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Role of homestead farming systems in the livelihoods and food security of poor farmers in southern Bangladesh

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Role of homestead farming systems in the livelihoods and food security of poor farmers in southern Bangladesh

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Executive summary

Areas in southern Bangladesh share common economic prospects but also challenges. The vast region is already undergoing adverse effects from natural disasters, such as tropical cyclones and accompanying storm surges. Integrated farming, with poultry, fish and crops, can play a significant role in increasing manifold production, income, nutrition and employment opportunities for rural populations in the southern part of the country.

This study covered fish, vegetable, poultry and fruit production, and the subsequent report presents the current homestead production pattern over five components: (1) productivity and profitability, (2) income, (3) nutrition, (4) gender and labor, and (5) integrating different homestead components for rural farm households. The report divides farming households into three landholding categories: functionally landless (fewer than 0.19 ha), small (0.2–0.6 ha) and marginal (more than 0.6–1.0 ha).

For many of the households, homestead land was not only used for housing but also for producing food. Overall, 55% of households had a pond. Functionally landless households produced 1859 kg of fish per hectare, while small households produced 1309 kg and marginal ones 1578 kg. Year-round carp polyculture with extensive production was the most common management practice for aquaculture. Functionally landless households had the fewest perennial ponds, which indicates limited land restrictions for digging deeper and bigger ponds.

Overall, small households had higher vegetable production (134 kg per household) than the other two groups and also used the most inputs per unit area. Average egg production per bird was 37. For meat, average production was 0.9 kg. Overall, milk production was 57 L per cow, and production consistently increased with larger landholdings. Fruit production was higher (89.5 kg per household) in low saline areas compared with the overall average across southern Bangladesh (45.8 kg per household). Functionally landless households depended more on off-farm incomes compared to the other two groups. Households in high saline areas tended to save more money, but they were highly vulnerable to national disasters.

In some cases, households faced heavy rainfall for vegetables and disease epidemics among poultry and livestock. These create shocks and negatively affect production and economic conditions.

The overall results revealed that integrated pond management (poultry, fish and vegetables) is an excellent approach for production and income generation to ensure the food security of poor rural households in the region.

1. Introduction

Southwest Bangladesh, which encompasses the divisions of Khulna and Barisal, has a population of almost 24 million and an overall density of 660 people per square kilometer (BBS 2011). These are some of the most impoverished, malnourished and vulnerable people in the world.

Land elevation rarely exceeds 3 m (UN 2010) and is strongly influenced by tributaries of the Ganges River flowing toward the Bay of Bengal. Because of the area's low-lying nature, proximity to the ocean and extreme poverty, natural disasters such as tropical cyclones and accompanying storm surges can have severe implications for the people here. In 2007, Cyclone Sidr killed between 10,000 and 15,000 people (Foster 2007) and caused extreme losses of crops both in terms of volume and economic value. In 2009, Cyclone Aila resulted in the deaths of 190 people and caused wide-scale economic damage. About 350,000 acres of crop land were lost and 100,000 livestock were killed (UN 2010). In addition, the embankments that the local people had relied upon to protect them from such events were destroyed, leaving them even more vulnerable to cyclones in the future.

Aquatic and agricultural systems are an important source of income, food and nutrition for people living in southwest Bangladesh. These systems produce a wide variety of foodstuffs, including cereals, fruits, vegetables, livestock and fish. These commodities can be produced on large off-household farms as well as in small homestead gardens. In addition to providing an income, food production can improve the food security and nutritional status of homestead members. For this reason, numerous interventions have been targeted at improving homestead food production, most of which have resulted in households increasing their consumption of a greater array of micronutrient-rich ingredients (Helen Keller International 2002; Talukder et al. 2000).

In southwest Bangladesh, salinity plays a central role in the levels of crop agriculture. Cropping is generally limited to the monsoon season, when rainwater can feed the crops. The areas within close proximity to the ocean are often inundated for long periods as drainage congestion causes persistent waterlogging of the land. This can hinder crop production (Roy 2004).

In the 1980s, the giant freshwater prawn (*Macrobrachium rosenbergii*) was introduced for cultivation into southwest Bangladesh (Kamp and Brand 1994). Ever since, there has been a shift away from the diverse array of animal-source foods that were previously produced in the region. Although animals such as goats, cattle and poultry are still produced, it is generally on a smaller-scale relative to shrimp production. Shrimp cultivation traditionally takes place in ghers, which are modified paddy fields where elevated dikes surround the main land—an indigenous system that combines the production of several commodities in one area (Kendrick 1994). A canal is usually constructed around the periphery and takes up approximately 20% of the land. During the rainy season (June–December), ghers fill with water, allowing the production of shrimp and fish. From January to May, ponds dry out and crops such as MV *boro* rice can be grown on the main land area while shrimp and fish shelter in the canals, which are also an important water supply for the crops. The system has since evolved to include black tiger shrimp (*Penaeus monodon)* in more saline regions.

Bangladesh is one of the countries that are most at risk from the effects of climate change. The southwest region is the most vulnerable part within the country because of its coasts and low-lying areas. It can be expected that tropical cyclones similar to Aila and Sidr will increase as intensity and frequency in the coming years, which will reduce the reliability and profitability of agriculture as a source of income. In addition, more frequent flooding will reduce the land available for production by as much as 10% (Chen et al. 2012). Furthermore, a rise in sea level up to 1 m within the century (Bobba 1998; Watson 2001) will reduce the drainage capacity of these floodwaters. This means arable land will remain inundated for longer periods of time. Rising sea levels, combined with changes in freshwater discharge in the major rivers, will also result

in saltwater intrusion and salinization of soils, which can have serious impacts for agricultural crops. Salinity levels in soils often limit intensification of crop production (Haque 2006) and increases have been one of the major difficulties facing agricultural practices for several years (Rahman et al. 2011). Intrusion of saline waters can also affect fish culture practices, especially in regions where freshwater fish are most commonly produced. Such intrusion may require fish farm owners to change practices. But this can be costly, and poor knowledge of an alternative farming practice may inhibit production. The salinization of fishponds has been observed with the increasing occurrence of black tiger shrimp in the region.

The Challenge Program for Water and Food of the Ganges Basin Development Challenge was established with the aim of reducing poverty, increasing food security and strengthening household resilience in the brackish-water coastal zone of the Ganges basin. Improved water management and governance along with more productive, diverse and resilient farming systems are crucial for tackling these issues. As part of this goal, a project called G2 was developed with the objective of introducing more productive, diverse and resilient agriculture-aquaculture systems. This project focuses on all aspects of homestead farming systems, including analysis of integrated vegetable, fish and livestock farming.

To improve upon current homestead systems, it was important to understand the current status of the homestead farming systems. To do this, an extensive survey of the current farming practices of 1280 randomly selected households was conducted from January to March 2012. The households were distributed between three polders. A polder is low-lying tract of land enclosed by embankments (barriers), known as dikes, that forms an artificial hydrological entity. It has no connection with outside water other than through manually operated devices of different environmental regimes in southwest Bangladesh.

The survey had three main aims:
1. to understand how people use homestead resources
2. to determine which households are the most efficient in terms of food production
3. to identify options for improving homestead production systems.

This report presents the current homestead production patterns of different components, including productivity, profitability, income, nutrition, gender and labor, and integrating different homestead components. It also addresses the salinity issue of on-farm and off-farm agricultural production systems of the survey areas.

2. Polder information

Three polders were selected for the study based on salinity. Polder 3 is considered a medium to high saline zone, Polder 30 a low to medium saline area and Polder 43 a low saline area. All three polders are located in the southwest part of the country under different upazilas from three separate districts. Polder 30 is located in Batiaghata of Khulna District, Polder 3 in Debhata and Kaliganj of Satkhira District and Polder 43 in Amtali of Barguna District (Figure 1). Polder 3 is very large and this survey focused on the most southerly region. Some physical information for the three polders is given in Table 1.

2.1. Agro-ecology

Physiography

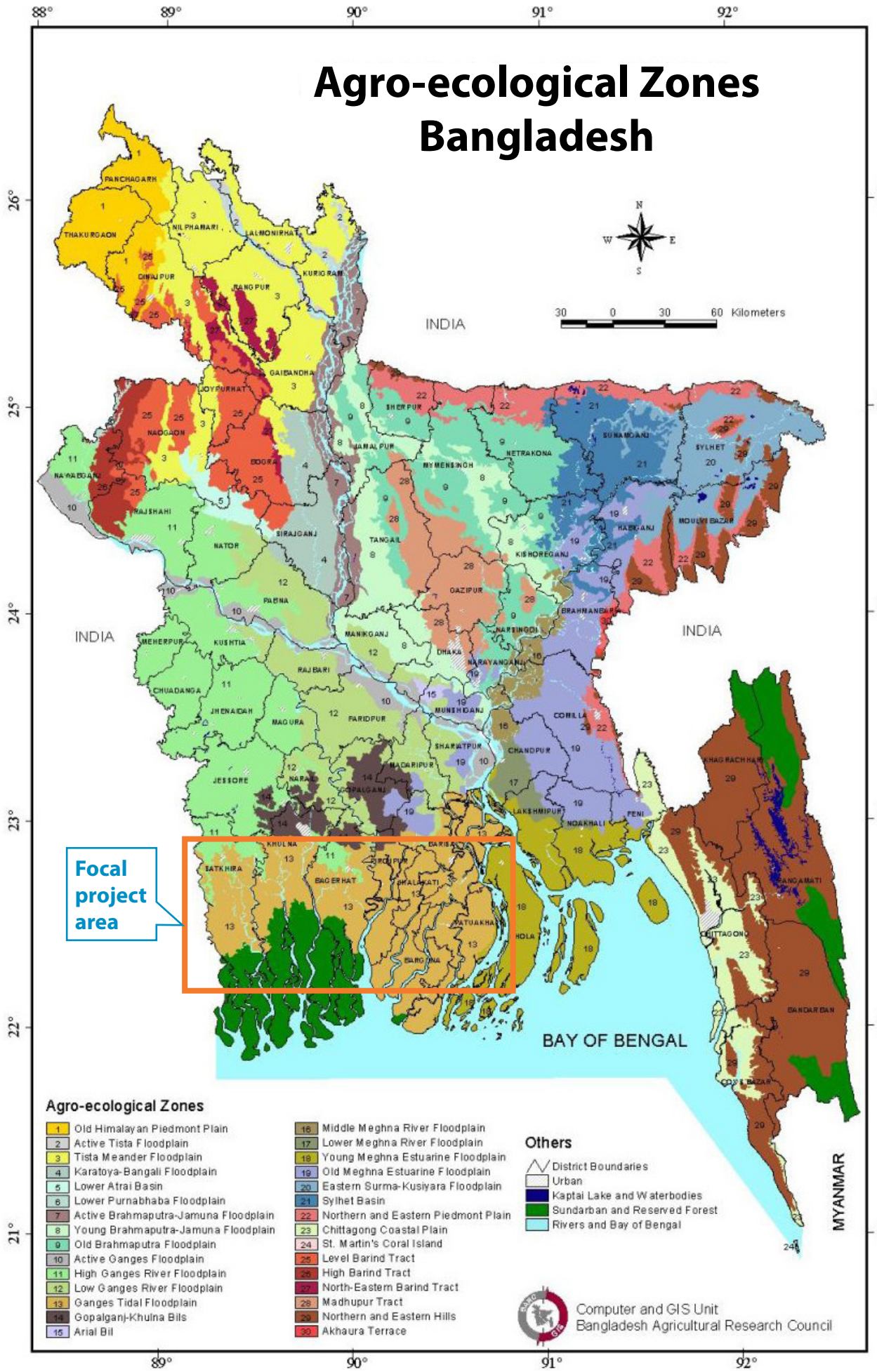
The study areas belong to the Ganges Tidal Floodplain (Figure 1). It occupies an extensive area of 17,066 km^2 in the southwest of the country. The greater part of this region is smooth. River banks generally stand about a meter or less above the level of adjoining basins. The region also has a close network of interconnected tidal rivers and creeks.

A dominating characteristic of the coastal areas is the daily water level fluctuations and the corresponding incoming and outgoing waterflows. These are the driving forces behind several physical processes, such as erosion and accretion, salinity intrusion and drainage congestion/inundations. These factors can dominate agriculture, ecosystems and human activities in the coastal area. Tidal fluctuations determine agricultural practices and set the timing of the movements of river transportation and riverine commercial activities. Filling and emptying land areas during each tidal cycle results in tidal flows. This provides water and nutrients, maintains a variety of special ecosystems, such as mangrove forests, keeps rivers and channels open for navigating and draining adjacent land areas, and is sometimes used to generate energy (Mia and Islam 2005).

Most of the land is considered medium highland (78%). The rest is made up of homestead water (16%), highland (2%), medium lowland (2%) and lowland (less than 1%).

