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Marie-Charlotte Buisson
Archisman Mitra
Nandish Kenia

WATER GOVERNANCE AND COMMUNITY BASED MANAGEMENT: G3

# REPORT FROM HOUSEHOLDS AND WATER MANAGEMENT ORGANIZATIONS QUANTITATIVE SURVEYS

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| | |
|---|---|
| BWDB | Bangladesh Water Development Board |
| EC | Executive Committee |
| FGD | Focus Group Discussion |
| IGA | Income Generating Activity |
| IPSWAM | Integrated Planning for Sustainable Water Management |
| KII | Key Informant Interview |
| KJDRP | |
| LGED | Local Government Engineering Department |
| NGO | Non-Government Organization |
| PCA | Principal Component Analysis |
| SSWRDP | Small Scale Water Resources Development Sector Project |
| TRM | Tidal River Management |
| WMA | Water Management Association |
| WMCA | Water Management Cooperative Association |
| WMG | Water Management Group |
| WMO | Water Management Organization |

# INTRODUCTION

The Ganges basin is one of the six basins of the Challenge Program for Water and Food. The Ganges program focuses on issues of concern to communities living in brackish water coastal zones of Bangladesh and India. This area is home to some of the world's poorest and most vulnerable people, whose livelihoods are exposed to rising sea levels, tidal surges, increasing surface-water and soil salinity with a growing incidence of severe cyclonic storms. With the aim of improving the livelihoods of Ganges coastal zone farmers, the CPWF Ganges Basin Development Challenge (BDC) seeks "to reduce poverty and increase the resilience of agriculture and aquaculture systems in the coastal areas of the Ganges Delta".

G3 is one of the research projects of the GBDC. This project entitled "Water governance and community based water management" focuses on water management from a community perspective. It is therefore considered that water access is the key to unlock agriculture and aquaculture systems productivity and resilience, and consequently to alleviate poverty. More specifically, the research is organized around three research questions:

- Is community management the best way of managing coastal polders in Bangladesh? If so under which circumstances is it likely to work best?
- If community management is indeed the way forward, what are the constraints that communities face in polder management?
- What kind of policies and institution are needed so that communities can indeed actively participate in the management of the polders?

In the 60s and 70s, polders have been built in all the coastal zone of Bangladesh. The primary purpose was to protect the area from tidal surges and salinity intrusion. The first consequence was an increase in the paddy production of the area which helped to meet the national objective of food self-sufficiency. Nevertheless steadily the importance of managing and maintaining these water infrastructures created by the polderization emerged as a key challenge to ensure the sustainability of the whole system.

This research project concentrates in south west coastal area in Bangladesh and more precisely in nine selected areas surrounded by embankments and rivers.
Five of these areas are proper polders built in the 60s by the Bangladesh Water Development Board (BWDB), whereas the four other research areas are sub-projects. Contrary to polders which gather tens of villages, the sub-projects are areas of less than 1,000 hectares and consequently count no more than 2 or 3 villages. The differences are not only in terms of size but also in terms of institutions, since embankments and water infrastructures in sub-projects have been built through Local Government Engineering Department (LGED) in partnership with the communities staring from the 90s.
Each of the research areas is a particular ecosystem with differences in terms of land and water (river flow, salinity levels, fresh water access). Nevertheless, three main agro-ecological zones can be identified:

- In the south-east of the delta the salinity level is low and the livelihoods rely mainly on agriculture;
- Then in central-south of Bangladesh in the Khulna area the level of salinity is intermediate which results into a mixed system of agriculture and aquaculture;
- Finally, the western part of the Delta near the India border is more saline which gives more opportunities for aquaculture but results in more challenging agriculture practices.

To answer to aforementioned research questions a first qualitative phase has been conducted from January to June 2012. The methodology used relied on Focus Group Discussions (FGDs) and Key

Informant Interviews (KIIs). The FGDs were conducting with general groups, with water management organizations and with landless, daily labourers and women. The KIIs shoot all the stakeholders in terms of water management from farmers, female headed households, *gher* owners to local officials.
It is worth to precise that the qualitative analysis has been conducted in depth as 54 FGDs and 87 KIIs were implemented. The main outputs from this qualitative phase are polders and sub-projects analysis reports. These reports describe the context of each area in terms of history, demography, infrastructures and cropping patterns. In addition the reports analyse the condition of the water infrastructures (embankment, gates, canals) as described by the local respondents. Institutional analysis is also used to understand the water management practices in each area. Consequently, this qualitative phase gives answers on the way institutions, both formal and informal, manage water related issues.

If the qualitative analysis gave an understanding of the communities' patterns, the individual and household perspectives were missing. As a result, the quantitative phase has to describe which are the households' livelihoods in the areas and the data collected aims to understand how these livelihoods, practices in agriculture and aquaculture are related to water management and water access. In addition, this phase has to give answers on how the households deal with water management, which is their involvement, their perception about operation and maintenance. The participation into the water management organizations and other informal groups has also to be understood from a household perspective: who is participating, how and why?

To answer to these questions, a household survey has been conducted in the research area. This report presents the methodology and describes the results from the survey. The report can be read as a quantitative situation analysis of the area. Most of the results are desegregated by location for a comparison purpose: comparison between two types of institutions (polders/sub-projects) and comparison between three main geo-hydrologic zones (high, medium and low level of salinity). In addition, when this is relevant, the figures are desegregated by gender, by age or by poverty level.
The first part of the report focuses on the methodology used for the survey, describing the sampling methodology, the instruments as well as the data collection and data entry processes. Based on the analysis from descriptive statistics, the second part of the report draws the picture of the surveyed areas in terms of poverty levels, domestic and productive water uses, agriculture and aquaculture cropping systems, livelihoods, participation and water management practices. Finally the third part presents the results from the survey conducted with Water Management Organizations, the institutional features, financial features and the activities and perceptions about these groups are analysed.

# PART 1 – METHODOLOGY OF THE SURVEY

## 1.1. Sampling strategy

### 1.1.1. Population of interest

The research project focuses on 9 polders and sub-projects. Even if this focus may appear as a small mandate at a first glance, the first feeling is easily dispel considering that these areas are located in 5 Zillas, 10 Upazillas and 22 Unions, and hosts 185 villages[1]. Considering these 185 villages and using the data from the last population census conducted in 2011, the population in the 9 locations is estimated to 273,623 persons, corresponding to 66,156 households.
Given the huge size of this population of interest and the geographic localisation of the 9 areas, we firstly wondered if the survey had to be conducted in each location or should concentrate on few.

The table 2 below concentrates on few characteristics of each locations, collected through the qualitative phase and the census data. By examining this table, the locations appear as quite diverse. The type of project is a first demarcation line. Five polders have been constructed by the BWDB, these polders are quite large area, between 56 and 194 square kilometres, with a long history since the embankments were built in the 60s. Then the four sub-projects have no more than few hundred hectares, the leading institution is LGED in their case and the intervention is recent (90s or 2000s). Given the institutional, technical and historical differences of these two kinds of project, the two categories have to be included in the sample.
Then, even inside each category, area, population and economic patterns vary. The portfolio between paddy, other agricultural crops, shrimp cultivation, other white fish and other livelihoods is never exactly the same. *Ghers* and shrimp cultivation dominate in polder 3, as well as in Latabunia, even if in this last case aquaculture is associated with paddy. Other polders are mainly agricultural; this is the case of polder 30, 24G or Jainkati. Other are interesting cases of balanced portfolio, polder 30 is split between two unions and two different economic specializations. Apart from agriculture and aquaculture, the other livelihoods also differ from one polder to another, for example Jabusa is an interesting case with industries and employment opportunities in shrimps and fishes processing plants.
The research areas are also socially different. Even if the information were quite limited initially, it is worth to note that the Muslim population counts for only 1% in Latabunia or for 21% in polder 30, whereas they are more than 90% in some other polders. Most probably some other differences can be found in terms of inequalities and land distribution for example.
Then apart from economic and social differences, but also related to these differences, the water management occurs differently in the 9 locations. Whereas no formal organization can be found in polder 3, Water Management Organizations (WMOs) lead the management in other places. The institutional forms of these organizations differ, their capacity to operate and maintain the infrastructure of the polders also. Then the degree of formality of the institution is never exactly the same depending on the holding of elections, the involvement of Union Parishad, of 'influential people" or the grabbing by elite farmers or *gher* owners. The representing the diversity of these water management institutions in the survey sample was important to better understand which are the best practices and which are the constraints preventing sustainable operation and maintenance.

Finally, if the inclusion of the four sub-projects and five polders was fully relevant in the qualitative phase to have a broader overview, then in the quantitative phase some choices were required. Focussing on a smaller number of areas produces a stronger sample in terms of representativity and in terms of power. We considered as important to keep both sub-projects and polders in our sample as water management

[1] The figures are updated following the IWM maps with Mouzas layers and based on the last census conducted in 2011.

practices and livelihoods differ, secondly keeping areas from the three identifies hydro-ecological zones was also important. Then the final choices were motivated by the main characteristics of each area in terms of cropping systems, water related institutions and geography. For the polders, the choice was also to concentrate on areas covered by the other GBDC research projects to benefit from synergies[2].

The quantitative survey has consequently been conducted in three polders, polder 3, 30, 43-2F and in three sub-projects, Jabusha, Latabunia and Jainkati. The location of these six locations is given by the below map.

| Sub-project in the sample | Polders in the sample |
|---|---|
| Jabusha | Polder 3 |
| Latabunia | Polder 30 |
| Jainkati | Polder 43-2F |

**Table 1 - Sampled polders and sub-projects**

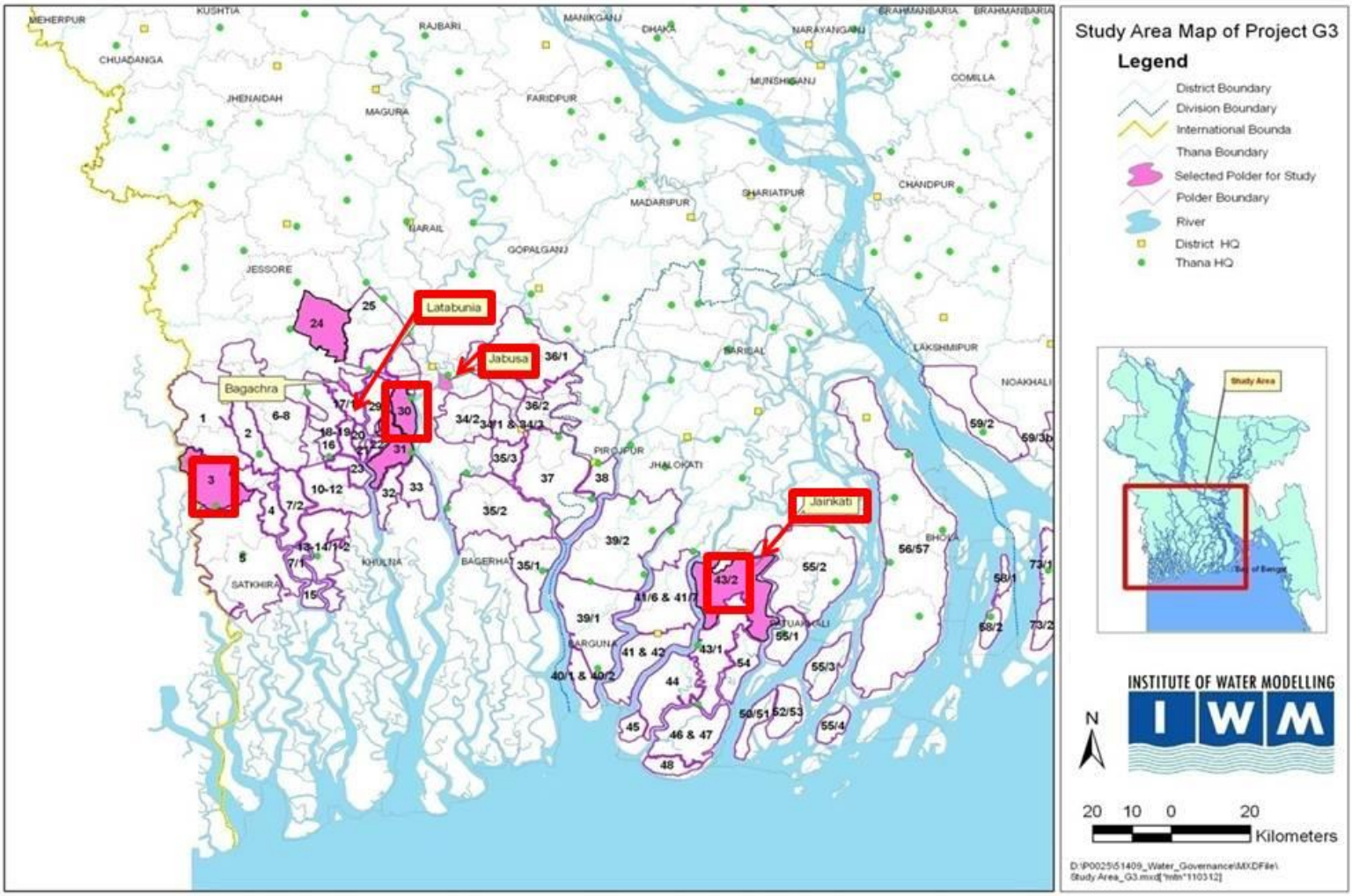



**Figure 1 - Map of the sampled locations**

[2] One of the synergy would be to merge our socio-economic data with GIS data collected by G4 and G1.

| | Area | Number of Upazilla [a] | Number of Unions [a] | Number of villages [a] | Number of households [a] | % of Muslim [a] | Major cropping system [b] | Level of salinity [b] | Project [b] | Water management institutions [b] | Public Gates [b] | Other gates and pipes [b] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Polder 3** | 194km sq | 2 | 6 | 117 | 35356 | 85% | *Ghers* | High | BWDB | No formal WMO, Gher control | 35 gates | Large number of private pipes |
| **Polder 30** | 72 km sq | 1 | 3 | 44 | 10117 | 21% | Agriculture | Medium | BWDB | WMOs, Gate committees | 28 gates | Few private pipes |
| **Polder 31** | 92 km sq | 1 | 2 | 24 | 6084 | 51% | *Gher*/ Agriculture | Medium/ High | BWDB | WMOs, Gher committees | 34 gates | Private pipes |
| **Polder 24G** | 103 km sq | 1 | 4 | 37 | 13742 | 75% | Agriculture | Low | BWDB (KJDRP, TRM) | 70 WMOs, almost all inactive | | |
| **Polder 43-2F** | 56 km sq | 1 | 1 | 12 | 6457 | 95% | Agriculture | Low | BWDB | WMOs, Gate committees | 58 gates | |
| **Badurgacha** | 375 ha | 1 | 2 | 5 | 790 | 85% | Aquaculture/ Agriculture | Medium | LGED | WMCA | 2 gates | Large number of private pipes |
| **Jabusa** | 1240ha | 1 | 1 | 4 | 6460 | 94% | Agriculture/ Industries/ Aquaculte | Medium | LGED | WMCA | 10 gates | |
| **Jainkati** | 107ha | 1 | 1 | 1 | 71 | 30% | Agriculture | Low | LGED | WMCA | 2 gates | |
| **Latabunia** | 240ha | 1 | 1 | 1 | 104 | 1% | Aquaculture/ Agriculture | Medium/ High | LGED | WMCA | 2 gates | Large number of private pipes |

Notes: ([a]) figures from the census data (2011), ([b]) from the qualitative data collection by G3.

**Table 2 - Polders and sub-projects main characteristics**

### 1.1.2. Defining the boundaries of the unit of analysis

The Guidelines for Participatory Water Management (GoB, 2001) establish that all the stakeholders have to participate in water management; therefore, local stakeholders are defined as "inhabitants of an area who are directly or indirectly affected by water management". As a consequence, all these local stakeholders have to be included in our sample and these local stakeholders are not only farmers or landowners. For example, landless can be farmers through leasing or share cropping, they may also be labourers in agriculture or in *ghers*. Similarly, women headed households have livelihoods which might be affected by water management. This is also the case of 'influential people" who may not be directly involved in agriculture but whose involvement in water management may have large consequences.
Consequently the unit of analysis is the household defined as an economic and social decisions unit, and all the households from the surveyed areas can be considered whatever are their characteristics in terms of composition or economic activities.

Then a choice was required between defining unit of analysis as households living in the polder or as household with economic interest in the polder. For most of the cases, the first group is included in the second one as the households living in the polders have most of their livelihoods in this polder. But then, some households living outside the polder have economic interests in these polders. These households are often landowners who cultivate plots in the polders by hiring local labourers. In some other polders, these households take land in lease, this is the case for some *gher* owners, they lease land in the polders without being owners and without living in the polders. The problem of these external stakeholders is that their influence in terms of water management may be important, most of the time they are considered as influential people in the villages and even if they are not physically present their interests are taken into account. If their role in water management would argue for their inclusion in the sample, then logistic problems argue in the other direction. These households are living in big cities, Khulna, Jessore or even Dhaka, which means that there is almost no way to survey them.
Consequently even if the role of these external actors has to be kept in mind, the default choice is to consider only households living in the polder. However, the role of *gher* and land owners settled outside the polder can be captured through several other variables: labourer employment, land market, gates operation…

Through the focus group discussions conducted, seasonal migrations have been identified as an usual livelihoods for many vulnerable households. The migrants are most of the time men who move out of the polder in dry season for finding employment. The inclusion of these members in the sample was considered as important: even if they need to migrate seasonally, their main place of living stays in the polder and they are fully concerned by water management. The livelihoods of the women and children left behind also largely depend from the income sent by the migrants. Consequently, to be sure to include these migrant households' members and to take into account their livelihoods in the sample, the chosen definition for a household member is quite flexible: each individual who spend at least 6 consecutive months per year in the household is considered as a permanent member and included in the household members' roster.

### 1.1.3. Defining clusters

If the choice was to keep the three polders and three sub-projects in the sample, clusters have nonetheless to be selected to build a representative sample. Clustering has to be at a lower scale than polders with clear geographical boundaries, and there should be large enough number of clusters per polder to capture variations and to design a representative sample. In addition, the definition of clusters has to be coherent with the geographical context but also with the purposes of the survey.

Considering our focus on water management and especially on operations and maintenance, the first idea was to consider clusters at gate level. Users of a gate would have been considered as members of this cluster. The advantage was to constitute quite homogeneous clusters with at least a commonality interest

on the water access through the gate. However, building cluster as gate level raises also a number of challenges. First, the users of the gate are far from being only the neighbours of this gate and can be several thousands. For example, in polder 30, during informal discussion, it was mentioned that the water flushing through a sluice gate was used by 7 villages. Secondly defining these gates clusters without overlaps is almost impossible. Farmers usually cultivate a large number of plots, with different location and different elevation; consequently the access to water is different from one plot to another and each farmer is the user of several gates or canals. Then the last but not least problem is the existence of private gates, used by unique (or small number) of farmers or *gher* owners. The inclusion as well as the exclusion of these private gate clusters would raise a selection bias in the sample.

Therefore, clusters are defined following a more traditional way. Clusters are considered at village level. Villages are the lower administrative unit in Bangladesh. At the next level, one *mouzza* can aggregate several villages or not. First, the number of villages is quite important and even if the size is never exactly the same, villages rarely exceed 1,000 households in the sampled areas and never count less than 20 households. Consequently, a fix number of household can be sampled in each village. Then, villages boundaries are clearly defined and overlap is impossible.
Hence, surveys have been conducted at household's level considered as settled in a determined village. Nevertheless, the questionnaires included questions on the gates or canals used by the households to match the collected information with the data on the infrastructures.

### 1.1.4. Sample size

Sample size calculation aims to define the number of households and the number of clusters to be selected. The sample size is defined to give to the sample a sufficient power to answer to the research questions.

Usually, sample size calculation uses data from other surveys conducted in similar context as a basis. In this case, given the particular context of these polders, very few other surveys can be used. However, a sample of 1000 households appeared as being reasonable. Given that the sample will be divided between six polders and sub-projects with very different context, a smaller sample size won't translate the diversity of the situations. Then even if a larger sample might always be useful, financial and logistical constraints determine the upper limit.

Then these 1000 households have to be divided at the cluster level. Initially a number of almost 50 villages is considered. Villages are usually quite homogeneous units in terms of cropping pattern, water access and socio-economic conditions. In this particular context, it is likely that the intra-cluster correlation is less than the inter-cluster correlation. Consequently to be able to capture enough variability, the number of cluster has to be large enough. We initially suggested a minimum number of 50 villages and 1,000 households.

### 1.1.5. Repartition rule

The main problem for the repartition of the clusters and 1,000 households lied in the under-representation of the sub-project areas first and in the huge differences in population size between the polders. Considering only the three sub-projects, they count only 6 villages and 6645 households (but 6470 are from Jabusha). Similarly, polder 3 is five times more populated than polder 43-2F. This means that sample design proportional to the population would give a sample size too small for the sub-project areas and that polder 3 would have the largest part of the sample. This design would consequently prevent any robust comparison between sub-projects and polders and between polders.

Then the repartition of the sample between the polders and sub-project should also answer to the purpose of the survey. One very important purpose is to be able to draw comparison analysis, comparison between LGED and BWDB projects and comparison between polders with different

geographical conditions and with different cropping patterns. Considering this objective of comparison, the different polders need to have a similar sample size.

Therefore, 40 or 20 households per villages were surveyed; these households are considered as member of the same community and may share the same interests and the same water infrastructures. In the sub-projects areas, 40 households were surveyed per villages, this is highly representative of the sub-project for Latabunia and Jainkati given the small number of households in these two polders. Then in Jabusha, we included two villages with 40 households each, the north-west part of the sub-project where plants are concentrated was excluded to focus on the rural areas of this sub-project. In BWDB polders, 20 households per village were surveyed[3]. Table 3 present the final design of the sample.

| | Number of households | Number of villages | Number of sampled households | Number of sampled villages |
|---|---|---|---|---|
| **Latabunia** | 104 | 1 | 40 | 1 |
| **Jabusa** | 2,267 | 2 | 80 | 2 |
| **Jainkati** | 71 | 1 | 40 | 1 |
| **Polder 30** | 8,462 | 44 | 280 | 14 |
| **Polder 3** | 35,356 | 117 | 280 | 14 |
| **Poler 43-2F** | 6,457 | 12 | 280 | 12 |
| **TOTAL** | **52,542** | **177** | **1,000** | **44** |

**Table 3 - Sample design**

### 1.1.6. Clusters and households selection

#### *Cluster selection*

In each polder, villages were randomly selected within the list of all the villages in the polder. The random selection ensure representatively of all different types of villages, especially in terms of location (near canals and gates or not, river border villages or inner polder villages…).
The list of villages surveyed is provided in Annex 1.

#### *Household selection*

The purpose was to have representative selection of the household, so that the sample reflects all the components of each village. To answer to this objective, two methods may be followed:

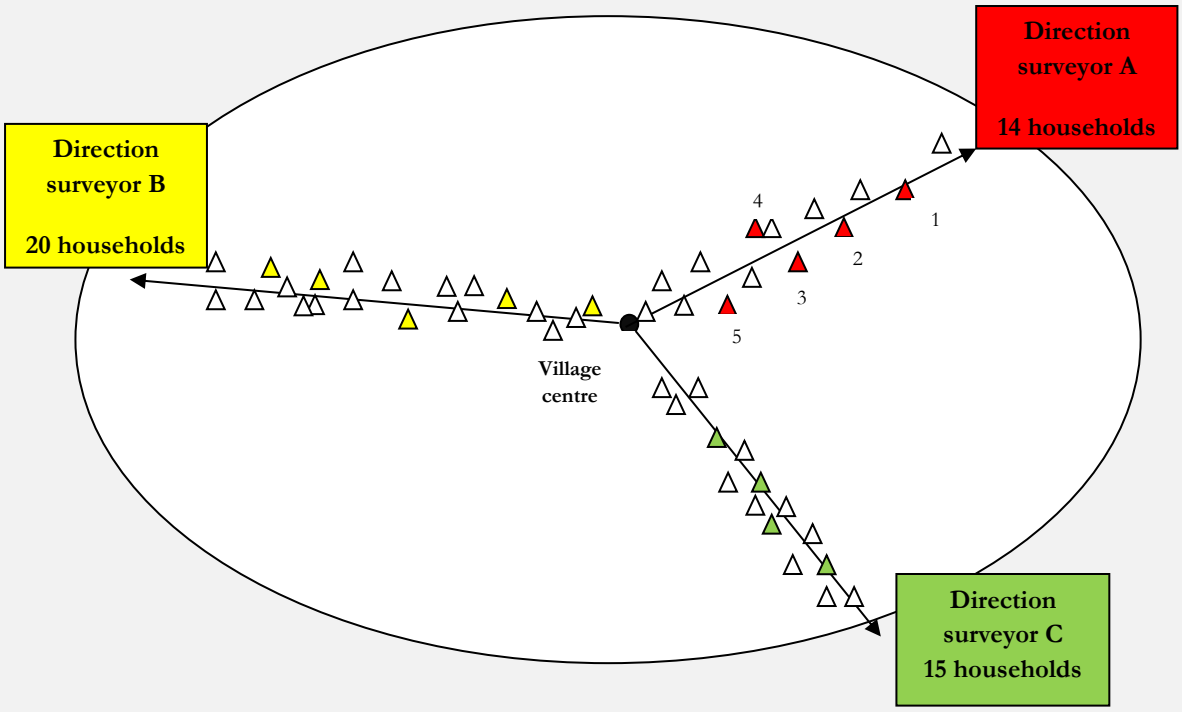
- Random selection of the household in voter lists.
- Geographical random displacement in the village by enumerators following a pre-determined method.

If the first method was preferred, it faced the lack of secondary data. Voter lists were available at the Union Parishad level, but then a lot of cleaning would have been required to establish village lists. Then these lists were lists of voters and identification of the households was impossible. Therefore, the second method based on random displacements to select the households has been implemented. Below are the instructions given to the enumerators to implement this method with an example for practice.

[3] Excepted in two large villages in polder 43-2F where 40 households were interviewed.

**Methodology for selecting the household through geographical random displacement**

1. All the surveyors are at the centre of the village.
2. Each of them will go in a different direction from the centre of the village to the limit of the settlement.
3. When he walks following his direction, the enumerator counts the number of household (right and left).
4. When arrived at the end, he will divide the total number of household by the number of household he has to survey in this village, let's consider the result as X.
5. Then, he will steadily go back to the centre by surveying the X$^{th}$ household, then the X+X$^{th}$ household… until being back in the centre.




For the surveyor A there are 14 household between the centre and the end of the settlement. He has to survey 5 households, 14/5 is approximately equal to 2. He will therefore conduct an interview each 2 households on the coming back way.
For the surveyor B, there are 20 households till the limit, 20/5=4. Consequently, he will survey the 4$^{th}$ household, then the 8$^{th}$, the 12$^{th}$…

## 1.2. Instruments of the survey

### 1.2.1. Household questionnaire

The household questionnaire was the main instrument of the survey and can be found in Annex 3 of this report. The questions were organized into 10 sections and classified by thematic:

- Section 1 – Identification
- Section 2 – Demography
- Section 3 – Housing and assets
- Section 4 – Lands
- Section 5 – Agriculture
- Section 6 – Aquaculture
- Section 7 – Income generating activities
- Section 8 – Saving and credit
- Section 9 – Social capital
- Section 10 – Water management

The respondent was in priority the head of the households and then his spouse if he was not available. Given that some sections required details knowledge about the agricultural practices in some cases several respondents from the same household came together to answer.

