	42%	1%	51%	4%	30%	0%	43%	0%
	47/3	33%	0%	5%	62%	33%	0%	14%	52%
	47/4	33%	0%	26%	39%	30%	0%	33%	31%
	55/2A	51%	0%	44%	0%	38%	0%	33%	0%
	55/2C	42%	0%	52%	0%	40%	0%	44%	0%
	total	41%	1%	39%	8%	34%	1%	38%	6%
season	Rabi	13%	1%	69%	12%	12%	1%	58%	9%
	Kharif 2	78%	3%	6%	3%	71%	1%	5%	1%
	Kharif 1	32%	1%	44%	9%	20%	0%	52%	7%
	Total	41%	1%	39%	8%	34%	1%	38%	6%
Zone	Khulna	37%	1%	40%	9%	33%	1%	39%	8%
	Satkhira	59%	1%	25%	6%	54%	1%	26%	0%
	Patuakhali	41%	2%	44%	8%	29%	0%	40%	5%
	total	41%	1%	39%	8%	34%	1%	38%	6%

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

Table 2: Other water management problems

	Polder	Other problem before				Other problem now				
		Waterlogging	Flooding	Water scarcity	Salinity	Waterlogging	Flooding	Water scarcity	Salinity	Other
Polder	22	3%	0%	14%	31%	0%	0%	11%	33%	0%
	25	4%	0%	13%	5%	4%	0%	14%	4%	0%
	26	0%	4%	2%	18%	0%	0%	4%	7%	0%
	29	1%	1%	6%	16%	1%	0%	2%	7%	1%
	30	3%	0%	15%	23%	0%	0%	21%	28%	0%
	31P	3%	0%	25%	19%	6%	0%	17%	11%	3%
	27/1	9%	9%	7%	4%	7%	7%	9%	0%	0%
	27/2	0%	6%	0%	0%	0%	6%	0%	0%	0%
	28/1	8%	6%	6%	6%	8%	6%	6%	6%	0%
	28/2	14%	0%	8%	19%	6%	0%	17%	17%	0%
	34/2	5%	0%	11%	21%	5%	0%	11%	21%	0%
	2	0%	1%	0%	2%	0%	0%	0%	0%	0%
	43/1A	10%	2%	0%	2%	0%	0%	0%	0%	10%
	43/2A	3%	13%	0%	2%	2%	3%	0%	0%	19%
	43/2B	5%	14%	9%	5%	0%	0%	0%	0%	15%
	43/2D	11%	2%	5%	0%	2%	1%	8%	0%	15%
	43/2E	14%	8%	0%	3%	8%	0%	0%	0%	8%
	43/2F	14%	11%	7%	2%	2%	0%	2%	0%	14%
	47/3	0%	0%	57%	5%	0%	0%	48%	10%	5%
	47/4	2%	6%	31%	22%	2%	0%	7%	22%	15%
	55/2A	8%	10%	0%	3%	0%	0%	5%	0%	21%
	55/2C	6%	0%	0%	2%	4%	0%	2%	0%	17%
	total	5%	3%	8%	9%	2%	1%	7%	7%	5%
Season	1	2%	1%	13%	18%	1%	0%	11%	12%	16%
	2	5%	8%	4%	2%	2%	2%	2%	1%	0%
	3	7%	1%	8%	8%	3%	0%	9%	8%	0%
	total	5%	3%	8%	9%	2%	1%	7%	7%	5%
zone	1	4%	1%	10%	14%	3%	1%	11%	12%	0%
	2	0%	1%	0%	2%	0%	0%	0%	0%	0%
	3	8%	7%	8%	4%	2%	1%	5%	3%	15%
	total	5%	3%	8%	9%	2%	1%	7%	7%	5%

Percentage of WMG reporting. 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%.

Table 3: Severity of water management problems

	Polder	Pre-project situation						Current situation					
		1	2	3	4	5	Severity score	1	2	3	4	5	Severity score
Polder	22	0%	11%	22%	47%	19%	3.8	6%	42%	33%	14%	6%	2.7
	25	6%	10%	24%	46%	14%	3.5	8%	31%	28%	22%	10%	2.9
	26	0%	9%	24%	51%	16%	3.7	0%	58%	42%	0%	0%	2.4
	29	1%	17%	36%	36%	11%	3.4	6%	67%	26%	1%	0%	2.2
	30	2%	18%	24%	33%	23%	3.6	5%	45%	32%	14%	3%	2.6
	31P	0%	14%	39%	22%	25%	3.6	19%	42%	36%	0%	3%	2.3
	27/1	0%	4%	20%	69%	7%	3.8	0%	20%	38%	40%	2%	3.2
	27/2	0%	0%	50%	39%	11%	3.6	11%	44%	17%	22%	6%	2.7
	28/1	3%	25%	19%	44%	8%	3.3	3%	36%	36%	22%	3%	2.9
	28/2	6%	6%	19%	50%	19%	3.7	6%	25%	28%	31%	11%	3.2
	34/2	0%	11%	33%	51%	5%	3.5	4%	16%	42%	32%	7%	3.2
	2	9%	22%	19%	30%	21%	3.3	16%	51%	21%	9%	2%	2.3
	43/1A	0%	0%	31%	57%	12%	3.8	14%	64%	19%	2%	0%	2.1
	43/2A	0%	2%	29%	54%	16%	3.8	6%	67%	25%	2%	0%	2.2
	43/2B	0%	2%	30%	53%	12%	3.7	9%	48%	30%	6%	3%	2.4
	43/2D	0%	1%	27%	55%	12%	3.6	12%	54%	24%	6%	0%	2.1
	43/2E	0%	3%	33%	39%	19%	3.6	14%	42%	22%	14%	3%	2.3
	43/2F	0%	0%	40%	52%	9%	3.7	6%	77%	17%	0%	0%	2.1
	47/3	0%	5%	24%	33%	38%	4.0	5%	33%	29%	33%	0%	2.9
	47/4	0%	2%	44%	46%	6%	3.5	2%	39%	48%	9%	0%	2.6
	55/2A	0%	0%	33%	36%	21%	3.5	8%	38%	44%	0%	0%	2.2
	55/2C	0%	4%	29%	58%	6%	3.6	6%	58%	31%	2%	0%	2.3
	total	2%	10%	28%	44%	15%	3.6	8%	48%	29%	11%	3%	2.5
season	1	2%	9%	24%	50%	15%	3.7	8%	51%	31%	9%	1%	2.5
	2	1%	13%	37%	37%	12%	3.5	10%	62%	16%	10%	3%	2.3
	3	4%	7%	24%	45%	17%	3.5	7%	30%	41%	15%	4%	2.7
	total	2%	10%	28%	44%	15%	3.6	8%	48%	29%	11%	3%	2.5
zone	1	2%	13%	28%	43%	14%	3.5	6%	42%	31%	16%	5%	2.7
	2	9%	22%	19%	30%	21%	3.3	16%	51%	21%	9%	2%	2.3
	3	0%	1%	33%	50%	13%	3.7	8%	55%	28%	5%	1%	2.3
	total	2%	10%	28%	44%	15%	3.6	8%	48%	29%	11%	3%	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 seasons.

Percentage of WMG reporting

Table 4: Change in severity water management problems

		Change in water management score								% of WMGs improving	Average net change
		-3	-2	-1	0	1	2	3	4		
season	1	0%	1%	1%	24%	33%	32%	8%	1%	74%	1.22
	2	0%	0%	3%	25%	36%	28%	7%	1%	71%	1.11
	3	0%	1%	4%	36%	32%	22%	4%	1%	59%	0.84
	total	0%	1%	3%	29%	33%	27%	6%	1%	68%	1.06
Polder	22	0%	0%	3%	31%	33%	28%	6%	0%	67%	1.03
	25	2%	0%	4%	52%	22%	16%	3%	1%	42%	0.56
	26	0%	0%	0%	18%	40%	36%	7%	0%	82%	1.31
	29	0%	0%	2%	25%	35%	28%	10%	0%	73%	1.17
	30	0%	1%	3%	29%	39%	25%	2%	1%	67%	0.93
	31P	0%	0%	3%	25%	33%	17%	19%	3%	72%	1.33
	27/1	0%	4%	4%	44%	27%	20%	0%	0%	47%	0.53
	27/2	0%	0%	11%	22%	39%	17%	11%	0%	67%	0.94
	28/1	0%	0%	0%	69%	19%	8%	3%	0%	31%	0.44
	28/2	0%	0%	6%	53%	22%	19%	0%	0%	42%	0.56
	34/2	0%	5%	9%	51%	26%	5%	4%	0%	35%	0.28
	2	0%	2%	2%	31%	32%	27%	4%	2%	66%	1.02
	43/1A	0%	0%	0%	10%	24%	52%	14%	0%	90%	1.71
	43/2A	0%	0%	0%	6%	40%	40%	14%	0%	94%	1.62
	43/2B	0%	0%	2%	17%	38%	38%	6%	0%	82%	1.30
	43/2D	0%	0%	1%	18%	26%	42%	12%	1%	81%	1.49
	43/2E	0%	0%	8%	17%	33%	28%	11%	3%	75%	1.25
	43/2F	0%	0%	0%	6%	41%	43%	9%	1%	94%	1.58
	47/3	0%	0%	0%	14%	62%	19%	5%	0%	86%	1.14
	47/4	0%	0%	0%	24%	63%	13%	0%	0%	76%	0.89
	55/2A	0%	0%	0%	23%	33%	33%	10%	0%	77%	1.31
	55/2C	0%	0%	4%	13%	33%	44%	6%	0%	83%	1.35
	total	0%	1%	3%	29%	33%	27%	6%	1%	68%	1.06
zone	1	0%	1%	4%	38%	31%	21%	5%	0%	57%	0.83
	2	0%	2%	2%	31%	32%	27%	4%	2%	66%	1.02
	3	0%	0%	1%	14%	38%	37%	9%	1%	84%	1.40
	total	0%	1%	3%	29%	33%	27%	6%	1%	68%	1.06

Percentage of WMG reporting

Table 5: Average WMG water management score

zone	Polder	Before	Now	Change
Khulna	22	3.75	2.72	1.03
Khulna	25	3.51	2.95	0.56
Khulna	26	3.73	2.42	1.31
Khulna	29	3.40	2.23	1.17
Khulna	30	3.59	2.66	0.93
Khulna	31P	3.58	2.25	1.33
Khulna	27/1	3.78	3.24	0.53
Khulna	27/2	3.61	2.67	0.94
Khulna	28/1	3.31	2.86	0.44
Khulna	28/2	3.72	3.17	0.56
Khulna	34/2	3.51	3.23	0.28
Satkhira	2	3.31	2.29	1.02
Patuakhali	43/1A	3.81	2.10	1.71
Patuakhali	43/2A	3.84	2.22	1.62
Patuakhali	43/2B	3.78	2.44	1.30
Patuakhali	43/2D	3.81	2.25	1.49
Patuakhali	43/2E	3.79	2.47	1.25
Patuakhali	43/2F	3.69	2.11	1.58
Patuakhali	47/3	4.05	2.90	1.14
Patuakhali	47/4	3.57	2.66	0.89
Patuakhali	55/2A	3.86	2.40	1.31
Patuakhali	55/2C	3.68	2.30	1.35
season	Rabi	3.67	2.45	1.22
	Kharif-2	3.45	2.34	1.11
	Kharif-1	3.65	2.79	0.84
Khulna	Rabi	3.72	2.70	1.03
	Kharif-2	3.23	2.50	0.73
	Kharif-1	3.67	2.94	0.73
Satkhira	Rabi	2.86	1.95	0.90
	Kharif-2	3.92	2.83	1.10
	Kharif-1	3.16	2.10	1.06
Patuakhali	Rabi	3.88	2.28	1.61
	Kharif-2	3.61	1.94	1.66
	Kharif-1	3.82	2.82	0.92
Zone	Khulna	3.54	2.71	0.83
	Satkhira	3.31	2.29	1.02
	Patuakhali	3.77	2.33	1.40
Total	All WMG	3.59	2.53	1.06