Characteristic	Polder 30	Polder 3	Polder 43
Area (hectares)	7874	35,780	4453
Number (and name) of unions	3 (Batiaghata, Gangarampur and part of Surkhali)	8 (Kaligonj: Varasimla, Tarali, Nalta, Champaful. Debhata: Parulia, Sakipur, Debhata, Nawapara)	1 (Gulishakhalai)
Number of villages	39	67	12
Total population	36,017	221,945	32,370
Period of water logging	None	July–September	None
Salinity range (ppt)	0–20	3–28	0–6

Table 1. General features of the three polders.



Source: www.bamis.gov.bd/en/page/aezs-maps/

Figure 1. The coastal agro-ecological zone of Bangladesh.

Climate

Mean annual rainfall is about 1700 mm in the west and 3300 mm in the southeast part of coastal zone, while the mean annual temperature is about 26.4°C. The whole coastal zone lies within the cyclone zone (ICZM 2004).

Soil type

Noncalcareous gray floodplain soil is the major component of general soil types. Acid sulfate soil also occupies a significant part of the area, where it is extremely acidic during the dry season. Most of the top soil is acidic, while sub-soils are neutral to mildly alkaline. Soil in the Sundarban area is alkaline. The general fertility level is high, with medium to high (1.7%–3.4%) organic matter content.

Water sources

This region is well stocked with surface water resources. Most places are less than 500 m from a tidal river or creek (Figure 2). Groundwater is saline in near surface aquifers throughout most of the region. Freshwater occurs in aquifers at about 300 m.

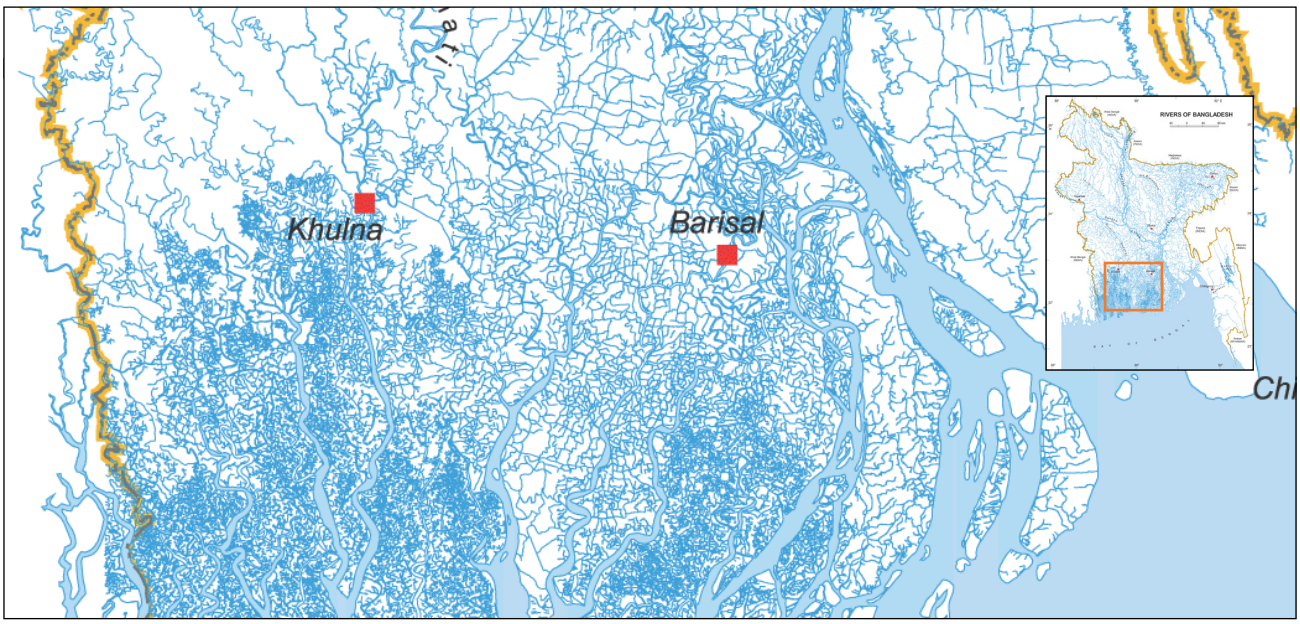
Land use

Land use in coastal Bangladesh is diverse, competitive and conflicting, and it has been changing for more than half a century. During the 1950s, land was primarily used for paddy cultivation, but salinity intrusion and tidal flooding prevented further intensification. So in the 1960s to the 1980s, more than one hundred polders were built to boost paddy production. A decade later, drainage congestion inside and heavy siltation outside polders made the southwest area unsuitable for agriculture and, in some extreme cases, human habitation. Polders provided an opportunity for shrimp farming, something that has been historically common in southwest Bangladesh. About 60% of the land was inundated to a depth of 30 cm or more to develop shrimp farming in the area. The dominant land use in all coastal districts is still agriculture (Mia and Islam 2005), but salt production, forestry, shipbreaking yards, ports, industries, settlements and wetlands are also important industries.

The gross area of the coastal zone is 4.72 million ha, of which the net cultivable area is 1.95 million ha. Like other parts of Bangladesh, coastal livelihoods are largely dependent on agricultural crops, particularly rice (Mia and Islam 2005) as shown in Figure 3.

In Bangladesh, coastal regions contribute about 16% of the country's total rice production. In coastal districts, *aman* rice is the dominant crop, covering about 70% of the total rice cropped area, while *aus* rice covers 16% and *boro* rice 14%. About 60% of the paddy cropped area is planted with local varieties that are adapted to poor water management, such as water logging and salinity (Mia and Islam 2005).

Since the coastal zone makes up about 25% of the cultivable land of Bangladesh, this area produces a relatively high portion of the pulses, oil seeds, betel



Source: en.banglapedia.org/index.php?title=River

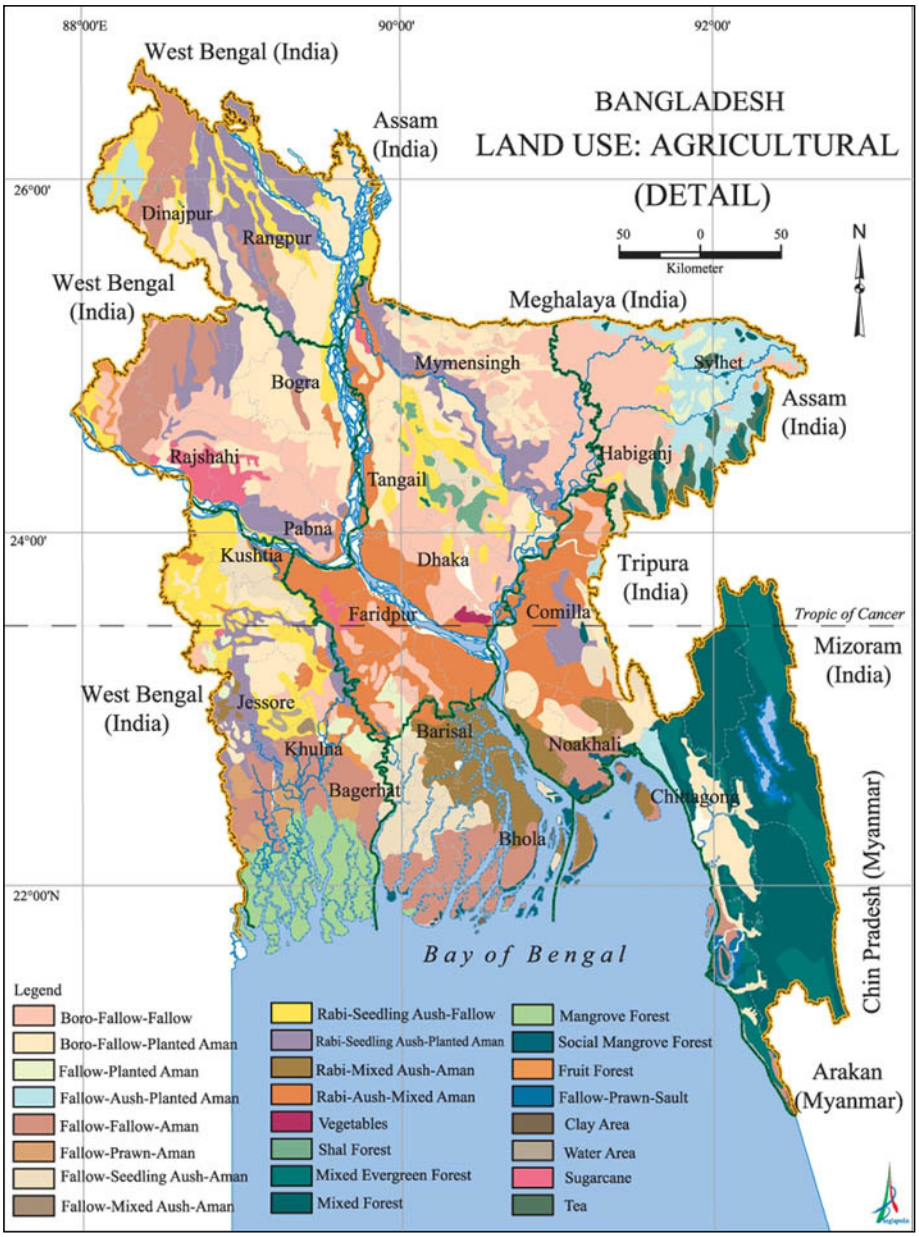
Figure 2. Interconnected river-canal-creek systems in the southwest coast of Bangladesh.

nuts and leaves, winter vegetables and potatoes. However, the share of the coastal zone production of cereals (including paddy), sugar crops and jute is relatively low (Mia and Islam 2005).

Bagda shrimp farms are mostly concentrated in the districts of Khulna, Satkhira and Cox's Bazar (Figure 4) and are located within polders. In the Khulna and Satkhira area, farms largely alternate between shrimp and rice, but in Cox's Bazar it is between shrimp and salt. Farms have gradually decreased in size, with external leaseholders and small holders dividing large ponds into *ghers*. Inside polders, 93% of shrimp farms are under 10 ha. In the whole coastal zone, there are 52,906 *bagda* farms in 49 upazilas. In total, they cover an area of 172,833 ha, with an average farm size of 3.27 ha. Most shrimp farms depend on tidal saline water from adjacent rivers and canals, so they rely on the tides for water. Only a minority of farms use low lift pumps for water from salt canals fed by tidal waters (DOF 2004).

2.2. Geography

Polder 3 is on the border with India, adjacent to the Ichamati River, and has the highest salinity levels of the study locations (Table 1). Because it is so large (Table 1), the focus of this study was on the most southerly region. For the sake of the survey, Polder 3 was further subdivided into households on land greater than 10 ft above sea level in the western part of the region (defined as Polder 3-H) and households on low-lying land



Source: en.banglapedia.org/index.php?title=File:LanduseDetailAgriculture.jpg

Figure 3. Agro-ecological land use pattern in the coastal areas of Bangladesh.

less than 10 ft above sea level in the eastern part (defined as Polder 3-L).

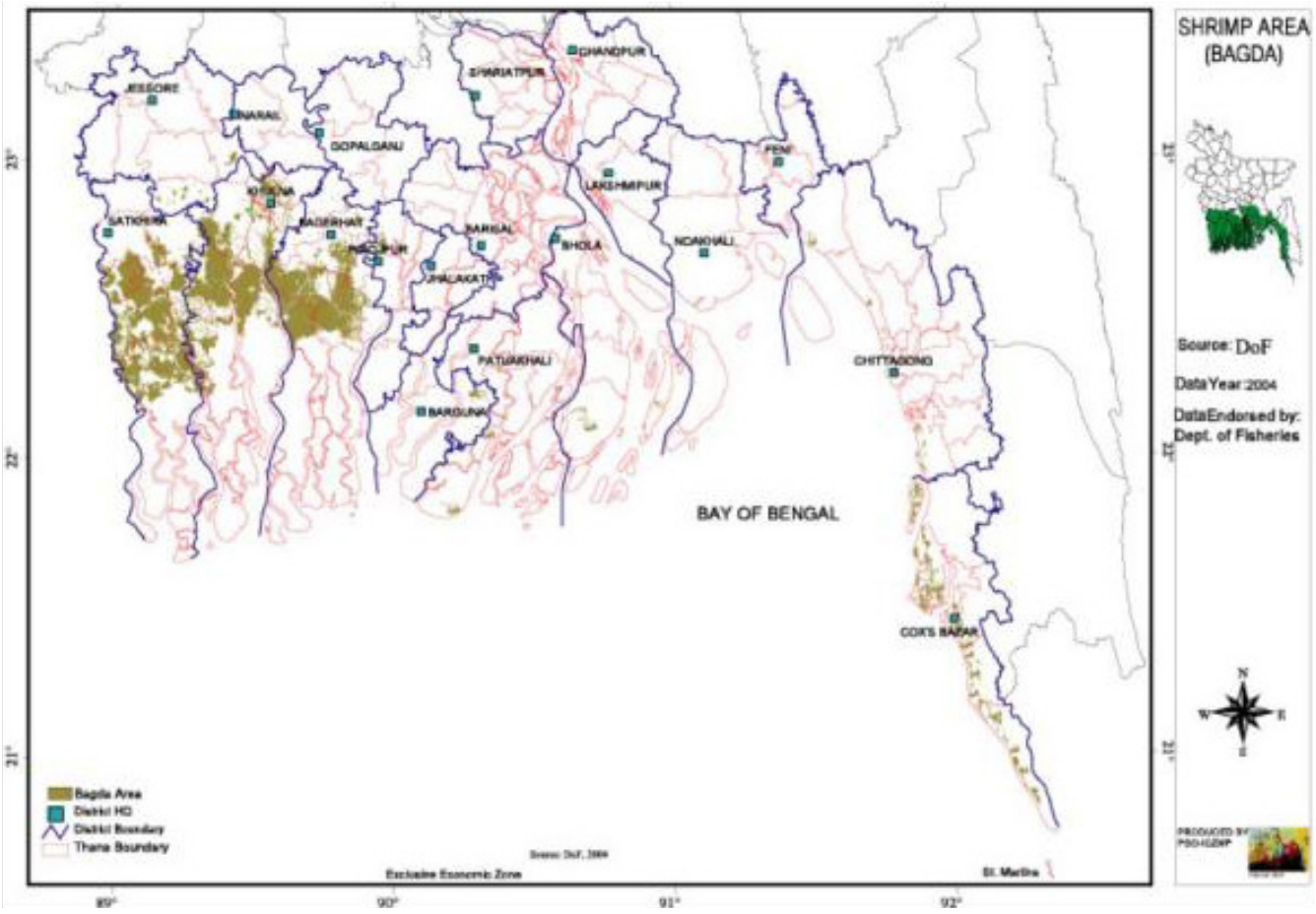
Polder 30 is a medium saline region where salinity levels rarely exceed 20 ppt (Table 1). The land is low-lying and is protected from the risk of flooding from the Kajibacha River by a 40 km long and 4.3 m wide embankment. Tidal regimes greatly affect the level of the river. During high tide, the water level can be nearly 3 m above the general elevation of the land.