Our data shows that 65% of the respondents were the head of the household himself and 25% were the spouse of the head of household, in the few remaining cases, the respondent was a son or daughter of the head of household.

### 1.2.2. Water Management Organisation questionnaire

In each of the villages selected for the survey, a Water Management Organization (WMO) questionnaire has been conducted. This questionnaire aimed to understand the water management infrastructures and practices in the villages, as well as the institutional characteristics in terms of water management. The WMO questionnaire is provided in Annex 4. This questionnaire was organized through 5 sections:

- Section 1 – Identification
- Section 2 – Institutional features
- Section 3 – Financial feature - Income
- Section 4 – Financial feature - Expenses
- Section 5 – Operation and Maintenance

When a formal institution Water Management Group (WMG) or Water Management Cooperative Association (WMCA) existed, the respondent was a member of the executive committee of the organization. When no formal institution was there, the strategy has been to go nearby an infrastructure (a gate most of the time) and to find a key informant to answer the questionnaire. This key informant was for example a gateman hired by a *gher* committee.

The WMO questionnaire has been conducted for each village from the sample, including in villages where no formal institutions were settled, this was especially the case for polder 3. Then, through this questionnaire it has been noticed that in-land villages which are formally included in a WMO might have very little knowledge of the water management practices and infrastructures, the WMO is most of the time led by members from the villages located near the embankments and gates.

It has to be noticed the village scale is not always corresponding to the WMO scale. In 59% of the WMO surveyed, the organization was acting for more than one village.

## 1.3. Description of the data collection

The survey has been conducted in partnership with Shushilan. Shushilan is an agro-ecology and right based NGO working in the south-west coastal region of Bangladesh for ensuring livelihood security. Shushilan was responsible for hiring the enumerators, training them and then took care of the logistical arrangements related to the survey. In total, Shushilan brought together a team of 21 members for the data collection.

This first step has been the training of the enumerators which has been conducted from 13th to 15th January 2013 in Shatkhira (Munshigonj Union of Shamnagar Upazila). The training was mainly conducted in Bangali by Mahanambrota Dash, Azim Uddin and Mustafa Bakuluzzaman. To support the training and give guidance on the research purposes and on the questionnaires, IWMI was also represented with Marie-Charlotte Buisson, Archisman Mitra and Nandish Kenia.

**Training session, 13th Januray 2013, Munshigonj, Satkhira**

After the training, the enumerators went on the field for two days of piloting. This step gave the enumerators the opportunity to familiarize with the questionnaire. In addition, the experiences faced by the enumerators during the piloting were used to finalize the questionnaires.

The enumerators were them split into three teams of four members. Each day, each team was working in one village and had to complete 20 household questionnaires and 1 WMO questionnaire. So, on average each team member completed 5 household questionnaires per day, whereas the WMO questionnaire was conducted by the supervisor.

After returning from the field, in the afternoon, the field team members cleaned their questionnaires before submission to their supervisor. The supervisor then checked the questionnaires, if any mistake was realized; the supervisor gave feedback to the enumerators for rectification.

From IWMI side, Nandish Kenia remained on the field throughout the survey. His task was to go into the villages with the enumerators, to supervise the operations and to give them further guidance when required. His presence on the field also brought useful qualitative insights to analyse the data.

**Examples of household interviews, Januray 2013**

## 1.4. Description of the data entry

The data entry has also been outsourced to Shushilan, whereas the data entry mask has been developed by IWMI. The data entry mask was developed through Epidata to limit the errors from the data entry side. Six data entry operators worked on this survey, they were split into two teams of three. Each of the team entered all the data, each of the 1000 household questionnaires was consequently entered twice. The double entry aimed to avoid any error in the data due to the entry: miss-reading of the answer or miss-typing.

The six operators were embedded with the data collection teams and were entering the data few days after the collection. This choice also allowed discussion between the enumerators and the data entry operators in case of problem.
At the end of the entry, Shushilan sent two databases to IWMI. Using Epidata software, IWMI researchers generated a list of mismatches between the two databases and therefore asked to review all the problems. Two rounds of cleaning were then required to produce a clean and final database.
The same procedure was followed for the WMO questionnaires.

## 1.5. Description of the data cleaning

Even if all the care were taken to limit the errors and the bias in the data, ex-post cleaning is still required. In our case the cleaning was especially required for values related to open questions. When it was possible to correct the answer through other questions (cross checked questions), the answer was corrected. But, when the value was unrealistic and no clue was there to correct it, realistic thresholds were determined (by using previous surveys, qualitative work, or literature) and all the unrealistic values were replaced by missing values.

# PART 2 – HOUSEHOLDS ANALYSIS

## 2.1. Demographic characteristics

### 2.1.1. Household composition

The survey has been conducted towards 1000 household in 44 villages from 6 main location, 3 were LGED sub-project whereas 3 were BWDB polders. The first section of the questionnaire was a demographic roster, all the household members have been included here. A household was defined as all the members living together and who usually take their meal together from a common kitchen (common pot). A time threshold was added and the members away from the household for more than 6 months were excluded.

Using these criteria, the average household size is of 4.7 members. No clear differences can be noticed from one location to another, even if the average household size is slightly higher for in polder 43-2F.

| | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F | TOTAL |
|---|---|---|---|---|---|---|---|
| Number of villages | 2 | 1 | 1 | 14 | 14 | 12 | 44 |
| Number of household | 80 | 36 | 40 | 280 | 280 | 284 | 1000 |
| Number of members | 373 | 163 | 170 | 1361 | 1293 | 1416 | 4776 |
| Average number of members per household | 4.66 | 4.52 | 4.25 | 4.86 | 4.61 | 4.98 | 4.77 |

**Table 4 - Detailed sample**

The age pyramid establishes that the population is quite young, with 50% of the sample members who are less than 28 years old and 25% less than 15. In comparison, polder 3 and polder 43/2F appear as demographically more dynamic as the median age of the household members for these two locations is 27 years old.

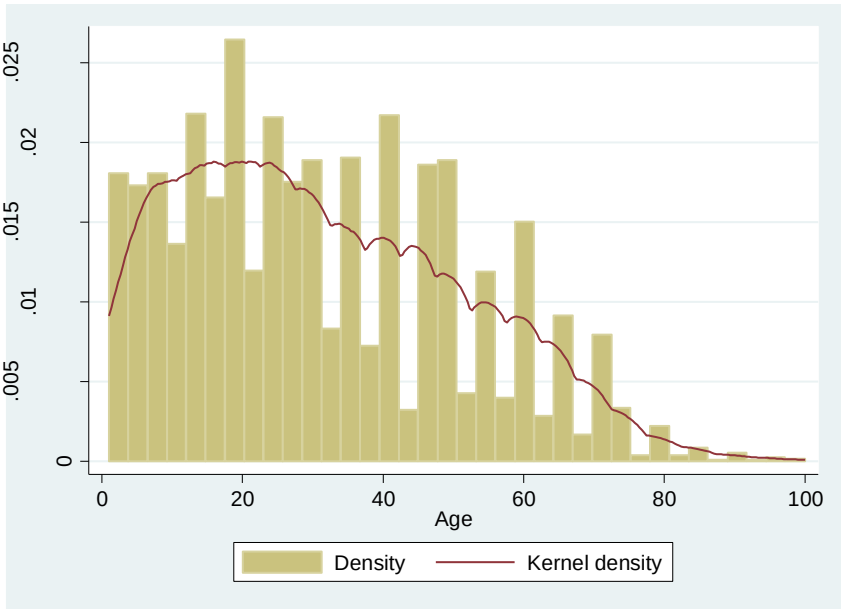



**Figure 2 - Age pyramid and kernel density for the age of the household members**

Considering the gender balance, we have a ratio of 1 male for 1.07 female. The difference is true for all the location but is more acute in Latabunia, where the households comprise 45.8% of women members. When considering the gender structure per age, it seems that the gap between the number of man and the number of woman is dug after 50. In the sub-sample of members who are more than 50, only 40.9% are woman, and after 60 they are only 38.63%. The reduced life expectancy of women can be a reason for

that, but it is also likely that elder women leave these remote areas and join their children in other locations when they become widows.

| | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F | TOTAL |
|---|---|---|---|---|---|---|---|
| Percentage of female members | 47.45 | 47.24 | 45.88 | 48.71 | 47.02 | 49.61 | 48.27 |
| Percentage of women head of household | 1.25 | 2.78 | 2.5 | 4.64 | 5.36 | 1.76 | 3.6 |

**Table 5 - Percentage of female members and female headed household, by location**

The figures on the religion from the households are consistent with the findings from the census and confirm that most of the community members share the same religion whereas mixed situation within one village are quite rare. Jainkati, Latabunia and polder 30 are mostly Hindus in country where Hindus are less than 10%.

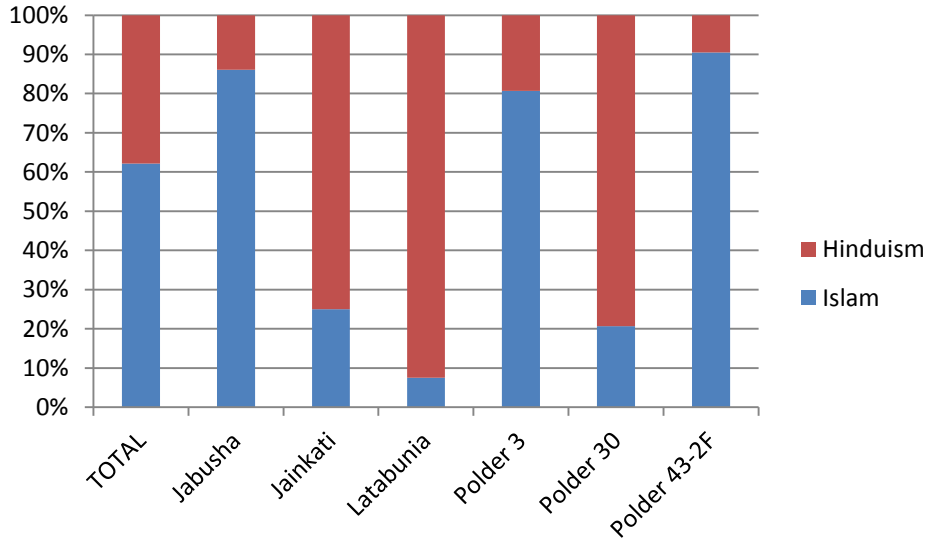



**Figure 3 - Household religion, by location**

### 2.1.2. Literacy and education

Considering all the sample members the literacy rate is 70.0% which is almost same as the literacy rate of the 18-60 years old members. However, the literacy rate is 96% when considering the 12 to 18 age group which is really good considering that most of these villages are very remote areas. In addition, no clear differences can be seen between the six different locations from the sample.

| | Male | Female | Total | Less than 5 years | | 5-12 years | | 12-18 years | | 18-60 years | | More than 60 years | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Male | Female | Male | Female | Male | Female | Male | Female | Male | Female |
| **Total literacy rate** | **74** | **65** | **70** | 5.2 | 4.4 | 85.7 | 86.8 | **94.2** | **98** | **80.7** | **69.5** | **52.8** | **21.7** |
| **No School** | 24.2 | 32.9 | 28.4 | 94.8 | 96.9 | 13.3 | 11 | 4.6 | 0.8 | 16.5 | 28.2 | 46.9 | 77.9 |
| **Primary education** | 26.8 | 27.4 | 27 | 1.3 | 0 | 54.6 | 60.1 | 18 | 15.6 | 19.7 | 22 | 21.2 | 17.7 |
| **Secondary education** | 42.8 | 37.2 | 40.1 | 0 | 0.6 | 6.5 | 7.3 | 76.5 | 53.1 | 52.4 | 44.6 | 28.8 | 4 |
| **Post-secondary education** | 6.3 | 2.5 | 4.5 | 0.6 | 0 | 1.4 | 0 | 0.4 | 0.4 | 10.1 | 4 | 2 | 0 |

**Table 6 - Literacy rates and education level, by sex and age**

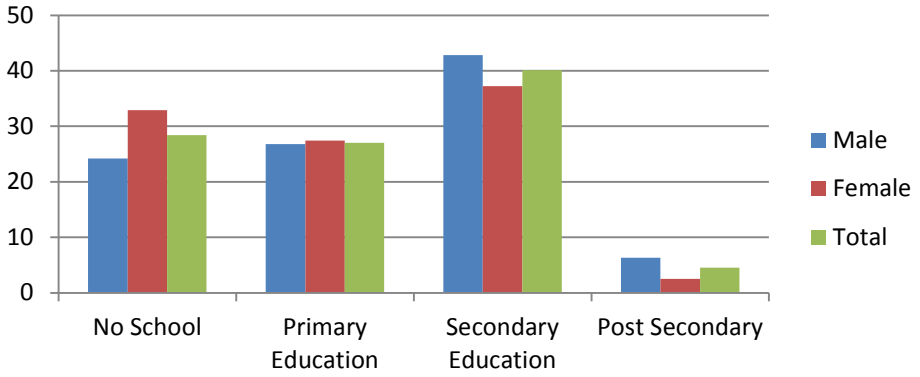



**Figure 4 - Literacy rates and education level, by sex**

Interestingly, if the gender bias was previously true (and remains true for the adult generation), the bias is not existing for the younger generation. On the contrary, 98% of the girls are literate in the 12 to 18 years old group versus 94% of the boys; this difference is significant at less than 5%. The same pattern appears for the 5 to 12 years old group for whom the girls are more likely to have primary education than boys. However, considering higher level of education, secondary and then post-secondary level, the women are less represented. This means that even if girls seems to have a better level of education than their mothers and can for most of them read and write and access to primary education, the gap remains for accessing higher level of education. From the secondary level of education, investments are required from the household (school fees, transport, hosing…) and these investments are most likely done for boys than for girls.

### 2.1.3. Temporal migrations

In the demography roster, one question asked if the member slept in the household the night before the interview. Considering that an household member is settle in the household for at least 6 months on the year, the negative answers to that question correspond to temporal migrant. Almost 7% of the surveyed individuals were in that situation, one quarter of the households have at least one temporal migrant among their members.

| | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43/2F | TOTAL |
|---|---|---|---|---|---|---|---|
| Percentage of temporal migrants | 3.5 | 9.2 | 7.6 | 6.4 | 6.3 | 8.5 | 6.9 |
| Percentage of temporal migrants for work | 2.41 | 6.7 | 1.2 | 2.4 | 2.9 | 5.2 | 3.5 |

**Table 7 - Seasonal migration, by location**

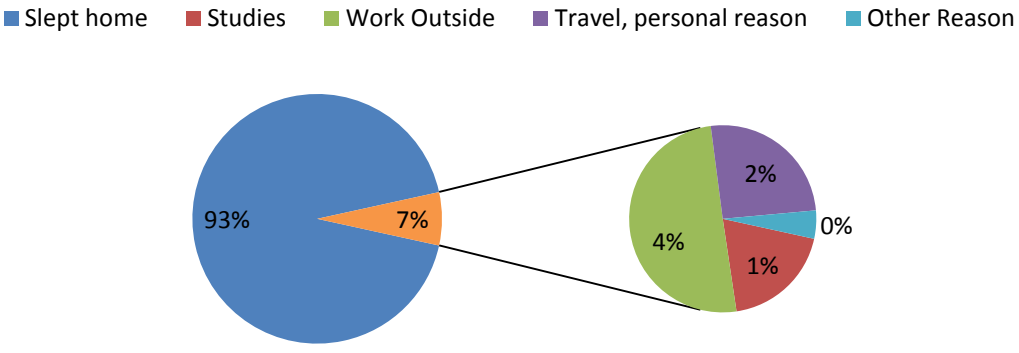



**Figure 5 - Seasonal migration and reasons**

While desegregating the average per location, it seems that more rural and remote areas have a larger number of migrant. This makes sense considering the reason for migrating. The first of these reasons is

the work (seasonal work) and the second is studies. Both of these reasons will happen more frequently when the member is located in a village far from non-agricultural job opportunities and education hubs. On the contrary, Jabusha which is located at few kilometres from Khulna and which have good opportunities of industrial works has the lowest percentage of temporal migrants.

It has to be underlined that even if these figures of temporal migration seems to be high, these data have been collected in January and it is likely that the dry season few month later would have shown even higher figures.

| | Male | Female | T-test of difference (p-value) | TOTAL |
|---|---|---|---|---|
| Percentage of temporal migrants | 9.35 | 4.3 | 0.000 | 6.91 |
| Percentage of temporal migrants for work | 5.66 | 1.08 | 0.000 | 3.45 |

**Table 8 - Seasonal migration, by gender**

The practice is nevertheless mainly masculine; women temporal migrants are two time less than men temporal migrants. And when women are out of their households it is rarely for working or studying but mostly for traveling in their family. Migration out of the polders and villages areas for seasonal work is indeed a common phenomenon in Coastal Bangladesh, but the practice is dominated by men, whereas women most of the time remains at home to take care of the house and of the family in the absence of men.

## 2.2. Poverty levels

In the household questionnaire, it has been decided not to collect the household expenditures. Indeed, this type of survey requires time for collecting adequate answers; in addition, bias and errors in the data are often non negligible. The poverty level of the household is then captured through other indicators which are not only financial: housing characteristics, possession of durable assets, productive assets used for aquaculture, agriculture and other income generating activities.

These indicators are multidimensional; it would consequently be difficult to achieve a comprehensive vision using an analysis of each of these variables. The solution usually followed is to build from these multidimensional variables a score that ranks the poverty level of the household. The method chosen here is the Principal Component Analysis (PCA). Each variable is assigned a weight (scoring factor) which then allows building a global indicator (wealth index). This indicator locates each household in comparison to the other households from the sample, it provides information on the level of household wealth in comparison with others. It is then not an absolute level of poverty but a relative poverty level. Households with the highest scores are the wealthier, while those with the lowest scores are on the contrary the poorest from this sample. Here, three composite indicators are considered to reflect several elements of household wealth: housing index, domestic assets index and productive assets index.

### 2.2.1. Housing characteristics and housing index

The housing conditions translate the life condition of the household but are also a way to understand the wealth of the household. Then in a context where the number of assets owned by a household can be small, the house is often the most important ownership of the household.

Even if all the villages surveyed are located in the same area of Coastal Bangladesh, very clear housing differences can be noticed. For example, the walls of the houses are mainly made by bricks or cement in polder 3 or in Jabusha (55.7% and 56.9% respectively), whereas they are made of earth in Latabunia and

in polder 30 (37.5% and 49.3% respectively); on the contrary metal sheets dominate in polder 43-2F (76.4%) and Jainkati (77.8%). These characteristic reflect the cultural uses of these areas but also show economic differences and different patterns in terms of market accessibility.

Most of the time (79.9%), earth is the only floor of the houses, this is true for all the locations. Then, having tiles, a concrete floor or at least some carpets is a sign showing the wealth of the household. Jabusha which is the most urbanized of the villages is also the one with the highest proportion of houses with tiles or flooring (48.7%).

| In percentage | TOTAL | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F |
|---|---|---|---|---|---|---|---|
| **WALLS of the house** | | | | | | | |
| Straw | 12.11 | 16.46 | 2.78 | 35 | 5.71 | 18.93 | 8.45 |
| Earth | 25.53 | 10.13 | 2.78 | 37.5 | 31.43 | 49.29 | 1.76 |
| Plastic, fabrics | 0.4 | 2.53 | 0 | 0 | 0.71 | 0 | 0 |
| Pricks, cement | 27.03 | 56.96 | 8.33 | 12.5 | 55.71 | 18.57 | 3.17 |
| Metal sheet | 28.33 | 10.13 | 77.78 | 10 | 1.79 | 7.5 | 76.41 |
| Wood | 6.51 | 3.8 | 8.33 | 2.5 | 4.64 | 5.71 | 10.21 |
| Other | 0.1 | 0 | 0 | 2.5 | 0 | 0 | 0 |
| **FLOOR of the house** | | | | | | | |
| Earth | 79.98 | 48.75 | 91.67 | 90 | 67.03 | 81.43 | 97.18 |
| Straw, carpet | 4 | 1.25 | 0 | 10 | 5.38 | 6.79 | 0.35 |
| Cement, concrete | 15.22 | 0 | 8.33 | 0 | 25.45 | 11.79 | 2.11 |
| Tiles, flooring | 0.6 | 48.75 | 0 | 0 | 2.15 | 0 | 0 |
| Other | 0.2 | 1.25 | 0 | 0 | 0 | 0 | 0.35 |
| **ROOF of the house** | | | | | | | |
| Straw | 15 | 3.75 | 0 | 25 | 13.21 | 34.64 | 1.06 |
| Plastic sheet | 0.3 | 0 | 0 | 0 | 0 | 0.71 | 0.35 |
| Metal sheet | 66.6 | 85 | 97.22 | 65 | 37.86 | 56.43 | 96.13 |
| Tiling | 9.2 | 0 | 0 | 0 | 30.71 | 2.14 | 0 |
| Other | 8.9 | 11.25 | 2.78 | 10 | 18.21 | 6.07 | 2.46 |
| **LATRINE used by the household** | | | | | | | |
| Sanitary | 18.09 | 40.51 | 19.44 | 2.5 | 32.62 | 12.9 | 4.61 |
| Traditional | 8.94 | 3.8 | 5.56 | 15 | 10.39 | 4.3 | 13.12 |
| Ring slab | 70.25 | 54.43 | 75 | 77.5 | 54.84 | 80.29 | 78.37 |
| No toilet | 2.41 | 0 | 0 | 5 | 1.79 | 2.51 | 3.55 |
| Other | 0.3 | 1.27 | 0 | 0 | 0.36 | 0 | 0.35 |

**Table 9 - Main materials of the houses and type of latrine, by location**

Considering the sanitation facilities, 70% of the houses are equipped with a ring slab, the second option is then sanitary, which is again quite common in polder 3 (32.6 % of the houses) and in Jabusha (40.51%).

Using these housing characteristics, the first indicator created through PCA is a housing index, this index gives information on the quality of life of the household and on the quality of housing. Seven indicators are included in this index:

- House with a level,
- Number of other buildings or houses owned by the household in addition to the main house,
- House with brick walls,
- House with a concrete floor
- House with a solid roof (tiles or metal sheets)
- House with its own tubewell
- House with sanitary or slab latrine.

It addition, these indicators correspond to costly house improvements which give an idea of the economic ability of the household to invest in its own well-being.

| | TOTAL | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F |
|---|---|---|---|---|---|---|---|
| Percentage of households who own a house with a level | 0.20 | 0.09 | 0.17 | 0.00 | 0.09 | 0.06 | 0.51 |
| Average number of other buildings owned by the household | 1.99 | 1.84 | 1.39 | 2.43 | 1.94 | 2.48 | 1.62 |
| Percentage of households who own a house with bricks walls | 0.55 | 0.66 | 0.86 | 0.23 | 0.58 | 0.26 | 0.80 |
| Percentage of households who own a house with concrete soil | 0.36 | 0.50 | 0.28 | 0.00 | 0.45 | 0.32 | 0.14 |
| Percentage of households who own a house with solide roof (tiles, metal sheets) | 0.76 | 0.85 | 0.97 | 0.65 | 0.69 | 0.59 | 0.96 |
| Percentage of households who own a tubewell | 0.21 | 0.59 | 0.17 | 0.00 | 0.30 | 0.15 | 0.12 |
| Percentage of households who own a house with sanitary or ring slab latrine acess | 0.88 | 0.94 | 0.94 | 0.80 | 0.87 | 0.93 | 0.82 |

**Table 10 - Indicators from the housing index, by location**

Using these seven indicators, the PCA gives a score for each of the 1000 households from the sample[4]. From this score, the sample is then split into three groups, each group is almost one third of the sample. So the first group gathers the households with the highest scores of housing index; similarly, the third group assembles households with the lowest scores and consequently the households with the worst housing condition, the second group is the one with medium level households in terms of their housing conditions.

We then consider the repartition of these three groups by location (Tables 11).

| | TOTAL | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F |
|---|---|---|---|---|---|---|---|
| 1st group | 34 | 53.75 | 36.11 | 2.5 | 37.5 | 20.71 | 42.25 |
| 2nd group | 30.7 | 28.75 | 50 | 27.5 | 29.64 | 20 | 40.85 |
| 3rd group | 35.3 | 17.5 | 13.89 | 70 | 32.86 | 59.29 | 16.9 |

**Table 11 - Category of housing index, by location**

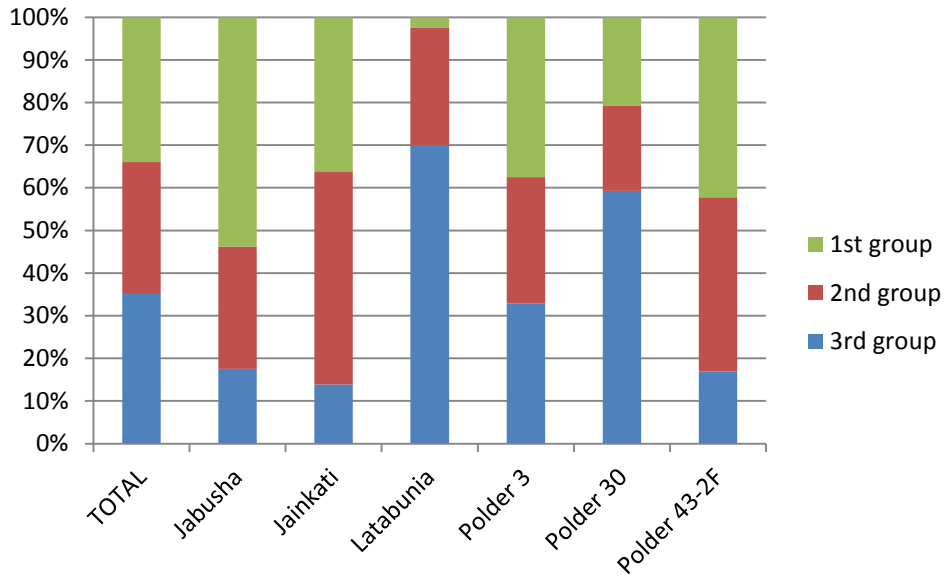



**Figure 6 - Category of housing index, by location**

Jabusha sub-project concentrate the highest proportion of households from the first group in terms of housing assets which makes sense since the area is much more urbanized than the other locations. On the contrary, Latabunia which is also very rural and far from main roads and main markets has 70% of its households classified in the last group. Other locations are somewhere in the space in between these two extremes. Polder 3 has the most balanced repartition of its households within the three groups.

[4] The scoring factors of each indicator included in this principal component analysis are given in Annexe 2.