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

Table 6: Sluice control

Zone	polder	WMG	Other WMG	Other persons	Non-functional
Khulna	22	25%	0%	75%	0%
	25	0%	10%	61%	30%
	26	27%	27%	20%	27%
	29	11%	34%	55%	0%
	30	13%	0%	80%	8%
	31P	50%	0%	25%	25%
	27/1	20%	80%	0%	0%
	27/2	33%	67%	0%	0%
	28/1	8%	0%	42%	50%
	28/2	0%	8%	67%	25%
	34/2	5%	21%	53%	21%
Satkhira	2	17%	22%	33%	27%
Patuakhali	43/1A	14%	50%	36%	0%
	43/2A	38%	33%	29%	0%
	43/2B	9%	55%	36%	0%
	43/2D	54%	36%	11%	0%
	43/2E	58%	42%	0%	0%
	43/2F	67%	33%	0%	0%
	47/3	86%	0%	14%	0%
	47/4	33%	6%	61%	0%
	55/2A	85%	8%	8%	0%
	55/2C	44%	44%	13%	0%
Total		25%	25%	39%	12%

Percentage of WMGs in each polder

Table 7: Rabi season land use

Zone	polder	Before in boro/rabi season				Now in boro / rabi season			
		paddy	other crops	fish	total	paddy	other crops	fish	total
Khulna	22	0.4	13.2	4.6	18.2	3.2	63.2	7.7	74.0
	25	57.6	8.7	14.7	80.9	63.2	11.0	17.0	91.2
	26	28.5	7.3	9.7	45.5	68.9	8.4	13.9	91.2
	29	12.2	34.0	12.2	58.4	46.6	19.9	23.9	90.4
	30	2.5	57.7	3.4	63.5	18.2	43.0	10.2	71.4
	31P	10.0	17.8	21.5	49.3	30.2	26.2	21.6	77.9
	27/1	52.7	12.7	15.7	81.0	65.3	14.0	13.0	92.3
	27/2	37.5	7.0	23.8	68.3	55.8	8.7	31.3	95.8
	28/1	47.1	27.9	13.3	88.3	69.4	13.8	14.8	97.9
	28/2	6.6	62.3	0.3	69.2	19.1	21.5	3.6	44.2
	34/2	36.7	15.0	10.4	62.1	58.8	7.2	11.1	77.1
Satkhira	2	74.7	1.8	8.7	85.2	84.8	1.7	12.2	98.7
Patuakhali	43/1A	0.0	65.7	0.0	65.7	2.5	92.1	0.0	94.6
	43/2A	0.0	52.6	0.0	52.6	0.0	95.7	0.0	95.7
	43/2B	0.0	51.1	0.0	51.1	0.2	95.6	0.1	95.9
	43/2D	0.2	52.0	0.0	52.1	6.2	88.4	0.0	94.6
	43/2E	0.2	65.3	0.0	65.4	2.1	95.4	0.0	97.5
	43/2F	0.0	54.6	0.0	54.6	0.1	94.2	0.0	94.3
	47/3	0.0	14.3	0.0	14.3	2.9	24.7	0.0	27.6
	47/4	0.6	24.4	0.0	25.0	1.9	36.4	0.0	38.3
	55/2A	0.4	73.5	0.0	73.8	1.6	96.1	0.0	97.7
	55/2C	0.0	70.9	0.0	70.9	5.8	92.3	0.0	98.1
Total		23.8	32.8	6.9	63.5	35.7	41.4	9.8	86.9

Percentage of cultivable land for WMG in each polder

Table 8: Kharif-1 season land use

Zone	polder	Before in kharif 1 season				Now in kharif 1 season			
		paddy	other crops	fish	total	paddy	other crops	fish	total
Khulna	22	0.0	1.7	9.0	10.7	0.4	4.4	13.8	18.6
	25	2.9	14.2	54.3	71.3	1.6	15.9	64.8	82.3
	26	0.7	9.0	28.1	37.8	0.3	15.3	48.2	63.9
	29	2.3	8.4	30.2	40.9	0.0	18.2	52.6	70.8
	30	0.0	5.4	6.3	11.7	0.0	6.9	12.3	19.2
	31P	0.0	0.6	23.2	23.8	0.4	7.5	43.3	51.3
	27/1	1.3	14.7	48.3	64.3	0.0	18.5	68.1	86.5
	27/2	0.0	8.8	35.3	44.2	0.0	12.2	58.3	70.5
	28/1	0.0	10.8	52.1	62.9	0.0	16.3	61.3	77.5
	28/2	5.0	17.9	3.6	26.5	0.0	11.0	6.7	17.7
	34/2	0.0	3.8	14.3	18.1	0.0	3.3	12.9	16.2
Satkhira	2	2.0	5.6	23.8	31.4	4.2	6.9	54.8	65.8
Patuakhali	43/1A	33.2	0.0	0.0	33.2	50.0	0.0	0.0	50.0
	43/2A	39.5	0.0	0.0	39.5	21.5	0.0	0.0	21.5
	43/2B	28.0	0.7	0.0	28.6	9.3	0.0	0.0	9.3
	43/2D	16.4	0.0	0.0	16.4	13.4	0.0	0.0	13.4
	43/2E	12.9	3.3	0.0	16.3	10.2	0.3	0.0	10.4
	43/2F	41.1	0.0	0.0	41.1	41.5	0.0	0.0	41.5
	47/3	11.1	0.0	0.0	11.1	4.4	0.0	0.0	4.4
	47/4	10.0	0.0	0.0	10.0	4.0	0.0	0.0	4.0
	55/2A	14.6	0.0	0.0	14.6	10.4	0.0	0.0	10.4
	55/2C	17.5	0.0	0.0	17.5	8.9	0.0	0.0	8.9
Total		9.7	5.6	18.8	34.2	7.4	7.6	29.3	44.4

Percentage of cultivable land for WMG in each polder

Table 9: Kharif-2 season land use

Zone	polder	Before in kharif 2 season				Now in kharif 2 season			
		paddy	other crops	fish	total	paddy	other crops	fish	total
Khulna	22	89.9	2.0	8.1	100.0	84.8	1.9	13.3	100.0
	25	15.8	11.9	54.2	81.9	11.2	13.9	62.8	87.9
	26	59.3	7.0	24.3	90.7	48.7	9.0	42.0	99.7
	29	69.8	6.4	22.2	98.4	48.0	9.9	42.0	100.0
	30	89.2	0.9	5.1	95.3	87.0	2.3	10.7	100.0
	31P	75.4	0.2	23.2	98.8	69.2	1.3	29.6	100.0
	27/1	17.7	11.5	64.0	93.2	11.3	15.2	68.9	95.4
	27/2	48.3	4.2	38.3	90.8	29.7	5.8	62.5	98.0
	28/1	30.8	10.4	54.6	95.8	23.1	14.6	69.6	107.3
	28/2	93.8	2.5	3.8	100.0	90.0	3.8	6.3	100.0
	34/2	74.6	2.4	19.1	96.1	79.4	1.9	17.1	98.4
Satkhira	2	33.0	0.0	26.0	59.0	28.4	0.6	53.5	82.4
Patuakhali	43/1A	98.6	0.0	0.0	98.6	96.1	0.0	0.0	96.1
	43/2A	90.5	0.5	0.0	91.0	100.0	0.0	0.0	100.0
	43/2B	88.9	0.0	0.0	88.9	69.3	0.0	0.0	69.3
	43/2D	99.3	0.0	0.0	99.3	100.0	0.0	0.0	100.0
	43/2E	85.4	0.0	0.0	85.4	100.0	0.0	0.0	100.0
	43/2F	98.5	0.0	0.0	98.5	99.6	0.0	0.0	99.6
	47/3	92.9	0.0	0.0	92.9	95.7	0.0	0.0	95.7
	47/4	94.2	0.0	0.0	94.2	99.2	0.0	0.0	99.2
	55/2A	95.4	0.0	0.0	95.4	100.0	0.0	0.0	100.0
	55/2C	95.6	0.0	0.0	95.6	100.0	0.0	0.0	100.0
Total		67.2	3.3	18.7	89.3	64.5	4.4	27.5	96.5

Percentage of cultivable land for WMG in each polder

Table 10: Land under different types of paddy

polder	Boro HYV		Boro hybrid		Aus local		Aus HYV		Aman local		Aman HYV	
	before	now	before	now	before	now	before	now	before	now	before	now
22	0.3	1.3	0.1	1.8	0.0	0.4	0.0	0.0	54.6	10.0	35.3	74.8
25	45.4	15.1	12.2	48.1	0.8	0.1	2.0	1.6	9.7	1.3	6.1	9.9
26	21.0	17.6	7.5	51.3	0.7	0.3	0.0	0.0	29.7	4.9	29.7	43.7
29	11.0	14.3	1.2	32.4	2.1	0.0	0.2	0.0	41.0	7.3	28.8	40.7
30	1.3	6.6	1.2	11.7	0.0	0.0	0.0	0.0	82.5	68.5	6.7	18.5
31P	9.1	10.4	0.9	19.8	0.0	0.0	0.0	0.4	58.8	26.3	16.6	42.9
27/1	38.3	15.0	14.3	50.3	1.3	0.0	0.0	0.0	14.7	6.3	3.0	5.0
27/2	27.5	28.3	10.0	27.5	0.0	0.0	0.0	0.0	38.3	16.3	10.0	13.3
28/1	44.4	11.6	2.7	57.8	0.0	0.0	0.0	0.0	15.8	7.3	15.0	8.5
28/2	6.3	7.2	0.3	11.9	5.0	0.0	0.0	0.0	68.3	57.5	25.4	32.5
34/2	35.2	29.6	1.6	29.2	0.0	0.0	0.0	0.0	64.4	62.8	10.3	16.6
2	64.1	57.2	10.6	27.5	0.7	0.6	1.3	3.6	10.1	5.4	22.9	27.8
43/1A	0.0	2.5	0.0	0.0	30.4	8.6	2.9	41.4	82.5	30.7	16.1	65.4
43/2A	0.0	0.0	0.0	0.0	27.6	3.6	11.9	18.0	82.9	61.2	7.6	38.8
43/2B	0.0	0.2	0.0	0.0	27.3	0.0	0.7	9.3	76.1	30.6	12.7	69.3
43/2D	0.2	5.0	0.0	1.3	16.3	1.3	0.2	12.1	93.7	56.1	5.6	43.9
43/2E	0.2	2.1	0.0	0.0	10.4	0.8	2.5	9.3	72.9	54.6	12.5	45.4
43/2F	0.0	0.1	0.0	0.0	24.9	0.9	16.2	40.6	87.4	40.2	11.1	59.4
47/3	0.0	2.9	0.0	0.0	10.4	0.4	0.7	4.0	60.0	31.4	32.9	64.3
47/4	0.6	1.9	0.0	0.0	6.7	1.5	3.3	2.5	49.2	21.7	45.0	77.5
55/2A	0.4	1.6	0.0	0.0	10.0	0.0	4.6	10.4	88.1	44.2	7.3	55.8
55/2C	0.0	5.8	0.0	0.0	15.0	0.0	2.5	8.9	78.8	30.0	16.9	70.0
total	19.8	15.1	4.0	20.6	7.4	0.7	2.3	6.8	50.8	27.2	16.4	37.4