Polder 43 is the most southerly of the polders but is highly influenced by the waterflow of the Meghna estuary. Salinity here rarely exceeds 6 ppt, making it the least saline environment in the study region. It is in close proximity to the Bay of Bengal, so it is very susceptible to damage from tropical cyclones and associated storm surges.

2.3. Socioeconomic situation

The coastal region of Bangladesh occupies approximately 20% of the country's surface area (Haque 2006). Average income is marginally higher than the national average, a fact that is emphasized by the small difference between coastal and national incomes. By contrast, higher literacy rates on the coast compared to the national rate show greater access to education (Table 2).

Within the coastal region, there is a great deal of variation in terms of the socioeconomic status, as highlighted by the differences between the three study sites. The average per capita annual income of Polder 30 (Khulna region) is higher (BDT 23,135) than the other two sites (BDT 16,077 and BDT 16,907) and even higher than the coastal and national average, yet this location has the highest number of ultra-poor households. This suggests a high income gap between the polders. Literacy rates in Polder 30 and Polder 43 (Barguna) are higher than the national and coastal averages. Although much lower than the other study sites, the literacy rate of Polder 3 (Satkhira) closely resembles the national average. In all observed locations, the percentage of literate women is between 5% and 12% lower than among men (Table 2).



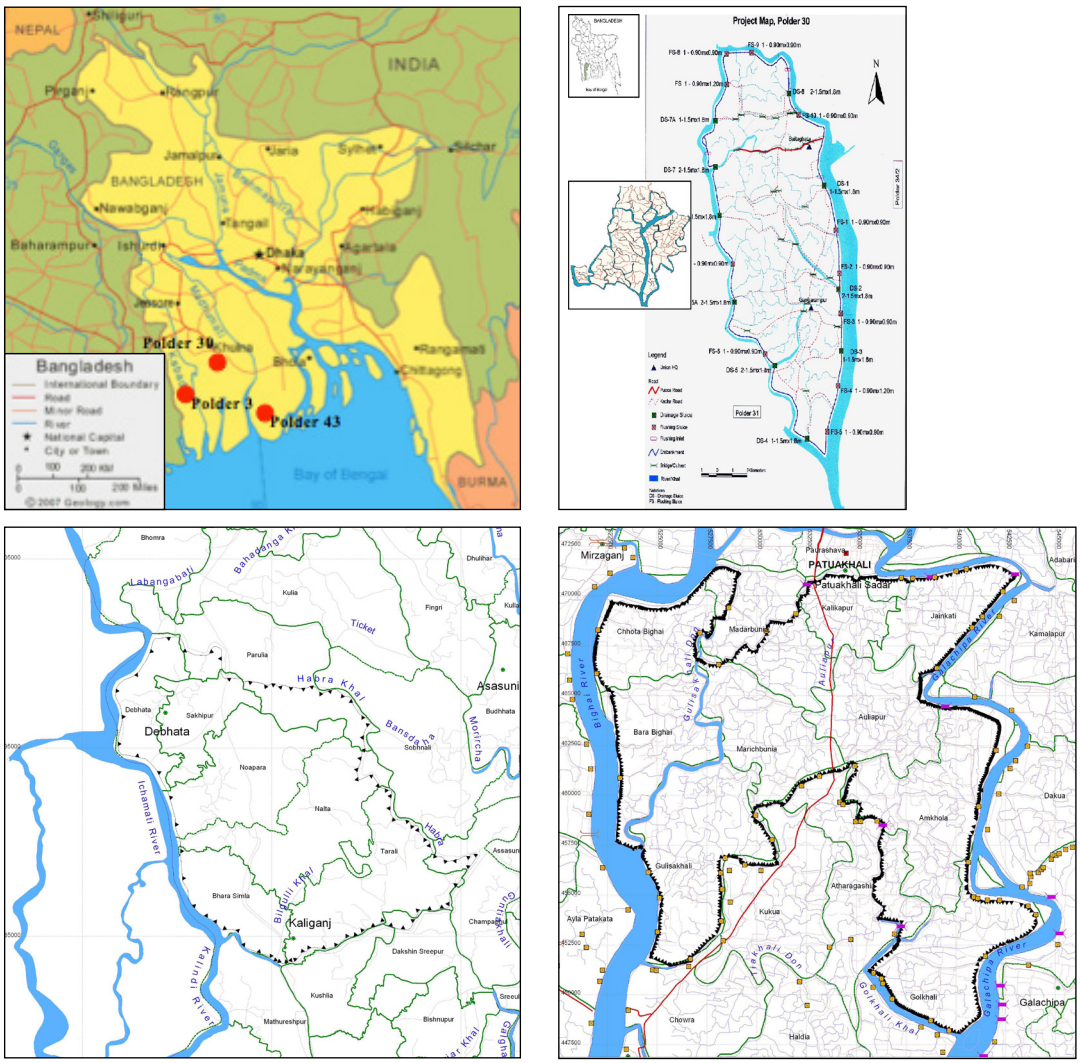
Source: Department of Fisheries, Sustainable Shrimp farming in the coastal zone of Bangladesh, Ministry of Fisheries, Government of Bangladesh, Dhaka, 2010.

Figure 4. Distribution of shrimp farming areas throughout the coastal zone of Bangladesh.

Indicators	Unit	Location				
		Khulna (Polder 30)	Satkhira (Polder 3)	Barguna (Polder 43)	Coastal zone	Bangladesh
Female population	%	49	49	49	49	49
Monthly income	(BDT/capita)	23,135	16,077	16,907	18,198	18,269
Working women (15–49 years old)	%	32	31	27	26	28
Poor	% household	55	55	52	52	49
Ultra-poor	% household	26	14	22	24	23
Illiteracy rate	%	57	45	54	51	45
Men illiteracy rate	%	63	51	56	54	50
Women illiteracy rate	%	51	39	51	47	41

Source: ICZM 2004.

Table 2. Socioeconomic overview of the study area versus coastal and national averages.



Source: Institute of Water Modelling for the CGIAR Challenge Program on Water and Food G3 project.

Figure 5. Location and map of each polder within Bangladesh.

3. Methodology

Complete lists of all the households in each polder were collected from the *union parishad*, the smallest administrative unit in Bangladesh. A total of 21,851 households were recorded throughout the sample region (Table 3).

Each polder, including the subdivisions of Polder 3 (Polder 3-L and Polder 3-H), was considered as a separate strata to allow for stratified random sampling. Statistical Package for Social Science (SPSS) software was used to randomly select households from each strata, with a 95% confidence level. The number of households sampled at each stratum is given in Table 3.

Ten male and one temporary female employee from WorldFish were then assigned the task of visiting each one of these households and interviewing the household head by asking the questions set out in the questionnaire.

Microsoft Access and Microsoft Excel were used to compile and analyze the data after it was collected.

All surveyed households were categorized into five classes according to the Bangladesh national level Household Income and Expenditure Survey 2010 (Table 4). Since the focus of this study is on reducing hunger and poverty through improvements to agriculture-aquaculture systems, analyzing the survey data was based on landholding sizes under 1 ha: 1 dec (decimal) equals 40.46 m^2 or 1 ha equals 247 dec. This includes the land household categories of functionally landless, small and marginal. This ensured that the focus of the study was on the most impoverished.

There were two phases of data analysis. Data was simply observed for patterns and some analyses were performed. After this, more complex multivariate analyses were performed to observe patterns between different production methods and household status indicators, such as food security, economic status and self-sufficiency.

Strata	Number of households	Number of households sampled
Polder 3-L	3836	306
Polder 3-H	4867	232
Polder 30	9507	381
Polder 43/2/F	5833	361
Total	**24,043**	**1280**

Table 3. Number of households in each strata and number of households sampled.

Household category	Farm size in ha	Farm size in dec
Functionally landless	<0.19	<47
Small	0.2–0.6	48–148
Marginal	>0.6–1	149–247
Medium	1–3	248–741
Large	>3	>741

Table 4. Different household categories according to landholding size.

4. General household information

4.1. Landholding size distribution

About 90% of the surveyed households were categorized as functionally landless, small or marginal. The most common category was functionally landless, which accounted for more than half of all households sampled. There was also a negative correlation between landholding size and frequency of occurrence, ending with few households in the largest category (Table 5).

4.2. Occupation

Across the study, agriculture was the most important occupation, contributing to the majority of one-third of income for all household owners (Figure 6). The same number of household heads stated that agriculture took up the majority of their working time (Figure 7), though this figure was almost halved in Polder 3. In comparison, only 7% of household heads spent the majority of

Household type	% of household				
	Polder 30	Polder 3-H	Polder 3-L	Polder 43	All polders
Functionally landless	56	64	52	40	52
Small	22	20	24	31	25
Marginal	11	7	6	17	11
Medium	10	8	14	11	11
Large	1	2	4	1	2
Total	**100 (n=381)**	**100 (n=232)**	**100 (n=306)**	**100 (n=361)**	**100 (n=1280)**

Table 5. Distribution of households according to landholding size.

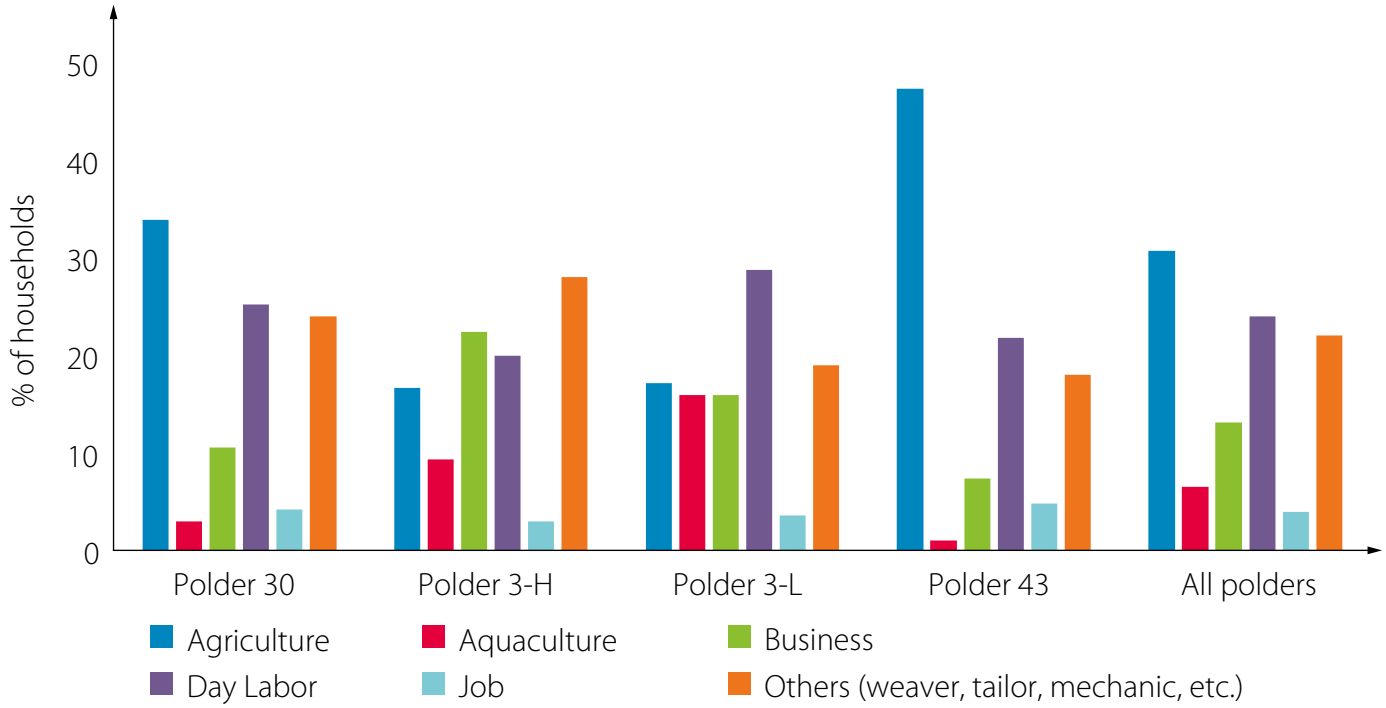


Figure 6. Main occupation for household heads in terms of income.

their working time on fish culture and 7% when looking at income. In contrast to agriculture, fish culture contributed much more significantly to the households in Polder 3 than in polders 30 and 43. Important income sources also came from off-farm activities, such as day labor. Ownership of businesses was the main source of income for 24% of households in Polder 30 and 13% in Polder 43.