### 2.2.2. Domestic assets index

The second index is a domestic assets index. The indicators are household assets used for daily life, leisure or transport. These items are durable goods purchased or granted year after year, this index consequently shows the medium/long term situation of the households. In addition, these items can most of the time be sold in case of problem or urgency, it is then also a way to understand the level of vulnerability of these households and how they would be able to face any shock. The items included in the list are both very common items own by most of the households (chair, table, *khat*, bicycle) and rare or luxury items (sofa, CD or DVD player, motorcycle), this is required to build a satisfactory index.

| | TOTAL | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F |
|---|---|---|---|---|---|---|---|
| Khat, palong | 0.49 | 0.76 | 0.42 | 0.55 | 0.58 | 0.55 | 0.26 |
| Chair | 0.78 | 0.85 | 0.92 | 0.65 | 0.78 | 0.68 | 0.85 |
| Table, desk | 0.69 | 0.84 | 0.78 | 0.68 | 0.69 | 0.67 | 0.65 |
| Sofa | 0.02 | 0.03 | 0.08 | 0.00 | 0.02 | 0.02 | 0.01 |
| Almira | 0.27 | 0.35 | 0.25 | 0.18 | 0.38 | 0.25 | 0.16 |
| Alna | 0.54 | 0.79 | 0.58 | 0.53 | 0.61 | 0.59 | 0.35 |
| Showcase | 0.35 | 0.48 | 0.44 | 0.33 | 0.50 | 0.28 | 0.22 |
| Wooden box | 0.24 | 0.21 | 0.22 | 0.30 | 0.21 | 0.31 | 0.20 |
| Steel trunk | 0.58 | 0.59 | 0.47 | 0.80 | 0.57 | 0.65 | 0.51 |
| Electric fans | 0.26 | 0.54 | 0.42 | 0.05 | 0.35 | 0.25 | 0.11 |
| Radio | 0.19 | 0.13 | 0.08 | 0.33 | 0.19 | 0.26 | 0.14 |
| Cassettes player | 0.04 | 0.04 | 0.03 | 0.05 | 0.08 | 0.03 | 0.01 |
| CD player | 0.06 | 0.13 | 0.03 | 0.10 | 0.08 | 0.06 | 0.02 |
| DVD player | 0.03 | 0.03 | 0.11 | 0.00 | 0.05 | 0.04 | 0.01 |
| Television | 0.29 | 0.56 | 0.50 | 0.33 | 0.36 | 0.29 | 0.12 |
| Sewing machine | 0.09 | 0.18 | 0.08 | 0.10 | 0.11 | 0.08 | 0.06 |
| Wrist machine | 0.35 | 0.43 | 0.44 | 0.30 | 0.38 | 0.39 | 0.25 |
| Mobile phone | 0.87 | 0.91 | 0.92 | 0.95 | 0.90 | 0.85 | 0.83 |
| Bicycle | 0.46 | 0.51 | 0.42 | 0.38 | 0.73 | 0.47 | 0.19 |
| Motorcycle | 0.07 | 0.08 | 0.00 | 0.03 | 0.14 | 0.04 | 0.04 |

**Table 12 - Indicators from the domestic assets index, by location**

As previously, the score is generated through the PCA and then the households are disaggregated into three groups according to the level of their score for this domestic assets index.

| | TOTAL | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F |
|---|---|---|---|---|---|---|---|
| 1st group | 34 | 63.75 | 44.44 | 30 | 45.36 | 32.86 | 14.79 |
| 2nd group | 32.8 | 28.75 | 25 | 45 | 33.93 | 35.71 | 29.23 |
| 3rd group | 33.2 | 7.5 | 30.56 | 25 | 20.71 | 31.43 | 55.99 |

**Table 13 - Category of domestic assets index, by location**

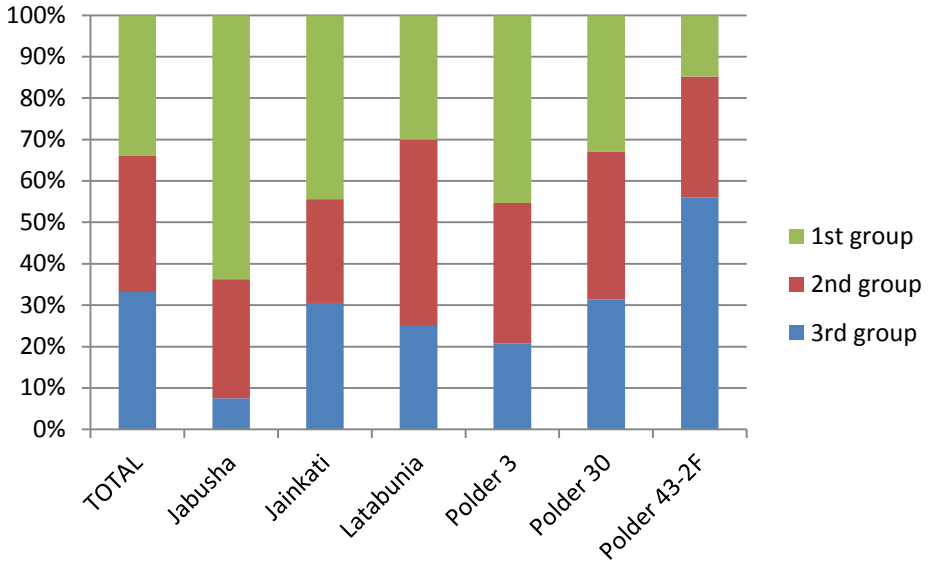



**Figure 7 - Category of domestic assets index, by location**

Again, Jabusha is the location with the highest number of households in the first group which means with the better access to domestic assets. This result is consistent with the previous findings from Jabusha. On the other side, polder 43-2F has 60% of the surveyed households in the group 3, which is the group with the lowest scores in terms of domestic assets. The other locations are more or less in the same situation. Interestingly, Latabunia which had the highest number of household with bad housing condition is in an intermediate position in terms of domestic assets.

### 2.2.3. Productive assets index

The last composite index is based on the productive assets owned by the household. The assets included in the list are related to agriculture, aquaculture and livestock:

- Access to water: deep or shallow tubewell, treadle pump, hand tubewell;
- Access to energy: diesel pump, solar panel;
- Agricultural equipment and level of mechanisation: plough, tractor, spray machine, husking machine;
- Transport facilities: rickchaw, rickshaw van, boat;
- Livestock and poultry: cow, calf, buffalo, goat, sheep, chicken, duck, goose.

This productive assets index describes the current situation of the household in terms of agriculture and livestock assets, but it is also an indicator of the household productive capacity. The household with the better scores for this index should consequently be households with better chances of improving their situation in the future.

| | TOTAL | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F |
|---|---|---|---|---|---|---|---|
| Deep tubewell | 0.11 | 0.26 | 0.14 | 0.03 | 0.12 | 0.11 | 0.06 |
| Shallow tubewell | 0.09 | 0.20 | 0.06 | 0.30 | 0.14 | 0.05 | 0.02 |
| Treadle pump | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| Hand tubewell | 0.10 | 0.20 | 0.03 | 0.08 | 0.21 | 0.05 | 0.03 |
| Diesel pump | 0.10 | 0.00 | 0.03 | 0.10 | 0.15 | 0.17 | 0.01 |
| Solar panel | 0.20 | 0.01 | 0.19 | 0.35 | 0.19 | 0.15 | 0.30 |
| Plough | 0.11 | 0.03 | 0.22 | 0.10 | 0.04 | 0.06 | 0.24 |
| Tractor | 0.05 | 0.00 | 0.03 | 0.03 | 0.01 | 0.10 | 0.04 |
| Spray machine | 0.16 | 0.03 | 0.14 | 0.33 | 0.20 | 0.23 | 0.07 |
| Husking machine | 0.04 | 0.00 | 0.00 | 0.05 | 0.05 | 0.05 | 0.03 |
| Rickshaw | 0.01 | 0.01 | 0.06 | 0.00 | 0.01 | 0.03 | 0.01 |
| Rickshaw van | 0.07 | 0.08 | 0.00 | 0.03 | 0.08 | 0.15 | 0.01 |
| Bark, small boat | 0.04 | 0.00 | 0.00 | 0.05 | 0.03 | 0.07 | 0.02 |
| Bullock | 0.22 | 0.20 | 0.17 | 0.40 | 0.20 | 0.22 | 0.24 |
| Cow | 0.52 | 0.34 | 0.75 | 0.63 | 0.41 | 0.61 | 0.55 |
| Calf | 0.26 | 0.14 | 0.50 | 0.40 | 0.18 | 0.28 | 0.30 |
| Buffalo | 0.01 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.02 |
| Goat | 0.25 | 0.18 | 0.11 | 0.15 | 0.41 | 0.23 | 0.19 |
| Sheep | 0.04 | 0.00 | 0.03 | 0.50 | 0.01 | 0.03 | 0.01 |
| Chicken | 0.67 | 0.60 | 0.47 | 0.80 | 0.60 | 0.67 | 0.77 |
| Duck | 0.55 | 0.36 | 0.56 | 0.65 | 0.50 | 0.61 | 0.60 |
| Goose | 0.09 | 0.05 | 0.03 | 0.13 | 0.07 | 0.15 | 0.06 |

**Table 14 - Indicators from the productive assets index, by location**

| | TOTAL | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F |
|---|---|---|---|---|---|---|---|
| 1st group | 34 | 12.5 | 41.67 | 57.5 | 25 | 40.71 | 38.03 |
| 2nd group | 34.5 | 33.75 | 38.89 | 20 | 37.14 | 32.5 | 35.56 |
| 3rd group | 31.5 | 53.75 | 19.44 | 22.5 | 37.86 | 26.79 | 26.41 |

**Table 15 - Category of productive assets index, by location**

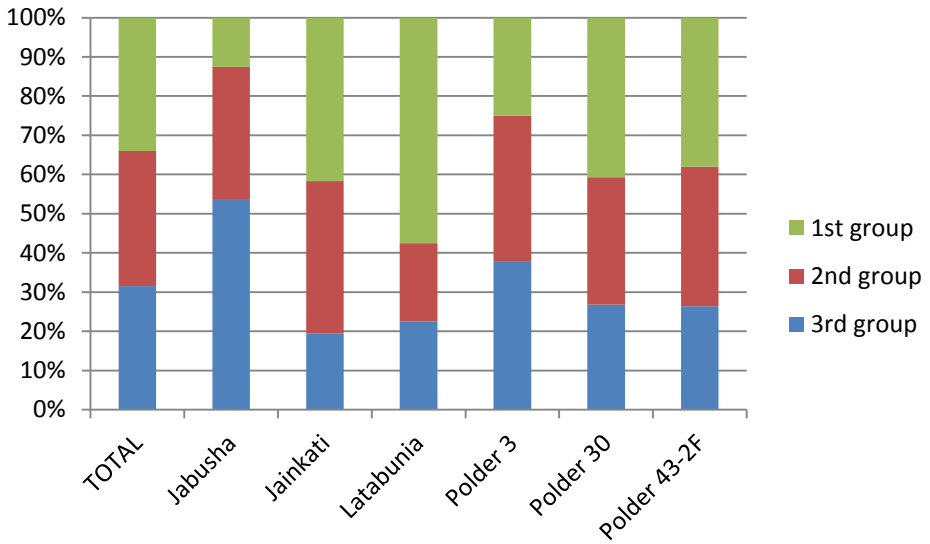



**Figure 8 - Category of productive assets index, by location**

The score produced by the PCA draws a very interesting picture. Contrary to the previous indexes, the household from Jabusha are mainly (53.7% of them) located in the third group considering their

productive assets. This result establishes the low investments in agriculture and livestock activities by the households from Jabusha since they have access to other sources of income through the presence of industries and the proximity with Khulna city. But then Latabunia or polder 43-2F which are much more remote areas have a larger number of their households in the first group with a higher number of agro-pastoral assets. This clearly denotes that for these households agriculture and subsequent activities concentrate their main investments and are their main (and almost unique) source of income and food security.

### 2.2.4. Food security and agricultural dependence

Information on the stock of cereals kept at home at the time of the survey and on the source of the paddy used for consumption has been collected for each household. These are used to estimate the food security of the households but more than that help to understand the dependency on agriculture.

| | Percentage of households who rely on their stock all the year long | Percentage of households who buy paddy all the year long | Duration of the paddy stock in 2012, in months [a] |
|---|---|---|---|
| Jabusha | 15 | 61.3 | 8.1 |
| Jainkati | 30.6 | 19.4 | 8.1 |
| Latabunia | 42.5 | 5.0 | 8.9 |
| Polder 3 | 17.1 | 57.1 | 8.5 |
| Polder 30 | 33.6 | 27.9 | 9.2 |
| Polder 43-2F | 25.7 | 29.6 | 8.3 |
| TOTAL | 25.5 | 38.0 | 8.6 |

(a) Calculated only for those who had stock in 2012.

**Table 16 - Paddy stock, paddy buying and duration of the stocks by location**

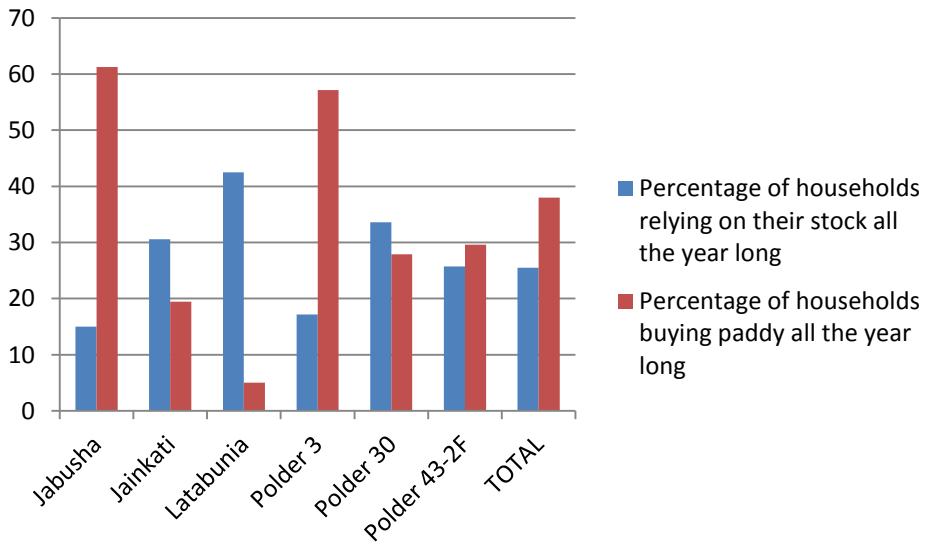



**Figure 9 - Paddy stock and paddy buying, by location**

Considering the whole sample, 25.5% of the households rely on their own production of paddy for their consumption all the yearlong, which mean that they never buy any rice. On the contrary, 38% of the households buy paddy all the yearlong for their consumption; they are consequently dependant from the market prices for their food security. However, through the desegregation of the figures by location, it is clear that villages where households rely on their own stock all the year are also villages more dependant from agriculture. It is then possible that these households have limited cash income available from other activities and don't have any other choice than relying on their own production to secure their food

intake. Then, in polder 3 or in Jabusha, which are areas with opportunities out of agriculture, households don't need to rely on their stock for their consumption and can easily access to the market.

In Latabunia, 42.5% of the inhabitants use their own stock of paddy all the year. This village is naturally highly saline and located in a low-lying area, shrimp culture consequently took an important place. But by understanding the dependence on the paddy harvest for the food security of these households, we better understand the conflicts between paddy and shrimp in the village, all the more that shrimp cultivation is done through leasing of the land and consequently doesn't really mean cash income for the household settled in the village.

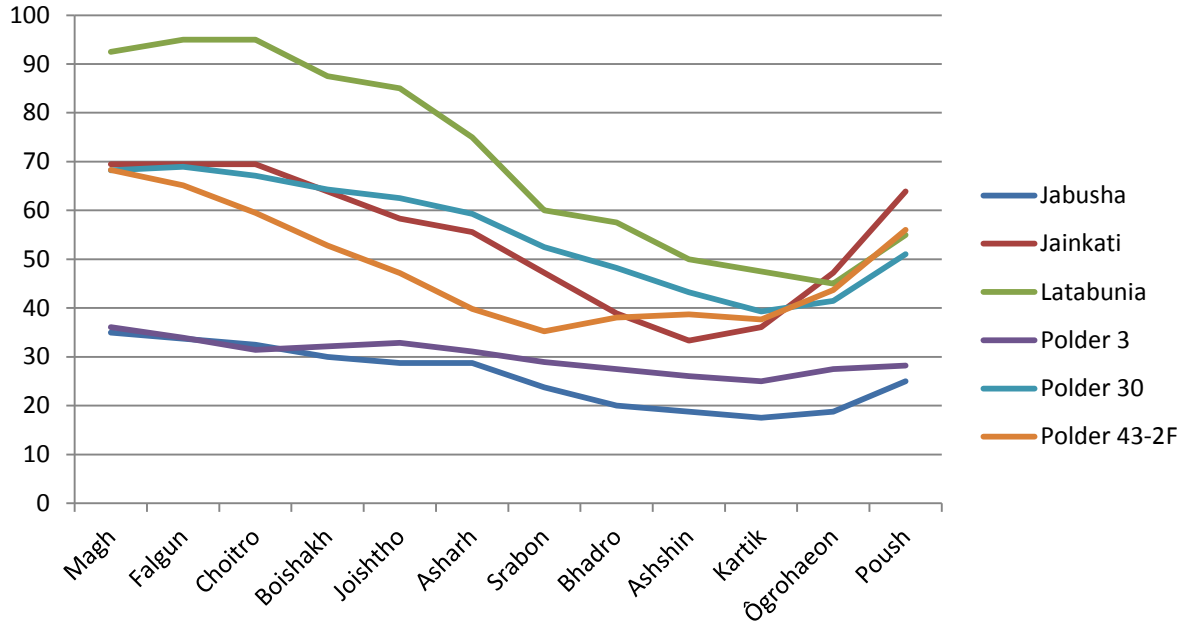



**Figure 10 - Percentage of household using their own production of paddy for cooking, by month (Bengali) and location**

These questions also allow understanding the lean cycle of the vulnerability for households who cannot rely on their stock for few months of the year whereas their financial access to the market is limited. Household consuming their own production can do so for eight and half months on average, which would mean a lean season of three and half months. Through the figure 7, it is clear that the lean season does almost not exist in polder 3 and in Jabusha, since the percentage of households using their stock for cooking remains stable all the year. The lean season is shorter (but probably more acute) for location more dependent on agriculture as polder 3 (stock duration of 9.2 months) or Latabunia (stock duration of 8.9 months) . Through the same figure, it can be noticed that lean season mainly occurs between August and November, so before the harvest of the *kharif* season. Then the end of the lean season is coming earlier in polder 43-2F and Jainkati than in Latabunia and polder 30. Polder 43-2F and Jainkati are localized at the east of the coastal zone in a less saline area, so the *aus* paddy may be harvested earlier and so ends the lean season earlier than in other west areas.

## 2.3. Domestic water uses

Are considered as domestic water uses are all the uses of water for a household daily life. Obviously drinking water is likely to be the more important of these uses considering the health consequences but water uses for cooking, bathing, cleaning should also be considered. Here not only the access but also the quality of the water (salinity, arsenic contamination) is essential.

| | TOTAL | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F |
|---|---|---|---|---|---|---|---|
| **Main source of water for drinking** | | | | | | | |
| Own tubewell | 21.4 | 58.7 | 16.7 | 0.0 | 30.4 | 15.0 | 11.9 |
| Government tubewell | 30.8 | 13.7 | 27.8 | 70.0 | 18.9 | 48.2 | 25.0 |
| Other tubewell | 33.4 | 18.7 | 47.2 | 20.0 | 29.6 | 30.4 | 44.4 |
| Network | 12.7 | 7.5 | 8.3 | 10.0 | 17.5 | 5.7 | 17.3 |
| Pond | 1.0 | 1.2 | 0.0 | 0.0 | 1.8 | 0.4 | 1.1 |
| Other | 0.7 | 0.0 | 0.0 | 0.0 | 1.8 | 0.4 | 0.3 |
| **Main source of water for bathing** | | | | | | | |
| Own tubewell | 16.5 | 48.7 | 11.1 | 35.0 | 16.1 | 14.3 | 8.1 |
| Government tubewell | 2.9 | 1.2 | 0.0 | 2.5 | 0.0 | 8.9 | 0.7 |
| Other tubewell | 3.3 | 2.5 | 5.6 | 2.5 | 0.4 | 8.9 | 0.7 |
| River | 7.1 | 0.0 | 0.0 | 10.0 | 1.4 | 8.9 | 13.4 |
| Pond | 57.8 | 46.2 | 58.3 | 42.5 | 81.1 | 55.3 | 42.6 |
| Khal | 11.0 | 1.2 | 25.0 | 7.5 | 0.0 | 1.4 | 32.7 |
| Other | 1.4 | 0.0 | 0.0 | 0.0 | 1.1 | 2.1 | 1.8 |

**Table 17 - Main source of water for domestic uses, by location**

The first statistics on the source of water used for drinking show the prevalence of the tubewells. This establishes the success of the investment policy in the 90s to reduce the health consequences due to use of ponds for drinking and cooking. Now, on average 85% of the households from our sample drink water from tubewells. These tubewells can be tubewells owned by the household himself, government tubewells or tubewells owned by other households allowing them to use it. In addition, network and water pipes are used in some areas, this kind of equipment have been mainly installed where the in-situ water was not proper for consumption due to arsenic contamination or salinity. Then few households are still drinking water from ponds (Jabusha, polder 3), they might be using filter to clean this water but the quality of these filters is most of the time questionable.

If drinking water is mainly coming from tubewells, on the contrary households still rely on other sources for other domestic uses. For example ponds is the most common source of water for bathing, this can also be replaced by *khals* or rivers (polder 43-2F), these sources of surface water are closer, the access is easier and at no cost (direct or indirect). However, the intensive use of pond water for multiple domestic uses, whereas the water is cleaned up only once a year through the monsoon rains is an issue which should be raised.

| | TOTAL | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F |
|---|---|---|---|---|---|---|---|
| **Distance from the source of drinking water, in km** | 0.530 | 0.544 | 0.194 | 1.278 | 1.164 | 0.271 | 0.269 |
| **Time required for fetching drinking water, in minutes** | 22.4 | 16.7 | 13.7 | 54.3 | 35.6 | 15.8 | 16.3 |
| **Transport used for fetching drinking water** | | | | | | | |
| Walking | 92.9 | 89.9 | 100.0 | 92.5 | 82.0 | 96.8 | 99.7 |
| Van | 4.4 | 8.9 | 0.0 | 2.5 | 10.5 | 2.5 | 0.0 |
| Boat | 0.5 | 0.0 | 0.0 | 5.0 | 0.7 | 0.4 | 0.0 |
| Motorcycle | 0.7 | 1.3 | 0.0 | 0.0 | 1.8 | 0.0 | 0.4 |
| Other | 1.5 | 0.0 | 0.0 | 0.0 | 5.1 | 0.4 | 0.0 |
| **Percentage of households with a male responsible for fetching drinking water** | 10.58 | 10.67 | 5.71 | 10 | 13.58 | 5.86 | 13.26 |

*Note: Distance and time are calculated only for household without in-house tubewell or network.*

**Table 18 - Distance and time for accessing drinking water, by location**

On average, household can access to drinking water at around 500 meters from their own home, which takes them around 20 minutes between the time they leave their place and the time they are back with water. However, below these figures clear differences are hidden, and for some villages the source of drinking water is quite far. This is especially the case in polder 3 and in Latabunia, both are highly saline areas where water salinity may explain that the household need to go far away to find drinking water. This is not true for all the villages in polder 3, but some are in a pretty bad situation as Kharhat or Naua Para for example.

However the situations in Latabunia and in polder 3 are not exactly the same, indeed if the distance to cross for finding drinking water is on average almost similar the time to do so is not the same. The main reason is that more households in polder 3 can use vans to carry water home (10.5%). Considering all the locations, there is a clear relation between the distance of the drinking water source and the transport used, the further is the source, the lowest is the proportion of households going to fetch water by walking.

Drinking water in itself is most of the time free, only 5.8% of the household surveyed declared that they have to pay for water, but the cost is very low and correspond to fees collected by owners of tubewells or owner of the water network if any. But when households need to use van, boat or motorcycle for bringing water back home, the cost of transport has to be considered. 46.1% of the households who are not fetching water by walking pay a direct transport cost, which runs from 5 to 25 taka per day.

We then consider who in the household is responsible for bringing drinking water home. If the task is obviously mainly feminized we still find male carrying this task in 10.5% of our sampled households. This phenomenon is occurring in all the locations even if it is less developed in polder 30 (5.9%) and Jainkati (5.7%).
But then whereas woman fetching water are most likely (72%) the wife of the head of the household, his daughter (7%) or his daughter in law, then men fetching drinking water are in half of the case the head of the household itself or his son (40%).

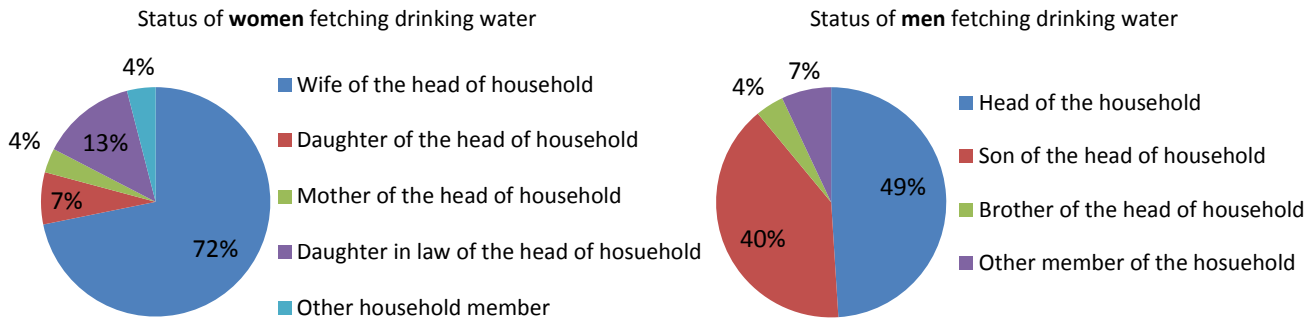



**Figure 11 - Status of the household member fetching drinking water, by sex**

| | Male | Female | Ttest of difference *P-value* |
|---|---|---|---|
| Average age of the member fetching drinking water | 33.83 | 35.48 | *0.2206* |
| Average distance of drinking water | 0.93 | 0.265 | *0.000* |
| Average time for drinking water | 32.13 | 15.61329 | *0.000* |

**Table 19 - Age, distance and time for fetching drinking water, by sex**

The assumption considering that male fetching drinking water might be younger than female, which would have meant that boys were sent for bringing back home water is rejected through the t-test of difference (Table 19). However, what is clearly established is that male are more likely to be responsible for taking care of drinking water when the distance of the source is further and when the time required for doing so is longer. On average, women are fetching drinking water at 260 meters from their home whereas men are going at 900 meters, and the double of time is required. These two differences are highly significant. So it seems that the unavailability of drinking water close the house, leads to unloading this women task to men. If this weakens the burden of women chores, in the cultural context of Bangladesh that might also mean that women are not allowed to move too far away from their house. The lack of drinking water access then consequently reduces the area of their responsibility and their source of social interactions out of the household.