Percentage of cultivable land for WMG in each polder

Table 11: Land under non-rice crops

	maize		mungbean		keshari		felon		sesame		groundnut		sunflower	
polder	before	now	before	now	before	now	before	now	before	now	before	now	before	now
22	0.0	0.0	6.2	0.7	0.0	0.0	0.0	0.0	8.3	7.3	0.0	0.0	0.0	0.0
25	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.3	0.0	0.0	0.7	0.0
29	0.2	0.0	3.8	0.8	0.0	0.0	0.0	0.0	20.3	4.7	0.0	0.0	0.5	0.0
30	0.0	0.0	10.6	6.2	0.0	0.0	0.0	0.0	44.3	18.3	0.0	0.0	0.0	0.0
31P	0.0	0.0	1.2	0.3	0.0	0.0	0.0	0.0	14.8	4.4	0.0	0.0	0.0	0.0
27/1	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
27/2	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
28/1	0.0	0.0	6.3	0.0	0.0	0.0	0.0	0.0	10.4	0.0	0.0	0.0	0.0	0.0
28/2	0.0	0.0	10.0	2.1	0.0	0.0	0.0	0.0	35.7	6.3	0.0	0.0	0.0	0.0
34/2	0.0	0.0	2.4	0.0	0.0	0.0	0.0	0.0	8.4	2.1	0.0	0.0	0.0	0.0
2	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
43/1A	0.0	0.0	15.7	44.6	20.0	4.3	0.1	0.0	0.1	0.1	8.0	10.7	0.0	0.0
43/2A	0.0	0.0	8.3	70.0	22.9	1.8	0.0	0.1	2.7	0.4	8.0	13.3	0.0	0.0
43/2B	0.0	0.0	12.1	51.1	20.4	0.4	0.3	0.2	3.5	0.0	3.2	10.6	0.1	0.0
43/2D	0.0	0.0	14.7	71.4	21.3	1.0	0.4	0.2	0.6	0.3	5.0	7.6	0.4	0.7
43/2E	0.0	0.0	8.3	76.7	40.7	1.1	0.0	0.1	0.8	0.0	3.9	6.5	0.0	0.0
43/2F	0.0	0.0	2.6	69.8	37.2	0.8	0.0	0.4	0.2	0.1	4.1	7.7	0.0	3.4
47/3	0.9	1.9	4.4	8.1	2.4	1.9	1.4	0.3	0.0	0.0	1.0	2.1	1.7	1.3
47/4	0.3	0.6	5.1	18.4	6.2	1.3	4.6	0.9	0.0	0.0	2.7	4.7	0.4	0.5
55/2A	0.0	0.0	32.8	75.4	23.4	0.2	0.1	1.5	3.3	0.2	2.5	6.0	0.0	0.5
55/2C	0.0	0.0	23.8	70.3	17.8	0.0	1.8	1.3	11.9	0.3	3.8	7.7	0.0	0.0
total	0.0	0.0	6.1	21.7	8.0	0.4	0.3	0.2	8.7	2.6	1.6	2.9	0.1	0.3

Percentage of cultivable land for WMG in each polder

	sweet potato		jute		chili		watermelon		vegetable		other		total	
polder	before	now	before	now	before	now	before	now	before	now	before	now	before	now
22	0.0	0.0	0.0	0.0	0.0	0.0	0.2	50.6	3.2	8.2	3.1	0.8	20.8	67.6
25	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	21.7	26.6	12.2	0.2	34.7	26.9
26	0.0	0.0	0.8	0.3	0.2	1.0	0.0	1.0	13.1	21.0	7.0	0.1	23.3	23.7
29	0.0	0.0	1.3	0.3	0.0	0.0	0.2	0.5	15.5	30.5	6.9	1.3	48.8	38.1
30	0.0	0.0	1.0	0.0	0.1	0.0	0.6	9.3	5.9	15.0	1.5	1.0	64.0	49.9
31P	0.0	0.0	0.0	0.4	0.0	0.0	0.0	15.6	2.3	10.9	0.3	2.1	18.6	33.7
27/1	0.0	0.0	0.0	0.0	1.3	1.3	0.0	0.0	23.0	28.8	14.5	2.3	38.9	32.5
27/2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.8	18.8	6.2	2.0	20.0	20.8
28/1	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	21.3	27.9	10.4	2.1	49.2	30.0
28/2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	34.4	24.2	2.5	0.0	82.8	32.5
34/2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.8	2.9	0.5	21.2	10.5
2	0.0	0.0	3.0	2.7	0.2	0.0	0.0	0.0	3.5	5.5	0.7	0.4	7.5	8.6
43/1A	1.4	0.4	0.0	0.0	4.2	4.1	10.9	20.9	1.1	0.9	4.2	6.1	65.7	92.1
43/2A	4.0	2.0	0.0	0.0	4.3	5.0	0.0	0.0	0.2	0.5	2.8	2.5	53.1	95.7
43/2B	2.5	0.7	0.0	0.0	3.0	3.6	4.0	26.0	0.4	0.4	2.3	2.6	51.8	95.6
43/2D	2.6	1.3	0.0	0.0	3.7	4.1	0.0	0.0	0.4	0.4	3.0	1.4	52.0	88.4
43/2E	4.1	1.6	0.0	0.0	5.3	5.5	0.0	0.0	1.6	1.7	1.5	2.6	66.1	95.7
43/2F	5.0	1.4	0.0	0.0	3.7	7.0	0.0	0.0	0.6	0.9	1.1	2.7	54.6	94.2
47/3	1.1	1.9	0.0	0.0	1.0	1.3	0.0	0.0	1.4	3.0	1.4	3.0	16.8	24.7
47/4	0.9	0.8	0.0	0.0	2.2	3.5	0.4	2.2	0.1	0.3	1.7	3.1	24.4	36.4
55/2A	1.8	1.6	0.0	0.0	3.9	5.5	0.0	1.2	0.8	0.8	4.8	3.5	73.5	96.1
55/2C	3.4	1.1	0.0	0.0	4.9	4.4	0.0	3.2	0.1	0.9	3.6	3.1	70.9	92.3
total	1.0	0.4	0.7	0.4	1.4	1.7	0.6	4.3	8.5	12.5	4.6	1.6	41.7	49.0

Percentage of cultivable land for WMG in each polder

Table 12: Total of crop areas in all seasons

		Paddy		Other crop		Fish		change		
		before	now	before	now	before	now	paddy	other	fish
Khulna	22	90	88	17	70	22	35	-2%	313%	60%
	25	76	76	35	41	123	145	0%	17%	17%
	26	88	118	23	33	62	104	33%	41%	67%
	29	84	95	49	48	65	119	12%	-2%	84%
	30	92	105	64	52	15	33	15%	-19%	126%
	31P	85	100	19	35	68	95	17%	88%	39%
	27/1	72	77	39	48	128	150	7%	23%	17%
	27/2	86	86	20	27	98	152	0%	33%	56%
	28/1	78	93	49	45	120	146	19%	-9%	21%
	28/2	105	109	83	36	8	17	4%	-56%	118%
	34/2	111	138	21	12	44	41	24%	-41%	-6%
Satkhira	2	110	122	7	9	58	120	11%	22%	106%
Patuakhali	43/1A	132	149	66	92	0	0	13%	40%	0%
	43/2A	130	122	53	96	0	0	-7%	80%	0%
	43/2B	117	109	52	96	0	0	-6%	84%	0%
	43/2D	116	120	52	88	0	0	3%	70%	0%
	43/2E	99	112	69	96	0	0	14%	39%	0%
	43/2F	140	141	55	94	0	0	1%	72%	0%
	47/3	104	103	14	25	0	0	-1%	73%	0%
	47/4	105	105	24	36	0	0	0%	49%	0%
	55/2A	110	112	73	96	0	0	1%	31%	0%
	55/2C	113	115	71	92	0	0	1%	30%	0%
total		101	108	42	53	44	67	7%	28%	50%

Sum of percentage of cultivable land covered by each crop type in each of three seasons

Table 13: Percentage of WMGs switching land into aquaculture

		Percentage of WMGs switching	
		From crops to fish	From fish to crops
Khulna	22	0%	8%
	25	18%	7%
	26	7%	13%
	29	34%	4%
	30	38%	3%
	31P	25%	8%
	27/1	7%	7%
	27/2	33%	17%
	28/1	17%	0%
	28/2	42%	0%
	34/2	5%	11%
	Zone total	23%	6%
Satkhira	2	22%	3%
total		15%	3%

Table 14: Cropping intensity

	polder	Rabi /boro season		Kharif 1 season		Kharif 2 season		Cropping intensity		
		before	now	before	now	before	now	before	now	change
Khulna	22	18	74	11	19	100	100	129	193	64
	25	81	91	71	82	82	88	234	261	27
	26	45	91	38	64	91	100	174	255	81
	29	58	90	41	71	98	100	198	261	63
	30	64	71	12	19	95	100	170	191	20
	31P	49	78	24	51	99	100	172	229	57
	27/1	81	92	64	87	93	95	239	274	36
	27/2	68	96	44	71	91	98	203	264	61
	28/1	88	98	63	78	96	107	247	283	36
	28/2	69	44	27	18	100	100	196	162	-34
	34/2	62	77	18	16	96	98	176	192	15
Satkhira	2	85	99	31	66	59	87	176	252	76
Patuakhali	43/1A	66	95	33	50	99	96	198	241	43
	43/2A	53	96	40	22	91	100	183	217	34
	43/2B	51	96	29	9	89	100	169	205	37
	43/2D	52	95	16	13	99	100	168	208	40
	43/2E	65	98	16	10	85	100	167	208	41
	43/2F	55	94	41	41	99	100	194	235	41
	47/3	14	28	11	4	93	96	118	128	9
	47/4	25	38	10	4	94	99	129	142	12
	55/2A	74	98	15	10	95	100	184	208	24
	55/2C	71	98	18	9	96	100	184	207	23
Total		64	87	34	44	89	96	187	228	41

Percentage of cultivable area used in each season

Table 15: Changes in cropping intensity

		Percentage of WMGs report change in cropping intensity			
	polder	increase	No change	decrease	total
Khulna	22	100%	0%	0%	100%
	25	66%	30%	5%	100%
	26	100%	0%	0%	100%
	29	91%	7%	2%	100%
	30	73%	3%	25%	100%
	31P	83%	17%	0%	100%
	27/1	80%	20%	0%	100%
	27/2	100%	0%	0%	100%
	28/1	50%	50%	0%	100%
	28/2	33%	17%	50%	100%
	34/2	58%	21%	21%	100%
Satkhira	2	92%	6%	2%	100%
Patuakhali	43/1A	93%	0%	7%	100%
	43/2A	76%	5%	19%	100%
	43/2B	91%	5%	5%	100%
	43/2D	96%	4%	0%	100%
	43/2E	83%	8%	8%	100%
	43/2F	89%	4%	7%	100%
	47/3	43%	43%	14%	100%
	47/4	83%	0%	17%	100%
	55/2A	85%	15%	0%	100%
	55/2C	63%	13%	25%	100%
Total		80%	11%	8%	100%

Table 16: Crop yields (kg/acre)

	Khulna		Satkhira		Patuakhail	
	before	now	before	now	before	now
boro HYV	2,003	2,238	2,089	2,484	1,830	2,252
boro hybrid	2,789	3,104	2,879	3,179	-	2,640
aman local	1,187	1,312	1,261	1,588	956	1,183
aman HYV	1,638	1,913	1,603	1,935	1,572	2,050
aus local	851	560	976	1,293	895	1,142
aus HYV	1,572	1,520	1,320	1,607	1,428	1,773
maize	1,220	-	-	-	1,150	1,211
mung bean	418	358	-	-	330	276
Keshari	280	-	-	-	464	430
felon	-	-	-	-	496	444
sesame	480	319	320	-	409	440
groundnut	-	-	-	-	847	895
sunflower	290	-	-	-	554	1,055
sweet-potato	-	-	-	-	5,342	5,325
jute	729	846	1,045	1,059	-	-
chilli	253	2,400	640	-	608	857
watermelon	19,000	20,213	-	-	18,000	19,400
vegetable	1,480	2,020	-	-	-	480

Table 17: Change in crop yields

	Khulna			Satkhira			Patuakhali		
	increase	no change	decrease	increase	no change	decrease	increase	no change	decrease
boro HYV	79%	9%	11%	97%	0%	3%	100%	0%	0%
boro hybrid	82%	6%	12%	97%	0%	3%			
aman local	66%	10%	24%	67%	22%	11%	84%	8%	8%
aman HYV	79%	10%	11%	88%	4%	8%	98%	2%	0%
aus local	0%	0%	100%	100%	0%	0%	86%	0%	14%
aus HYV	75%	25%	0%	100%	0%	0%	94%	4%	2%
maize							75%	0%	25%
mung bean	39%	7%	54%				38%	6%	56%
Keshari							38%	21%	41%
felon							50%	13%	38%
sesame	20%	11%	69%				67%	0%	33%
groundnut							58%	11%	30%
sunflower							100%	0%	0%
s-potato							40%	13%	48%
jute	40%	0%	60%	53%	21%	26%			
chilli							71%	9%	20%
watermelon	33%	0%	67%				50%	0%	50%
vegetable	100%	0%	0%						

WMGs with change in yield as percentage of those reporting yields beor now and before BGP

Table 18: Land tenure (percentage of land)