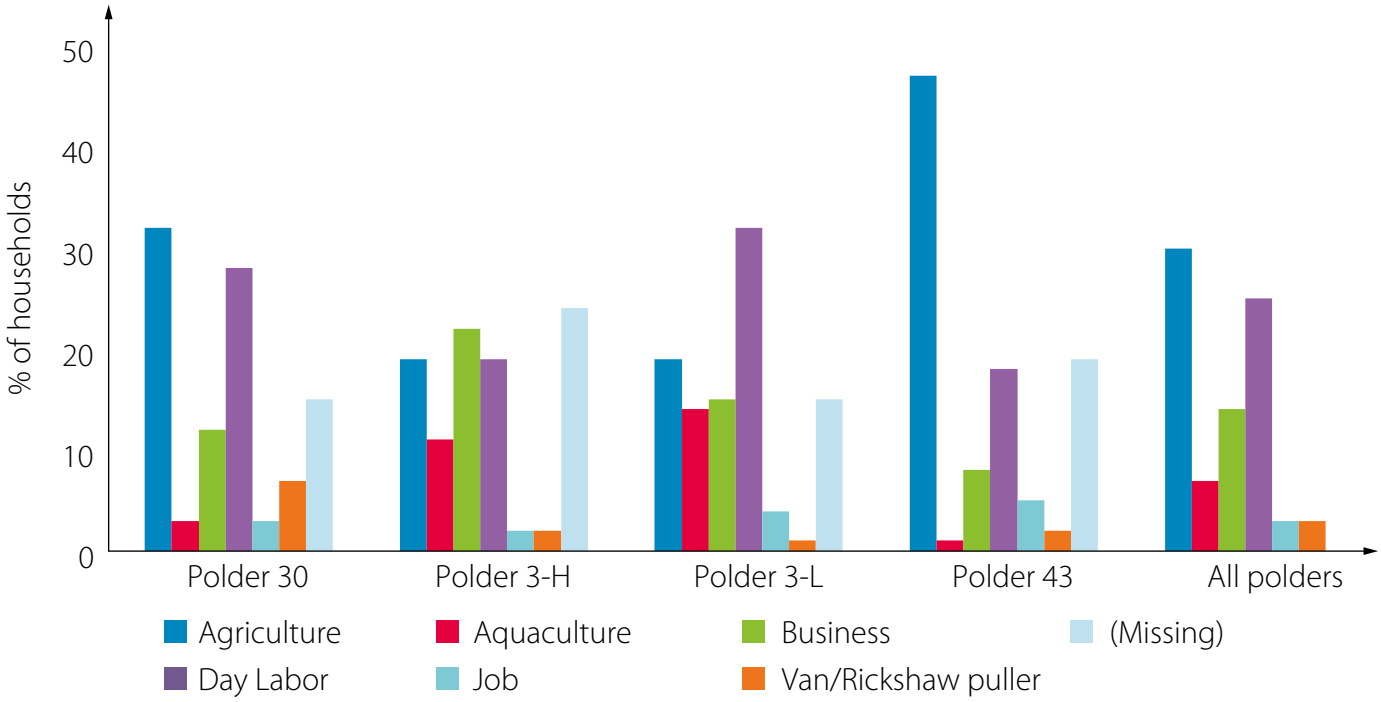


Figure 7. Main occupation for household heads in terms of time spent.

Average area (dec) of homestead and non-homestead land					
Land type by household category	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	**15 (±17)**	**10 (±16)**	**13 (±16)**	**17 (±19)**	**14 (±17)**
Homestead land	10 (±8)	7 (±7)	10 (±8)	11 (±9)	9 (±8)
Non-homestead (field) land	5 (±9)	3 (±9)	3 (±8)	6 (±10)	5 (±9)
Small	**87 (±48)**	**92 (±48)**	**78 (±59)**	**95 (±57)**	**91 (±54)**
Homestead land	21 (±18)	21 (±16)	27 (±27)	29 (±22)	25 (±22)
Non-homestead (field) land	66 (±30)	71 (±28)	61 (±32)	66 (±35)	66 (±32)
Marginal	**195 (±46)**	**183 (±108)**	**194 (±62)**	**195 (±64)**	**193 (±68)**
Homestead land	21 (±17)	42 (±51)	28 (±22)	41 (±28)	33 (±29)
Non-homestead (field) land	174 (±29)	141 (±57)	166 (±40)	154 (±36)	160 (±39)
Average	**56 (±74)**	**42 (±67)**	**47 (±68)**	**79 (±83)**	**58 (±76)**
Homestead land	14 (±14)	13 (±19)	16 (±19)	23 (±22)	17 (±19)

Note: Figures within the parentheses indicate standard deviation of the respected area.

Table 6. Average area of homestead and non-homestead land.

4.3. Land ownership and production

On average, non-homestead land ownership was two and half times the area of homestead land. This contrast was most pronounced in Polder 30, where non-homestead land was three times higher, and least pronounced in Polder 3-L, where it was double (Table 6). Nevertheless, there was a great deal of variation within land categories and polders.

A range of activities was operated on homestead land. Most of these activities were based on producing foodstuffs such as fruits, vegetables and animal products. In comparison, non-homestead land, or field land, has less variety because the majority of products are produced for commercial purposes. Cropping was the most frequent type of land use, practiced by 55% of all land users. The production of shrimp and fish in ghers was particularly common in Polder 3 (Table 7).

Data from the Bangladesh Bureau of Statistics (2010) suggests that cropping takes place on 53% of the country's land area. This matches reasonably closely with data obtained from this survey. However, the results presented here suggest that cropping intensity is slightly higher in the surveyed locations, especially polders 30 and 43, than the national average. According to the BBS (2010), double cropping takes place on 51% of cropped land and triple cropping on 13%. In addition, substantially less land is occupied by forests compared to the national average of 18%, though the BBS estimate of 4% fallow land is similar to the data collected here. In terms of aquaculture, the most recent estimate suggests that 1.3 billion dec, or 1.4%, of total land is given over to inland fish culture (DOF 2010). This figure is substantially lower than the average field land use observed in this study.

	% of land used for specific crops and other items				
	Polder 30	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Homestead	**25**	**31**	**34**	**29**	**29**
House	5	5	5	3	4
Fruit garden/trees	4	8	6	4	5
Livestock shade	0.8	0.5	0.8	0.3	0.6
Pond	8	9	11	10	10
Poultry	0.3	0.2	0.5	0.2	0.3
Tree-covered area	1	1	2	5	3
Vegetable garden	3	5	4	2	3
Yard	4	3	4	4	4
Field (Non-homestead)	**75**	**69**	**66**	**71**	**71**
Crop land	62	37	39	63	55
Fallow land	1	0.4	1	3	2
Forest land	1	0.8	0.5	1	1
Shrimp ghers	6	24	16	2	9
Rice-fish ghers	5	6	10	1	5

Table 7. Land use pattern by major crops and items.

4.4. Land leasing or renting

Eighteen percent of functionally landless households either rented or leased land for agricultural purposes, more than any other landholding size category. The trend of land leasing decreases with bigger landholding sizes (Figure 8). This might be because larger landholders mainly use their own land to produce crops whereas small landholders produce crops by leasing or renting land. Overall, 32% of households rented or leased extra land.

There is an obvious switch of priorities by location in terms of the use of rented or leased land. In polders 30 and 43, the majority of leased land is used to grow crops. In Polder 3, a far greater proportion (about 50%) cultivates shrimp, rice and fish in ghers (Figure 9).

4.5. Income and expenditure patterns

For Polder 3, average household income, both from homestead and field farming activities, was substantially higher than that of polders 30 and 43, especially for small and marginal landholding groups. By contrast, Polder 43 is heavily reliant on alternative sources of employment, away from farming practices, to supplement income. The highest portion of income (41%) was earned from field farming by the marginal households, but this was comparatively low for the other two categories (Table 8). Functionally landless households depended on off-farm incomes.

However, if overall income versus expenditure patterns are looked at across the polders and landholding size, each group has more or less the similar pattern of savings proportionate to its income. Households in the coastal area saved a good portion of income (25%) as did functionally landless households (Table 9). The savings tendency was higher for households in Polder 3-L, which are highly vulnerable to national disasters compared to other polders.

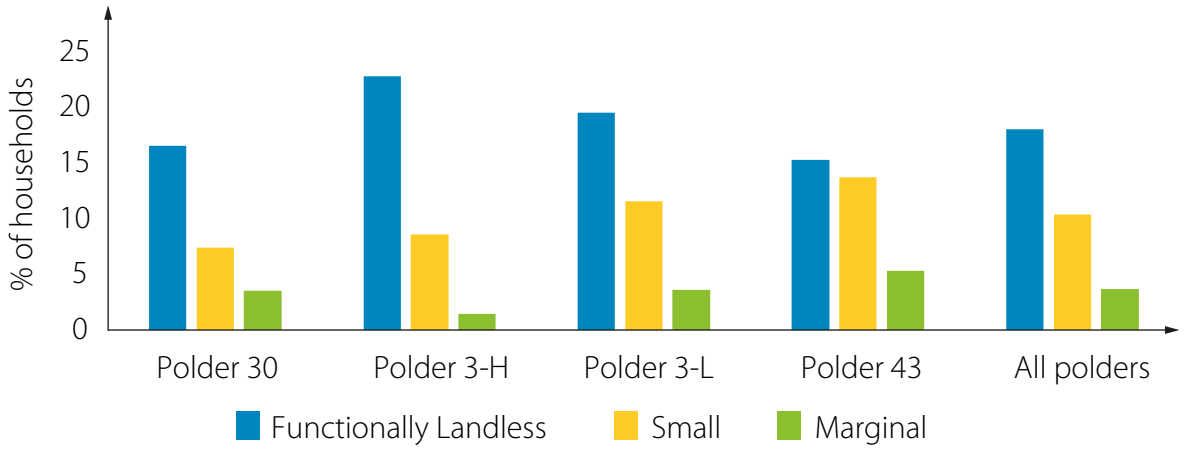


Figure 8. Percentage of households that leased or rented land.

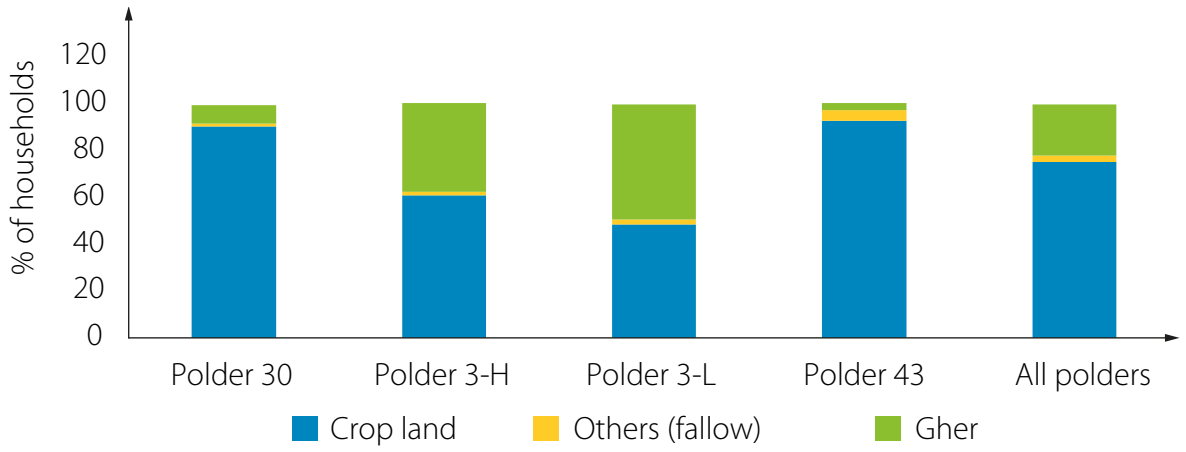


Figure 9. Percentage distribution of the use of land that is leased or rented.