## 2.4. Main activities

The household included in the sample were randomly selected within each village, their economic activities consequently reflect the economic activities in practice in these villages. Here we desegregate these activities by agriculture, aquaculture, agriculture and aquaculture and other non-agricultural activities. For each household this activity is considered as the main source of income, which doesn't mean that other activities are not in practise (see section 2.8 on other income generating activities).

On average, 30% of the surveyed households are not involved in agriculture or aquaculture. Jabusha is the location with the highest percentage of this group of households which is consistent with the proximity to Khulna city and the presence of a certain number of industries in the sub-project. Then it has to be noticed that combining agriculture and aquaculture is not uncommon. This is the usual system in Latabunia, but this is also well developed in polder 3, polder 30 and even in polder 43-2F. This kind of livelihood is consequently found in very different locations in terms of water quality (salinity level).

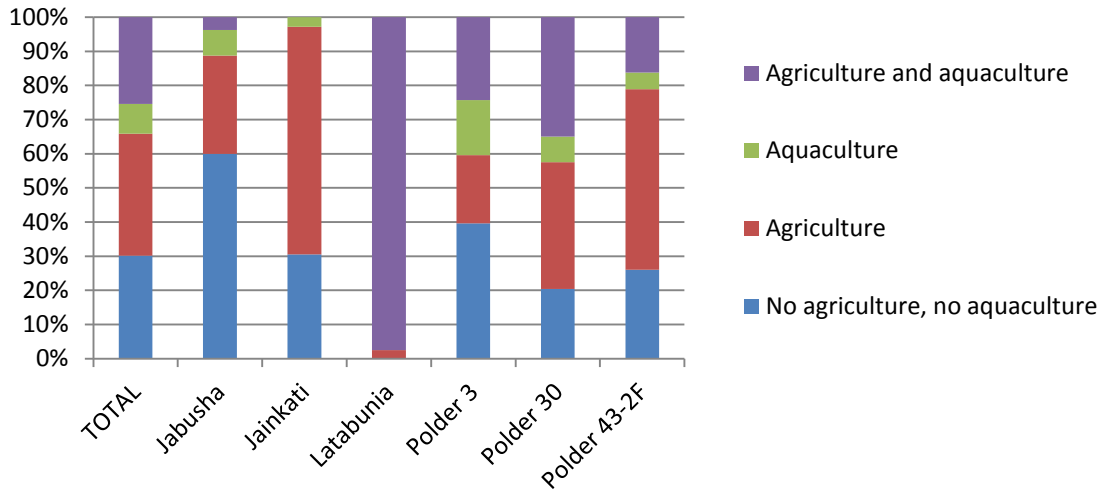



**Table 20 - Main economic activity, by location**

## 2.5. Land

### 2.5.1. Landless

The first thing which needs to be emphasized when considering agriculture, aquaculture and related water management choices in the Coastal zone is that one quarter of the households from the area are landless. In our sample, we found an average of 30.3% of landless but it may be due to the inclusion of two villages with refugees households in polder 30 (Kismat Phultala and Gagramari). We here consider as landless, an household who doesn't have ownership of any agricultural land, or ponds, or orchard. Pure landless are then households who don't even own their dwelling area. By excluding the two villages with refugees from polder 30, we found 1.9% of pure landless in our sample. These households are most of the time occupying river banks without any legal status.

| | TOTAL | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F |
|---|---|---|---|---|---|---|---|
| Percentage of landless households | 30.3 | 47.5 | 11.1 | 7.5 | 38.6 | 28.6 | 24.6 |
| Percentage of pure landless households | 4 | 1.2 | 0.0 | 2.5 | 2.5 | 10.4 | 0.7 |

**Table 21 - Percentage of landless, by location**

Most of these landless household (65.7%) are not involved in agriculture or in aquaculture. But then more than one third of these landless households still rely on agriculture and aquaculture, they consequently need to access land through share-cropping or leasing. For example, in Latabunia, all the landless households are involved in aquaculture.

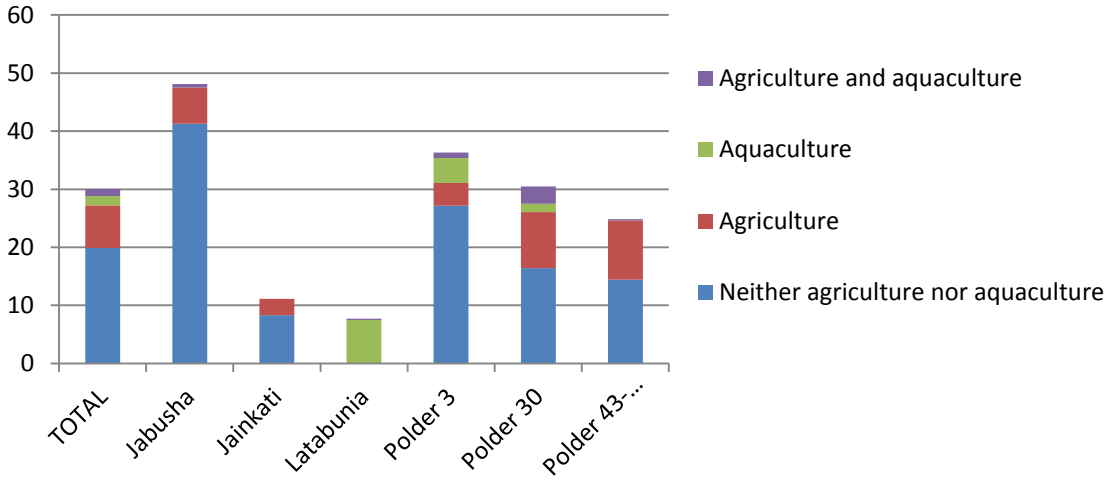



**Table 22 - Percentage of landless households by location and activities**

### 2.5.2. Land holding and land distribution

One of the main characteristics of the land holding in coastal zone is the small land holding by household and consequently the small size of the plots cultivated. From the households practising agriculture or aquaculture, 34.7% are marginal farmers cultivating less than 0.5 acres. Marginal and small farmers are the most important group in all the locations excepted for Latabunia where there is almost no marginal farmer.

| | Marginal farmer (less than 0.5 acres) | Small farmer (0.5 - 1.49 acres) | Medium farmer (1.5 - 2.49 acres) | Large farmer (more than 2.5 acres) |
|---|---|---|---|---|
| TOTAL | 34.7 | 29.29 | 16.35 | 19.66 |
| Jabusha | 55.7 | 21.52 | 10.13 | 12.66 |
| Jainkati | 38.89 | 44.44 | 2.78 | 13.89 |
| Latabunia | 2.5 | 32.5 | 27.5 | 37.5 |
| Polder 3 | 44.96 | 23.74 | 11.87 | 19.42 |
| Polder 30 | 28.93 | 27.5 | 18.93 | 24.64 |
| Polder 43-2F | 28.52 | 36.27 | 20.07 | 15.14 |
| Neither agriculture nor aquaculture | 80.94 | 8.7 | 3.34 | 7.02 |
| Agriculture | 14.85 | 48.18 | 20.73 | 16.25 |
| Aquaculture | 41.38 | 28.74 | 11.49 | 18.39 |
| Agriculture and aquaculture | 5.91 | 27.17 | 27.17 | 39.76 |

**Table 23 - Land size holding of farmers, by location and by activity**

Considering the activity and the area used by the household, it appears that marginal farmers are more likely to do aquaculture than agriculture; this might mean that land size requirements for aquaculture are lower than for agriculture. However, considering large farmers, 39.8% of them are doing both agriculture and aquaculture, so somehow their large land area is used to diversify their activities.

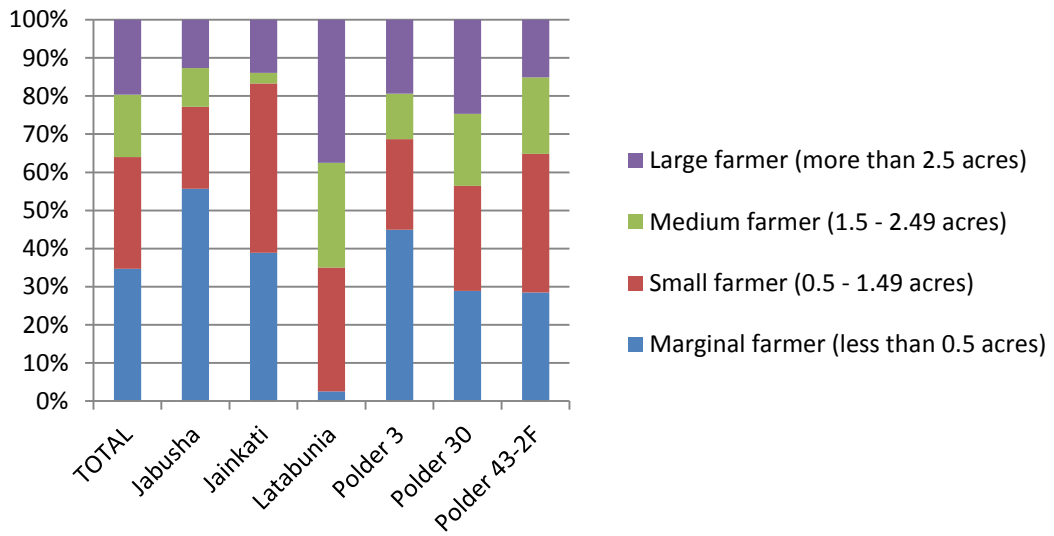



**Figure 12 - Land holding, by location**

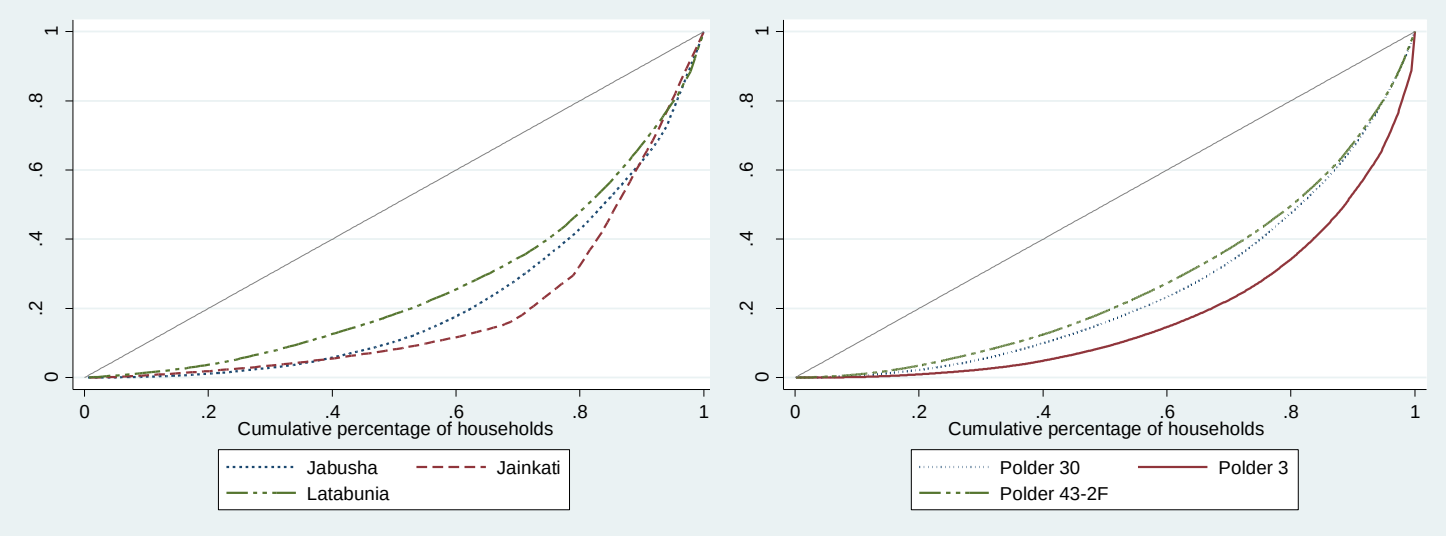



**Figure 13 - Distribution of operated land, by location, Lorenz curves**

The distribution of operated land is characterized by clear inequalities. Indeed, 60% of the household work on 20% of the land operated in our sample. Medium and large farmers are few in number but operate the larger part of the cultivable land. Within the sub-projects, inequalities are deeper in Jainkati, where land ownership is clearly dominated by few families of landowners. Similarly, within polders, polder 3 is the one with more inequalities in land distribution, especially at the top end, 10% of the households operate 40% of the land available.

| | Average number of plots operated per household |
|---|---|
| TOTAL | 4.2 |
| Jabusha | 3.0 |
| Jainkati | 4.4 |
| Latabunia | 4.3 |
| Polder 3 | 3.4 |
| Polder 30 | 4.5 |
| Polder 43-2F | 4.8 |

**Table 24 - Average number of plots operated per household, by location**

Another clear insight from the land holding in the area is the crumbling of the plots. Each farmer will cultivate several very tiny plots. Few figures are given through the above table (Table 24), but these figures might underestimate the phenomena as respondents were reluctant to list all their plots.

### 2.5.3. Land market

Through the survey detailed information on the plots have been collected, the following descriptive statistics are based on a sample of 3,037 plots. From these plots, 23.4% are not directly used by the household who own the plots. Interestingly, the lease-in system is more common than the share-cropping system, this is true both for plots used for agriculture and aquaculture. Nevertheless, the sharecropping system is almost non-existent for aquaculture practices. Contrary to what is though, aquaculture is not mainly based on leased plots, on the contrary, the use of its own plot for doing aquaculture is more common than for doing agriculture (72.1% versus 61.0%).

| Status of the plot | Agriculture | Aquaculture | Agriculture and aquaculture | TOTAL |
|---|---|---|---|---|
| Own and operated used by the household | 61.0 | 72.1 | 67.5 | 76.6 |
| Leased in | 14.1 | 17.8 | 23.3 | 9.4 |
| Shared-cropping in | 12.5 | 0.5 | 4.2 | 5.7 |
| Leased out | 8.4 | 8.2 | 4.2 | 5.0 |
| Shared-cropping out | 3.7 | 0.5 | 0.0 | 1.7 |
| Occupied | 0.2 | 0.7 | 0.8 | 1.2 |
| Others | 0.2 | 0.3 | 0.0 | 0.4 |

**Table 25 - Land market by activities**

Seasonal agreements for land use are very rare; on the contrary, most of the land exchanges (86.1%) are based on annual agreements. As a consequence, most of the leasers or share croppers have a short term insurance on the plot use and this might explain limited investments. Then, agreements from 2 to 5 years are more usual when the plot is suitable for aquaculture, which is consistent with the investments requirements for aquaculture.

| | TOTAL | Plot suitable for aquaculture | Plot suitable for agriculture |
|---|---|---|---|
| Land agreement - 1 year | 86.1 | 75.17 | 89.34 |
| Land agreement – 2 to5 years | 11.38 | 22.07 | 8.18 |
| Land agreement - More than 5 year | 2.53 | 2.76 | 2.44 |

**Table 26 - Length of the renting agreement of the plots, by activity**

The prices of the leasing (or the equivalent price in case of share-cropping) have been collected. On average, the price of land would be almost 200 BDT per year per decimal. But behind this average, many differences appear depending on the location or on the use of the plot. Indeed, plots used for aquaculture are rented at a higher price than plots used for agriculture, there is almost 50 BDT of difference per decimal and the difference is highly significant. The location also matters. Jainkati which doesn't have any aquaculture is however the location with the highest cost of land lease, 280 BDT per decimal per year. On the contrary, in Jabusha where agriculture is not such an important activity on terms of livelihoods, the price is the lowest.

| | TOTAL | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F |
|---|---|---|---|---|---|---|---|
| Price of land leasing per decimal, per year, in BDT | 199.3 | 108.8 | 282.6 | 170.9 | 252.9 | 189.8 | 162.2 |
| Price of land leasing per decimal, per year, plots **for aquaculture,** in BDT | 239.8 | | | 170.9 | 236.3 | 231.8 | |
| Price of land leasing per decimal, per year, plots **for agriculture,** in BDT | 186.8 | 108.8 | 282.6 | | 276.6 | 183.8 | 162.2 |

**Table 27 - Price of land leasing, by location and activity on the plot**

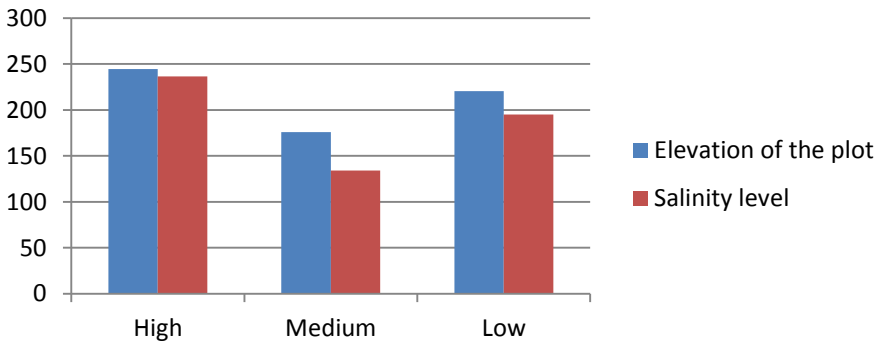



**Figure 14 - Renting value of the plots, per decimal and per year, in BDT**

The cost of the plot is also related to the quality of the plot in terms of elevation and salinity. In both the case, the plots with lower prices are in an intermediate situation in terms of elevation and salinity. Plots in highland are more valuable for agriculture which explains their higher price, but then plots in low lying areas are suitable for aquaculture which gives them almost the same value. The same trend is followed with the salinity level, the plots with a low level of salinity are rented at a higher price considering that they will be better for agriculture, but then the price of plots with a high level of salinity is also quite high considering their suitability for fish cultivation.

Finally, plots with an annual rent agreement have a much lower price (184 BDT per decimal, per year) than plots with a longer terms agreement (257 BDT per decimal, per year), this difference is highly significant through a t-test of difference. Consequently, it seems that the stability and the reduction of risk or uncertainty related to a longer term agreements have to be paid through a higher price.

### 2.5.4. Land use

In Bangladesh, three main agricultural seasons can be considered: *kharif* 1, *kharif* 2 and *rabi*. *Kharif* 1 is the pre-monsoon season, from April to July. *Kharif 2* is then the most important season, mostly dedicated to paddy (Aus) from July to December, this season follows the monsoon and requires almost no irrigation. Then, r*abi* is the dry season, from December to April and requires irrigation. If a cropping intensity of 300% is possible in some areas it also remains difficult because of the irrigation constraints and of the salinity level. These three seasons are relevant for agriculture but not for aquaculture since most of the species can be cultivated all the yearlong as far as fresh water can be introduced into the ponds. Here we consider the use of the plot, which might be for agriculture and for aquaculture, it is consequently not the cropping intensity of the plot but more the intensity of the plot use.

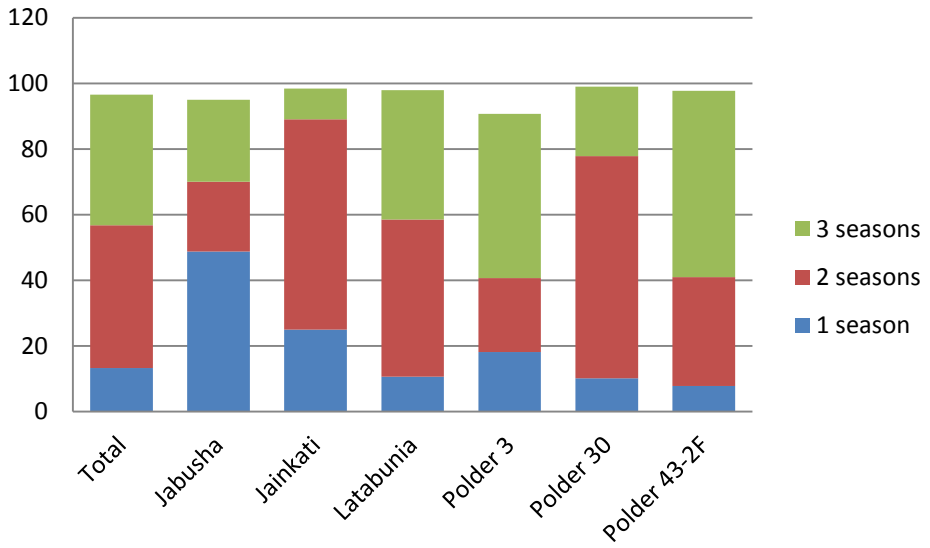



**Figure 15 - Percentage of plots operated for 1, 2 or 3 seasons per location**

This is in polder 43-2F which is mainly dependant on agriculture and which has a lower level of salinity that the highest number of plots can be used for three seasons, this is consistent with the agro-ecological situation of the area. In Jainkati and in polder 30, farmers mostly use their plot for 2 seasons. In polder 3, the plots are operated mostly for 3 seasons but this is mainly due to aquaculture activities. In Jabusha, 48.7% of the plots are used for one season only whereas the agro-ecological conditions would allow for 2 or 3 seasons. This result confirms the low importance of agriculture in Jabusha and the presence of other sources of income. In this sub-project, the plots are cultivated in *kharif* 2 to bring the paddy harvest used for own consumption but then other activities are practiced to bring cash income the rest of the year.

| | Percentage of plots operated in each season | | |
|---|---|---|---|
| | *Kharif 1* | *Kharif 2* | *Rabi* |
| TOTAL | 48.0 | 92.3 | 80.1 |
| Jabusha | 26.3 | 92.5 | 47.5 |
| Jainkati | 9.4 | 93.8 | 78.1 |
| Latabunia | 61.2 | 94.9 | 70.2 |
| Polder 3 | 58.1 | 80.2 | 75.1 |
| Polder 30 | 24.3 | 95.3 | 89.8 |
| Polder 43-2F | 69.1 | 96.3 | 79.8 |

**Table 28 - Percentage of plots cultivated in each season, by location**

While considering how the plots are used, the agriculture remains the first activity. This is true in all the locations of our sample, at different range. In polder 3, agriculture and aquaculture are at the same level, 41.2% of the plots are used for agriculture and 40.3% for aquaculture. In all the locations, at least few plots are kept for aquaculture, even when the level of salinity is low, this is consistent with the usual cultivation if fishes in the household ponds and with the Bangladeshi food habits. Latabunia is in a particular shape as most of the plots are used both for aquaculture and for agriculture. The intake of fresh water by the monsoon is used for cultivating paddy whereas the fishes are kept in the field, the rest of the year the plots can be considered as ponds used for fish or *bagda* cultivation.

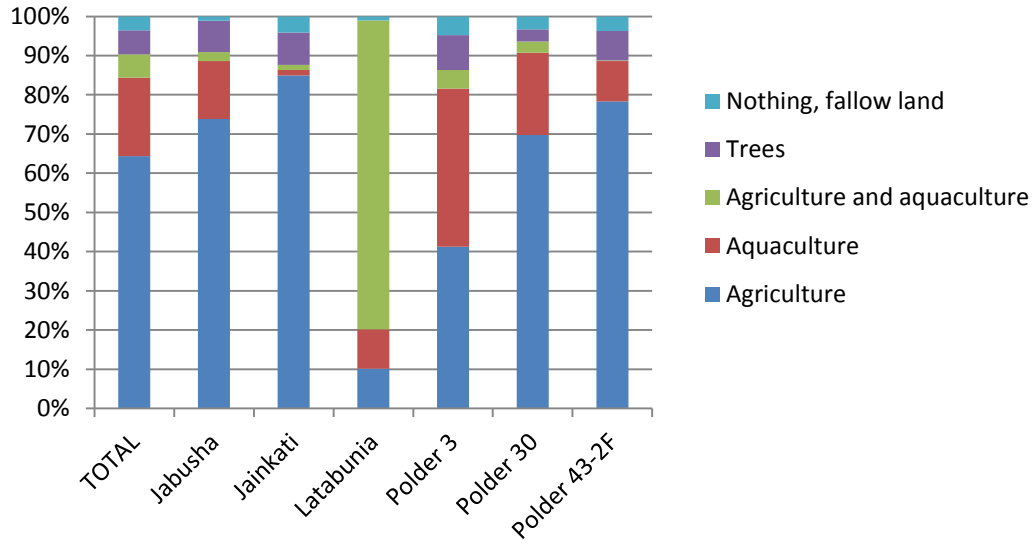



**Table 29 - Plots uses by location**

### 2.5.5. Characteristics of the plots

For each plot, the household was asked to rate the elevation and the salinity level of the plot. The statistic consequently didn't really reflect the real condition of the plot but the perception by the farmers as compared with the nearby areas.

In terms of elevation, most of the farmers consider their plot as being in a high elevated area. Interestingly, in Latabunia 43.3% of the plot were considered as low-lying and 24.4% were in the same category in polder 3. The high elevation of the plots in Jainkati and polder 43-2F is confirmed by the data on the salinity level, almost none of the plots from these location were categorized with a high level of salinity. This is again in Labunia and in polder 3 that high levels of salinity were likely to be recorded.

| | TOTAL | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F |
|---|---|---|---|---|---|---|---|
| **Elevation of the plot** | | | | | | | |
| High | 42.4 | 55.8 | 63.3 | 23.2 | 51.2 | 37.9 | 38.4 |
| Medium | 41.5 | 32.1 | 35.8 | 33.3 | 24.4 | 46.3 | 52.8 |
| Low | 16.1 | 12.1 | 0.9 | 43.5 | 24.4 | 15.9 | 8.9 |
| **Salinity level of the plot** | | | | | | | |
| High | 9.2 | 1.2 | 0.0 | 54.1 | 26.8 | 0.8 | 0.3 |
| Medium | 3.9 | 1.9 | 0.0 | 16.3 | 8.7 | 1.9 | 1.4 |
| Low | 86.8 | 96.9 | 100.0 | 29.6 | 64.5 | 97.3 | 98.3 |

**Table 30 - Elevation and salinity levels of the plots, by location**

## 2.6. Cropping patterns

### 2.6.1. Agriculture, aquaculture and intensity of plot uses

In this part of Bangladesh the hydrological conditions explain the ability of the household to develop a particular cropping system which mixes agriculture and aquaculture. A same farmer can be involved in both of these activities, but a same plot can also be used for producing both crops and fishes. Indeed, from the sampled plots, 70.3% are used only for agriculture, 22.3% are only for aquaculture whereas 7.4% are both for agriculture and aquaculture.