		Owner cultivator			Sharecropper			Other lease		
	polder	before	now	change	before	now	change	before	now	change
Boro / rabi	22	72.3	70.0	-2.3	13.2	12.8	-0.4	6.2	17.3	11.1
	25	51.9	45.4	-6.5	13.3	8.6	-4.8	34.8	46.1	11.3
	26	52.9	41.9	-11.0	25.1	17.9	-7.1	22.1	40.2	18.1
	29	49.7	36.8	-12.9	23.0	10.8	-12.2	25.5	52.3	26.8
	30	58.0	56.6	-1.4	27.7	24.8	-2.8	14.4	18.6	4.2
	31P	51.9	52.5	0.6	24.3	20.0	-4.3	23.8	27.5	3.8
	27/1	52.7	43.0	-9.7	9.7	4.3	-5.3	31.0	52.7	21.7
	27/2	51.7	48.3	-3.3	20.0	7.5	-12.5	28.3	44.2	15.8
	28/1	40.8	28.3	-12.5	28.8	12.9	-15.8	30.4	58.8	28.3
	28/2	42.9	31.3	-11.7	45.0	46.3	1.3	12.1	14.2	2.1
	34/2	61.8	42.1	-19.7	26.1	31.8	5.8	12.1	15.5	3.4
	2	58.3	55.2	-3.1	28.5	13.0	-15.5	11.7	31.8	20.2
	43/1A	58.9	49.6	-9.3	18.6	10.0	-8.6	22.5	40.4	17.9
	43/2A	62.6	57.4	-5.2	26.6	18.6	-8.0	10.8	24.0	13.2
	43/2B	63.2	51.1	-12.0	20.9	18.6	-2.3	15.9	30.2	14.3
	43/2D	61.1	53.4	-7.7	23.9	20.1	-3.8	15.0	26.5	11.5
	43/2E	70.4	54.2	-16.3	17.1	11.7	-5.4	12.5	34.2	21.7
	43/2F	57.4	46.5	-10.9	23.0	7.1	-15.9	15.9	42.7	26.9
	47/3	52.9	35.0	-17.9	22.9	20.7	-2.1	24.3	44.3	20.0
	47/4	53.1	35.6	-17.5	18.1	9.7	-8.3	28.9	54.7	25.8
	55/2A	51.2	41.9	-9.2	28.8	11.9	-16.9	20.0	46.2	26.2
	55/2C	59.4	43.3	-16.1	25.4	13.9	-11.6	15.2	42.8	27.6
	total	56.0	47.2	-8.8	23.0	15.1	-7.9	20.0	36.9	16.9
Kharif-2	22	76.4	69.0	-7.4	13.5	14.2	0.7	10.1	16.8	6.8
	25	54.4	49.1	-5.3	9.0	3.3	-5.8	36.6	47.6	11.0
	26	55.5	40.2	-15.3	25.7	17.6	-8.1	18.7	42.2	23.5
	29	54.2	37.9	-16.3	20.2	9.8	-10.4	25.6	52.3	26.7
	30	66.1	64.5	-1.6	24.0	22.1	-1.9	10.0	13.5	3.5
	31P	52.8	60.8	8.1	26.3	12.5	-13.8	21.0	26.7	5.7
	27/1	53.7	42.7	-11.0	10.3	6.3	-4.0	29.3	51.0	21.7
	27/2	53.3	48.3	-5.0	20.0	7.5	-12.5	26.7	44.2	17.5
	28/1	41.7	33.3	-8.3	22.1	1.3	-20.8	36.3	65.4	29.2
	28/2	43.8	37.5	-6.3	45.0	46.7	1.7	11.3	15.8	4.6
	34/2	68.7	67.9	-0.8	21.8	17.6	-4.2	9.5	14.5	5.0
	2	45.3	46.5	1.2	19.0	9.4	-9.7	16.6	44.1	27.5
	43/1A	59.6	49.6	-10.0	17.9	10.0	-7.9	22.5	40.4	17.9
	43/2A	64.8	56.9	-7.9	23.7	19.8	-4.0	11.5	23.3	11.8
	43/2B	61.6	49.8	-11.8	22.3	20.0	-2.3	16.1	30.2	14.1
	43/2D	60.4	53.4	-7.0	24.3	20.1	-4.1	15.4	26.5	11.1
	43/2E	68.8	54.2	-14.6	17.5	11.7	-5.8	13.8	34.2	20.4
	43/2F	55.6	46.5	-9.1	22.7	7.1	-15.6	18.1	42.7	24.6

		Owner cultivator			Sharecropper			Other lease		
	polder	before	now	change	before	now	change	before	now	change
	47/3	52.9	35.0	-17.9	22.9	20.7	-2.1	24.3	44.3	20.0
	47/4	53.1	35.6	-17.5	18.1	9.7	-8.3	28.9	54.7	25.8
	55/2A	50.4	41.9	-8.5	31.2	11.9	-19.2	18.5	46.2	27.7
	55/2C	59.4	43.3	-16.1	25.4	13.9	-11.6	15.2	42.8	27.6
	total	56.3	48.6	-7.6	20.4	12.9	-7.6	20.5	38.3	17.8
Kharif-1	22	86.7	81.5	-5.2	8.3	6.7	-1.7	5.0	11.8	6.8
	25	55.0	48.5	-6.4	8.2	3.3	-4.9	36.8	48.2	11.4
	26	57.9	41.2	-16.7	10.3	13.6	3.3	31.8	45.2	13.4
	29	58.8	39.2	-19.6	11.3	7.4	-3.9	29.9	53.4	23.4
	30	74.8	79.3	4.6	5.4	6.0	0.6	9.9	12.2	2.4
	31P	64.8	66.7	1.8	6.0	5.4	-0.6	20.8	27.9	7.1
	27/1	53.3	43.3	-10.0	7.7	2.3	-5.3	32.3	54.3	22.0
	27/2	53.3	50.0	-3.3	20.0	4.2	-15.8	26.7	45.8	19.2
	28/1	36.7	36.3	-0.4	18.8	0.0	-18.8	36.3	63.8	27.5
	28/2	47.1	52.1	5.0	17.1	17.9	0.8	19.2	21.7	2.5
	34/2	41.1	43.2	2.1	5.5	4.2	-1.3	11.3	10.5	-0.8
	2	37.5	44.6	7.1	13.9	7.2	-6.7	16.9	45.0	28.1
	43/1A	55.4	49.6	-5.7	16.6	10.0	-6.6	20.9	40.4	19.4
	43/2A	53.8	49.0	-4.8	22.5	15.2	-7.3	9.4	21.4	12.0
	43/2B	47.3	23.2	-24.1	16.8	8.0	-8.9	13.2	14.3	1.1
	43/2D	41.3	41.1	-0.2	10.7	9.5	-1.2	8.8	17.3	8.5
	43/2E	24.6	33.3	8.8	5.0	8.3	3.3	3.8	16.7	12.9
	43/2F	56.3	49.1	-7.2	18.8	6.2	-12.6	17.5	41.0	23.5
	47/3	52.9	19.3	-33.6	22.9	17.1	-5.7	24.3	35.0	10.7
	47/4	38.1	26.7	-11.4	12.5	8.3	-4.2	21.7	42.8	21.1
	55/2A	24.2	29.2	5.0	14.2	9.6	-4.6	7.7	30.4	22.7
	55/2C	35.6	25.0	-10.6	8.4	8.1	-0.3	5.9	23.1	17.2
	total	50.8	45.6	-5.1	11.9	7.4	-4.5	19.9	35.2	15.2

Appendix 3: Calculation of farm income and returns on BGP investment

Table 1: Summary of crop budgets: Khulna zone

	Current situation				Before BGP	
	yield kg/ac	cost Tk/acre	Income Tk/acre	Net income Tk/ac	yield decrease	Net income Tk/ac
Watermelon	19,000	69,181	285,000	215,819	4%	206,699
Seasame	335	9,023	18,425	9,402	0%	9,402
Mungbean	450	9,635	22,500	12,865	0%	12,865
Amon HYV	1,900	27,940	35,150	7,210	5%	5,804
Amon Local	1,300	20,794	29,120	8,326	5%	7,161
Boro Hybrid	3,500	50,256	56,700	6,444	5%	4,176
Boro HYV	2,250	41,532	44,471	2,939	5%	1,160
Vegetable[1]	-	-	-	94,448	15%	77,726
Fish gher	640	82,730	204,000	121,270	15%	96,790
per season[2]				60,635		48,395

[1] Combination of gourd (70%) and okra (30%)
[2] Fish/shimp gher model has a 12 month production cycle. Adjusted to a 4 month season

Table 2: Summary of crop budgets: Satkhira zone

	Current situation				Before BGP	
	yield kg/ac	cost Tk/acre	Income Tk/acre	Net income Tk/ac	yield decrease	Net income Tk/ac
Amon HYV	1,950	26,792	36,150	9,358	12%	5,887
Amon Local	1,200	18,344	26,000	7,656	12%	5,160
Boro Hybrid	3,200	41,799	50,000	8,201	12%	3,401
Boro HYV	2,200	34,573	40,600	6,027	12%	2,129
Vegetable[1]	-	-	-	168,672	15%	142,032
White Fish	840	83,700	126,000	42,300	15%	27,180
Shrimp	195	36,375	111,000	74,625	15%	61,305
Combined[2]	-	-	-	24,523	0%	17,983

[1] combination of cauliflower (70%) and brinjal (aubergine) 30%
[2] Combined budget is 50% white fish and 50% shrimp, with white fish 7 month and shrimp 12 month production cycles both adjusted to a 4 month season

Table 3: Summary of crop budgets: Patuakhali zone

	Current situation				Before BGP	
	yield kg/ac	cost Tk/acre	Income Tk/acre	Net income Tk/ac	yield decrease	Net income Tk/ac
Aus (Local)	1,100	19,855	18,425	(1,430)	12%	(3,199)
Aus (HYV)	1,800	24,767	25,688	921	12%	(1,545)
Amon (Local)	1,200	22,068	25,620	3,552	12%	1,092
Amon (HYV)	2,050	28,350	32,698	4,348	12%	1,209
Boro (HYV)	2,250	31,240	32,310	1,070	12%	(2,032)
Mungbean	290	11,358	14,500	3,142	0%	3,142
Ground-nut	890	24,069	62,300	38,231	0%	38,231
Chilli	270	22,640	40,500	17,860	20%	11,380
Sweet-potato	5,300	23,177	74,200	51,023	0%	51,023
Keshari (Cowpea)	430	6,335	12,900	6,565	0%	6,565
Watermelon	18,000	61,562	306,000	244,438	4%	234,646

Table 4: Adjusted cropping pattern – non-rice crops

	Before BGP – percent of cultivable land								
polder	mungbean	Keshari	sesame	g-nut	s-potato	chili	w-melon	vegetable	total
22	2.2	0.0	11.3	0.0	0.0	0.0	0.2	3.2	16.8
25	0.6	0.0	12.5	0.0	0.0	0.0	0.0	21.7	34.7
26	1.5	0.0	8.5	0.0	0.0	0.0	0.0	13.3	23.3
29	5.8	0.0	27.2	0.0	0.0	0.0	0.2	15.6	48.8
30	11.6	0.0	45.8	0.0	0.0	0.0	0.6	6.0	64.0
31P	1.2	0.0	15.1	0.0	0.0	0.0	0.0	2.3	18.6
27/1	0.0	0.0	14.5	0.0	0.0	0.0	0.0	24.3	38.9
27/2	0.0	0.0	6.2	0.0	0.0	0.0	0.0	13.8	20.0
28/1	6.3	0.0	20.8	0.0	0.0	0.0	0.8	21.3	49.2
28/2	10.0	0.0	38.2	0.0	0.0	0.0	0.2	34.4	82.8
34/2	2.4	0.0	11.3	0.0	0.0	0.0	0.0	7.5	21.2
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.5
43/1A	15.8	20.1	0.0	8.0	1.4	9.5	10.9	0.0	65.7
43/2A	11.0	22.9	0.0	8.0	4.0	7.3	0.0	0.0	53.1
43/2B	15.6	20.7	0.0	3.3	2.5	5.6	4.0	0.0	51.8
43/2D	15.3	21.6	0.0	5.4	2.6	7.1	0.0	0.0	52.0
43/2E	11.6	40.7	0.0	3.9	4.1	8.3	0.0	0.0	68.6
43/2F	2.9	37.2	0.0	4.1	5.0	5.4	0.0	0.0	54.6
47/3	2.7	3.9	0.0	2.7	1.1	3.9	0.0	0.0	14.3
47/4	5.3	10.8	0.0	3.2	0.9	3.9	0.4	0.0	24.4
55/2A	36.2	23.5	0.0	2.5	1.8	9.5	0.0	0.0	73.5
55/2C	35.8	19.6	0.0	3.8	3.4	8.5	0.0	0.0	70.9