(BDT/household/year)					
Landholding category	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	**84,869 (±63,415)**	**89,427 (±79,897)**	**95,647 (±74,179)**	**75,334 (±67,294)**	**86,398 (±71,000)**
Off-farm income	50,950 (±41,798)	57,661 (±48,950)	57,772 (±46,274)	52,001 (±38,444)	54,314 (±43,921)
Homestead farm with pond income	25,836 (±29,147)	20,283 (±18,205)	30,281 (±47,255)	15,838 (±31,150)	23,584 (±33,910)
Homestead farm without pond income	12,681 (±21,358)	11,154 (±23,528)	17,164 (±21,421)	4201 (±9004)	11,619 (±20,535)
Field farm income	15,280 (±39,493)	17,528 (±63,572)	14,891 (±42,686)	15,115 (±53,744)	15,651 (±49,539)
Small	**99,899 (±58,559)**	**141,511 (±67,952)**	**170,999 (±155,519)**	**100,910 (±67,904)**	**123,038 (±98,582)**
Off-farm income	33,336 (±35,900)	67,552 (±58,885)	69,400 (±89,342)	53,489 (±58,702)	53,970 (±64,055)
Homestead farm with pond income	38,239 (±37,064)	35,419 (±29,204)	45,738 (±36,966)	22,593 (±23,512)	33,268 (±32,312)
Homestead farm without pond income	21,866 (±27,134)	32,521 (±34,052)	21,808 (±22,161)	9158 (±11,222)	20,385 (±24,903)
Field farm income	34,045 (±31,099)	39,422 (±37,241)	63,622 (±111,114)	27,466 (±28,804)	39,439 (±61,738)
Marginal	**130,696 (±76,477)**	**213,181 (±215,465)**	**276,367 (±299,441)**	**128,438 (±107,422)**	**156,983 (±158,480)**
Off-farm income	45,237 (±61,580)	84,275 (±86,409)	75,729 (±140,859)	52,013 (±58,814)	56,531 (±77,485)
Homestead farm with pond income	33,293 (±22,894)	52,463 (±51,122)	53,817 (±32,751)	31,321 (±38,859)	37,121 (±36,852)
Homestead farm without pond income	47,414 (±52,350)	59,705 (±63,042)	54,453 (±55,637)	12,121 (±8070)	36,989 (±45,371)
Field farm income	47,897 (±36,725)	75,086 (±200,504)	146,671 (±219,597)	48,457 (±91,557)	63,361 (±123,224)
Average	**94,390 (±65,680)**	**110,265 (±100,743)**	**130,103 (±137,877)**	**94,741 (±79,374)**	**105,480 (±97,246)**
Off-farm income	45,898 (±43,989)	61,855 (±55,007)	62,416 (±70,730)	52,524 (±50,388)	54,493 (±55,134)
Homestead farm with pond income	30,800 (±31,202)	29,785 (±30,292)	38,332 (±43,060)	21,573 (±26,816)	29,144 (±33,203)
Homestead farm without pond income	17,225 (±27,742)	15,021 (±27,856)	19,392 (±23,936)	5984 (±9738)	14,752 (±24,439)
Field farm income	24,038 (±39,058)	26,709 (±79,378)	38,183 (±95,861)	26,002 (±58,103)	28,274 (±68,449)

Note: figures in parentheses indicate standard deviation of the respected income.

Table 8. Sources of household income and annual average.

	(BDT/household/year)				
	Polder 30	Polder 3-H	Polder 3-L	Polder 43	All polders
Functionally landless					
Income	84,869 (±63,415)	89,427 (±79,897)	95,647 (±74,179)	75,334 (±67,294)	86,398 (±71,000)
Expenditure	63,448 (±33,402)	75,895 (±37,433)	80,619 (±38,221)	66,918 (±40,539)	71,106 (±37,772)
Savings	21,421 (±30,013)	13,532 (±42,464)	15,028 (±35,958)	8416 (±26,755)	15,292 (±33,228)
Small					
Income	99,899 (±58,559)	141,511 (±67,952)	170,999 (±15,519)	100,910 (±67,904)	123,038 (±98,582)
Expenditure	68,509 (±27,245)	98,724 (±44,370)	107,529 (±51,371)	85,181 (±46,995)	88,016 (±45,800)
Savings	31,390 (±31,314)	42,787 (±23,582)	63,470 (±35,852)	15,729 (±20,909)	35,022 (±52,782)
Marginal					
Income	130,696 (±76,477)	213,181 (±215,465)	276,367 (±299,441)	128,438 (±107,422)	156,983 (±158,480)
Expenditure	85,884 (±40,079)	129,414 (±48,483)	131,522 (±36,144)	101,141 (±50,391)	103,391 (±48,477)
Savings	44,812 (±36,398)	83,767 (±166,982)	144,845 (±263,297)	27,297 (±57,031)	53,592 (±110,003)
Average					
Income	94,390 (±65,680)	110,265 (±100,743)	130,103 (±137,877)	94,741 (±79,374)	105,480 (±97,246)
Expenditure	67,545 (±33,763)	84,973 (±42,987)	92,000 (±45,356)	80,048 (±46,824)	79,877 (±43,166)
Savings	26,845 (±31,917)	25,292 (57,756)	38,103 (±92,521)	14,693 (±32,550)	25,603 (±54,080)

Note: figures in parentheses indicate standard deviation of the respected figure.

Table 9. Average household income, expenditure and savings patterns.

5. Homestead farming systems

The homestead lands of many households were only not used for their dwelling house but also for producing diversified food. This system has a number of different components that can be broadly divided into five main categories: pond aquaculture, vegetables, poultry, livestock and fruit. A wide variety of production strategies was used for the production of each component, and each benefits the household to different financial and nutritional extents. The following sections examine the production strategies used and the benefits gained by the households from the production systems.

5.1. Homestead pond aquaculture

5.1.1. Number, size and seasonality of homestead ponds

Overall, 55% of people have a pond within their homestead, but only 43% of the functionally landless had one. There was a positive correlation between total land area and pond availability among homesteads across all polders (Figure 10).

There was a great deal of variability in pond area within landholding categories and polders. However, with the exception of marginal farmers in Polder 30 and low-lying land in Polder 3, there was a consistent positive relationship between landholding size and average pond area. Though most of the ponds were small, there was a large variation from one household to another. Average pond size was highest for Polder 43 (Table 10).

Year-round aquaculture was practiced in the majority of homestead ponds in each polder (Table 11). There was little variation between polders in terms of the percentage of seasonal ponds, except for Polder 30 where the proportion was slightly higher. About 90% of ponds were perennial, which provided the opportunity to culture fish year-round. Functionally landless households had fewer perennial ponds compared to other landholding categories, which shows the restrictions on digging deeper and bigger ponds.

5.1.2. Aquaculture

Culture

Polyculture was practiced in the vast majority of ponds at every location and within every landholding category. Households on low-lying land in Polder 3 had the highest number of monoculture ponds (Table 12). The potential to earn income from polyculture was huge.

Management practice

The most common management practice was extensive production, which was practiced among 91% of all ponds, on average, in every polder and within every landholding category. Improved extensive management was only seen in polders 30 and 43, while only one household in Polder 43

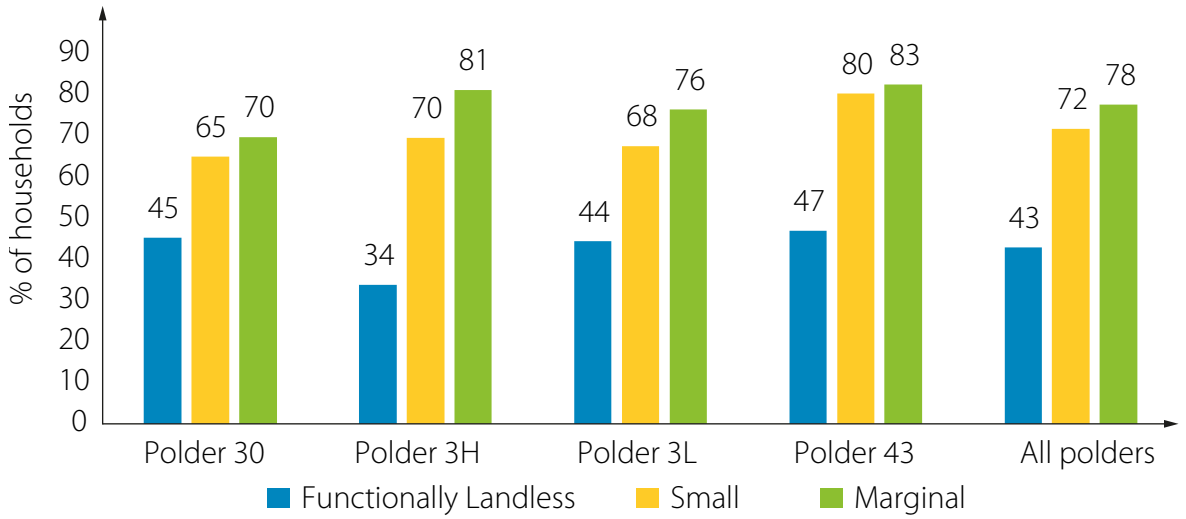


Figure 10. Percentage of households with a pond in the homestead area.

Landholding category	Average pond surface area (dec/household)				
	Polder 30	Polder 3-H	Polder 3-L	Polder 43	All polders
Functionally landless	6.4 (±5)	5.4 (±5)	5.9 (±7)	7.1 (±5)	6.3 (±6)
Small	11.1 (±11)	8.5 (±8)	13.7 (±23)	13.5 (±12)	12.3 (±14)
Marginal	8.3 (±7)	16.5 (±20)	13.6 (±15)	18.4 (±19)	14.8 (±16)
Average	8 (±8)	8 (±10)	9.6 (±16)	12.6 (±13)	10 (±12)

Note: figures within parentheses indicate standard deviation of pond area of respective categories.

Table 10. Pond area.

% of households					
	Polder 30	Polder 3-H	Polder 3-L	Polder 43	All polders
Perennial	**89**	**93**	**95**	**91**	**92**
Functionally landless	87	91	93	90	90
Small	92	93	98	92	93
Marginal	91	100	92	92	93
Seasonal	**11**	**7**	**5**	**9**	**8**
Functionally landless	13	9	7	10	10
Small	8	7	2	8	7
Marginal	9	0	8	8	7

Table 11. Households that practiced seasonal or perennial production in their pond (2011).

% of ponds					
	Polder 30	Polder 3-H	Polder 3-L	Polder 43	All polders
Monoculture	**2**	**2**	**11**	**1**	**4**
Functionally landless	2	4	11	1	5
Small	2	0	10	1	3
Marginal	0	0	15	0	2
Polyculture	**98**	**98**	**89**	**99**	**96**
Functionally landless	98	96	89	99	95
Small	98	100	90	99	97
Marginal	100	100	85	100	98

Table 12. Households that practiced monoculture and polyculture in ponds (2011).

throughout the entire study practiced intensive aquaculture (Table 13). Switching from extensive to semi-intensive and intensive practices could improve their culture system and provide an opportunity to increase production and income from fish culture.

5.1.3. Species cultured

Carp was the most commonly cultured species, with 60% of all fish-producing homestead ponds having at least one species. Rui (*Labeorohita*) was the most common type of carp followed by silver carp, catla and mrigal.

Puti (*Puntiussophore*) was the second-most frequently cultured species, mainly in polders 30 and 43 (medium and low saline areas). Tilapia was third, and its importance is increasing, not only in the coastal region, but throughout Bangladesh (WorldFish 2012). Other important species included catfish and shrimp (Figure 11).

5.1.4. Intensity input use in homestead ponds

There was not much difference in input use among the polders, except in the highland area of Polder 3 (high saline area). Among homestead ponds in Polder 3-H, the intensity was low. Supplementary feed was the most commonly

	% of pond				
Management practice	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Extensive	**97**	**97**	**95**	**93**	**95**
Functionally landless	99	96	97	94	97
Small	94	97	92	93	94
Marginal	97	100	92	90	94
Improved extensive	**3**	**3**	**5**	**7**	**5**
Functionally landless	1	4	3	6	3
Small	6	3	8	7	6
Marginal	3	0	8	10	6

Table 13. Households practicing a variety of management strategies in their ponds (2011).