Plots uses obviously largely depend from the hydrology of the village, from the distance to the rivers and canals and from the elevation. In Latabunia, which is a low-lying village in an area with a moderate level of salinity, 74.4% of the plots were used both for agriculture and aquaculture in 2012. Polder 3 then counts the higher number of plots used only for aquaculture, which is consistent with a higher degree of salinity. On the contrary, in Jainkati and polder 43-2F the plots are mainly used for agriculture and aquaculture occurs only in a small number of cases, this is due to a higher elevation and to a low level of salinity.

| | | TOTAL | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F |
|---|---|---|---|---|---|---|---|---|
| **Plots for agriculture** | | **70.3** | **83.0** | **97.4** | **15.9** | **50.5** | **71.9** | **87.0** |
| *Including:* | 1 crop | 26.1 | 75.0 | 24.3 | 92.3 | 42.3 | 18.8 | 19.4 |
| | 2 crop | 48.8 | 25.0 | 59.5 | 7.7 | 34.9 | 74.7 | 34.2 |
| | 3 crops | 25.1 | 0.0 | 16.2 | 0.0 | 22.8 | 6.5 | 46.4 |
| **Plots for aquaculture** | | **22.3** | **17.0** | **2.6** | **9.8** | **42.4** | **23.4** | **12.8** |
| *Including:* | 1 fish | 27.0 | | | | 40.8 | 21.6 | 8.3 |
| | Mixed fish | 73.0 | 100.0 | | | 59.2 | 78.4 | 91.7 |
| **Plots for agriculture and aquaculture** | | **7.4** | **0.0** | **0.0** | **74.4** | **7.1** | **4.7** | **0.2** |
| *Including:* | 1 crop | 92.5 | 0.0 | 0.0 | 100.0 | 81.0 | 82.6 | 100.0 |
| | 2 crops | 7.6 | 0.0 | 0.0 | 0.0 | 19.1 | 17.4 | 0.0 |

**Table 31 - Plot uses, agriculture, aquaculture or both, by location**

The intensity of plots uses is then measured by the number of crops per plot. On average, 48.8% of the plots dedicated to agriculture will produce two crops. However, in polder 43-2F, 46.4% of the plots will be used for three seasons, and in Jabusha 83.0% of the plots will be used only once a year. These results confirm the importance of agriculture in polder 43-2F in terms of food security, whereas agriculture is not the main activity on Jabusha, where landowners use their plot only for one crop and have additional activities.

Also in aquaculture, the choice can be made between a single fish or mixed fishes. However, as far as producing several fishes don't have any negative impact on the production of shrimps (*bagda*) or prawns

(*golda*) (which are the main fish cultures in terms of income), 73.0% of the plots dedicated to aquaculture welcome several species of fishes.
When the plot is used both for agriculture and aquaculture, it is generally difficult to have more than one crop, however few household succeed in using their plots for 2 crops and for fishes.

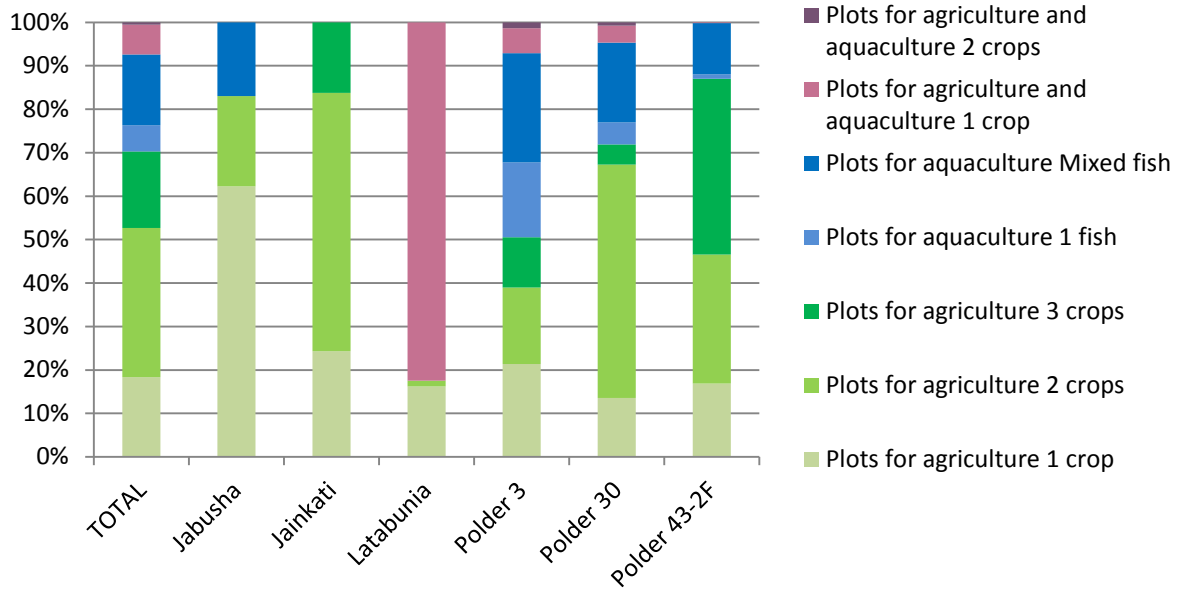



**Figure 16 - Plot uses, agriculture, aquaculture and number of crops and fishes, by location**

### 2.6.2. Cropping systems

Given the diversity of the hydro-ecological conditions, we find in this sample a diversity of cropping systems. However, one similarity across the different areas and across the different cropping choices is the *aman* cultivation during the monsoon season (*kharif 2*). Whatever the number of seasons the plot is cultivated, a very small number of plots are not used for producing *aman*.

When we then consider the plots used for agricultural purpose with only one crop per year, 55.5% of these plots will be used for *aman* paddy and 11.8% for *boro* paddy. Then betel leave cultivation is quite common in polder 43-2F, these plots produce a single crop but they are used all the yearlong since betel leave is an annual crop.
When the agricultural plots are used for 2 crops, *aman* is associated with another crop. In polder 30, it is mainly an *aman*/sesame system, in polder 3 it is mainly an *aman*/*boro* system, and Jainkati's farmers mainly go for an aman/pulses system. These different choices are mainly due to the hydrological conditions. For example, the lack of water in winter and in dry season in polder 30 explains the adoption of sesame which requires a low level of humidity. On the contrary, the access to irrigation through groundwater in polder 3 makes the choice of *boro* paddy possible.
Only 25.1% of the plots from our sample are used for a three crops system, the sample is consequently small and concentrated in few locations. The dominant cropping choice is *aus*/*aman*/pulses, it can be commonly found in Jainkati and in polder 43-2F. The other 3 crops systems found in our sample include *boro* and *aman* paddies, and then either pulses either oil seeds are cultivated in between (*kharif* 1).

Considering the plots used for aquaculture, it is possible to note that when a single fish is cultivated it is mainly *bagda* (86.3%) in polder 3, but mainly *golda* in polder 30. Pangas is then common in polder 43-2F, but other fish species (rui, tilapia) are mostly cultivated with *bagda* and *golda*. The crab cultivation which is said to increase due the increasing level of salinity in the area remains minor and cannot be find outside polder 3.

When agriculture is practiced in the same plot as aquaculture, it is mainly for *aman* which is consequently associated with *bagda*, *golda* or mixed fishes in the rainy season. Then few cases of *boro* cultivation in addition to aquaculture have also been found.

| *Percentage of cropping system in each sub-category.* | | TOTAL | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F |
|---|---|---|---|---|---|---|---|---|
| **AGRICULTURE PLOTS** | | | | | | | | |
| 1 crop | Aman | 55.5 | 75.8 | 55.6 | 100.0 | 55.6 | 55.2 | 40.5 |
| | Boro | 11.8 | 15.2 | | | 28.6 | 9.0 | 2.5 |
| | Betel leaves | 8.8 | 6.1 | | | 3.2 | | 24.1 |
| | Vegetables | 8.4 | | 33.3 | | 3.2 | 6.0 | 16.5 |
| 2 crops | Aman + Sesame | 44.3 | | | | | 81.5 | 0.7 |
| | Aman + Boro | 18.0 | 0.6 | | | 66.1 | 3.0 | 26.6 |
| | Aman + Pulses | 10.6 | | 72.7 | | 3.6 | 1.9 | 21.6 |
| | Aman + Oil seed | 3.6 | | | | 1.8 | 11.1 | 1.4 |
| 3 crops | Aus + Aman + Pulses | 48.0 | | 50.0 | | | | 62.4 |
| | Aman + Pulses + Boro | 13.5 | | | | | | 18.0 |
| | Aman + Oilseeds + Boro | 3.6 | | | | 11.8 | | 2.6 |
| **AQUACULTURE PLOTS** | | | | | | | | |
| 1 fish | Bagda | 62.79 | | | | 86.3 | 28.0 | |
| | Tilapia | 4.65 | | | | 3.9 | 4.0 | |
| | Rui | 3.49 | | | | 3.9 | 4.0 | |
| | Golda | 18.6 | | | | | 60.0 | 20.0 |
| | Pangas | 5.81 | | | | | 4.0 | 80.0 |
| Mixed fishes | Bagda + Golda | 3.0 | 12.5 | | | 2.7 | 1.1 | |
| | Bagda + Mixed fishes | 21.9 | | | | 58.1 | 6.6 | |
| | Bagda + Crabs | | | | | 4.1 | | |
| | Golda + Mixed fishes | 7.7 | | | | | 19.8 | |
| | Other mixed fishes | 67.0 | 87.5 | | | 35.1 | 72.5 | 100.0 |
| **AGRI AND AQUA SYSTEM** | | | | | | | | |
| | Aman + Bagda | 36.8 | | | 52.5 | 23.8 | 8.7 | |
| | Boro + Golda | 3.8 | | | | | 17.4 | |
| | Aman + Mixed fishes | 29.2 | | | 41.0 | 23.8 | | |
| | Boro + Mixed fishes | 9.4 | | | 3.3 | 38.1 | | |

**Table 32 - Main cropping patterns and frequency, by location**

The following table (Table 33) gives an overview of the calendar related to these different cropping systems. The starting of the crop corresponds to the month of planting or sowing whereas the end is the month of harvesting. Given the different practices within the areas but also within the farmers, we show the planting at the earliest and at the latest as well as harvesting at the earliest and at the latest.

| *Cropping calendar* | | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **AGRICULTURAL SYSTEM** | | | | | | | | | | | | | |
| **1 crop** | Aman | | | | | | 1 | 1 | 1 | 1 | 1 | | |
| | | | | | | | | 1 | 1 | 1 | 1 | 1 | |
| | | | | | | | | | 1 | 1 | 1 | 1 | 1 |
| | Boro | 1 | 1 | 1 | | | | | | | | | |
| | | | 1 | 1 | 1 | 1 | 1 | | | | | | |
| | Vegetables | 1 | 1 | 1 | | | | | | | | 1 | 1 |
| | | 1 | 1 | 1 | 1 | | | | | | | | 1 |
| | | 1 | 1 | 1 | 1 | 1 | | | | | | | |
| **2 crops** | Aman + Sesame | 2 | 2 | 2 | 2 | | 1 | 1 | 1 | 1 | 1 | 1 | |
| | | | 2 | 2 | 2 | 2 | | 1 | 1 | 1 | 1 | 1 | 1 |
| | | 1 | 2 | 2 | 2 | 2 | 2 | | 1 | 1 | 1 | 1 | 1 |
| | Aman + Boro | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | 1 | 2 | 2 |
| | | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| | | | | | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| | Aman + Pulses | 2 | 2 | 2 | | | 1 | 1 | 1 | 1 | 1 | 2 | 2 |
| | | 2 | 2 | 2 | 2 | | | 1 | 1 | 1 | 1 | 1 | 2 |
| | | 2 | 2 | 2 | 2 | 2 | | | 1 | 1 | 1 | 1 | 1 |
| | Aman + Oil seed | 2 | 2 | 2 | 2 | 2 | | 1 | 1 | 1 | 1 | 1 | |
| | | | 2 | 2 | 2 | 2 | 2 | | 1 | 1 | 1 | 1 | 1 |
| | | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| **3 crops** | Aus + Aman +Pulses | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 3 |
| | | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 |
| | | 2 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |
| | Aman + Pulses + Boro | 2 | 2 | 2 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | 2 | 2 | 2 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 |
| | | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 1 | 1 | 1 | 1 |
| | Aman + Oilseeds + Boro | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| | | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 2 |
| | | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 |
| **AGRI AND AQUA SYSTEM** | | | | | | | | | | | | | |
| | Aman + Bagda | | | | | | | 1 | 1 | 1 | 1 | 1 | 1 |
| | | | | | | | | | 1 | 1 | 1 | 1 | 1 |
| | | 1 | | | | | | | 1 | 1 | 1 | 1 | 1 |
| | Boro + Golda | 3 | 3 | 3 | 3 | | | | | | | | |
| | | | 3 | 3 | 3 | | | | | | | | |
| | | | 3 | 3 | 3 | 3 | | | | | | | |
| | Aman + Mixed fishes | | | | | | | 1 | 1 | 1 | 1 | 1 | |
| | | | | | | | | | 1 | 1 | 1 | 1 | 1 |
| | | | | | | | | | 1 | 1 | 1 | 1 | 1 |
| | Boro + Mixed fishes | | 3 | 3 | 3 | 3 | | | | | | | |
| | | | | 3 | 3 | 3 | 3 | | | | | | |
| | | | | 3 | 3 | 3 | 3 | | | | | | |

**Table 33 - Calendar of the different cropping systems**

## 2.7. Water uses in agriculture and in aquaculture

### 2.7.1. Irrigation practices in agriculture

By considering the whole sample, 32.1% of the crops from the surveyed household have been irrigated, which means that in addition to the natural humidity of the soil and the rainwater, water has been brought to the crop. When this figure is split by crops, *boro* is obviously the main irrigated crop. Nevertheless it is worth to notice that *aus* is also largely irrigated, in 57.6% of the cases and even *aman* requires irrigation in 20.0% of the plots.

Then, the irrigation patterns are completely different from one location to another. Whereas the agriculture is at 70.7% irrigated in polder 3, in Jainkati which is highly dependent on its agriculture, no more than 13.7% of the crops are irrigated. Polder 3 clearly shows a different path as it seems that irrigation is required for almost all the crops in this polder.

| | TOTAL | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F |
|---|---|---|---|---|---|---|---|
| TOTAL | 32.1 | 29.0 | 13.7 | 9.8 | 70.7 | 17.2 | 30.3 |
| Aman | 20.0 | 4.4 | 4.6 | 5.1 | 44.3 | 15.5 | 17.9 |
| Sesame | 2.1 | | | | 2.1 | | |
| Boro | 77.6 | 80.0 | | | 94.0 | 84.6 | 48.9 |
| Aus | 57.6 | | 33.3 | | 90.9 | | 51.4 |
| Pulses | 8.9 | | 0.0 | | 15.8 | | 7.4 |
| Oil seeds | 34.5 | | | | 86.7 | 7.7 | 25.0 |
| Betel leaves | 72.2 | | | | | | 72.2 |

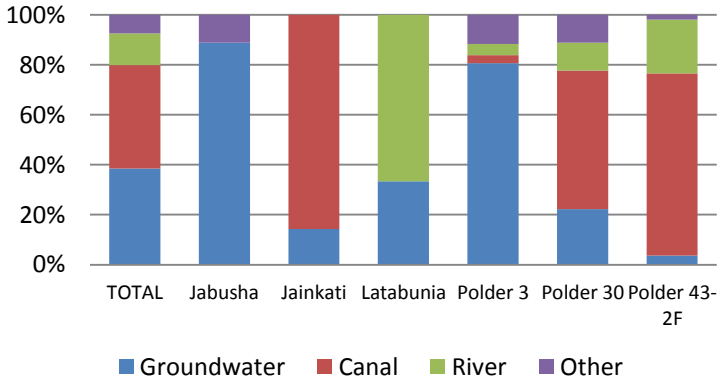
**Table 34 - Percentage of crop irrigated, by crops and by location**

In this polder area, water bodies are numerous and surface water is never very far; however, when investigating the source of water used for irrigation, groundwater is used for 38.5% of the crops. Canal and river water are then as expected the first source of irrigation, but this is not true everywhere. For example, polder 3 is relying at 80.6% on groundwater irrigation and the canals and rivers are almost not used for this purpose, the same thing is happening in Latabunia and in Jabusha. On the contrary, in polder 43-2F or Jainkati, farmers are using the canals as the primary source of irrigation. Canals are supposed to be the veins of the polders and aim to bring water in and out of the polders. At least two reasons can explain that the canals are not used for irrigation. The first reason is related to the quality of the water in the canal and to its level of salinity. If canals are supposed to stock fresh water to be used for agriculture, the canals are also used for aquaculture including in dry season and cannot consequently be used for agriculture. This first problem is related to the management of the canals and of the gates and to the decision making process. The second reason is the quality of the canals themselves and their level of siltation. Silted canals *de facto* are not able to bring enough water for irrigation and are not able to bring the water far enough inside the polder. In polder 3, the fact the canals are not used for irrigation can be explained by these two reasons, in addition, it is clear that influential people related to shrimp culture are using the gates and canal for their private interest and the access to canal water is denied for agriculture. The same problem is occurring in Jabusha, canals are leased for fish cultivation and access to canal is disallowed to farmers. What can be seen here is that when the access to canal is impossible, then farmers have to rely on groundwater.

In the absence of agricultural electric connexion, diesel pump is the main tool used for irrigation. Only Jabusha and few households in polder 3 can rely on electricity for irrigation. Gravitation remains an important system in these areas but is not possible for all the plots and is only possible when surface water is available. Indeed, farmers using groundwater need to use a diesel pump in 85.9% of the cases.

Groundwater use is also costly for farmers. Only 18.6% of the households from our sample have a shallow or deep tubewell (and most of them are used for domestic uses and not for agriculture) and 9.8%

of the households have their own diesel pump. This means that most the groundwater users have to buy their irrigations. This is much more costly than using canal or river water which is free and can be brought through gravitation into the field. For example, the average cost of irrigation for *boro* crop is 47 BDT per decimal by using groundwater through diesel pump, it is costing 22 BDT by using canal water through diesel pump and then the cost is free if the canal water is used through gravitation. Consequently, the inability to use water from canals clearly induces higher costs of cultivation for farmers.



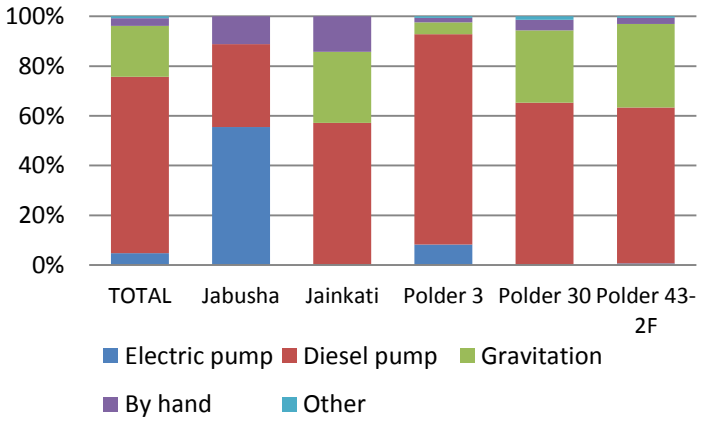




**Table 35 - Source of water used and system used for irrigation in agriculture**

For each crop cultivated by the farmers it has been asked if they consider that they had a water problem with this crop for the last season. 22.7% of them answered positively. By location, Jainkati, polder 3 and polder 43-2F are the location where the positive answers are the most frequently given. By desegregating per crop, *boro* paddy faced water problems in 34.4% of the cases. But interestingly, farmers are also facing water problems when they cultivate *aman* paddy (25.2%), *aus* (22.7%) or oil seeds (15.8%). This is consistent with the reason of the problem they give: water scarcity is the first main problem in all the six locations, far before salinity. This result is baffling in an area with usual excess of water but underlines that the challenge is not on the availability of water but on the access of water and on it management.

### 2.7.2. Drainage practices

Drainage practices are not very prevalent in the coastal zone, indeed in our sample, only 16.3% of the crops have required drainage. Drainage is nevertheless an important tool to consider the intensification of the agriculture system and to allow the adoption of a 3 crops system.

Then, when the figure is disaggregated, it has to be noticed that most of the drainage is done when the plot is used both for aquaculture and agriculture, in this case, 21.9% of the crops are drained versus 12.5% in a pure agricultural system. The practice is more or less commonly spread among the different location even if drainage is logically more usual when agricultural and aquatic systems are more common, this is the case in Latabunia or in polder 3 for example.

| | TOTAL | Jabusha | Jainkati | Latabunia | Polder 3 | Polder 30 | Polder 43-2F |
|---|---|---|---|---|---|---|---|
| TOTAL | 16.3 | | | | | | |
| Agriculture system | 12.5 | 8.8 | 12.2 | | 13.0 | 17.4 | 10.1 |
| Agriculture and aquatic system | 21.9 | | | 48.8 | 27.6 | 19.3 | 12.8 |

**Table 36 - Percentage of crop drained by location and plot use**

Drainage is mainly used for *aman* paddy crop, 40.2% of the plots with *aman* and in mixed system (agriculture and aquaculture) were drained and 21.7% of the *aman* crops in pure agricultural system were drained. This practice confirms the paradox of the area which oscillates between excess of water and scarcity within few weeks.

### 2.7.3. Water uses in aquaculture

Aquaculture is heavily dependent on water, the quality of the water, its level of salinity and its renewal are crucial for the survival of the fishes. The sources of water used for aquaculture differs from one location to another. In polder 30, polder 43-2F and Jabusha, rainwater is the main source of water used for aquaculture, which means that it is mainly fresh fish cultivation. On the contrary, Latabunia and polder 3 rely on water from form the rivers and from the canal, to bring salty water to the ponds. Interestingly, the canals from polder 3, which were used for less than 3.2% of cases for crop irrigation, are used in 31.2% of the cases for bringing water to the ponds. This confirms clearly that the canals are mainly dedicated to aquaculture in that polder and used to bring saline water. The use of groundwater for aquaculture remains minimal excepted in Jabusha.

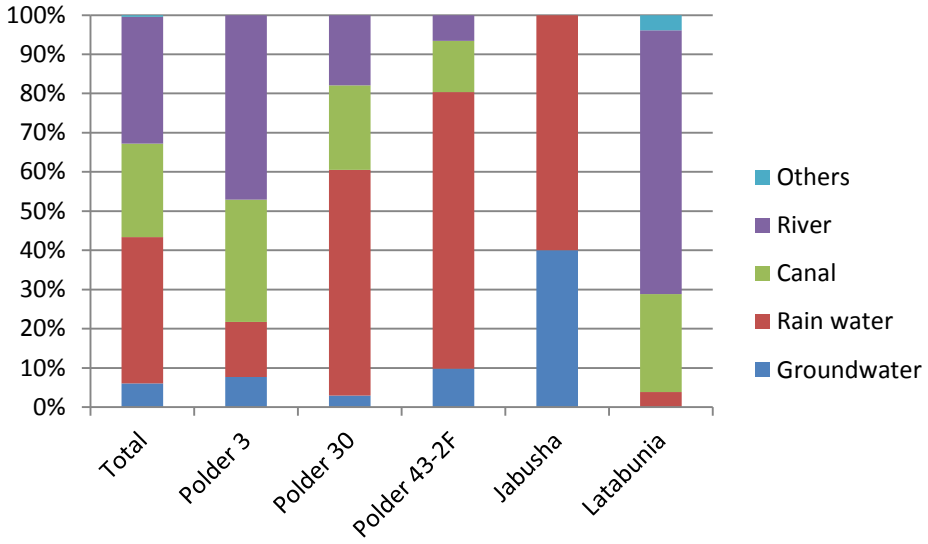



**Figure 17 - Source of water used in aquaculture by location**

The different sources of water from one location to another reflect the different sources of water required by different species of fish. *Bagda* cultivation requires saline water which is consequently brought through canals (35.3%) and rivers (58.8%) through the tide. On the contrary *golda* requires fresh water as well as other species of fishes. In these two cases, rainwater is the main source of water (51.8% for *golda* and 53.6% for ther other fishes) but canals and rivers are also used. Rivers can only be used to bring fresh water in rainy season or in areas with a low level of salinity. Similarly, the use of canals to bring fresh water for example in polder 30 or in polder 43-2F denotes the ability of the communities to manage adequately the canals.

| | ***Bagda*** | ***Golda*** | **Other fishes** | **TOTAL** |
|---|---|---|---|---|
| Groundwater | 2.9 | 7.4 | 7.6 | 6.1 |
| Rain water | 1.5 | 51.9 | 53.6 | 37.3 |
| Canal | 35.3 | 27.8 | 17.0 | 23.9 |
| River | 58.8 | 13.0 | 21.9 | 32.3 |
| Others | 1.5 | 0.0 | 0.0 | 0.4 |

**Table 37 - Source of water for aquaculture, by fish species**

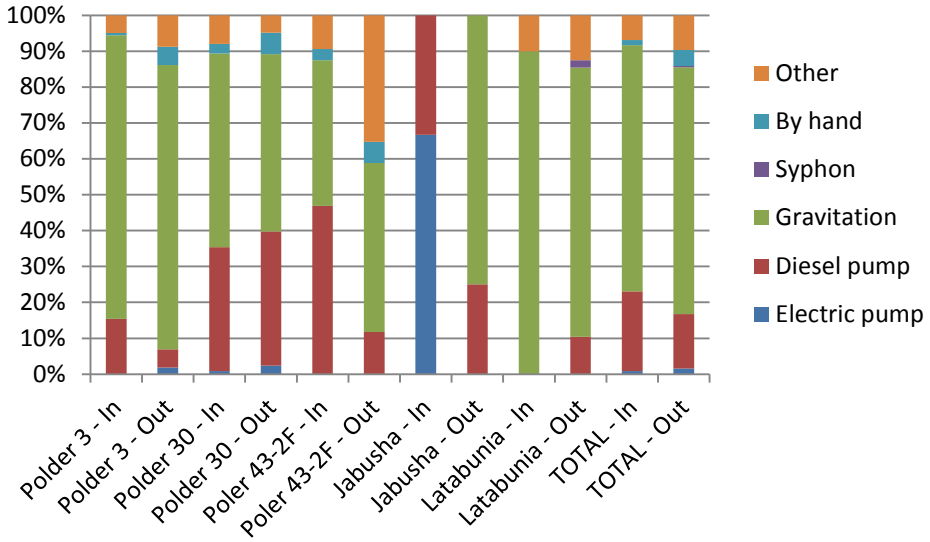



**Table 38 - Systems used to flush water in and out for aquaculture, by location**

The gravitation remains the principal tool used to bring water into the ponds but also to flush out wasted water; diesel pump is then the second mechanism. The use of diesel pump is more important in polder 30 than in other locations, this might be due to the structure of the polder itself which prevent the use of gravitation. In Jabusha, only diesel and electric pumps are used but this is consistent with the use of groundwater, gravitation is then inappropriate.

In 80.1% of the cases the same system is used to flush in and to flush out water. For example, 87.1% of the water which enters into the ponds through gravitation will be flush out through the same system. But when diesel pump is used to bring water to the pond, the same diesel pump is used only in 54.7% of the cases to flush out wasted water. This confirms that when the gravitation system is possible it is always preferred to diesel pumps which are costly. This is all the more important that flushing water in and out is required very often. For example, in our sample on average, new water is brought 37 times per year for *bagda* cultivation, 8 times per year for *golda* and 16 times for the other fishes.