	Current situation – percent of cultivable land								
polder	mungbean	keshari	sesame	g-nut	s-potato	chili	w-melon	vegetable	total
22	0.7	0.0	10.1	0.0	0.0	0.0	50.6	8.2	69.5
25	0.0	0.0	14.1	0.0	0.0	0.0	0.0	26.6	40.8
26	0.3	0.0	9.4	0.0	0.0	0.0	1.0	22.0	32.7
29	1.1	0.0	15.9	0.0	0.0	0.0	0.5	30.5	48.1
30	6.2	0.0	21.6	0.0	0.0	0.0	9.3	15.0	52.1
31P	0.7	0.0	7.8	0.0	0.0	0.0	15.6	10.9	34.9
27/1	0.0	0.0	17.5	0.0	0.0	0.0	0.0	30.1	47.7
27/2	0.0	0.0	7.8	0.0	0.0	0.0	0.0	18.8	26.7
28/1	0.0	0.0	16.7	0.0	0.0	0.0	0.0	27.9	44.6
28/2	2.1	0.0	10.0	0.0	0.0	0.0	0.0	24.2	36.3
34/2	0.0	0.0	4.6	0.0	0.0	0.0	0.0	7.8	12.4
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.1	9.1
43/1A	44.8	4.3	0.0	10.7	0.4	11.1	20.9	0.0	92.1
43/2A	70.4	1.9	0.0	13.3	2.0	8.1	0.0	0.0	95.7
43/2B	51.1	0.6	0.0	10.6	0.7	6.6	26.0	0.0	95.6
43/2D	71.7	1.2	0.0	8.3	1.3	6.0	0.0	0.0	88.4
43/2E	76.7	1.2	0.0	6.5	1.6	9.8	0.0	0.0	95.7
43/2F	69.9	1.2	0.0	11.0	1.4	10.6	0.0	0.0	94.2
47/3	10.0	2.1	0.0	3.4	1.9	7.3	0.0	0.0	24.7
47/4	19.1	2.2	0.0	5.2	0.8	6.9	2.2	0.0	36.4
55/2A	75.5	1.6	0.0	6.5	1.6	9.7	1.2	0.0	96.1
55/2C	70.6	1.3	0.0	7.7	1.1	8.5	3.2	0.0	92.3

Table 5: Adjusted cropping pattern – paddy crops

	Before BGP - percent of cultivable land						Before BGP - percent of cultivable land						All paddy	
Polder	HYV boro	Hybrid boro	aus local	aus HYV	aman local	aman HYV	HYV boro	Hybrid boro	aus local	aus HYV	aman local	aman HYV	before	now
22	0.3	0.1	0.0	0.0	54.6	35.3	1.3	1.8	0.0	0.0	10.4	74.8	90.3	88.3
25	45.4	12.2	0.0	0.0	10.5	8.2	15.1	48.1	0.0	0.0	1.4	11.4	76.3	76.0
26	21.0	7.5	0.0	0.0	30.3	29.7	17.6	51.3	0.0	0.0	5.3	43.7	88.5	117.9
29	11.0	1.2	0.0	0.0	43.2	29.0	14.3	32.4	0.0	0.0	7.3	40.7	84.4	94.7
30	1.3	1.2	0.0	0.0	82.5	6.7	6.6	11.7	0.0	0.0	68.5	18.5	91.7	105.2
31P	9.1	0.9	0.0	0.0	58.8	16.6	10.4	19.8	0.0	0.0	26.3	43.3	85.4	99.8
27/1	38.3	14.3	0.0	0.0	16.0	3.0	15.0	50.3	0.0	0.0	6.3	5.0	71.7	76.7
27/2	27.5	10.0	0.0	0.0	38.3	10.0	28.3	27.5	0.0	0.0	16.3	13.3	85.8	85.5
28/1	44.4	2.7	0.0	0.0	15.8	15.0	11.6	57.8	0.0	0.0	7.3	8.5	77.9	85.3
28/2	6.3	0.3	0.0	0.0	73.3	25.4	7.2	11.9	0.0	0.0	57.5	32.5	105.3	109.1
34/2	35.2	1.6	0.0	0.0	64.4	10.3	29.6	29.2	0.0	0.0	62.8	16.6	111.4	138.2
2	64.1	10.6	0.0	0.0	10.8	24.2	57.2	27.5	0.0	0.0	6.0	31.4	109.7	122.2
43/1A	0.0	0.0	30.4	2.9	82.5	16.1	2.5	0.0	8.6	41.4	30.7	65.4	131.8	148.6
43/2A	0.0	0.0	27.6	11.9	82.9	7.6	0.0	0.0	3.6	18.0	61.2	38.8	130.0	121.5
43/2B	0.0	0.0	27.3	0.7	76.1	12.7	0.2	0.0	0.0	9.3	30.6	69.3	116.8	109.5
43/2D	0.2	0.0	16.3	0.2	93.7	5.6	6.2	0.0	1.3	12.1	56.1	43.9	115.9	119.6
43/2E	0.2	0.0	10.4	2.5	72.9	12.5	2.1	0.0	0.8	9.3	54.6	45.4	98.5	112.3
43/2F	0.0	0.0	24.9	16.2	87.4	11.1	0.1	0.0	0.9	40.6	40.2	59.4	139.6	141.2
47/3	0.0	0.0	10.4	0.7	60.0	32.9	2.9	0.0	0.4	4.0	31.4	64.3	104.0	103.0
47/4	0.6	0.0	6.7	3.3	49.2	45.0	1.9	0.0	1.5	2.5	21.7	77.5	104.7	105.1
55/2A	0.4	0.0	10.0	4.6	88.1	7.3	1.6	0.0	0.0	10.4	44.2	55.8	110.4	112.0
55/2C	0.0	0.0	15.0	2.5	78.8	16.9	5.8	0.0	0.0	8.9	30.0	70.0	113.1	114.7

Table 6: Total net income from crops and aquaculture

Polder	Before BGP - Tk million per year				Now - Tk million per year				change	
	paddy	other crops	fish	total	paddy	other crops	fish	total		
22	16.98	11.77	29.83	58.57	18.25	335.47	59.95	413.66	355.09	606%
25	84.24	669.63	2,218.93	2,972.80	167.02	986.41	3,266.50	4,419.93	1,447.13	49%
26	22.71	57.40	153.67	233.78	37.86	121.82	322.13	481.81	248.04	106%
29	101.91	324.89	643.17	1,069.97	124.54	649.57	1,478.87	2,252.98	1,183.01	111%
30	75.23	138.35	84.09	297.66	94.32	438.53	238.48	771.34	473.67	159%
31P	50.19	31.81	309.73	391.73	64.99	422.28	540.63	1,027.90	636.17	162%
27/1	17.79	151.88	466.45	636.13	34.43	226.72	684.57	945.71	309.59	49%
27/2	6.66	18.48	77.38	102.53	8.08	30.38	151.32	189.77	87.25	85%
28/1	7.12	56.61	157.26	221.00	14.33	75.64	239.05	329.02	108.01	49%
28/2	26.64	124.43	14.35	165.42	31.72	93.99	39.13	164.84	(0.58)	0%
34/2	43.24	54.39	161.16	258.79	69.87	59.67	189.53	319.07	60.28	23%
2	100.61	288.86	285.46	674.94	247.16	418.63	801.81	1,467.59	792.66	117%
43/1A	0.39	155.83	-	156.22	20.44	286.35	-	306.78	150.57	96%
43/2A	(0.67)	74.00	-	73.33	37.92	94.51	-	132.43	59.10	81%
43/2B	0.93	130.43	-	131.35	37.86	638.87	-	676.73	545.38	415%
43/2D	6.57	70.81	-	77.38	47.26	84.07	-	131.33	53.95	70%
43/2E	2.05	27.11	-	29.16	14.37	26.96	-	41.33	12.17	42%
43/2F	0.35	61.08	-	61.43	36.73	76.64	-	113.37	51.94	85%
47/3	2.12	7.19	-	9.32	11.92	12.04	-	23.96	14.64	157%
47/4	10.24	49.56	-	59.80	52.95	123.11	-	176.06	116.26	194%
55/2A	7.10	61.39	-	68.49	44.76	112.50	-	157.26	88.77	130%
55/2C	7.63	91.30	-	98.93	59.45	210.99	-	270.44	171.51	173%
Total	590.04	2,657.20	4,601.50	7,848.73	1,276.23	5,525.14	8,011.95	14,813.33	6,964.60	89%

Table 7: Cumulative expenditure on water management infrastructure and FFS

Polder	Million Taka BWDB	DAE	Total
22	40.94	5.45	46.39
25	204.59	1.40	205.99
26	121.08	0.74	121.82
29	139.91	4.21	144.12
30	104.94	4.63	109.57
31P	200.23	1.32	201.55
27/1	65.44	0.41	65.86
27/2	23.65	0.33	23.98
28/1	87.65	0.50	88.15
28/2	107.25	0.66	107.91
34/2	158.43	-	158.43
2	352.85	9.00	361.85
43/1A	52.27	4.46	56.73
43/2A	238.42	1.73	240.16
43/2B	185.29	3.88	189.17
43/2D	131.12	3.88	135.00
43/2E	25.55	0.41	25.96
43/2F	147.33	2.73	150.06
47/3	103.52	0.83	104.35
47/4	205.11	2.40	207.51
55/2A	186.20	4.87	191.07
55/2C	140.25	4.87	145.12
total	3,022.02	58.73	3,080.75

Table 8: Payback period for project investment

	Payback period (years)	
	A	B
22	0.13	0.37
25	0.14	0.41
26	0.49	1.40
29	0.12	0.35
30	0.23	0.66
31P	0.32	0.91
27/1	0.21	0.61
27/2	0.27	0.79
28/1	0.82	2.33
28/2	-184.45	-529.86
34/2	2.63	7.51
2	0.46	1.31
43/1A	0.38	1.08
43/2A	4.06	11.61
43/2B	0.35	0.99
43/2D	2.50	7.15
43/2E	2.13	6.10
43/2F	2.89	8.25
47/3	7.13	20.36
47/4	1.78	5.10
55/2A	2.15	6.15
55/2C	0.85	2.42
Total	0.44	1.26

Payback period is the period required for the increase in annual net farm income to equal cumulative project expenditure to date.
Column A is payback period for BWDB and DAE expenditure only. Column B is period for total BGP expenditure assuming that DAE and BWDB expenditure are 35% of total BGP expenditure.