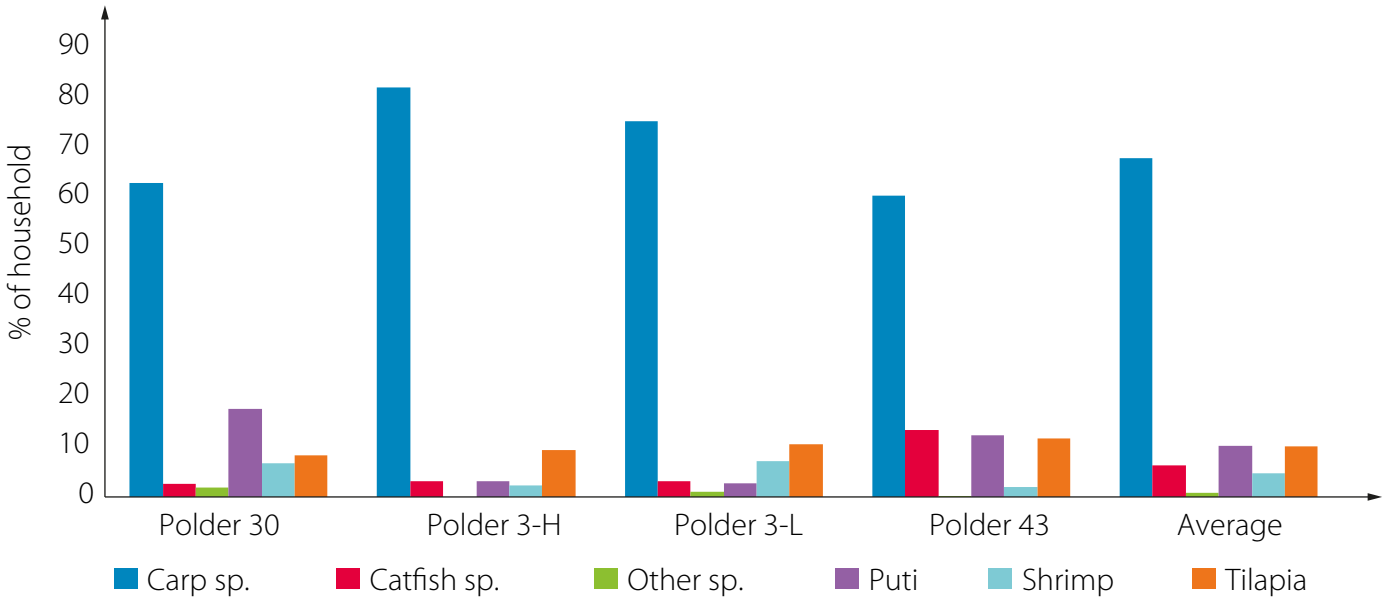


Figure 11. Households producing different types of fish in their homestead pond.

used input by most of the households among all polders (thought the cost was not high) and made up the highest share of total variable costs. Chemicals were a common input at each location, and organic fertilizers were used more than inorganic ones throughout the study area (Table 14). The use of inputs became more frequent with increasing landholding size and income, but the proportion of each type of input remained fairly similar, except for small landholders in Polder 43 and marginal landholders in Polder 3-H. This pattern remained consistent at each location, but expenditures on inputs, such as feed and fertilizer, in Polder 43 were much higher than the other locations (Table 14).

(BDT/dec/year)					
Landholding categories	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	**90,53 (±22,994)**	**5487 (±12,179)**	**7377 (±22,420)**	**26,840 (±112,831)**	**12,254 (±58,294)**
Chemical (lime, rotenone, etc.)	615 (±1316)	506 (±1190)	1096 (±3281)	394 (±1365)	663 (±1997)
Inorganic fertilizer	755 (±6143)	402 (±1623)	51 (±375)	1596 (±7377)	718 (±5125)
Organic fertilizer	731 (±2852)	2613 (±6665)	1045 (±3666)	5085 (±20,902)	2178 (±10,948)
Fingerlings	949 (±3970)	238 (±911)	98 (±679)	46 (±269)	397 (±2388)
Supplementary feed	6004 (±19,580)	1729 (±5604)	5087 (±20,517)	19,720 (±939)	8298 (±486)
Small	**15,754 (±43,958)**	**7409 (±12,256)**	**14,550 (±33,644)**	**7798 (±14,349)**	**11,138 (±286)**
Chemical (lime, rotenone, etc.)	637 (±1089)	932 (±932)	445 (±1107)	360 (±815)	476 (±971)
Inorganic fertilizer	318 (±1141)	1505 (±4825)	703 (±3343)	763 (±2406)	748 (±2892)
Organic fertilizer	754 (±1839)	1949 (±3315)	673 (±2266)	1539 (±2767)	1218 (±2587)
Fingerlings	369 (±1743)	0 (±000)	6361 (±17,837)	64 (±477)	1521 (±8763)
Supplementary feed	13,677 (±42,724)	3377 (±9791)	6368 (±22,339)	5072 (±12733)	7175 (±25,102)
Marginal	**38,847 (±940)**	**1819 (±3157)**	**29,831 (±573)**	**38,138 (±1534)**	**32,963 (±118)**
Chemical (lime, rotenone, etc.)	1360 (±1950)	125 (±201)	1149 (±1884)	473 (±1273)	759 (±1554)
Inorganic fertilizer	256 (±7)	665 (±1979)	3343 (±9359)	747 (±1589)	913 (±3529)
Organic fertilizer	769 (±1815)	321 (±1156)	4692 (±107)	1434 (±3239)	1507 (±4524)
Fingerlings	250 (±1369)	0 (±0)	372 (±973)	0 (±0)	114 (±797)
Supplementary feed	36,212 (±919)	709 (±1864)	20,275 (±400)	35,484 (±1524)	29,670 (±1169)
Average	**21,218 (±22,631)**	**4905 (±9197)**	**17,253 (±18,879)**	**24,259 (±42,905)**	**18,785 (±19566)**
Chemical (lime, rotenone, etc.)	871 (±1452)	521 (±774)	897 (±2091)	409 (±1151)	633 (±1507)
Inorganic fertilizer	443 (±2430)	857 (±2809)	1366 (±4359)	1035 (±3791)	793 (±3849)
Organic fertilizer	751 (±2169)	1628 (±3712)	2137 (±2013)	2686 (±8969)	1634 (±6020)
Fingerlings	523 (±2361)	79 (±304)	2277 (±6496)	37 (±249)	677 (±3983)
Supplementary feed	18,631 (±21,074)	1938 (±5753)	10,577 (±14419)	20,092 (±5065)	15,048 (±8919)

Note: figures in parentheses indicate standard deviation of respective input cost.

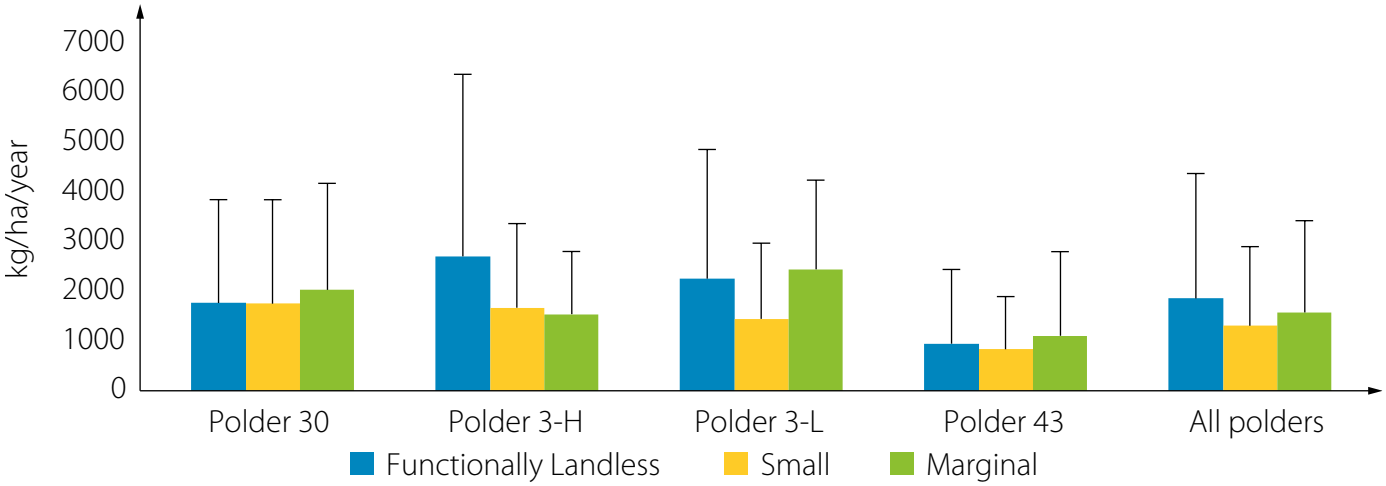
Table 14. Expenditures as variable costs in homestead aquaculture.

5.1.5. Use of major equipment in homestead ponds

Cast nets were the most frequently used equipment in homestead aquaculture in every polder, but particularly high across all landholding categories in Polder 30 (Table 15). Only 5% of households used irrigation pumps, and this was highest in the highland area of Polder 3. The intensive use of irrigation pumps shows fish farmable water sufficiency in homestead ponds in the coastal area, though not many poor households were able to irrigate their ponds because of the high cost.

5.1.6. Productivity of homestead pond aquaculture

There was great variability in terms of pond productivity within landholding categories and polders. Overall, functionally landless households had better fish productivity. However, there was no consistent pattern in terms of productivity between different landholding categories. Overall, pond productivity in Polders 3 and 30 was similar but noticeably more than Polder 43 (high saline area) (Figure 12).



Note: error bars indicate standard deviation.

Figure 12. Fish production of homestead ponds.

	% of households				
	Polder 30	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Cast net	**64**	**49**	**60**	**59**	**59**
Functionally landless	58	40	45	44	48
Small	76	63	74	70	71
Marginal	63	54	85	58	62
Irrigation pump	**4**	**11**	**4**	**2**	**5**
Functionally landless	2	4	1	0	2
Small	9	16	8	1	7
Marginal	0	23	8	8	7
Other net (benti net, pull net, etc.)	**4**	**2**	**2**	**11**	**6**
Functionally landless	4	2	3	15	6
Small	6	3	2	11	7
Marginal	0	0	0	6	3
Average	**72**	**62**	**66**	**72**	**69**

Table 15. Percentage of households that used major equipment in aquaculture production.

There was a consistent increase in fish production with increased landholding size (Figure 13). It is likely that this is a result of larger ponds and therefore greater stocking potential.

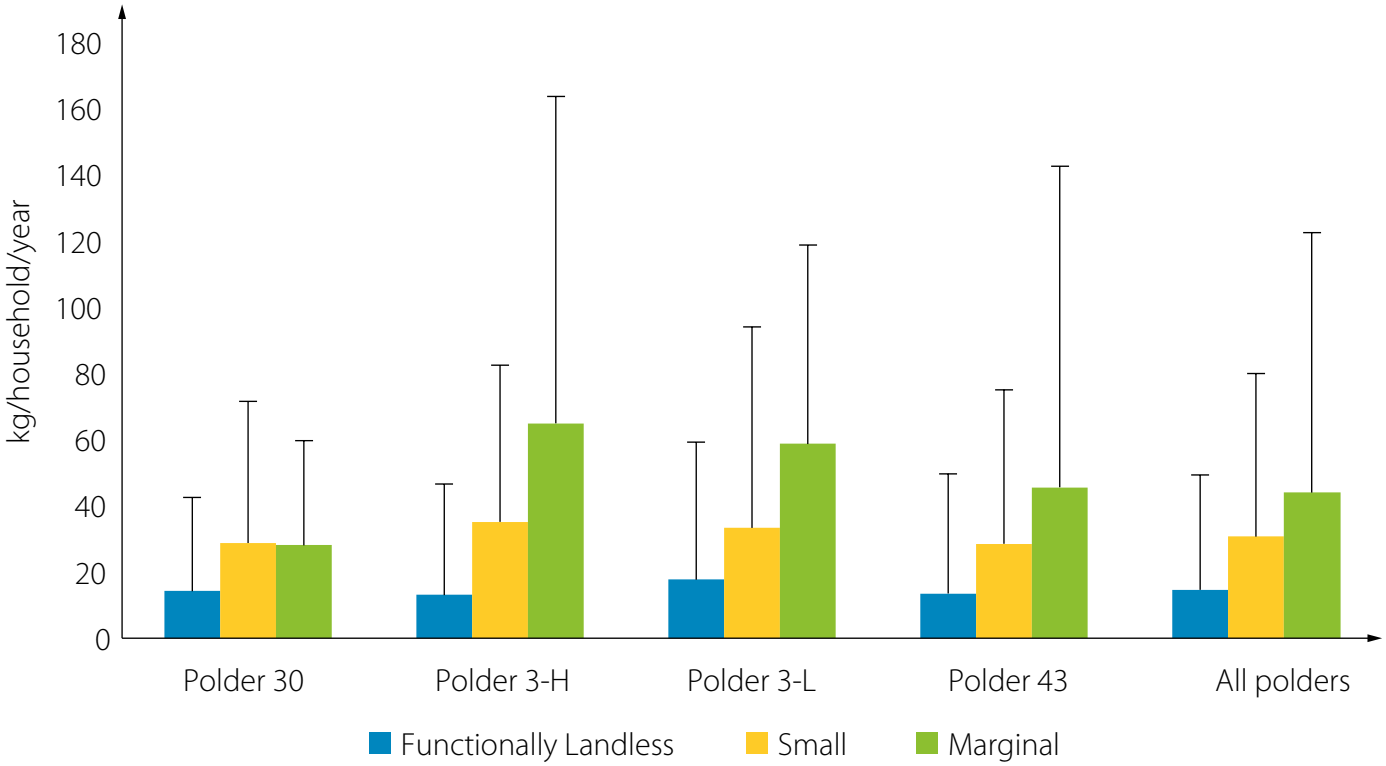
5.1.7. Seasonality and homestead pond fish productivity

Annual yield from perennial ponds was consistently higher than seasonal ponds, except for in Polder 30 (Table 16). Overall, perennial ponds averaged twice the annual yield of seasonal ponds, though this difference was much greater in polders 3 and 43. This suggests that longer culture periods result in higher yield.