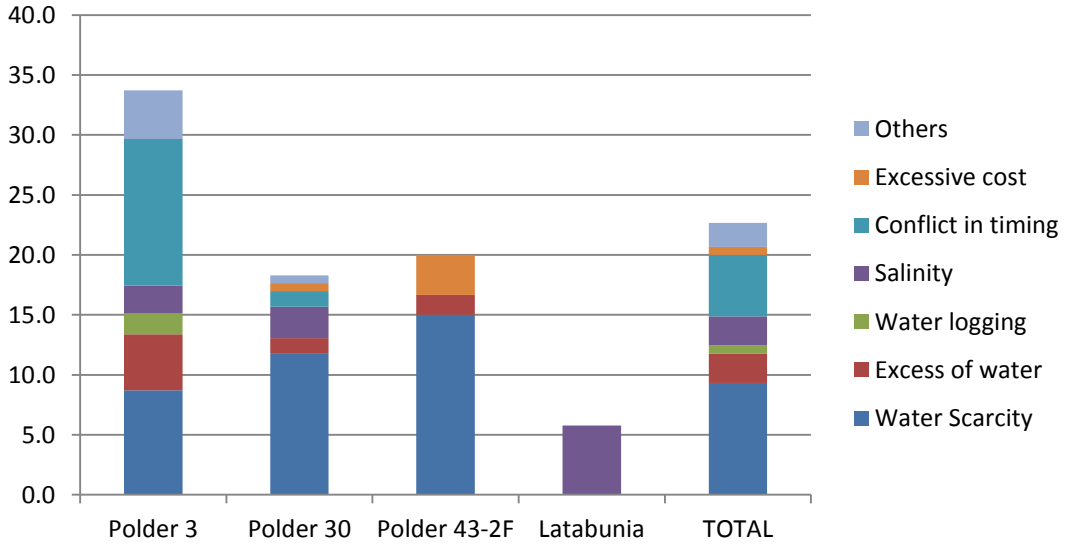



**Figure 18 - Percentage of water problems and reasons, by location**

As for agriculture, it has been asked for each fish cultivated if there was any problem related to water. On average problems have been faced in 22.7% of the cases. Most of the problems are occurring in polder 3 which is maybe the location where the dependence from water for aquaculture is the most important. Interestingly water scarcity is again the main reason given for these problems; this is true both in areas with fresh water uses and in areas with saline water uses. In both cases the challenge is to have access to water.

## 2.8. Livelihoods, income generating activities

This part focuses on Income Generating Activities (IGAs) apart from aquaculture and agriculture. For the households which are not involved in agriculture or aquaculture, these activities are their main source of income. On the contrary for other household these activities come in addition and are a way to diversify the sources of income and to diversify the members involved in such activities. For households practicing agriculture mainly for a self-consumption purpose these activities are also a way to bring cash income to the household to support the essential expenses.

### 2.8.1. Households and income generating activities

In the sample, 84.6% of the households have a least one income generating activity (IGA), the average number is 1.6 activities per household. So, most of the households rely on these activities to generate incomes. These activities are obviously more important for households not involved in agriculture or aquaculture, 94.3% of them have IGAs, and they are also involved in a slightly higher number of activities. Households practicing both agriculture and aquaculture are less often involved in IGAs (74.4%), this is consistent since they already have diversified activities and they may also have constraints in terms of time. Similarly, we notice that the practice if IGAs is decreasing with the size of operated area. Indeed, marginal farmers cannot rely exclusively on agriculture and consequently 95.1% of them have IGAs to bring additional incomes to their household.

As expected it is in Jabusha that the number of households with IGAs is the higher (94.9%), but interestingly Jainkati and polder 43-2F also have a high number of households with this kind of activities. This demonstrates the need for these households to collect cash income apart from agriculture which is mainly for subsistence.

| | Percentage of households with IGA | Average number of IGAs* |
|---|---|---|
| TOTAL | 84.6 | 1.578 |
| Neither agriculture nor aquaculture | 94.3 | 1.656 |
| Agriculture | 82.1 | 1.502 |
| Aquaculture | 90.8 | 1.595 |
| Agriculture and aquaculture | 74.4 | 1.566 |
| Marginal farmer (less than 0.5 acres) | 95.1 | 1.629 |
| Small farmer (0.5 - 1.49 acres) | 85.6 | 1.544 |
| Medium farmer (1.5 - 2.49 acres) | 77.3 | 1.516 |
| Large farmer (more than 2.5 acres) | 70.4 | 1.565 |
| Jabusha | 94.9 | 1.640 |
| Jainkati | 91.7 | 1.394 |
| Latabunia | 67.5 | 1.111 |
| Polder 3 | 79.9 | 1.550 |
| Polder 30 | 81.8 | 1.716 |
| Polder 43-2F | 90.5 | 1.529 |

*Calculated only for households who have at least one activity

**Table 39 - Practice of IGAs, by activity, land area and location**

### 2.8.2. Members and income generating activities

When considering the members involved in these activities, the head of household remain most of the time responsible (55.7%), followed by his son (or daughter) and finally by his spouse. This questions the

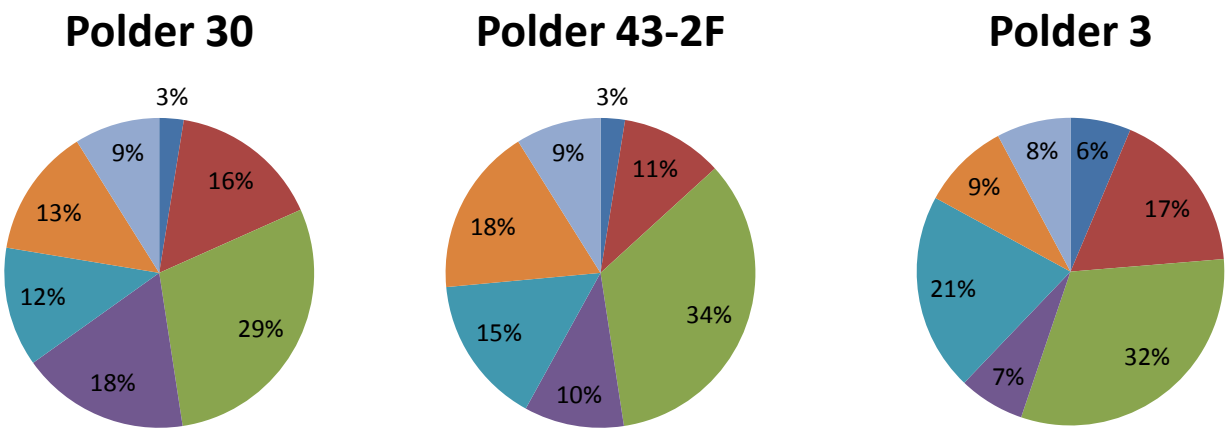
role of diversifying the source of income within the household since the members most probably already involved in agriculture or aquaculture are also responsible for these IGAs.
The gender bias is also clear, 85.8% of the activities are under male responsibility. Indeed, from our sample, 42% of the males are involved in IGAs versus 7.6% of the females. These figures are consistent with the socio-economic status of rural women in Bangladesh who are largely confined to in house domestic chores.

| Who are the members doing IGAs? | | Percentage |
|---|---|---|
| **Status** | Head of household | 55.7 |
| | Spouse of the head of household | 10.3 |
| | Son/daughter | 27.6 |
| | Other | 6.4 |
| **Age** | Less than 16 year old | 1.2 |
| | 16-24 years old | 11.9 |
| | 25-50 years old | 67.6 |
| | More than 50 years old | 19.2 |
| **Sex** | Men | 85.8 |
| | Women | 14.2 |

**Table 40 - Demographic characteristics of the household members involved in IGAs**

### 2.8.3. Type of income generating activities

Activities have been collected through an open list of 36 activities to capture the large diversity of these activities. However, the main way to bring income to the household is to be hired as a labourer for agriculture or for aquaculture. This activity doesn't require any particular training and the wage is low, the mean is 220 BDT per day for men and 130 BDT per day for women. These labourers remain vulnerable: the load of work depends from the land owners and then the work is only seasonal. On the contrary skilled workers (masons, carpenters, rickshaw pullers…) may be more independent and are also more specialized. Then activities related to trade or services are also quite usual, this is especially true in Jabusha.



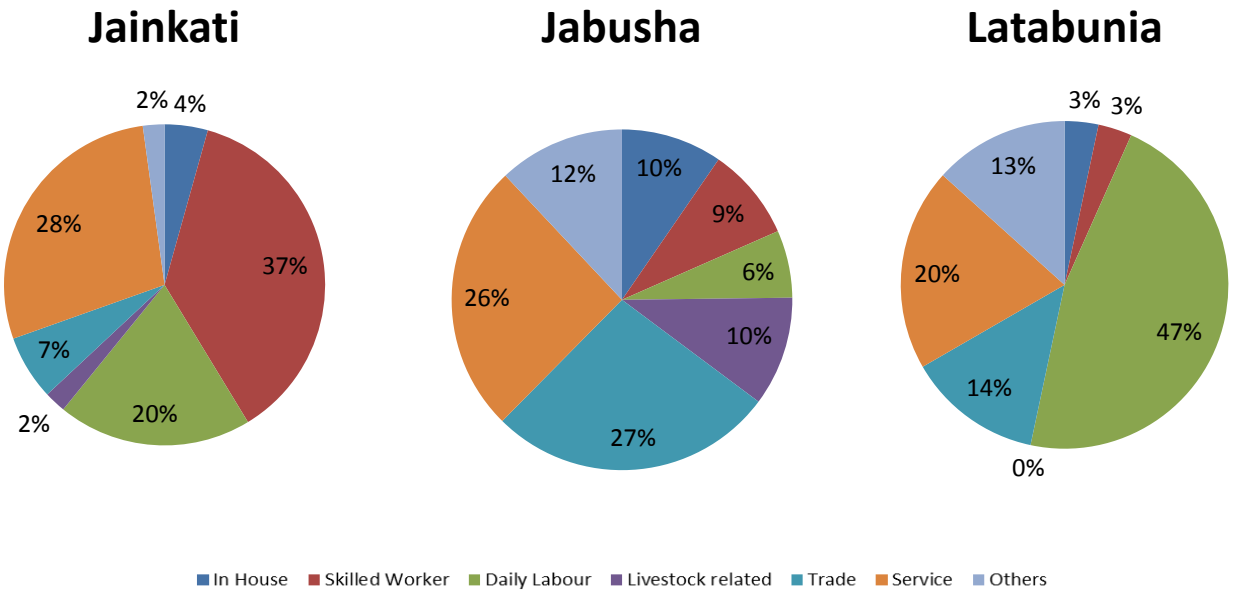



**Figure 19 - Type of IGA, by location**

Most of these activities are mainly done by men. Only a small number of IGAs are dedicated to women. When women are involved in IGAs, it is most of the time for in house activities like handicraft, sewing or poultry. Only a small number of activities (and a small number or members are involved in these activities) take them out of the household sphere: teacher, nurse, Labour Contracting Societies (LCS) jobs.

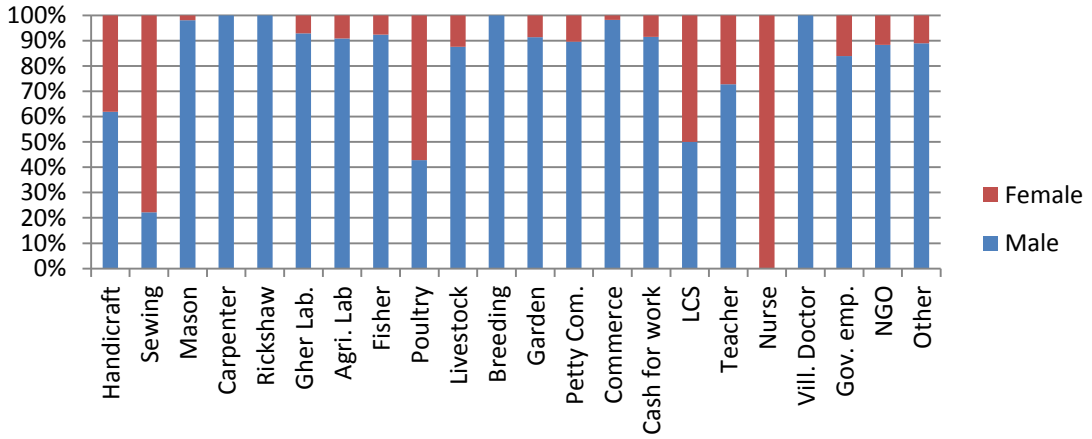



**Figure 20 - IGAs by gender**

Most of these IGAs are done in the village itself and don't require any displacement out of the polder area. However, 11.7% of the activities involve travelling more than 50km, this happen for employee positions or for seasonal workers. Jainkati and polder 43-2F again are the location with most of these cases (17.4% in Jainkati and 18.3% in polder 43-2F). Activities implying displacement out of the village or out of the polder are largely restricted to men; indeed, only 4.3% of activities with more than 50 km of travel are done by women.

### 2.8.4. Income from income generating activities

A large number of activities are practiced; the reasons also differ as well as the time dedicated to these activities by the household. As a consequence, the income from these IGAs can hardly be compared.
However, the below scale (Figure 21) of mean incomes by activity shows that lower incomes are drawn from in house non skilled activities whereas skilled activities bring higher income. Finally at the top of the scale, we found employees and permanent jobs like teacher, nurse or NGO workers, all these activities

bring a regular wage. Commerce is also found at the top of this scale but it has to be underlined that the mean is calculated with a huge standard deviation: commerce activities range from in-house petty commerce to large scale business.

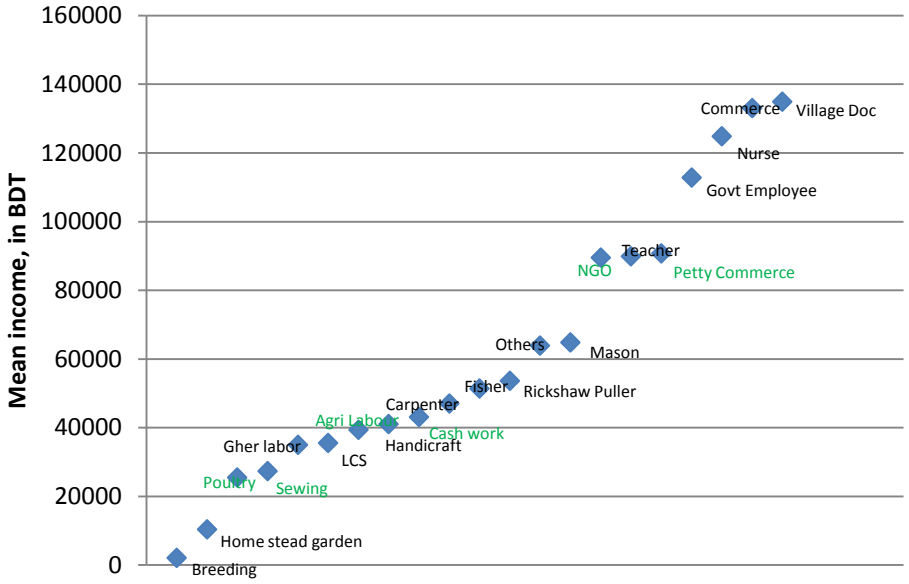



**Figure 21 - Mean income from IGAs, by activity**

Then the gender bias previously noticed is confirmed through the income drawn from IGAs. The mean of the annual income for male activities is 75,530 BDT versus 32,543 BDT for activities led my women.

## 2.9. Participation and social capital

The participation in formal or informal groups translates the network and consequently the social capital at the disposal of the household. This social capital has to be taken into account while considering the vulnerability level of the households. In Bangladesh with a high level of Non-Government Organizations (NGOs) coverage, participation in a group is also a safety net. Participation denotes the power relationships within a community and the organizational ability of this community. In addition to participation in groups we also took into consideration the participation in trainings delivered by these groups.

In our sample of 1000 households, 39.5% of them participate in at least one formal group. At individual level, this means that 10.6% of all the members are part of a group. This result is quite high and translates the density of social networking in the area. The rate of participation is higher for Jainkati and Latabunia which are nevertheless small villages. This might be related to the presence of water management organizations in these villages which are supposed to include all the households. On the contrary, the lowest rate is found in polder 3, which doesn't have any formal organization in terms of water management.

30.5% of the households have already benefitted from training. The rate is the lowest for Jabusha and Jainkati and the highest for polder 43-2F. These differences are mainly due to the location of the NGOs which are the main providers of trainings.

| | TOTAL | Polder 3 | Polder 30 | Polder 43-2F | Jabusha | Jainkati | Latabunia |
|---|---|---|---|---|---|---|---|
| Household participation rate | 39.5 | 36.1 | 40.7 | 34.9 | 37.5 | 66.7 | 67.5 |
| Individual participation rate | 10.6 | 9.2 | 11.5 | 9.2 | 9.1 | 18.9 | 20.7 |
| Household training rate | 30.5 | 29.6 | 36.2 | 30.1 | 18.9 | 17.3 | 32.2 |
| Individual training rate | 8.2 | 7.5 | 10.2 | 8.0 | 4.6 | 4.9 | 9.9 |

**Table 41 - Participation and training, by location**

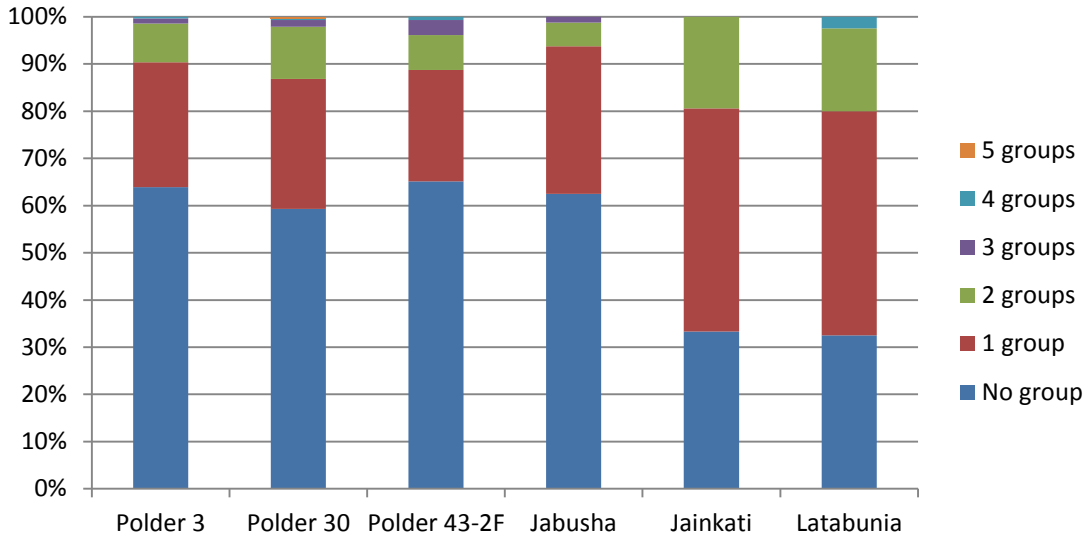



**Figure 22 - Household's involvement in social groups (numbers), by location**

The households participating in groups are most of the time involved in only one group; however, in Jainkati and in Jabusha, almost 20% of the households have members involved in more than one group. So in these two villages, not only more members participate in groups but they also participate in more groups.

When considering who in the household participates in these social groups or benefits from trainings, the usual differences can be seen. Women participation rate is 3.4 points less than men, and their rate of participation in training is 5.5 point less. These two differences are highly significant. The literacy rate is another break line, literate or educated members have better chance to be found in groups as well as better chance to be found in trainings. As for the gender differences, differences in terms of literacy are higher for training than for participation. This questions the selection of the participants and the purposes of these trainings.

| | | Percentage of household members participating in formal groups | Percentage of household member benefitting from training |
|---|---|---|---|
| **Sex** | Men | 12.2 | 10.8 |
| | Women | 8.8 | 5.3 |
| | *T-test of difference* | *0.000* | *0.000* |
| **Literacy** | Literate | 11.1 | 9.8 |
| | Illiterate | 9.3 | 4.4 |
| | *T-test of difference* | *0.050* | *0.000* |

**Table 42 - Participation and training, individual rates by sex and literary**

The groups have been aggregated into five categories: groups related to water, political party, youth or sports groups, NGOs and other. Most of the individuals (53.1%) stating that they are member of a group

are members of an NGO. But then water related groups come in second position, this might be partially due to the sampling but also translate the importance of water management in the area.
For each of these memberships it has been ask if the members received any support in the last 12 months. All sort of supports were considered from emotional support to economic support. 39.4% of the members of water related groups answered that they did not received any support from the group. This figure obviously leads to question the role of such organizations.

| | Water Related | Political Party | Youth /Sport | NGO | Others |
|---|---|---|---|---|---|
| Repartition of the group membership | 21.9 | 6.1 | 6.7 | 53.1 | 12.1 |
| Percentage of members who did not receive any support from this group | 39.4 | 11.0 | 3.7 | 36.5 | 9.5 |

**Table 43 - Type of groups and supports received from the organizations**

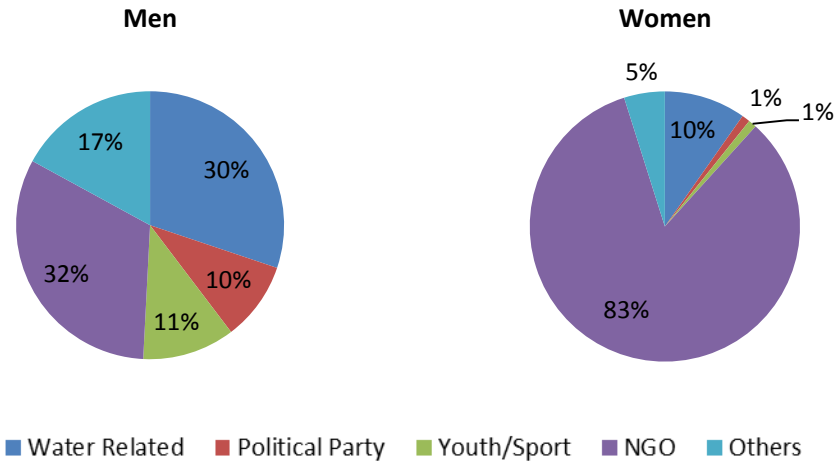



**Figure 23 - Type of groups, by sex**

We have previously seen that participation and training were more usual for men than for women, but in addition they are not participating in the same kind of organization. When women are members of a group, it is for 83% of them an NGO, their participation in political parties, in youth or sport groups are then anecdotal.

## 2.10. Water management

### 2.10.1. Water related problems

According to the sampled households, the first reason to explain BWDB or LGED interventions was to alleviate water intrusion in high tide. But then from one location to another, the other reasons vary. In Jabusha, salinity intrusion is pointed out as an important reason as well as in polder 30. In Jainkati and in polder 43-2F, crop damages are brought to the front to explain the required intervention.

| | Polder 3 | Polder 30 | Polder 43-2F | Jabusha | Jainkati | Latabunia | TOTAL |
|---|---|---|---|---|---|---|---|
| Water intrusion in high tide | 47.1 | 32.9 | 53.2 | 30.0 | 50.0 | 50.0 | **43.7** |
| Crop damage | 3.2 | 16.1 | 23.6 | 16.2 | 33.3 | 7.5 | **14.9** |
| Salinity | 14.6 | 35.7 | 13.7 | 37.5 | 16.7 | 27.5 | **22.7** |
| Water-logging | 3.9 | 2.9 | 2.1 | 6.2 | 0.0 | 2.5 | **3.1** |
| River erosion | 27.9 | 10.7 | 5.6 | 10.0 | 0.0 | 5.0 | **13.4** |
| Natural disaster | 1.4 | 0.7 | 1.8 | 0.0 | 0.0 | 2.5 | **1.2** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Other | 1.8 | 1.1 | 0.0 | 0.0 | 0.0 | 5.0 | **1.0** |

**Table 44 - Reasons for BWDB or LGED intervention, by location**

The household were then asked to evaluate to which extend the initial problem was solved by the intervention of BWDB or of LGED. Most the households consider the problem as being more of less satisfactory solved and give intermediate answers. But interestingly, the highest level of satisfaction and the lowest are occurring in LGED sub-projects: in Jainkati 88.9% of the households consider the initial problem as solved, whereas in Latabunia 23.1% of the household consider that the problem has not been solved at all.

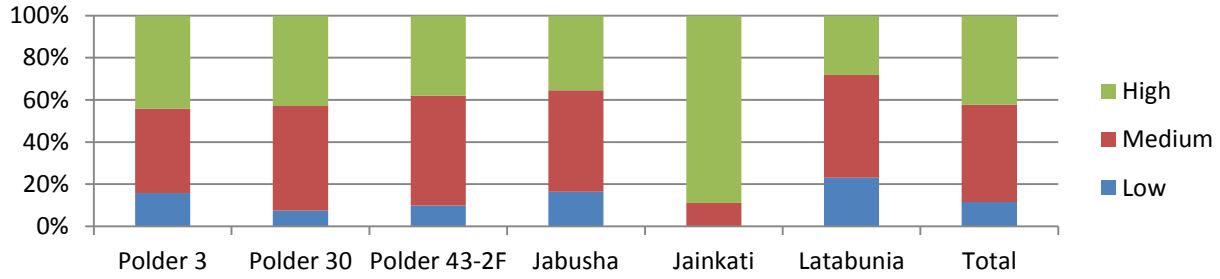



**Figure 24 - Extent to which the initial problem has been solved, by location**

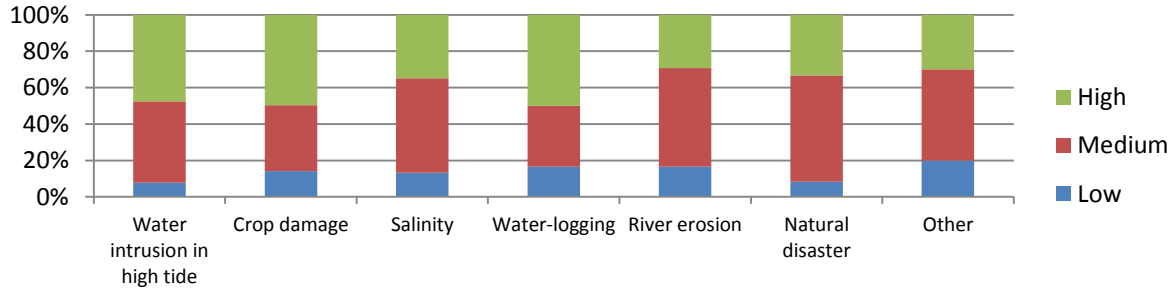



**Figure 25 - Extent to which the initial problem has been solved, by type of problem**

Apart from these initial problems, respondents were asked to point out the main current water related problems for their household. As previously seen for agriculture, households indicate water scarcity as their main concern, this is true all our 6 locations. Water logging is then the second most common water problem pointed out in polder 3, polder 30, polder 43-2F, Jabusha and Latabunia. But in Jainkati the condition of the infrastructures (sluice gate and canal) are the second and third problems selected.

| | Polder 3 | Polder 30 | Polder 43-2F | Jabusha | Jainkati | Latabunia | TOTAL |
|---|---|---|---|---|---|---|---|
| **Water Scarcity** | 57.9 | 36.1 | 53.2 | 30.0 | 27.8 | 60.0 | 47.2 |
| **Water Logging** | 6.4 | 16.4 | 9.2 | 15.0 | 5.6 | 12.5 | 10.9 |
| **Canal Leasing** | 0.0 | 0.4 | 0.7 | 3.8 | 2.8 | 2.5 | 0.8 |
| **Degraded Environment** | 1.1 | 0.4 | 0.7 | 12.5 | 0.0 | 0.0 | 1.6 |
| **Sluice gate condition** | 0.4 | 2.9 | 2.1 | 0.0 | 13.9 | 0.0 | 2.0 |
| **Embankment weakness** | 3.2 | 2.1 | 0.4 | 1.3 | 2.8 | 7.5 | 2.1 |
| **River Erosion** | 4.3 | 2.1 | 1.1 | 2.5 | 0.0 | 0.0 | 2.3 |
| **Canal Siltation** | 1.1 | 2.1 | 3.9 | 1.3 | 8.3 | 0.0 | 2.4 |
| **Conflict** | 2.5 | 4.3 | 3.2 | 3.8 | 5.6 | 0.0 | 3.3 |
| **Salinity** | 5.0 | 2.5 | 2.1 | 6.3 | 0.0 | 7.5 | 3.5 |
| **Lack of irrigation** | 1.4 | 7.5 | 3.2 | 1.3 | 13.9 | 0.0 | 4.0 |
| **Natural Disaster** | 4.6 | 6.1 | 7.0 | 2.5 | 2.8 | 0.0 | 5.3 |
| **Other** | 12.1 | 17.1 | 13.4 | 20.0 | 16.7 | 10.0 | 14.6 |

**Table 45 - Most important water related problem for the households, by location**

When considering who should solve the remaining problems related to water, Union Parishad is picked out by 35.5% of the households. Then BWDB is coming in second position in polders whereas LGED is coming in second position in sub-projects. 23.7% of the household consider that they should solve it by themselves (community people). Nevertheless, the role of WMOs is clearly not recognized since only few households consider that solving water problems is the responsibility of WMOs. These figures underline the importance of Union Parishad which has never had any formal role in water management, and the disclaiming for water management organizations which were supposed to have this role.