Table 9: Labour inputs from hired male labour

polder	Before BGP thousands of person-days				Now - thousands of person days				Change
	paddy	other	fish	total	paddy	other	fish	total	
22	31.9	1.5	6.5	40.0	33.8	30.3	10.9	74.9	34.9
25	502.1	57.4	485.2	1044.7	499.6	46.3	592.6	1138.4	93.7
26	69.8	5.1	33.6	108.5	98.5	6.1	58.4	163.0	54.5
29	232.9	35.4	140.6	409.0	305.9	32.2	268.3	606.4	197.4
30	97.1	21.7	18.4	137.2	134.7	36.5	43.3	214.5	77.3
31	91.4	4.5	67.7	163.6	129.2	34.8	98.1	262.1	98.4
27-1	90.8	13.0	102.0	205.7	100.3	10.8	124.2	235.3	29.6
27-2	20.0	1.5	16.9	38.5	21.7	1.4	27.5	50.5	12.0
28-1	35.1	5.7	34.4	75.2	39.9	3.6	43.4	86.9	11.7
28-2	46.5	12.4	3.1	62.1	49.4	4.5	7.1	61.0	-1.0
34-2	105.5	5.7	35.2	146.4	136.5	2.8	34.4	173.8	27.4
2	434.4	42.6	168.0	645.0	457.0	44.7	359.7	861.4	216.4
43-1A	105.3	27.1	0.0	132.4	146.2	11.7	0.0	157.9	25.6
43-2A	204.7	25.0	0.0	229.7	226.6	9.6	0.0	236.2	6.5
43-2B	173.3	29.5	0.0	202.8	204.9	25.4	0.1	230.4	27.6
43-2D	218.8	28.9	0.0	247.7	275.8	10.5	0.0	286.3	38.6
43-2E	58.3	10.6	0.0	68.9	79.8	3.3	0.0	83.1	14.2
43-2F	195.1	19.1	0.0	214.2	240.2	7.9	0.0	248.1	33.9
47-3	53.0	2.7	0.0	55.7	63.8	0.6	0.0	64.5	8.7
47-4	232.0	15.9	0.0	247.9	281.4	6.5	0.0	287.9	40.0
55-2A	197.3	38.2	0.0	235.5	246.7	11.0	0.0	257.7	22.2
55-2C	262.0	49.5	0.0	311.5	332.7	15.9	0.0	348.6	37.1

Table 10: Labour inputs from hired female labour

	Before BGP thousands of person-days				Now - thousands of person days				Change
polder	paddy	other	fish	total	paddy	other	fish	total	
22	3.9	0.4	0.0	4.2	12.0	1.7	2.0	15.7	11.5
25	57.9	32.7	0.0	90.5	158.4	73.4	107.7	339.6	249.0
26	7.9	2.7	0.0	10.6	32.2	8.3	10.6	51.1	40.5
29	27.6	13.0	0.0	40.5	101.1	46.7	48.8	196.6	156.1
30	16.6	2.9	0.0	19.4	47.4	13.8	7.9	69.1	49.6
31	12.6	0.9	0.0	13.5	44.0	7.7	17.8	69.5	55.9
27-1	11.2	7.4	0.0	18.6	31.7	16.8	22.6	71.1	52.5
27-2	2.6	0.9	0.0	3.5	6.9	2.3	5.0	14.2	10.7
28-1	3.9	2.3	0.0	6.2	12.7	5.6	7.9	26.2	20.0
28-2	6.3	5.5	0.0	11.8	17.3	7.1	1.3	25.7	13.9
34-2	14.2	2.3	0.0	16.5	45.3	4.4	6.3	55.9	39.4
2	152.5	22.8	43.8	219.1	307.0	38.7	650.2	995.9	776.8
43-1A	0.0	13.9	0.0	13.9	0.0	54.1	0.0	54.1	40.3
43-2A	0.0	16.7	0.0	16.7	0.0	90.0	0.0	90.0	73.4
43-2B	0.0	15.4	0.0	15.4	0.0	106.0	0.0	106.0	90.6
43-2D	0.0	19.1	0.0	19.1	0.0	96.2	0.0	96.2	77.1
43-2E	0.0	5.5	0.0	5.5	0.0	32.6	0.0	32.6	27.1
43-2F	0.0	8.6	0.0	8.6	0.0	79.1	0.0	79.1	70.5
47-3	0.0	1.9	0.0	1.9	0.0	8.6	0.0	8.6	6.7
47-4	0.0	10.3	0.0	10.3	0.0	52.4	0.0	52.4	42.1
55-2A	0.0	26.0	0.0	26.0	0.0	100.3	0.0	100.3	74.3
55-2C	0.0	34.4	0.0	34.4	0.0	127.3	0.0	127.3	92.9

Table 11: Labour inputs from men in farm households

	Before BGP thousands of person-days				Now - thousands of person days				Change
polder	paddy	Other	fish	total	paddy	other	fish	total	
22	28.3	2.3	6.8	37.4	31.2	2.6	9.9	43.7	6.3
25	291.0	77.1	504.4	872.5	295.4	78.6	538.7	912.7	40.2
26	48.2	7.0	34.9	90.2	66.6	8.5	53.1	128.3	38.1
29	188.5	52.4	146.2	387.0	218.5	50.5	243.9	512.9	125.9
30	119.0	34.9	19.1	173.0	122.8	23.4	39.3	185.6	12.6
31	87.7	7.9	70.4	166.0	103.9	9.2	89.2	202.2	36.2
27-1	55.4	17.4	106.0	178.8	58.4	18.4	112.9	189.7	10.9
27-2	14.9	2.0	17.6	34.5	14.4	2.3	25.0	41.7	7.2
28-1	21.9	7.4	35.7	65.0	23.6	6.2	39.4	69.2	4.2
28-2	45.1	17.9	3.3	66.2	44.2	7.4	6.5	58.1	-8.1
34-2	90.5	8.6	36.6	135.7	104.2	4.9	31.3	140.4	4.7
2	305.8	51.7	174.6	532.1	307.0	62.5	327.0	696.5	164.4
43-1A	52.6	32.2	0.0	84.8	67.6	35.4	0.0	103.0	18.3
43-2A	103.1	42.6	0.0	145.7	102.6	49.9	0.0	152.5	6.8
43-2B	86.4	39.2	0.0	125.6	90.7	70.1	0.0	160.8	35.2
43-2D	108.9	47.1	0.0	156.0	124.0	52.0	0.0	176.0	20.0
43-2E	29.2	18.6	0.0	47.7	35.6	17.6	0.0	53.2	5.4
43-2F	98.6	36.3	0.0	134.9	110.9	43.3	0.0	154.2	19.3
47-3	26.5	4.1	0.0	30.6	28.1	5.2	0.0	33.3	2.7
47-4	116.4	25.9	0.0	142.3	123.1	31.4	0.0	154.5	12.3
55-2A	98.7	54.8	0.0	153.6	109.9	54.9	0.0	164.8	11.2
55-2C	130.9	70.3	0.0	201.2	147.7	71.0	0.0	218.7	17.5

Table 12: Labour inputs from women in farm households

polder	Before BGP thoudands of person-days				Now - thousands of person days				Change
	paddy	Other	fish	total	paddy	other	fish	total	
22	7.4	1.2	1.5	10.2	9.8	2.1	2.5	14.3	4.1
25	104.4	52.4	114.6	271.4	118.3	73.0	134.7	326.0	54.6
26	14.8	4.6	7.9	27.3	24.7	8.1	13.3	46.1	18.7
29	53.0	30.0	33.2	116.3	79.4	46.6	61.0	187.0	70.7
30	28.3	16.6	4.3	49.3	42.4	17.7	9.8	70.0	20.7
31	23.1	4.2	16.0	43.3	36.2	8.1	22.3	66.5	23.2
27-1	19.2	11.9	24.1	55.2	23.7	16.9	28.2	68.9	13.7
27-2	4.5	1.4	4.0	9.9	5.8	2.2	6.2	14.2	4.3
28-1	7.6	4.4	8.1	20.1	9.3	5.7	9.9	24.9	4.7
28-2	11.7	10.7	0.7	23.1	15.1	6.9	1.6	23.6	0.5
34-2	26.1	5.0	8.3	39.5	39.6	4.5	7.8	51.8	12.4
2	121.8	20.3	39.7	181.8	150.2	26.8	81.7	258.7	76.9
43-1A	14.1	16.6	0.0	30.7	21.4	28.7	0.0	50.1	19.4
43-2A	27.0	30.3	0.0	57.4	30.5	75.0	0.0	105.4	48.1
43-2B	22.9	25.0	0.0	48.0	30.1	52.3	0.0	82.3	34.4
43-2D	28.0	36.0	0.0	64.0	38.4	82.6	0.0	120.9	57.0
43-2E	7.8	12.7	0.0	20.5	11.0	27.9	0.0	38.9	18.3
43-2F	26.2	22.2	0.0	48.4	34.6	65.6	0.0	100.3	51.9
47-3	7.7	3.0	0.0	10.8	9.4	6.7	0.0	16.1	5.3
47-4	35.8	18.1	0.0	53.9	42.4	37.4	0.0	79.7	25.9
55-2A	25.8	49.6	0.0	75.4	35.0	83.9	0.0	118.9	43.5

Table 13: Total labour inputs

Zone		Before BGP thousands of person-days				Now - thousands of person days				Change
		paddy	Other crop	fish	total	paddy	Other crop	fish	total	
Khulna	hired men	1323	164	944	2431	1549	209	1308	3067	636
	hired woman	165	71	0	235	509	188	238	935	699
	HH men	990	235	981	2206	1083	212	1189	2484	278
	HH women	300	142	223	666	404	192	297	893	228
Satkhira	hired men	434	43	168	645	457	45	360	861	216
	hired woman	152	23	44	219	307	39	650	996	777
	HH men	306	52	175	532	307	63	327	696	164
	HH women	122	20	40	182	150	27	82	259	77
Patuakhali	hired men	1700	247	0	1947	2098	103	0	2201	254
	hired woman	0	152	0	152	0	747	0	747	595
	HH men	851	371	0	1222	940	431	0	1371	149
	HH women	231	277	0	508	302	561	0	863	355
total	hired men	3457	453	1112	5022	4105	357	1668	6129	1107
	hired woman	317	245	44	606	816	973	888	2677	2071
	HH men	2148	657	1156	3961	2330	705	1516	4552	591
	HH women	653	440	263	1355	857	780	379	2016	660