5.1.8. Stocking pattern and productivity of homestead ponds

Returns from both forms of culture practices varied greatly in polders 3-H and 43. In general, households practicing monoculture had greater production than households practicing polyculture, though this trend was reversed in Polder 43 (Table 18). However, it should be noted that the value of polyculture reported here only represents that of two households.

There was a great deal of variability in terms of fish production among the polders. However, except for 43, improved extensive had higher production than extensive management.



Note: error bars indicate standard deviation.

Figure 13. Fish production from homestead ponds.

Seasonality	Production (kg/ha/year)				
	Polder 30	Polder 3-H	Polder 3-L	Polder 43	All polders
Perennial	1852 (±2062)	2523 (±3087)	2173 (±2255)	1039 (±1422)	1733 (±2168)
Seasonal	1652 (2193)	903 (±1484)	507 (±995)	202 (±693)	964 (±1713)
Average	**1807 (±2087)**	**2199 (±2907)**	**1974 (±2209)**	**939 (±1382)**	**1609 (±2119)**

Note: figures in parentheses indicate standard deviation of production.

Table 16. Fish production from seasonal and perennial homestead ponds.

5.1.9. Shocks and constraints

Data analysis showed that there was no clear pattern in homestead aquaculture with regards to the vulnerability of different landholding categories to losses, though households categorized as "small" suffered most frequently. Flooding was the most common shock for aquaculture across the polders, with Polder 3-L suffering the most (Figure 14).

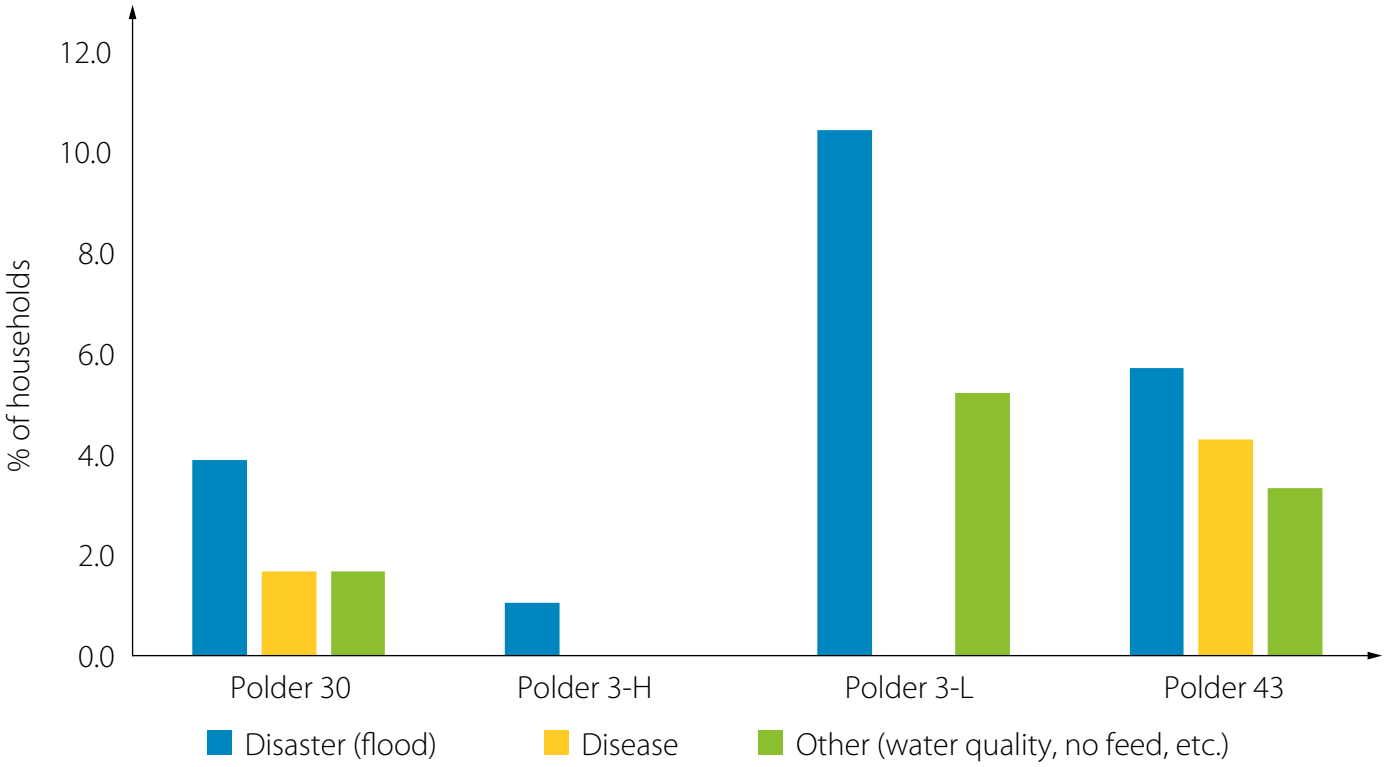


Figure 14. Major shocks for homestead pond aquaculture.

Production (kg/ha/year)					
Culture species	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Monoculture	2184 (±2020)	3520 (±786)	2092 (±2101)	141 (±100)	2057 (±1979)
Polyculture	1801 (±2093)	2171 (±2931)	1959 (±2231)	947 (±1386)	1593 (±2124)
Average	**1807 (±2087)**	**2199 (±2907)**	**1974 (±2209)**	**939 (±1382)**	**1609 (±2119)**

Note: figures in parentheses indicate standard deviation of production.

Table 17. Fish production from monoculture and polyculture of homestead ponds (2011).

Average production (kg/ha)					
Management practice	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Extensive	1778 (±2072)	2088 (±2850)	1935 (±2208)	915 (±1408)	1574 (±2110)
Improved extensive	2848 (±2615)	5614 (±3111)	2586 (±2284)	1263 (±958)	2281 (±2216)
Average	**1807 (±2087)**	**2199 (±2907)**	**1974 (±2209)**	**939 (±1382)**	**1609 (±2119)**

Note: figures in parentheses indicate standard deviation of production.

Table 18. Fish production under management practices of homestead ponds (2011).

Fish farming households in Polder 43 faced substantially more constraints to aquaculture production than those in the other polders. The main constraint in polders 43 and 30 was insufficient funds to manage aquaculture. Limited land, poor water quality and disputes between joint owners of a single pond were also reported (Table 19).

5.2. Vegetable production of homestead farming

5.2.1. Homestead vegetable production area

The average area per homestead devoted to vegetable production ranged from 0.7–3.4 dec across land sizes and polders, except for marginal landholdings in Polder 3-H, where the area was much larger (10 dec). Despite the fact that functionally landless households had the smallest vegetable producing area, the relationship between landholding size and area for vegetable production was always uneven among the polders (Figure 15).

5.2.2. Common homestead vegetable varieties

A diverse array of vegetables is produced on the homestead. The production pattern in polders 3 and 30 was fairly similar. Beans and gourds were common in Polder 43 but not so prominent in Polder 30 (Table 20).

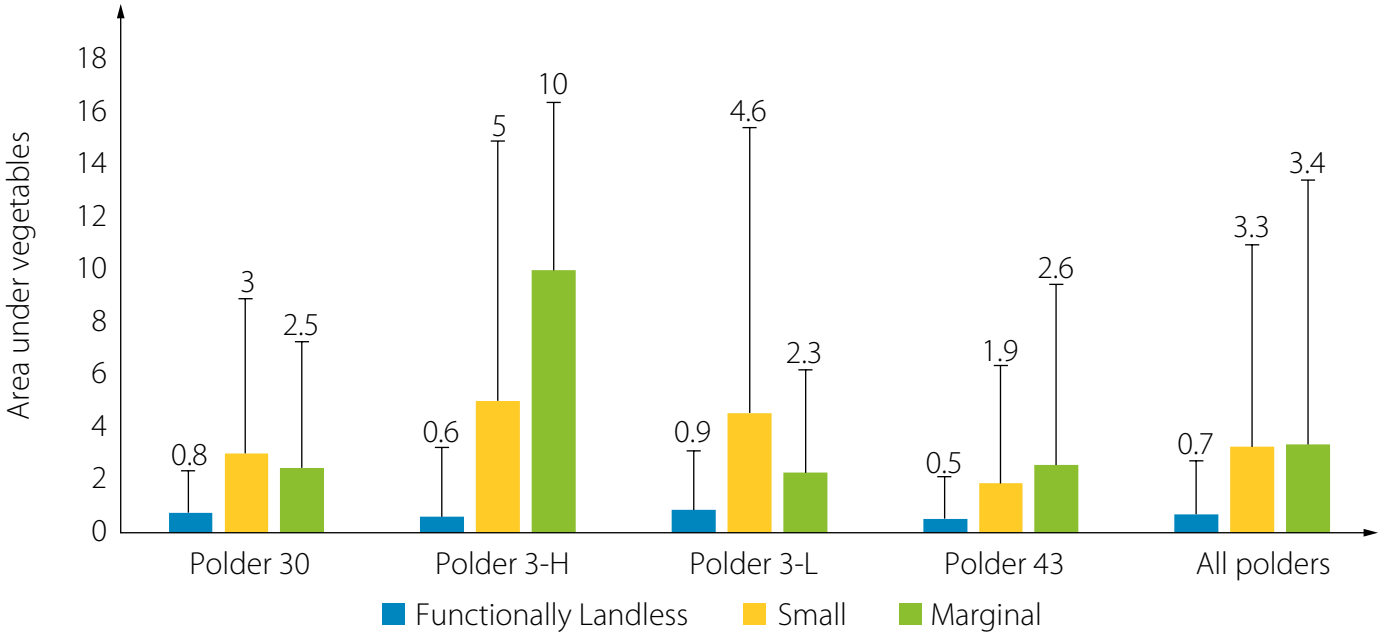


Figure 15. Average area of the homestead used for vegetable production in the month of December.

Constraints	% of households				
	Polder 30	Polder 3-H	Polder 3-L	Polder 43	All polders
Disease	1.11	0.00	0.00	0.00	0.32
Lack of capital	11.11	2.11	0.75	30.48	14.05
Flood	0.56	0.00	0.75	0.48	0.48
Limited land	3.33	2.11	0.75	4.76	3.07
Others (tidal water, water quality, etc.)	4.44	2.11	3.73	1.90	3.07
Conflict of land ownership	1.11	6.32	0.00	2.86	2.26

Table 19. Major constraints for expanding homestead pond aquaculture.

	% of households				
Vegetable variety	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Bean	4	11	12	15	10
Beetroot	0.2	1	3	0.0	1
Bitter gourd	-	1	1	2	1
Brinjal (eggplant)	18	10	8	12	13
Cabbage	6	3	0.3	1	3
Cauliflower	7	3	3	-	4
Chilly	5	5	2	2	4
Cucumber	0.5	1	0.3	3	1
Data shak (white amaranths)	3	-	0.3	4	2
Gourd	3	7	10	12	8
Green pea	0.2	1	1	1	1
Kohlrabi	7	3	6	1	4
Lalshak (red spinach)	4	5	5	6	5
Luffa	-	3	1	0.3	1
Okra	2	3	3	1	2
Potato	12	8	5	2	7
Pumpkin	3	8	9	11	7
Radish	2	-	1	2	1
Green leafy vegetable	3	1	-	-	1
Spinach	4	8	12	2	6
Tomato	9	8	4	7	7
Turmeric	1	1	1	3	2
Water spinach	3	6	6	0.3	3
Yam	1	1	1	0.3	1
Others (snake gourd, turnip, etc.)	3	3	3	12	5

Table 20. Most common varieties of vegetables produced in the homestead area.