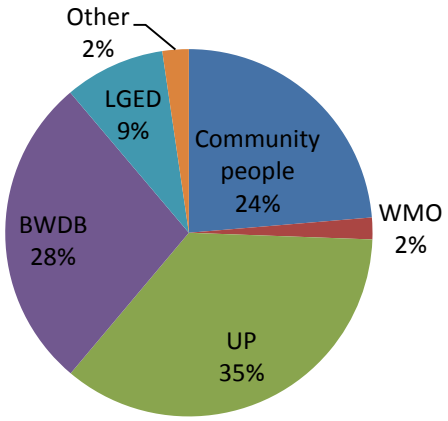



**Figure 26 - Who should act to solve water related problems in your area?**

### 2.10.2. Perception of the quality of the infrastructures

In these areas, embankments ensure the protection from natural disaster, tide and salinity intrusion. Sluice gates are then the meeting point between the rivers and the canals which bring water inside the polder. These canals can be considered as the veins of the polders, they are supposed to flush in water required for productive purposes and to flush out excess of water to avoid water logging for example. Embankment, sluice gates and canals are consequently the three key water infrastructures. Their quality ensures the protection of the lives and the protection of the livelihoods inside the polders areas.

Each household has been asked to rate the quality of the embankments, gates and canals. Their answers considered the nearest infrastructure from their home. The ranking was initially between 1 and 6 but were then aggregated into 3 groups for the analysis: good quality, intermediate quality and low quality of the infrastructure.

The embankments are the infrastructures with the better ranking in terms of quality. However, in polder 3, 20.0% of the surveyed households consider that their embankment is in bad or very bad condition and Latabunia follows a similar pattern with 45.0% of the household considering the embankment as being weak. The situation is nevertheless different, in polder 3 the embankment has been built in the 70s and rehabilitation work might have been missing since then, but in Latabunia the embankment has been built in 2000 and is already weak due to river erosion, natural disasters and the intrusion of informal pipes.
Then, one fourth the sample considers that the gates are in poor or very poor condition. In Jainkati, 50.0% of the households share this view. In this sub-project, 2 sluice gates have been built, one is out of service since located on private land whereas the other gate is in bad condition. Jabusha and polder 3 have relatively less households considering the gates as being in bad condition; one reason might be that in both of these areas, the gates are very large structures built on large rivers with an important flow (Rupsha river in Jabusha and Ichamoti river in polder 3).
The canals are finally the infrastructures in the worst condition. On average, 35.8% of the households rated the canals as being in bad condition and only 12.5% considered these canals as being in good condition. The situation is almost the same in all the location which established that canal siltation is a commonality across the polders and sub-projects. This result questions the maintenance and especially

the regular re-excavation of the canals which is required so that they can fulfil their role of irrigation and drainage.

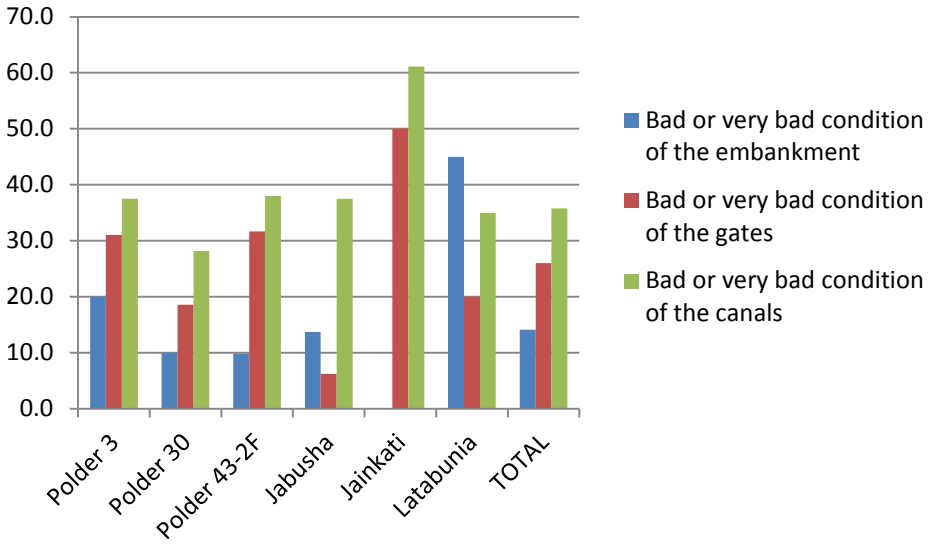



**Figure 27 - Condition of the infrastructure (embankment, gates canals) , by location**

### 2.10.3. Participation in water management organizations

In the surveyed area, two main types of formal water management organizations (WMOs) can be found. In polder 30 and in polder 43-2F, IPSWAM project[5] created Water management Groups (WMG) whereas in sub-projects Water Management Cooperative Associations (WMCA) were created through the LGED's SSWRDSP[6]. Then, in polder 3 no formal WMO can be found.

Jainkati and Latabunia are small villages and almost half of the households have (or had) a member in the WMCA. Them the same structure is existing in Jabusha but two villages share the same WMCA and these villages are quite large, as a consequence, WMO members were found in 10.0% of the households in this sub-project. Polder 30 and polder 43-2F are almost in the same situation with respectively 13.9 and 10.9% of the households with membership in WMGs. Then in polder 3 only one household considered that he was member of a WMO which was most probably an informal group.

| | Polder 3 | Polder 30 | Polder 43-2F | Jabusha | Jainkati | Latabunia | TOTAL |
|---|---|---|---|---|---|---|---|
| **Percentage of household with a WMO member** | 0.4 | 13.9 | 10.9 | 10.0 | 47.2 | 42.5 | **11.3** |
| Average amount paid to become a WMO member | | 119.4 | 96.5 | 223.8 | 45.4 | 205.9 | **121.3** |
| Average annual amount paid to saving fund of WMO | | 2284.5 | 1222.5 | 205.0 | 1194.2 | 356.8 | **1398.2** |
| Average amount paid to maintenance fund of WMO | | 218.7 | 0.0 | 100.0 | 145.8 | 124.4 | **137.5** |
| Average annual number of payments to saving fund of WMO | | 6.7 | 4.2 | 3.4 | 13.9 | 6.3 | **6.8** |
| Average annual number of payments to maintenance fund of WMO | | 2.5 | 0.0 | 2.4 | 0.7 | 0.9 | **1.3** |

**Figure 28 - Household membership in WMOs and contributions, by location**

Apart from membership, it is interesting to consider the financial participation of the households in these groups. If most of these members contributed at the initial stage to become member of the group, their involvement has then steadily been cut. Most the financial contribution of the members to WMOs are allocated to saving funds, the average annual contribution for saving is ten times higher than the average

[5] Integrated Planning for Sustainable Water Management (IPSWAM) project was implemented by BWDB in 9 polders.

[6] Small Scale Water Resources Development Sector Project (SSWRDSP) is the community water management project implemented by LGED in areas less than 1000 hectares.

annual contribution for maintenance. Similarly, the frequency of the contribution is much higher for saving fund than for the maintenance fund. This phenomenon is especially occurring in polder 30, polder 43-2F and Jainkati where the WMOs collect saving contributions to distribute micro-credits. So, most of the contributions toward the WMOs are dedicated to activities not related to water management and the maintenance fund is neglected.

Describing the households who are members and non-members of these WMOs by using some of the previously defined indicators clearly show that the members differ from the non-members. WMOs members are more likely to operate larger areas of land. Indeed, 10.6% of the WMO members are marginal farmers whereas they are 37.8% from the non-members households. The reverse figures are also true when considering the large farmers who over-represented in these water management organizations.

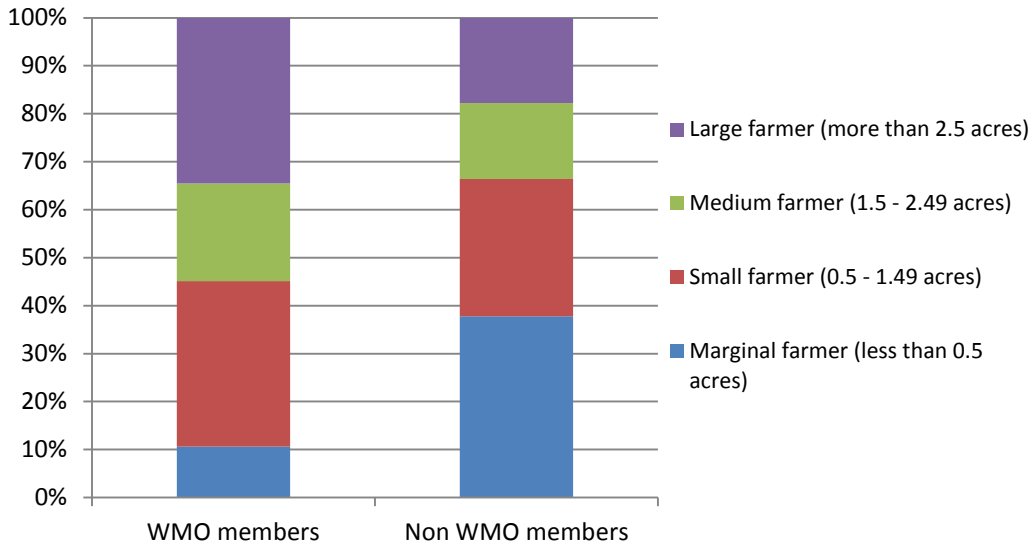



**Figure 29 - Land holding, by WMO membership**

Similarly, by using the wealth indexes (housing index, assets index and productive index), the WMO members are more likely to be find in the groups with higher scores, which are the groups of wealthier household. This is true for the three indexes; households from the first group are over represented in WMOs.

These findings don't mean that poorer households are not members of these groups, some of them are members, but these groups don't reflect the population from these areas. Wealthier household, commonly called "influential people" are over-represented in these groups. This firstly questions the selection of the members from these WMOs. Secondly, the decisions taken by the groups may reflect the interests of the members which are not a good representation of all the stakeholders.

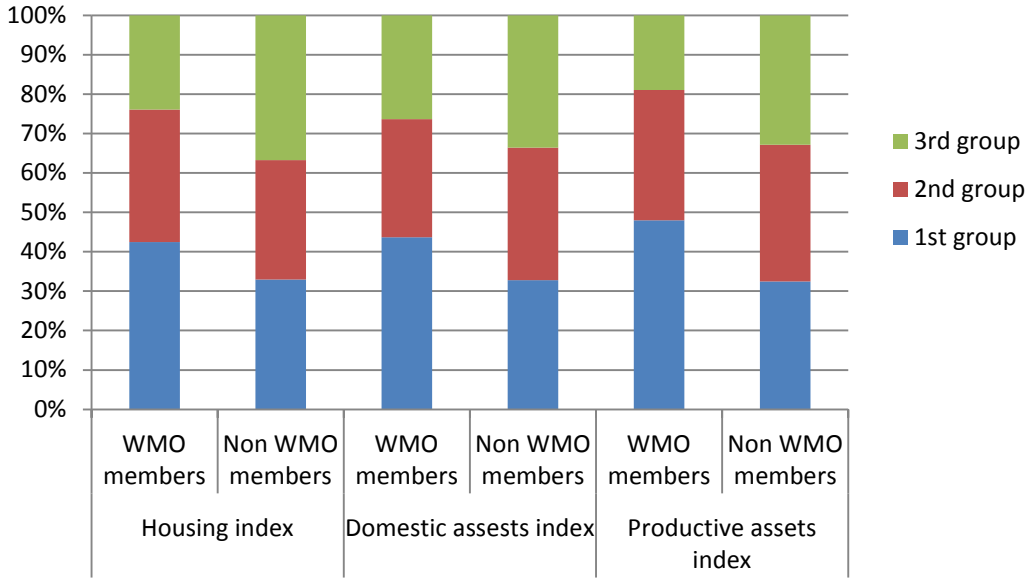



**Figure 30 - Wealth indexes, by WMO membership**

### 2.10.4. Participation in water management

Formal membership in a WMO and contribution to this organization is one way to be involved in water management; nevertheless, participation in water management cannot be reduced to WMOs. Here are considered all kind of involvements in water management through formal or informal mechanisms. Participation related to sluice gate can either be through participation in operation (opening, closing the gates) or through participation in maintenance. In our sample, 24.0% of the household are involved for operating at least one gate and 20.1% participate in the maintenance of this gate. Then participation for canal maintenance is less common (20.1%) and even less for embankments maintenance (12.3%). These figures confirm that the gates are not only the most important infrastructure for the households but the gates are also the infrastructure were the involvement in operation and in maintenance is the easiest. On the contrary, maintenance of the canals and maintenance of the embankments require higher costs (or time) and require higher degree or coordination considering that the canals and the embankments are spread over kilometres.

Then the involvement of households in water management can be done through two major channels: voluntary work or financial contribution; this can be sum up as contributing in time or contributing in cash[7]. Participation through voluntary work is more usual than through financial contribution. 22.4% of the households have given time for water management last year whereas 19.3% of them have given money. These two ways of being involved may depend of the wealth situation of the household but can also be complementary.

[7] Contribution can also be in kind (wood, bamboo, other materials), but it can be understood as a financial contribution.

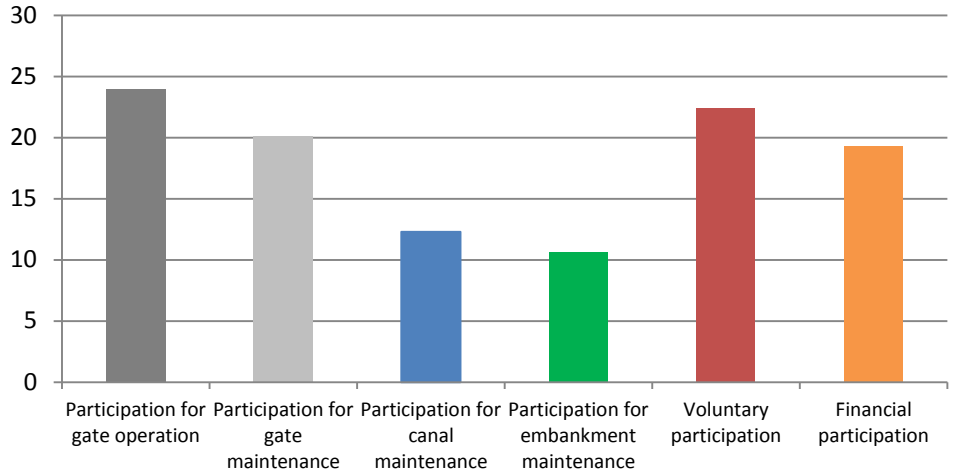



**Figure 31 - Percentage of households involved in water management, by type of infrastructure and type of participation**

The following figures (Figures 32, 33 and 34) present the percentage of household participating through voluntary work or through financial contribution for each infrastructure and by location.
Considering the involvement in water management for the sluice gates, two main observations can be done. First the involvment in operation (physical opereration or decisioin making) is higher than the involvement for maintenance. Secondly the voluntary work is prefered over financial contribution. The first observation translates the preference of the present of the household. But polder 3 and Jainkati are examples where voluntary work for maintenance is prevalent and as usual as the involvement in operation. In polder 43-2F, 14.9% of the households contribute to finance the gates operation which means that gatemen have been hired by the community, this is also usual in poler 3 but in this latest case the gatemen are hired by private gher owners.

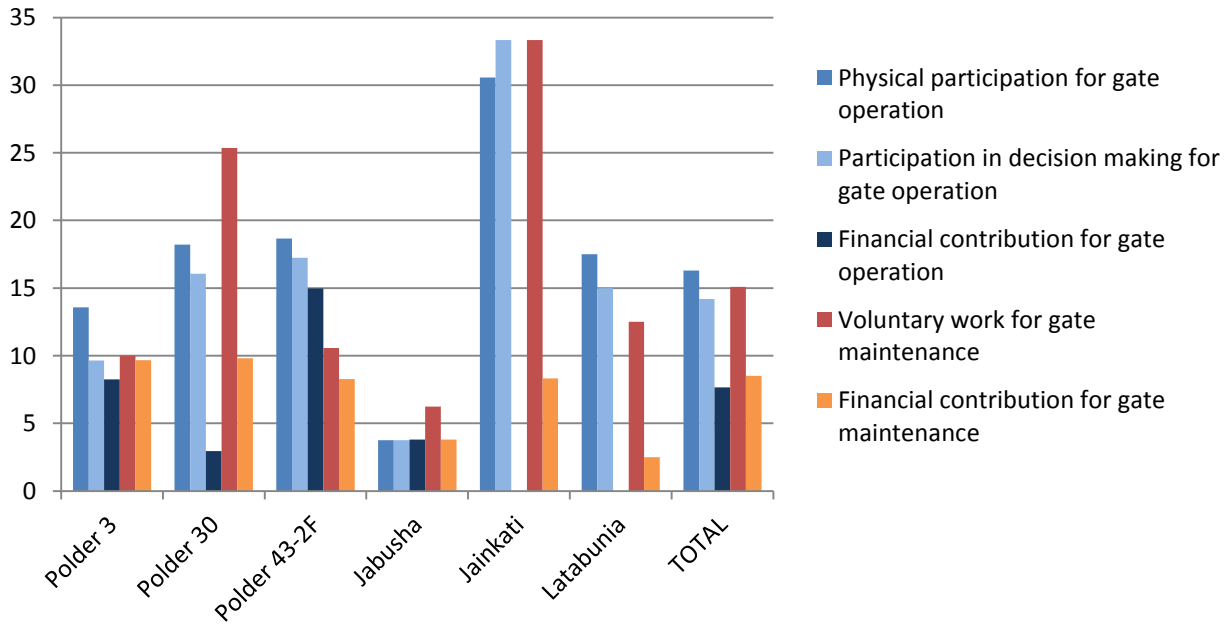



**Figure 32 - Percentage of household involved in gate operation and gate maintenance, by location**

Then as previously seen the involvement in canal maintenance is less usual than the involvement in gate operation and maintenance. This is true everywhere apart in Latabunia, where 21.6% of the households have contributed through voluntary work to maintain the canal in 2012. The fact that Latabunia is a small community with only one shared canal (many other small private canals) probably made things easier to coordinate the re-excavation work.

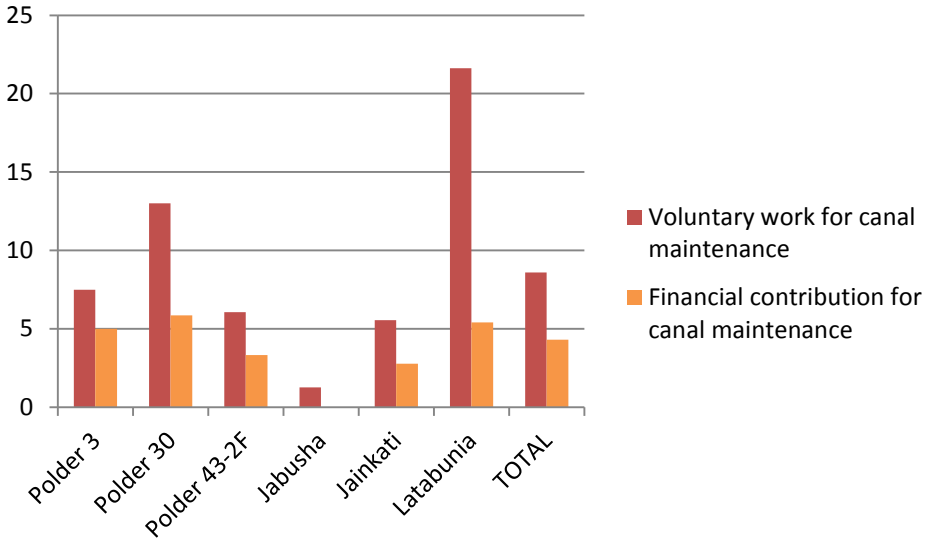



**Figure 33 - Percentage of household involved in canal maintenance, by location**

The involvement in water management through embankment maintenance is uncommon; on average only 7.7% of the household give voluntary work for embankment maintenance and 3.5% of them give financial contribution. In Latabunia where the embankments were said to be in bad or very bad condition by 45.0% of the households, 17.5% of them are involved in embankment maintenance through voluntary work. The same phenomena is found in Jainkati, where 13.9% of the households financially contribute for the maintenance of the embankment whereas none of them rated the embankment as being in bad or very bad condition. In polder 43-2F and in Jabusha almost no household is involved in maintenance of the embankment which mean that this responsibility is completely transferred onto other actors out of the community.

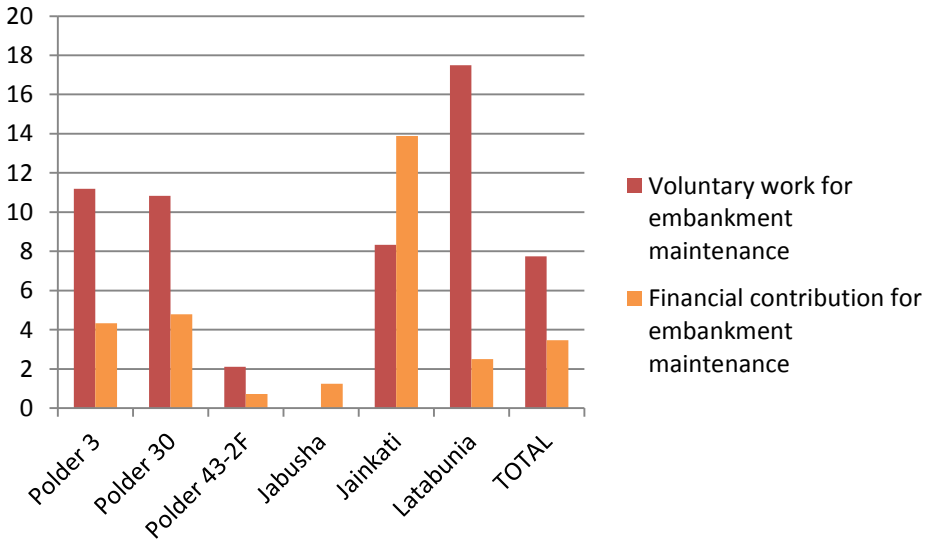



**Figure 34 - Percentage of household involved in embankment maintenance, by location**

# PART 3 – WATER MANAGEMENT ORGANIZATION ANALYSIS

## 3.1. Water management organization in the three surveyed polders

### 3.1.1. Institutional features

For each of the village surveyd, a WMO questionnaire has been filled. The priority was given to formal organizations but when these ones were not existing or when they were not active, informal groups of su-groups have answered the questions.

In polder 3, formal water management organisations do not exist. They consequently rely on informal committees to manage and operate their gates. Interestingly these groups are sometimes defined as gate committees, sometimes as *gher* committees and 7 of them have been classified as "other" informal committees. Unlike this polder, the other two polders have formal water management organisations dedicated to water management. In polder 30, all the 12 surveyed WMOs are Water Management Group (WMGs) created following the IPSWAM project. In polder 43-2F, 7 WMGs have also been sampled, in addition with one Water Management Association (WMA) and one group who defined himself as informal. In polder 30 and polder 43-2F all the surveyed WMGs are formally registered as cooperatives.

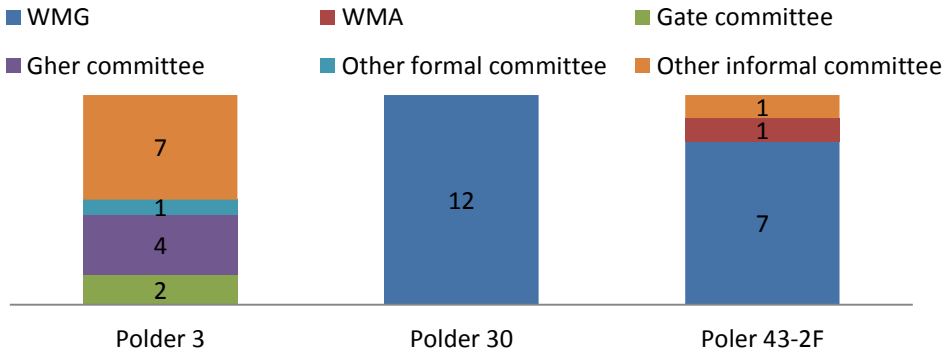



**Figure 35 - Type of WMOs, by location**

The initiative for creating these groups differs. In polder 3, the Union Parishad took the initiative in 50.0% of our cases. Then the influential people[8] created five of these committees, whereas two have been created following a BWDB initiative. So, even if no BWDB project worked to create WMOs in this polder, their examples in other locations may have initiated some of the informal groups. In the others polders, the initiatives were mainly taken by IPSWAM, this is the case in all the WMOs from polder 30. Interestingly in polder 43-2F, four groups gave the initiative to BWDB even if their creation was probably led by the IPSWAM project.