Attachment A – Crop budgets

Khulna zone crop budgets

Crop name	Watermelon			Seasame			Mungbean			Amon HYV			Amon Local			Boro Hybrid			Boro HYV		
Month of planting	December			February			February			July			July			December - January			December - January		
Month of harvesting	April			May-June			May-June			November/December			November/December			May			May		
Preceding crop	Amon Rice			Amon Rice			Amon Rice			Fallow			Fallow			Amon			Amon		
Next crop	Fallow			Fallow			Fallow			Boro			Boro			Fallow			Fallow		
Unit of land1	1 acre			1 acre			1 acre			1 acre			1 acre			1 acre			1 acre		
	Quantity	**Price**	**Cost**	**Quantity**	**Price**	**Cost**	**Quantity**	**Price**	**Cost**	**Quantity**	**Price**	**Cost**	**Quantity**	**Price**	**Cost**	**Quantity**	**Price**	**Cost**	**Quantity**	**Price**	**Cost**
Input cost			**35,515**			**1,532**			**1,405**			**4,590**			**4,290**			**23,460**			**17,055**
Seed/seedling (kg)	0.200	25,000	5,000	6.00	150	900	10.00	100	1,000	20	75	1,500	30.00	60	1,800	3.00	360	1,080	10.00	75	750
Seed bed preparation/input			-			-			-	LS		1,000	LS		1,000	LS		1,200	LS		1,200
Urea (kg)	160	17	2,720	10	17	170	15	17	255	30	17	510	30	17	510	180	17	3,060	160	17	2,720
TSP (kg)	120	30	3,600	10	30	300	5	30	150	15	30	450	10	30	300	60	30	1,800	30	30	900
MP (kg)	40	18	720	9	18	162			-	15	18	270	10	18	180	30	18	540	15	18	270
Zinc (kg)	12	125	1,500			-			-			-			-	6	125	750	3	125	375
Gypsum (kg)	45	15	675			-			-			-			-	30	15	450	20	15	300
Boron/DAP/Other (kg)	100	27	2,700			-			-	2	180	360			-	6	180	1,080			-
Organic (kg)	400	5	2,000			-			-			-			-			-			-
Insecticide (kg)	10	500	5,000			-			-	0.060	5,000	300	0.060	5,000	300	0.100	5,000	500	0.100	5,000	500
Fungicide (ml)	4	250	1,000			-			-	0.020	5,000	100	0.020	5,000	100	0.100	5,000	500	0.100	5,000	500
Herbicide (ml)	4	250	1,000			-			-	0.020	5,000	100	0.020	5,000	100	0.100	5,000	500	0.100	5,000	500
Other inputs			-			-			-			-			-			-			-
Irrigation (hours)	120	80	9,600			-			-			-			-	150	80	12,000	113	80	9,040
Staking & support (Tk)			-			-			-			-			-			-			-
Machinery (hire)			**-**			**3,000**			**3,300**			**4,400**			**4,400**			**5,000**			**5,000**
Land preparation (times)			-	3	1,000	3,000	3	1,100	3,300	4	1,100	4,400	4	1,100	4,400	4	1,100	4,400	4	1,100	4,400
Irrigation (times/hours)			-			-			-			-			-	8	80	600	8	80	600
Threshing (maund)3			-			-			-			-			-			-			-
Labour (hired & family)7			**33,666**			**4,491**			**4,930**	36		**18,000**			**11,454**	39		**20,046**			**18,352**
Seedling production (days)	1	410	410			-			-			-			-	1	514	514	1	496	496
Land preparation (days)	8	410	3,280			-			-	2	500	1,000	2	498	996	2	514	1,028	2	496	992
Planting/transplanting (#)	8	410	3,280	1	450	450	1	460	460	9	500	4,500	7	498	3,486	10	514	5,140	10	496	4,960
Fertilization (days)	1	410	410			-			-	2	500	1,000	1	498	498	2	514	1,028	2	496	992
Weeding/earthing up (#)	14	410	5,740			-			-	10	500	5,000	2	498	996	8	514	4,112	8	496	3,968
Irrigation (days)	25	410	10,250			-			-			-			-			-			-
Pesticide application (day)	4	410	1,640			-			-	1	500	500			-	1	514	514	1	496	496
Harvesting (day/share)	21	410	8,656	7	450	3,141	7	460	3,090	10	500	5,000	9	498	4,482	12	514	6,168	10	496	4,960
Threshing/winnowing			-	2	450	900	3	460	1,380	2	500	1,000	2	498	996	3	514	1,542	3	496	1,488
Others			-			-			-			-			-			-			-
Marketing5			**-**			**-**			**-**			**950**			**650**			**1,750**			**1,125**
Bags/packing material (no.)6										47.5	14	665	32.5	14	455	87.5	14	1225	56.25	14	787.5
Transport to local market										47.5	6	285	32.5	6	195	87.5	6	525	56.25	6	337.5
Total Cost			**69,181**			**9,023**			**9,635**			**27,940**			**20,794**			**50,256**			**41,532**
Yield																					
Main product (kg)	19000	15	285000	335	55	18425	450	50	22500	1900	17	32300	1300	20	26000	3500	15	52500	2250	18	40500
By-product (kg)										475	6	2850	520	6	3120	700	6	4200	662	6	3970.5882
Gross Returns			**285,000**			**18,425**			**22,500**			**35,150**			**29,120**			**56,700**			**44,471**
Net Returns			**215,819**			**9,402**			**12,865**			**7,210**			**8,326**			**6,444**			**2,939**
Total labour input	**82**	**364**	**29,900**	**10**	**361**	**3,600**	**11**	**457**	**4,900**	**36**	**500**	**18,000**	**23**	**498**	**11,450**	**39**	**499**	**19,450**	**37**	**496**	**18,350**
hired male	20	500	10,000	2	500	1,000	4	500	2,000	14	550	7,700	8	550	4,400	19	550	10,450	17	550	9,350
hired female	13	300	3,900			-	1	300	300	5	350	1,750	3	350	1,050	6	350	2,100	5	350	1,750
family male	20	500	10,000	4	500	2,000	4	500	2,000	13	550	7,150	9	550	4,950	10	550	5,500	10	550	5,500
family female	20	300	6,000	2	300	600	2	300	600	4	350	1,400	3	350	1,050	4	350	1,400	5	350	1,750
Net return per day of family la	**40**	**400**	**16,000**	**6**	**433**	**2,600**	**6**	**433**	**2,600**	**17**	**503**	**8,550**	**12**	**500**	**6,000**	**14**	**493**	**6,900**	**15**	**483**	**7,250**

Satkhira zone crop budgets

Crop name	Amon HYV			Amon Local			Boro Hybrid			Boro HYV		
Month of planting	July			July			December - January			December - January		
Month of harvesting	November/December			November/December			May			May		
Preceding crop	Fallow			Fallow			Amon			Amon		
Next crop	Boro			Boro			Fallow			Fallow		
Unit of land1	1 acre			1 acre			1 acre			1 acre		
	Quantity	**Price**	**Cost**	**Quantity**	**Price**	**Cost**	**Quantity**	**Price**	**Cost**	**Quantity**	**Price**	**Cost**
Input cost			**5,046**			**3,614**			**11,625**			**8,260**
Seed/seedling (kg)	15	80	1,200	22.00	62	1,364	5	360	1,800	15	75	1,125
Seed bed preparation/input	LS		800	LS		1,000	LS		1,200	LS		1,200
Urea (kg)	40	17	680	30	17	510	120	17	2,040	80	17	1,360
TSP (kg)	20	30	600	10	30	300	40	30	1,200	25	30	750
MP (kg)	12	18	216	5	18	90	20	18	360	10	18	180
Zinc (kg)			-			-	6	125	750	3	125	375
Gypsum (kg)			-			-	25	15	375	18	15	270
Boron/DAP/Other (kg)	2	175	350			-	5	180	900			-
Organic (kg)			-			-			-			-
Insecticide (kg)	0.120	5,000	600	0.050	5,000	250	0.200	5,000	1,000	0.200	5,000	1,000
Fungicide (ml)	0.050	5,000	250	0.010	5,000	50	0.200	5,000	1,000	0.200	5,000	1,000
Herbicide (ml)	0.070	5,000	350	0.010	5,000	50	0.200	5,000	1,000	0.200	5,000	1,000
Other inputs			-			-			-			-
Irrigation (hours)			-			-			-			-
Staking & support (Tk)			-			-			-			-
Machinery (hire)			**3,000**			**3,000**			**12,000**			**12,000**
Land preparation (times)	3	1,000	3,000	3	1,000	3,000	3	1,000	3,000	3	1,000	3,000
Irrigation (times/hours)			-			-	1	9,000	9,000	1	9,000	9,000
Threshing (maund)3			-			-			-			-
Labour (hired & family)7			**17,235**			**10,800**			**15,694**			**12,608**
Seedling production (days)			-			-	1	413	413	1	394	394
Land preparation (days)	2	383	766	2	400	800	2	413	826	2	394	788
Planting/transplanting (#)	10	383	3,830	8	400	3,200	10	413	4,130	8	394	3,152
Fertilization (days)	1	383	383	1	400	400	2	413	826	2	394	788
Weeding/earthing up (#)	12	383	4,596	5	400	2,000	8	413	3,304	7	394	2,758
Irrigation (days)			-			-			-			-
Pesticide application (day)	1	383	383			-	1	413	413	1	394	394
Harvesting (day/share)	14	383	5,362	7	400	2,800	10	413	4,130	8	394	3,152
Threshing/winnowing	5	383	1,915	4	400	1,600	4	413	1,652	3	394	1,182
Others			-			-			-			-
Marketing5			**1,511**			**930**			**2,480**			**1,705**
Bags/packing material (no.)6	48.75	13	633.75	30	13	390	80	13	1040	55	13	715
Transport to local market	48.75	18	877.5	30	18	540	80	18	1440	55	18	990
Total Cost			**26,792**			**18,344**			**41,799**			**34,573**
Yield												
Main product (kg)	1950	17	33150	1200	20	24000	3200	15	48000	2200	18	39600
By-product (kg)	LS		3000	LS		2000	LS		2000	LS		1000
Gross Returns			**36,150**			**26,000**			**50,000**			**40,600**
Net Returns			**9,358**			**7,656**			**8,201**			**6,027**
Total labour input	**45**	**366**	**16,450**	**27**	**383**	**10,350**	**38**	**382**	**14,500**	**32**	**381**	**12,200**
hired male	16	450	7,200	9	450	4,050	16	450	7,200	12	450	5,400
hired female	11	250	2,750	6	250	1,500	11	250	2,750	7	250	1,750
family male	10	450	4,500	9	450	4,050	9	450	4,050	9	450	4,050
family female	8	250	2,000	3	250	750	2	250	500	4	250	1,000
Net return per day of family la	**18**	**361**	**6,500**	**12**	**400**	**4,800**	**11**	**414**	**4,550**	**13**	**388**	**5,050**

Patuakhali zone paddy crop budgets

Crop name	Aus (Local)			Aus (HYV)			Amon (Local)			Amon (HYV)			Boro (HYV)		
Month of planting	May			May			August			August			January		
Month of harvesting	Septemebr			September			December			December			April		
Preceding crop	Robi/Boro			Robi/Boro			Aus			Aus			Aman		
Next crop	Aman			Aman			Robi/Boro			Robi/Boro			Aus		
Unit of land1	1 acre			1 acre			1 acre			1 acre			1 acre		
	Quantity	**Price**	**Cost**	**Quantity**	**Price**	**Cost**	**Quantity**	**Price**	**Cost**	**Quantity**	**Price**	**Cost**	**Quantity**	**Price**	**Cost**
Input cost			**3,010**			**4,400**			**3,290**			**5,350**			**6,920**
Seed/seedling (kg)	18	25	450	15	40	600	12	25	300	15	50	750	18	50	900
Seed bed preparation/input			-			-			-			-			-
Urea (kg)	30	20	600	50	20	1,000	40	20	800	60	20	1,200	60	20	1,200
TSP (kg)	20	35	700	30	35	1,050	30	35	1,050	40	35	1,400	35	28	980
MP (kg)	15	20	300	20	20	400	15	20	300	25	20	500	20	20	400
Zinc (kg)			-			-			-			-			-
Gypsum (kg)			-			-			-			-	10	220	2,200
Boron/DAP/Other (kg)			-			-			-			-			-
Organic (kg)			-			-			-			-			-
Insecticide (kg)	3	220	660	3	300	900	3	180	540	3	300	900	4	200	800
Fungicide (ml)			-			-			-			-			-
Herbicide (ml)	1	300	300	1.5	300	450	1	300	300	2	300	600	2	220	440
Other inputs			-			-			-			-			-
Irrigation (hours)			-			-			-			-			-
Staking & support (Tk)			-			-			-			-			-
Machinery (hire)			**4,138**			**4,320**			**4,270**			**4,663**			**6,500**
Land preparation (times)	3	1,000	3,000	3	1,000	3,000	3	1,050	3,150	3	1,050	3,150	3	1,050	3,150
Irrigation (times/hours)			-			-			-			-	20	90	1,800
Threshing (maund)	1.75	650	1,138	2.4	550	1,320	1.4	800	1,120	2.75	550	1,513	3.10	500	1,550
Labour (hired & family)7			**11,745**			**14,472**			**13,608**			**16,800**			**16,695**
Seedling production (days)	2	435	870	2	432	864	2	486	972	2	480	960	2	477	954
Land preparation (days)	1	435	435	1	432	432	1	486	486	1	480	480	1	477	477
Planting/transplanting (#)	9	435	3,915	10	432	4,320	10	486	4,860	11	480	5,280	11	477	5,247
Fertilization (days)	0.5	435	218	0.5	432	216	0.5	486	243	0.5	480	240	1	477	477
Weeding/earthing up (#)	1	435	435	3	432	1,296	1	486	486	3	480	1,440	2	477	954
Irrigation (days)			-			-			-			-	2	477	954
Pesticide application (day)	0.5	435	218	1	432	432	0.5	486	243	1	480	480	1	477	477
Harvesting (day/share)	10	435	4,350	12	432	5,184	10	486	4,860	12	480	5,760	10	477	4,770
Threshing/winnowing	1	435	435	1	432	432	1	486	486	1	480	480	1	477	477
Others	2	435	870	3	432	1,296	2	486	972	3.5	480	1,680	4	477	1,908
Marketing5			**963**			**1,575**			**900**			**1,538**			**1,125**
Bags/packing material (no.)6			-			-			-			-			-
Transport to local market	27.5	35	963	45	35	1,575	30	30	900	51.25	30	1,538	56.25	20	1,125
Total Cost			**19,855**			**24,767**			**22,068**			**28,350**			**31,240**
Yield															
Main product (kg)	1100	16.25	17,875	1800	13.75	24,750	1200	20	24,000	2050	13.75	28,188	2250	12.5	28,125
By-product (kg)	1100	0.50	550	1876	0.50	938	1080	1.50	1,620	2255	2.00	4,510	2093	2.00	4,185
Gross Returns			**18,425**			**25,688**			**25,620**			**32,698**			**32,310**
Net Returns			**(1,430)**			**921**			**3,552**			**4,348**			**1,070**
Total labour input	**27**	**435**	**11,750**	**34**	**432**	**14,475**	**28**	**486**	**13,600**	**35**	**480**	**16,800**	**35**	**477**	**16,700**
hired male	17	450	7,650	20	450	9,000	18	500	9,000	22	500	11,000	21	500	10,500
hired female			-			-			-			-			-
family male	8	450	3,600	11	450	4,725	8	500	4,000	10	500	4,750	10	500	5,000
family female	2	250	500	3	250	750	2	300	600	4	300	1,050	4	300	1,200
Net return per day of family labour	**10**	**410**	**4,100**	**14**	**406**	**5,475**	**10**	**460**	**4,600**	**13**	**446**	**5,800**	**14**	**443**	**6,200**