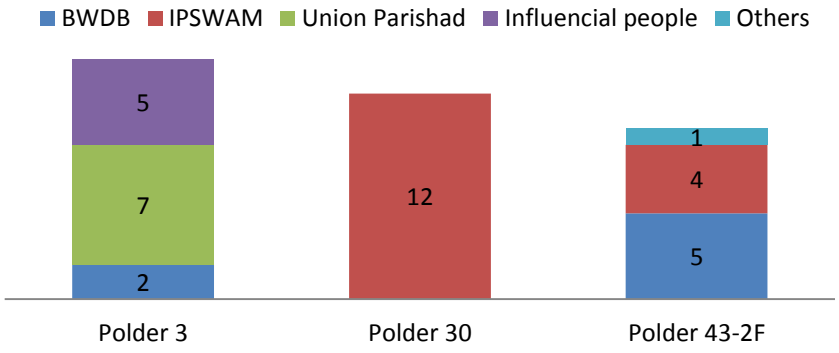



**Figure 36 - Who took the initiative for creating these committees, by location**

When considering the participation in these groups, the distribution of men and women members ratio is three for one. However, this ratio doesn't reflect the decision making, in most of the villages, men take all

[8] Overlaps between Union Parishad members and those who are called influential people are usual in polder 3.

the decisions. On the contrary this ratio follows the Guidelines for Participatory Water Management (GoB, 2001) which impose women members and women in the executive committees of these groups.

The number of members in each WMO varies from 20-25 per village to more than 100 members. As per the questionnaire, the number of members is remaining constant over the past few years, but this doesn't mean that they are active members with regular participation or contribution.

The dynamism of a group and the interest aroused by its activities can be read through the interest of the members in the electoral process of the group. Here, only in a few villages voting has taken place recently and there has been no contest for the position of president or secretary this group. This also means that most of the WMGs are now withering away. The members do not take sufficient interest in the activities and meetings of the organization which in turn leads to less participation and less involvement.

### 3.1.2. Project intervention and problems

The respondants from the water manageemnt groups give the same kind of reasons than the household to explain the intervention of LGED or BWDB in their area: water intrusion in high tide, salinity intrusion, water logging and crop damages. In polder 30 embankment weaknesses and canal siltation is also seen as one of the main reasons for IPWAM involvement. Apart in polder 3, polder 30 and 43-2F feel that most of the time the problems were solved through the project intervention. In polder 3 since there is no intervention and no formal committee or organisation the problems remain. In this polder, the main problems underlined by the respondents is the siltation of the canals and the poor condition of the sluice gates. In polder 30, salinity intrusion and canal siltation come as the first problems. Then in polder 43-2F respondents from the WMOs pointed out the following problems among others: condition of the gates, conflicts, canal siltation and salinity intrusion.

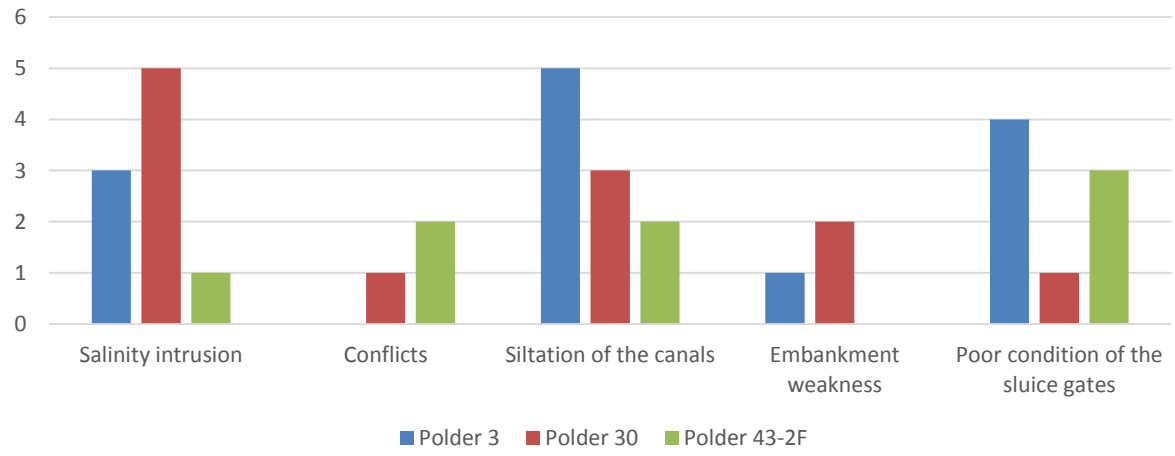



**Figure 37 - Main problems in the villages from the WMOs respondents, by location**

### 3.1.3. Assessment of the WMOs

Through the questionnaire, respondents were asked to rank their water management organization based on six criteria:

- Transparency: access to the information related to activities, organization and rules of the group;
- Financial accountability: clarity on the budgets, expenditures, use of the contributions, existence of corruption;
- Participation: inclusion of all the stakeholders through fair rules and inclusion in decision making process;
- Rules and legitimacy: ability of the group to have clear rules, to resolve conflicts, to regulate the water uses;

- Operation: ability to operate the gates satisfactory;
- Maintenance: ability to maintain the infrastructures in good condition.

The below graphic shows the average level of ranking for each of the indicators in the three polders. The perception about maintenance is low in polder 30, whereas in all the other aspects, all the polders don't show any major problems. Here have to be underlined the bias introduced by the selection of the respondents, since all these respondents are themselves presidents or members of the WMOs, most likely they were not very keen to criticise the action of the group.

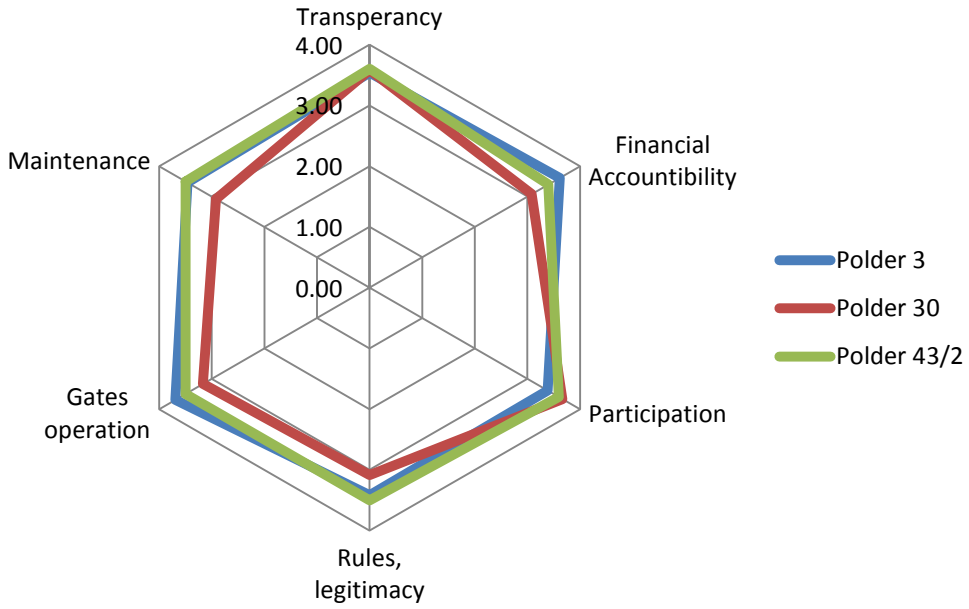



**Figure 38 - Perception about the practices of the WMOs in polders**

### 3.1.4. Financial features

The picture given through the survey conducted with these WMOs describe the poor financial management of the groups as well as the lack of activity of these groups.

As expected, there are no accounts and no organised financial structure in polder 3. However, in polder 30 and 43-2F, most of the villages have saving accounts, in and some villages, maintenance funds are available. The average amount on saving account in polder 30 is around 11,500 BDT and 46,000 BDT in polder 43-2F in which one village has around 300,000 BDT.

Considering the expenses, very few information were available. In polder 3, the all the mentioned expenses were related to gates operation. The amounts spent were roughly around 30,000 BDT per year which fit with the employment of a gatemen. In Polder 30 and polder 43-2F, only few villages have done some minor expenses in 2012 and most of the groups remained financially inactive.

Most of the time, decisions on the expenses is said to be taken by all the members from the executive committee in polder 30 and 43-2F. In polder 3, the decision is more personal and is taken only by one member (acting as president).

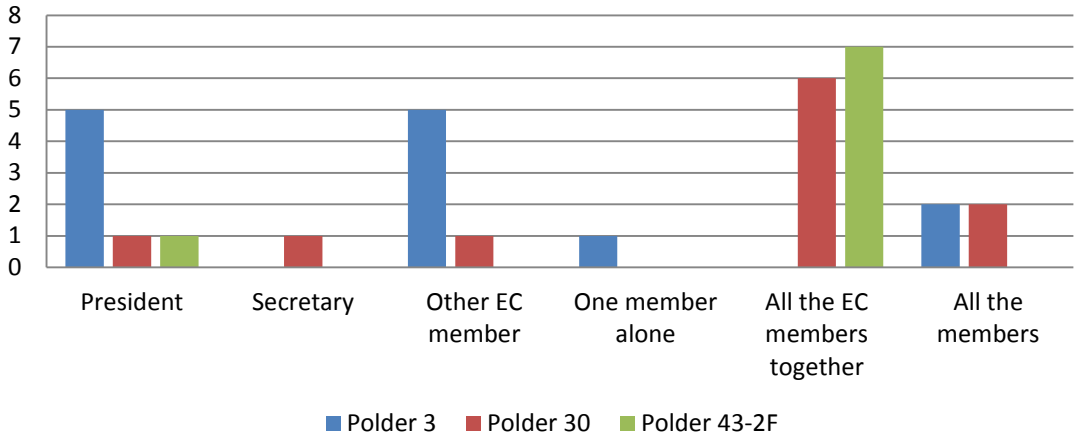



**Figure 39 - Who get the decision on the expenses of the WMOs, by location**

### 3.1.5. Operation and maintenance

In terms of operation, in polder 3 the majority of the decisions are taken by the *gher* owners or the beel committee and in some villages Union Parishad members are also involved in decision about operation of the gates. In polders 30 and 43-2F the decisions on the operations of the gates are mainly taken by the gate committees and the Water Management Groups. The operation in itself is the responsibility of a gateman appointed by the gate committee most of the time. In polder 30 the gatemen are not paid in any form for maintaining the gate and are hence voluntary but in polder 43-2F the gateman are paid in kind for maintaining the gates. In polder 3 the *gher* owners appoint the gatemen for operating the gates and he is paid in cash or is given some fishing rights.

On the maintenance side, WMGs claim that the gates are in good condition in all the surveyed groups. They are less positive about the canals which are considered as being in an intermediate condition (neither good nor bad) in polder 30 and polder 43-2F. There is also no annual activity of maintenance of the canals happening in these polders. Most of the villages in these polders claim that there has been no re-excavation or desiltation of the canals. Similarly, half of the villages in all three polders said that annual maintenance of the embankment is not carried out every year.

## 3.2. Water management organizations in the three surveyed sub-projects

### 3.2.1. Latabunia

A Water Management Cooperative Association is present in Latabunia, the respondents told that it was created in 1998 by the village members. The participatory process at the creation of the group was rated as not very good neither very bad. At the time of creation there were 397 members and at present only 122 members. No information on recent elections was given which means that no elections were held recently, and the respondent told that no political party is affiliated to this WMCA. However, it was said that the WMCA members meet regularly.

The main reason for LGED intervention was crop damages but the respondent from the WMCA still feels that their problems are not yet solved. The most important water related problem in the village for this respondent is the weakness of the embankment followed by the salinity intrusion and the issue canal uses.

The WMCA is registered as a cooperative. Currently (January 2013), they have a saving account in which 1,700 BDT are deposited and maintenance account has 137,500 BDT. It has been notices that they have been given a grant of 90,000 BDT last year (2012) from LGED. Their general expenses are around 29,000 BDT per year. The decision on the expenses is taken by all the executive committee (EC) members together.

There is only one sluice gate in Latabunia and interestingly the quality of this gate has been rated as very good. The decision on the operations of the gate is said to be taken by the WMCA. For the physical operation of the gate, several people come voluntary together depending on the need. Contrary to the gate, the canal quality was considered as not very good and there have been no annual maintenance activity in the canal. Similarly, the quality of the embankment is very poor and no maintenance is being done by the WMCA.

### 3.2.2. Jainkati

In Jainkati, the WMCA was created in 2002 through LGED project. As for Latabunia, the participatory process was neither very good nor very bad. At the time of creation there were 150 members and at present 120 members. There are regular elections and the last one was held in 2012. Two persons contested the position of the president and secretary. It has been said that no political party is affiliated with this WMCA. Meeting of the WMCA seems to be regular, once in a month.

The main reason for the LGED intervention pointed out was the salinity intrusion but they feel that their problems are completely solved now. The most important water related problems in the village are currently the weakness of the embankment followed by the condition of the sluice and the issue of canal siltation.

This WMCA is also registered as a cooperative; they have a savings account in with 70,000 BDT. It was said that members still contribute for this account: 120 members contribute 22 BDT each month. The general expenses are around 5,000 BDT per year. Then, the decision on the expenses is taken by all the EC members together.

In terms of operation, the decision on for opening and closing the gate is taken collectively by all the land owners. The gate is then operated by a voluntary gateman living nearby. This person is not paid in anyway. The maintenance of the infrastructures is then quite poor. First, the canal quality is very poor and there have been no annual maintenance activity in the canal in 2012. The last re-excavation occurred in 2009. Similarly, the quality of the embankment is said to be very poor but no maintenance has been done by the WMCA last year.

### 3.2.3. Jabusha

In Jabusha, the WMCA was created in 1997 created by the community itself through a participatory process rated as neither very good nor very bad.

The respondent from this group told that they were 20 members at the creation and 735 at present, which would mean that only few influential household were initially included to create the group. The last election was held in 2010 where 700 people voted. The position of secretary was contested by two candidates. The results of the election have been contested and since then conflicts remain and freeze the activities of the group. It has been confirmed that political parties are related to some of the members of the WMCA.

The main reason for the LGED intervention was due to crop damages and they feel that their problems are completely solved. Now, the most important water related problem in the village is canal siltation followed by sluice gates condition and embankment weakness.

In term of finance, the cooperative has a savings account in which 300,000 BDT are deposited, a maintenance account in which 50,000 BDT are deposited and an emergency account with 10,000 BDT. In terms of income, in 2012, the WMCA received money from canal leasing (150,000 BDT annually), interests from micro credit (20,000 BDT), interests from savings (4,000 BDT) and a grant from LGED (300,000 BDT). The general expenses were 273,000 BDT last year. The decision on the expenses is taken by all the EC members together.

The respondent of this group rated the quality of the gates at an intermediate level. The decisions on the operations of the gates are taken by gate committees and the gates are operated by gatemen appointed by the WMCA or voluntary people. These gatemen are paid in cash. The canal quality is neither very good

nor very poor and there have been no annual maintenance activity in the canals mainly due to leasing issues. The last re-excavation occurred in 2004. On the contrary, the quality of the embankment is said to be good and the last rehabilitation work occurred last in 2012.

### 3.2.4. Assessment of the WMCAs

As for the WMOs in the 3 surveyed polders, the respondents from the WMCAs in the three sub-projects assess the actions and results of their group based on the same six indicators.

The assessment of Jainkati is better in terms of accountability, participation and rules and legitimacy which is consistent with the qualitative analysis from this sub-project. However, in the three cases, the WMCA failed to reach good rating in terms of transparency, operation and maintenance. The only exception is Jabusah with a good rating for maintenance, which can probably be questioned. But in this sub-project, the level of financial accountability is low which can be related to personal conflicts and to the charges of corruption towards some members of the EC.

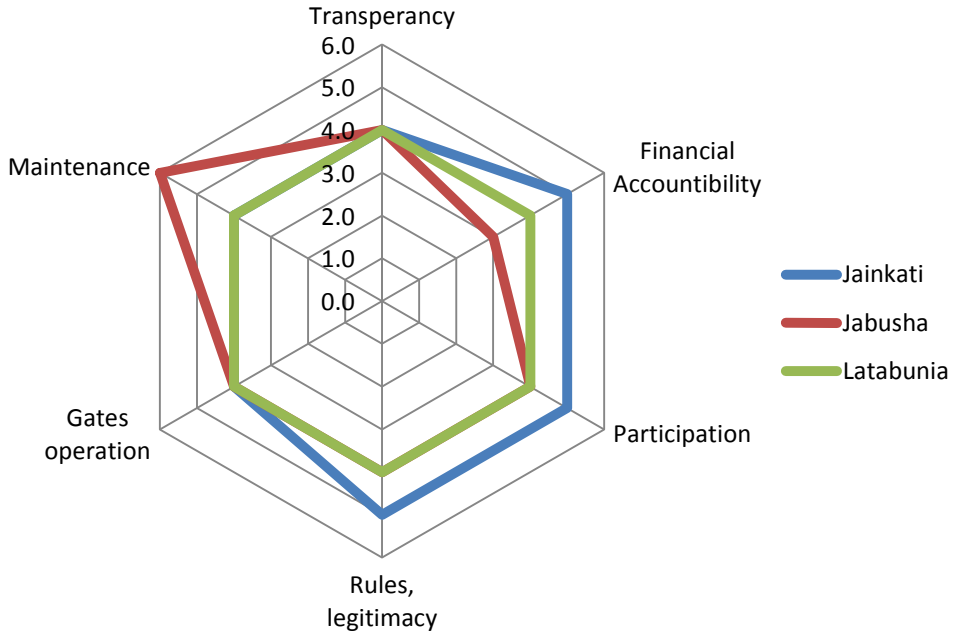



**Figure 40 - Perception about the practices of the WMOs in sub-projects**

# CONCLUSION

Based on a survey conducted with 1000 households and with 44 water management organization of the visited villages, this report draws the picture of an economically and socially active Coastal Bangladesh and of a population who learns day after day how to draw the best from their environmental constraints.

The eastern part of the Ganges basin takes advantage of a low level of salinity for intensifying its agriculture and in these areas a three crops per year system is not uncommon. Then, the intermediate part of the basin introduces mixed livelihoods systems, where agriculture and aquaculture can be complementary. Finally, in the western part more saline, the aquaculture is easier, but still some farmers manage to do agriculture.

Behind this picture, is also hidden a high level of inequalities, between the polders, from an area to another one but also within a same community. The most obvious inequalities are related to the land access. A large number of landless are involved in agriculture and have to rely on costly and uncertain agreements. The short term vision of these farmers as well as the scattering of the plots are clear constraints for considering the adoption of new technologies or of new practices which are required for an intensification of the agriculture and aquaculture and for alleviating the poverty.

Then, if agriculture and aquaculture are the main livelihoods, the analysis also clearly stated the importance of water management to sustain these livelihoods, in these areas each household is concerned about water and these households pointed out the water scarcity as one of their major issue, this is true for agriculture, for aquaculture but also for domestic purpose. If dealing with water is a key thing, the data also underline the failure of the Water Management Organization per se: operation is mainly informal, maintenance is not satisfactory, participation is not inclusive and finally households refer their water management issues to the Union Parishad rather than to these groups. Similarly, the quality of water infrastructures (gates, canals and embankments) is not really well rated. The households are not the only responsible for that situation; nevertheless, it is clear that they prefer to allocate their resources on the short term, ie toward the operations, rather than to the long term, ie toward maintenance.

Considering the intra-household patterns, this report also highlights the economic and social discriminations against women, mainly oriented toward in-house domestic chores, with a consequently low involvement in productive activities, in income generating activities, in social groups as well as in water management.

# ANNEXES

## Annex 1 - List of sampled villages

| POLDER | ZILA | UPAZILLA | UNION | MOUZA | VILLAGE | Households 2011 | Households surveyed |
|---|---|---|---|---|---|---|---|
| 3 | SATKHIRA | Debhata | Debhata | *Sreepur | Char Sreepur | 145 | **20** |
| 3 | SATKHIRA | Debhata | Debhata | *Ghalghalia Rahimpur | Char Rahimpur | 164 | **20** |
| 3 | SATKHIRA | Debhata | Debhata | *Dadpur | | 137 | **20** |
| 3 | SATKHIRA | Debhata | Noapara | *Bara Jagannathpur | Jagannathpur | 929 | **20** |
| 3 | SATKHIRA | Debhata | Sakhipur | *Sakhipur | Kamta | 249 | **20** |
| 3 | SATKHIRA | Kaliganj | Bhara Simla | *Kharhat | | 120 | **20** |
| 3 | SATKHIRA | Kaliganj | Bhara Simla | *Chaltabaria | | 148 | **20** |
| 3 | SATKHIRA | Kaliganj | Champaphul | *Rajapur | Rajapur | 469 | **20** |
| 3 | SATKHIRA | Kaliganj | Nalta | *Kashibati | | 699 | **20** |
| 3 | SATKHIRA | Kaliganj | Nalta | *Naua Para | | 315 | **20** |
| 3 | SATKHIRA | Kaliganj | Nalta | *Indranagar | | 509 | **20** |
| 3 | SATKHIRA | Kaliganj | Nalta | *Ghona | | 149 | **20** |
| 3 | SATKHIRA | Kaliganj | Tarali | *Bathuadanga | Golkhali | 144 | **20** |
| 3 | SATKHIRA | Kaliganj | Tarali | *Barea | | 1019 | **20** |
| **Total polder 3** | | | | | **14 villages** | | **280** |
| 30 | KHULNA | Batiaghata | Batiaghata | *Mailmara | . | 192 | **20** |
| 30 | KHULNA | Batiaghata | Batiaghata | *Kismat Phultala | . | 328 | **20** |
| 30 | KHULNA | Batiaghata | Batiaghata | *Madia Asannagar | . | 216 | **20** |
| 30 | KHULNA | Batiaghata | Batiaghata | *Hatbati (Baro) | . | 1042 | **20** |
| 30 | KHULNA | Batiaghata | Batiaghata | *Chak Solemari | . | 114 | **20** |
| 30 | KHULNA | Batiaghata | Batiaghata | *Baguladanga Patharghata | Patharghata | 74 | **20** |
| 30 | KHULNA | Batiaghata | Batiaghata | *Hetalbunia | . | 866 | **20** |
| 30 | KHULNA | Batiaghata | Gangarampur | *Kaemkhola | . | 183 | **20** |
| 30 | KHULNA | Batiaghata | Gangarampur | *Titukhali | . | 91 | **20** |
| 30 | KHULNA | Batiaghata | Gangarampur | *Debitala | . | 377 | **20** |
| 30 | KHULNA | Batiaghata | Gangarampur | *Britti Khalsebunia | . | 231 | **20** |
| 30 | KHULNA | Batiaghata | Gangarampur | *Salua | . | 96 | **20** |
| 30 | KHULNA | Batiaghata | Gangarampur | *Gagramari | . | 42 | **20** |
| 30 | KHULNA | Batiaghata | Gangarampur | *Charkhali Machalia | Tengramari | 74 | **20** |
| **Total polder 30** | | | | | **14 villages** | | **280** |
| 43/2F | BARGUNA | Amtali | Gulisakhali | *Fakirkhali | . | 169 | **20** |
| 43/2F | BARGUNA | Amtali | Gulisakhali | *Gojkhali | Gojkhali | 802 | **20** |
| 43/2F | BARGUNA | Amtali | Gulisakhali | *Gojkhali | Dalachara | 772 | **20** |
| 43/2F | BARGUNA | Amtali | Gulisakhali | *Gojkhali | Bazarkhali | 181 | **20** |
| 43/2F | BARGUNA | Amtali | Gulisakhali | *Gojkhali | Bainbunia | 303 | **20** |
| 43/2F | BARGUNA | Amtali | Gulisakhali | *Gojkhali | Deppur | 79 | **20** |
| 43/2F | BARGUNA | Amtali | Gulisakhali | *Gulisakhali | Gulisakhali | 925 | **40** |
| 43/2F | BARGUNA | Amtali | Gulisakhali | Gulisakhali | Haridrabaria | 326 | **20** |
| 43/2F | BARGUNA | Amtali | Gulisakhali | *Kalagachhia | . | 937 | **40** |
| 43/2F | BARGUNA | Amtali | Gulisakhali | *Kalibari | . | 766 | **20** |
| 43/2F | BARGUNA | Amtali | Gulisakhali | *Khekuani | Khekuani | 611 | **20** |
| 43/2F | BARGUNA | Amtali | Gulisakhali | *Khekuani | Angulkata | 586 | **20** |
| **Total polder 42/2F** | | | | | **12 villages** | | **280** |
| **Latabunia** | KHULNA | Dumuria | Sahas | *Latabunia | . | 104 | **40** |
| **Jabusa** | KHULNA | Rupsa | Naihati | *Ilaipur | . | 793 | **40** |
| **Jabusa** | KHULNA | Rupsa | Naihati | *Jabusa | . | 1,474 | **40** |
| **Jainkati** | PATUAKHALI | Patuakhali Sadar | Jainkati | *Keshabpur (Part) | Bagirabad | 71 | **40** |
| **Total sub-projects** | | | | | **4 villages** | | **160** |
| **TOTAL** | | | | | **44 villages** | | **1000** |

## Annex 2 – Scoring factors from the principal component analysis

| Indicators | Scoring factor 1st component |
|---|---|
| House with a level | 0.2734 |
| Number of other building | 0.2195 |
| Walls of the hosue with bricks | 0.569 |
| Soil of the house with concrete | 0.5345 |
| Solide roof (tiles, mela sheets) | 0.1948 |
| Own tubewee | 0.3717 |
| Sanitary or ring slab latrine | 0.3024 |

**Table 46 - Scoring factors, PCA for housing index**

| Indicators | Scoring factor 1st component |
|---|---|
| Khat, palong | 0.3421 |
| Chair | 0.2089 |
| Table, desk | 0.2848 |
| Sofa | 0.0323 |
| Almira | 0.3002 |
| Alna | 0.3451 |
| Showcase | 0.3129 |
| Wooden box | 0.0745 |
| Steel trunk | 0.1887 |
| Electric fans | 0.2928 |
| Radio | 0.1111 |
| Cassettes player | 0.0553 |
| CD player | 0.0866 |
| DVD player | 0.0546 |
| Television | 0.3431 |
| Sewing machine | 0.0914 |
| Wrist machine | 0.2833 |
| Mobile phone | 0.1137 |
| Bicycle | 0.2607 |
| Motorcycle | 0.0999 |

**Table 47 - Scoring factors, PCA for domestic assets index**

| Indicators | Scoring factor 1st component |
|---|---|
| Deep tubewell | 0.0048 |
| Shallow tubewell | 0.033 |

| | |
|---|---|
| Tredle pump | 0.0207 |
| Hand tubewell | 0.1416 |
| Diesel pump | 0.1318 |
| Solar panel | 0.1287 |
| Plough | 0.0436 |
| Tractor | 0.2267 |
| Spray machine | 0.0626 |
| Husking machine | -0.0081 |
| Rickchaw | -0.0016 |
| Richshaw van | 0.0259 |
| Bark, small boat | 0.2906 |
| Bullock | 0.5638 |
| Cow | 0.4151 |
| Calf | 0.0021 |
| Buffalo | 0.1153 |
| Goat | 0.0411 |
| Sheep | 0.3443 |
| Chicken | 0.4161 |
| Duck | 0.0725 |

**Table 48 - Scoring factors, PCA for productive assets index**

## Annex 3 – Household questionnaire

## Annex 4 – Water Management Organizations questionnaire