Patuakhali zone non-rice crop budgets

Crop name	Mungbean			Ground-nut			Chilli			Sweet-potato			Keshari (Cowpea)			Watermelon		
Month of planting	February			January			December			November			November			January		
Month of harvesting	March			April			February			March			February			May		
Preceding crop	Amon			Amon			Amon			Amon			Amon			Aman		
Next crop	Aus			Aus			Aus			Aus			Aus			Aus		
Unit of land1	1 acre			1 acre			1 acre			1 acre			1 acre			1 acre		
	Quantity	**Price**	**Cost**	**Quantity**	**Price**	**Cost**	**Quantity**	**Price**	**Cost**	**Quantity**	**Price**	**Cost**	**Quantity**	**Price**	**Cost**	**Quantity**	**Price**	**Cost**
Input cost			**700**			**5,625**			**3,094**			**1,100**			**1,360**			**15,880**
Seed/seedling (kg)	7	100	700	35	100	3,500	4,800	0.3	1,440	LS		500	20.00	50	1,000	0.500	16,000	8,000
Seed bed preparation/input			-			-			-			-			-			-
Urea (kg)			-			-	18	18	324			-	20	18	360	20	18	360
TSP (kg)			-	35	35	1,225	35	35	1,225			-			-	60	32	1,920
MP (kg)			-			-			-			-			-	30	20	600
Zinc (kg)			-			-			-			-			-			-
Gypsum (kg)			-			-			-			-			-			-
Boron/DAP/Other (kg)			-			-			-			-			-			-
Organic (kg)			-			-			-			-			-			-
Insecticide (kg)			-	LS		900	LS		105	LS		600			-	LS		5,000
Fungicide (ml)			-			-			-			-			-			-
Herbicide (ml)			-			-			-			-			-			-
Other inputs			-			-			-			-			-			-
Irrigation (hours)			-			-			-			-			-			-
Staking & support (Tk)			-			-			-			-			-			-
Machinery (hire)			**3,000**			**4,500**			**4,000**			**3,000**			**1,400**			**3,500**
Land preparation (times)	3	1,000	3,000	4	1,125	4,500	4	1,000	4,000	3	1,000	3,000	2	700	1,400	4	875	3,500
Irrigation (times/hours)			-			-			-			-			-			-
Threshing (maund)			-			-			-			-			-			-
Labour (hired & family)7			**7,513**			**13,499**			**15,411**			**15,102**			**3,575**			**30,932**
Seedling production (days)			-			-			-			-			-			-
Land preparation (days)	2	318	636	3	345	1,035	2	348	696	4	363	1,452			-	12	407	4,884
Planting/transplanting (#)	0.5	318	159	9	345	3,105	9	348	3,132	10	363	3,630	0.5	359	180	10	407	4,070
Fertilization (days)			-	0.5	345	173	1	348	348			-	0.5	359	180	2	407	814
Weeding/earthing up (#)			-	5	345	1,725			-			-			-			-
Irrigation (days)			-			-	8	348	2,784			-			-	20	407	8,140
Pesticide application (day)	1	318	318	0.5	345	173	1	348	348			-			-	2	407	814
Harvesting (day/share)	15	318	4,611	12	345	4,040	19	348	6,711	28	363	10,020	9	359	3,216	30	407	12,210
Threshing/winnowing	4	318	1,153	7	345	2,559			-			-			-			-
Others	2	318	636	2	345	690	4	348	1,392			-			-			-
Marketing5			**145**			**445**			**135**			**3,975**			**-**			**11,250**
Bags/packing material (no.)6																		
Transport to local market	7.25	20	145	22.25	20	445	6.75	20	135	132.5	30	3975				450	25	11250
Total Cost			**11,358**			**24,069**			**22,640**			**23,177**			**6,335**			**61,562**
Yield																		
Main product (kg)	290	50	14500	890	70	62300	270	150	40500	5300	14	74200	430	30	12900	18000	17	306000
By-product (kg)																		
Gross Returns			**14,500**			**62,300**			**40,500**			**74,200**			**12,900**			**306,000**
Net Returns			**3,142**			**38,231**			**17,860**			**51,023**			**6,565**			**244,438**
Total labour input	**24**	**259**	**6,125**	**39**	**304**	**11,900**	**44**	**322**	**14,250**	**42**	**326**	**13,550**	**10**	**397**	**3,950**	**76**	**282**	**21,400**
hired male	1	450	450	2	450	900	5	450	2,250	9	450	4,050	2	450	900	8	500	4,000
hired female	8	250	2,000	16	250	4,000	18	250	4,500	9	250	2,250	2	250	500	18	300	5,400
family male	4	450	1,800	10	450	4,500	10	450	4,500	10	450	4,500	4	450	1,800	15	500	7,500
family female	8	250	1,875	10	250	2,500	12	250	3,000	11	250	2,750	3	250	750	15	300	4,500
Net return per day of family labour	**12**	**320**	**3,675**	**20**	**350**	**7,000**	**22**	**341**	**7,500**	**21**	**345**	**7,250**	**7**	**364**	**2,550**	**30**	**400**	**12,000**

Vegetable crop budgets

	KHULNA						SATKHIRA					
Crop name	**Gourd**			**Ladies finger**			**Cauliflower**			**Brinjal**		
Month of planting	October			October			December			December		
Month of harvesting	December - February			December - March			February - march			February - April		
Preceding crop	Amon			Amon			Amon			Amon		
Next crop	Boro			Boro			Boro			Boro		
Unit of land1	33 decimal			33 decimal			33 decimal			33 decimal		
	Quantity	**Price**	**Cost**	**Quantity**	**Price**	**Cost**	**Quantity**	**Price**	**Cost**	**Quantity**	**Price**	**Cost**
Input cost			**9,710**			**5,135**			**9,310**			**8,440**
Seed/seedling (kg)	LS		600	LS		1,200	LS		1,500	LS		500
Seed bed preparation/input							LS		500			
Urea (kg)			-	15.00	17	255	50.00	17	850	30.00	17	510
TSP (kg)	18.00	30	540	10.00	30	300	50.00	30	1,500	50.00	30	1,500
MP (kg)	5.00	18	90	10.00	18	180	10.00	18	180	10.00	18	180
Zinc (kg)			-			-			-			-
Gypsum (kg)			-			-			-			-
Boron/DAP/Other (kg)			-			-			-			-
Organic (kg)	LS		500	LS		500	LS		2,500	LS		2,000
Insecticide (ml)	0.500	1,000	500	1.5	1,000	1,500	0.500	1,000	500	2.5	1,500	3,750
Foradon (kg)	2.0	140	280			-	2.0	140	280			-
Herbicide (ml)			-			-			-			-
Other inputs (macha)	LS		6,000									
Irrigation (Tk)	6	200	1,200	6	200	1,200	5	300	1,500			-
Staking & support (Tk)			-			-			-			-
Machinery (hire)			**-**			**1,200**			**1,200**			**1,200**
Land preparation (times)			-	4	300	1,200	3	400	1,200	4	300	1,200
Irrigation (times/hours)			-			-			-			-
Threshing (maund)3			-			-			-			-
Labour (hired & family)7			**4,200**			**9,600**			**4,500**			**11,000**
Seedling production (days)	2	300	600	3	300	900			-			-
Land preparation (days)	5	300	1,500	1	300	300	1	250	250	1	250	250
Planting/transplanting (#)			-			-	4	250	1,000	4	250	1,000
Fertilization (days)	1	300	300	1	300	300	1	250	250	1	250	250
Weeding/earthing up (#)			-	4	300	1,200	6	250	1,500	8	250	2,000
Irrigation (days)			-			-			-			-
Pesticide application (day)	1	300	300	3	300	900	1	250	250	8	250	2,000
Harvesting (day/share)	3	200	600	30	200	6,000	5	250	1,250	22	250	5,500
Threshing/winnowing			-			-			-			-
Made of macha	3	300	900			-			-			-
Marketing5			**2,000**			**1,000**			**2,000**			**200**
Bags/packing material (no.)												
Transport to local market	LS		2000	LS		1000	LS		2000	LS		200
Total Cost			**15,910**			**16,935**			**17,010**			**20,840**
Yield												
Main product (kg)	3000	15	45000	4500	12	54000	7000	10	70000	6000	15	90000
By-product (kg)												
Gross Returns			**45,000**			**54,000**			**70,000**			**90,000**
Net Returns			**29,090**			**37,065**			**52,990**			**69,160**
Total labour input	**15**	**280**	**4,200**	**42**	**229**	**9,600**	**18**	**250**	**4,500**	**44**	**250**	**11,000**
hired male	3	284	852	5	229	1,145	5	250	1,250	10	250	2,500
hired female	2	284	568	20	229	4,580	4	250	1,000	10	250	2,500
family male	4	284	1,136	10	229	2,290	7	250	1,750	14	250	3,500
family female	6	284	1,704	7	229	1,603	2	250	500	10	250	2,500
Net return per day of family la	**10**	**284**	**2,840**	**17**	**229**	**3,893**	**9**	**250**	**2,250**	**24**	**250**	**6,000**

Khulna zone fish gher budgets

System type	Fish/Prawn/Shrimp		
Month of planting	May to January		
Month of harvesting			
Preceding crop			
Next crop			
Unit of land1	1 acre		
	Quantity	**Price**	**Cost**
Input cost			
Prawn/Shrimp fingerings	6000 PC	1	6,000
Fish fingerlings	50 kg	50	7,500
Land Preparetion (Irrigation)	LS		2,000
Land Preparetion (day)	6	500	3,000
Line	50	15	750
TSP	25	32	800
MP	12	15	180
Oilcake	40	30	1,200
Bamboo/Neet	LS		2,500
Feed	LS		37,800
Medicine	LS		1,000
Fishing	16	500	8,000
Marketing	4	500	2,000
Family labour	25	400	10,000
Other costs			-
Total Cost			**82,730**
Fish kg	400	150	60,000
Prawn/shrimp kg	240	600	144,000
Gross Returns			**204,000**
Net Returns			**121,270**

Satkhira zone fish gher budgets

System type	White Fish			Shrimp		
Month of planting	January			January to December		
Month of harvesting	July			-		
Preceding crop	Aman			-		
Next crop	Aman			-		
Unit of land1	1 acre			1 acre		
	Quantity	**Price**	**Cost**	**Quantity**	**Price**	**Cost**
Input cost						
Prawn/Shrimp fingerings	-	-	-	7,500	0.75	5,625
Fish fingerlings	240	80	19,200			-
Land Preparetion (Irrigation)	LS		4,000	LS		600
Land Preparetion (day)	16	250	4,000	2.4	250	600
Land Preparetion (plaw)	1	1,500	1,500			-
Repair Gher boundary (female day)	10	170	1,700	15	170	2,550
Line	90	17	1,530	100	17	1,700
TSP	60	25	1,500	24	25	600
Uria	60	17	1,020			-
MP	30	15	450			-
Bamboo/Neet	LS		1,200	LS		1,500
Feed	LS		27,000	LS		2,000
Medicine	LS		600	LS		1,200
Fishing	LS		3,000	LS		2,000
Marketing	LS		2,000	LS		1,000
Family labour	52	250	13,000	60	250	15,000
Other costs	LS		2,000	LS		2,000
Total Cost			**83,700**			**36,375**
Fish kg	840	150	126,000	45	300	13,500
Shrimp kg				150	650	97,500
Gross Returns			**126,000**			**111,000**
Net Returns			**42,300**			**74,625**