5.2.3. Costs of inputs for homestead vegetable production

Expenditures on inputs was highest among small landholders in Polder 43 followed by the functionally landless groups of low-lying land in Polder 3. Seed and fertilizer were the major inputs for vegetable production. Few households used pesticides. Overall, costs for inputs was higher among small landholding households (Table 21). In cases where integration between agricultural systems has taken place, organic fertilizers were used, though they were not recorded here because they do not require cash expenditure.

5.2.4. Homestead vegetable production

Overall, small households had higher production than the other two groups and also used maximum inputs per unit area (Figure 16). The functionally landless group had minimum production because they have little land for production. However, if we look at unit area (per decimal) the functionally landless and marginal groups had similar efficiency in terms of production. Those in the small landholding category used their land most efficiently for vegetable production.

(BDT/household/year)					
Inputs	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	**36.5 (±128)**	**36.1 (±137)**	**126.7 (±689)**	**65.4 (±245)**	**64.4 (±371)**
Chemicals (pesticides)	0.6 (±8)	1.4 (±16)	0.0	0.4 (±5)	0.6 (±9)
Inorganic fertilizer	3.8 (±43)	2.7 (±14)	2.0 (±11)	9.9 (±68)	4.4 (±41)
Organic fertilizer	7.8 (±77)	9.3 (±62)	0.8 (±9)	14.7 (±64)	8.0 (±60)
Seed	22.6 (±69)	22.4 (±115)	124 (±681)	40.4 (±138)	50.8 (±348)
Other costs	1.8 (±24)	0.2 (±2)	0.0	0.0	0.6 (±14)
Small	**72.0 (±217)**	**98.6 (±384)**	**106.1 (±234)**	**211.2 (±983)**	**133.4 (±625)**
Chemicals (pesticides)	9.1 (±66)	6.8 (±31)	0.9 (±8)	24.5 (±194)	12.3 (±121)
Inorganic fertilizer	15.0 (±90)	50.0 (±289)	19.6 (±74)	86.9 (±689)	46.7 (±429)
Organic fertilizer	16.0 (±61)	15.5 (±76)	2.8 (±12)	29.1 (±112)	17.5 (±80)
Seed	31.5 (±67	26.3 (±74)	82.9 (±198)	70.6 (±253)	56.7 (±185)
Other costs	0.4 (±4)	0.0	0.0	0.1 (±1)	0.1 (±2)
Marginal	**69.6 (±163)**	**22.9 (±42)**	**68.5 (±164)**	**69.4 (±158)**	**64.0 (±151)**
Chemicals (pesticides)	0.0	0.0	0.0	5.1 (±25)	2.3 (±17)
Inorganic fertilizer	10.5 (±38)	4.0 (±10)	26.0 (±93)	12.6 (±48)	12.6 (±50)
Organic fertilizer	9.0 (±32)	2.2 (±4)	7.9 (±22)	9.2 (±27)	8.2 (±26)
Seed	50.2 (±157)	16.7 (±37)	31.7 (±64)	42 (±93)	40.4 (±110)
Other costs	0.0	0.0	2.8 (±12)	0.4 (±2)	0.5 (±4)

Note: figures in parentheses indicate standard deviation of the respective cost.

Table 21. Per household input cost for homestead vegetable production.

5.2.5. Shocks and constraints

Only five households in Polder 43 reported shocks in vegetable production. These were a result of heavy rainfall and vegetable die-off.

5.3. Poultry production on homesteads

5.3.1. Poultry variety reared on homesteads

The distribution of poultry production is almost equal between ducks and chickens while pigeons are produced in much smaller quantities. This distribution shows little variation by location and landholding size (Table 22). Nationally, more than 54% of households in Bangladesh raise poultry (BBS 2011).

5.3.2. Inputs used in poultry rearing on homesteads

Feed was, by a wide margin, the most heavily invested input for poultry production in every

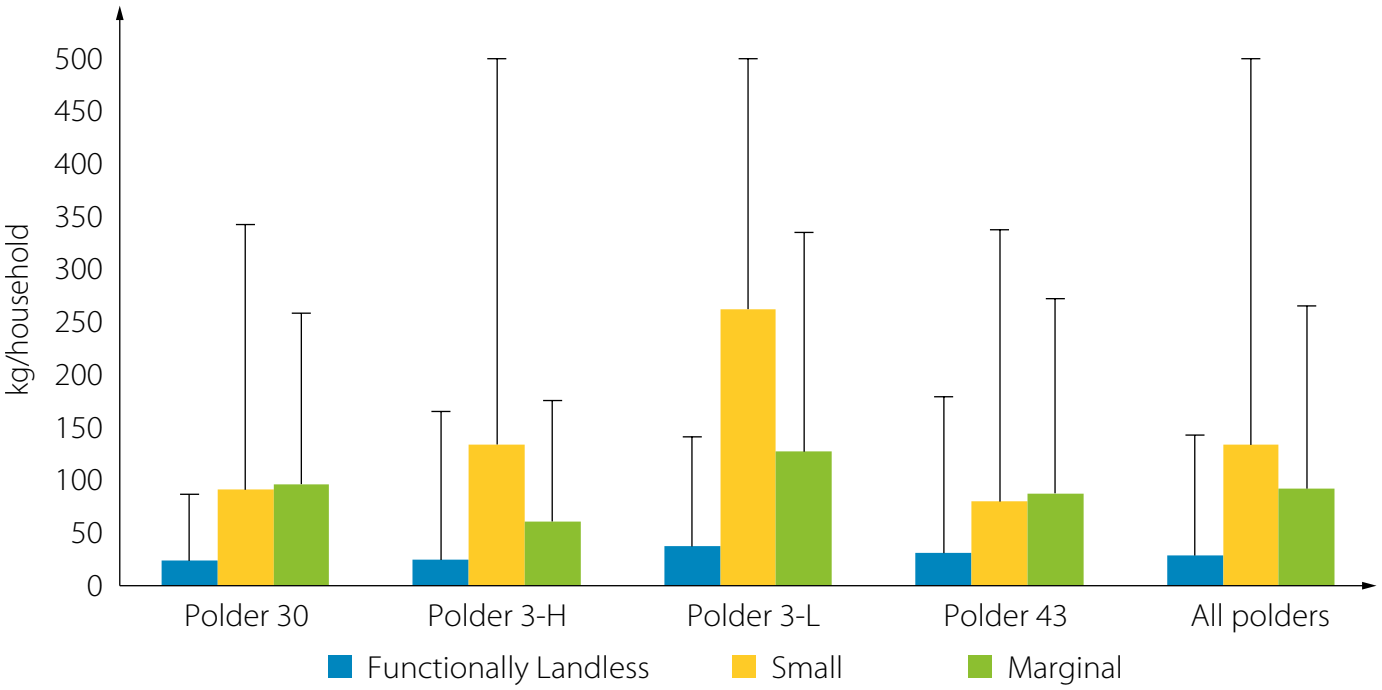


Figure 16. Average household vegetable production.

	% of households				
	Polder 30	Polder 3-H	Polder 3-L	Polder 43	All polders
Functionally landless					
Chicken	50	55	54	56	54
Duck	50	44	45	40	45
Pigeon	-	1	1	4	1
Small					
Chicken	43	51	55	51	51
Duck	57	49	43	42	46
Pigeon	-	-	2	7	3
Marginal					
Chicken	52	65	56	48	52
Duck	48	35	44	46	45
Pigeon	-	-	-	5	3

Table 22. Percentage of common varieties of poultry reared on homesteads.

polder. Investment in other inputs, such as medicine, was consistently low. The cost of feed was much higher in Polder 43 than the others because of the nature of intensive vegetable production system, regardless of landholding size. The functionally landless had less investment in poultry than the other categories irrespective of polders (Table 23).

5.3.3. Production of poultry rearing on homesteads

Eggs

Average annual egg production per bird in terms of returns was substantially lower in Polder 43 than the others. In fact, productivity in every landholding category at this location was, at most, half that of any other polder or any other category (Table 24).

Most of the households reared more than one poultry bird. Average annual production in a household was 124, and it was highest in high saline areas (Polder 3-H) (Table 25). Marginal households had comparatively larger homestead areas, so they have the opportunity to increase the numbers of poultry birds that they raise.

Meat

In contrast to egg production, average returns per bird from poultry meat were highest in Polder 43 (Table 26). This indicates that people in this region are more focused on meat rather than egg production.

(BDT/bird/year)					
	Polder 30	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	**25.8 (±92)**	**65.4 (±204)**	**92.1 (±233)**	**150.8 (±380)**	**77.8 (±241)**
Feed	25.4 (±91)	64.9 (±203)	86.4 (±225)	140.1 (±344)	73.9 (±227)
Medicine	0.4 (±3)	0.5 (±3)	1.5 (±6)	10.7 (±55)	3 (±26)
Small	**47.5 (±119)**	**65.7 (±169)**	**139 (±577)**	**217.5 (±467)**	**132.1 (±409)**
Feed	47.1 (±119)	64.4 (±167)	136.1 (±574)	206.6 (±439)	127.2 (±396)
Medicine	0.4 (±3)	1.3 (±5)	3.0 (±12)	10.9 (±38)	4.9 (±24)
Marginal	**34.7 (±107)**	**169.0 (±287)**	**101.6 (±251)**	**194.2 (±293)**	**130.6 (±252)**
Feed	34.7 (±107)	166.8 (±284)	98.8 (±243)	185.6 (±283)	178 (±244)
Medicine	0.0	2.3 (±9)	2.8 (±9)	8.3 (±17)	4.3 (±13)

Note: figures in parentheses indicate standard deviation of the respective input costs.

Table 23. Average cost of inputs for poultry rearing on homesteads.

(eggs/bird/year)					
Landholding category	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally Landless	38 (±29)	64 (±70)	54 (±49)	15 (±15)	44 (±49)
Small	41 (±30)	27 (±21)	37 (±48)	15 (±20)	29 (±34)
Marginal	41 (±19)	60 (±53)	39 (±25)	15 (±28)	29 (±33)
Total	**39 (±28)**	**54 (±61)**	**47 (±47)**	**15 (±21)**	**37 (±43)**

Note: figures in parentheses indicate standard deviation of respective numbers.

Table 24. Poultry egg production.

Poultry meat production in Polder 43 was nearly double that of the other polders. This suggests that there was a greater number of chickens produced as well as a greater amount of meat per bird at this location. Annual poultry meat production per household also increased with landholding size, though this was not the case in Polder 30 (Table 27).

5.3.4. Shocks and constraints in poultry rearing on homesteads

There were substantial losses in poultry rearing as a result of external factors, particularly disease epidemics, which resulted in many deaths. Households in low saline areas (Polder 43) suffered more often from disease epidemics, and disaster was highest there compared to other areas (Figure 17).

(eggs/household/year)					
Landholding category	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	89 (±180)	148 (±344)	142 (±242)	52 (±108)	107 (±234)
Small	136 (±214)	278 (±952)	166 (±227)	79 (±157)	143 (±408)
Marginal	148 (±251)	241 (±355)	252 (±209)	135 (±254)	166 (±263)
Total	**108 (±200)**	**184 (±539)**	**156 (±236)**	**78 (±166)**	**124 (±297)**

Note: figures in parenthesis indicate standard deviation of respective numbers.

Table 25. Poultry egg production.

(kg/bird/year)					
Landholding category	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	0.8 (±0.5)	0.8 (±0.6)	0.7 (±0.5)	1.2 (±0.4)	0.9 (±0.5)
Small	0.8 (±0.6)	1 (±0.6)	0.7 (±0.5)	1 (±0.6)	0.8 (±0.6)
Marginal	0.7 (±0.5)	1.2 (±0.5)	0.7 (±0.5)	0.8 (±0.5)	0.8 (±0.5)
Total	**0.8 (±0.5)**	**0.9 (±0.6)**	**0.7 (±0.5)**	**1 (±0.5)**	**0.9 (±0.5)**

Note: figures in parentheses indicate standard deviation of respective production.

Table 26. Poultry meat production.

(kg/household/year)					
Landholding category	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	15 (±71)	8 (±16)	7 (±13)	11 (±25)	11 (±43)
Small	9 (±17)	12 (±15)	15 (±38)	25 (±49)	16 (±36)
Marginal	9 (±16)	12 (±15)	17 (±21)	42 (±115)	25 (±79)
Total	**13 (±57)**	**9 (±16)**	**10 (±24)**	**22 (±62)**	**14 (±48)**

Note: figures in parentheses indicate standard deviation of respective production.

Table 27. Poultry meat production.

The smallest households, particularly in polders 3 and 43, appear to be most vulnerable to shocks in poultry rearing. This may be because they are generally closely packed together, so diseases can spread between poultry farms quickly and easily. The larger households are generally less vulnerable possibly because of better production practices and higher feed input, meaning that the disease resistance of the animals is higher and proximity to other households is lower.

5.4. Livestock production on homesteads

5.4.1. Inputs used in livestock rearing on homesteads

As with poultry production, the highest expenditure for rearing livestock was feed. The cost of feed hugely exceeds that of veterinary costs, which is the other substantial financial sink (Table 28). In comparison to other homestead food

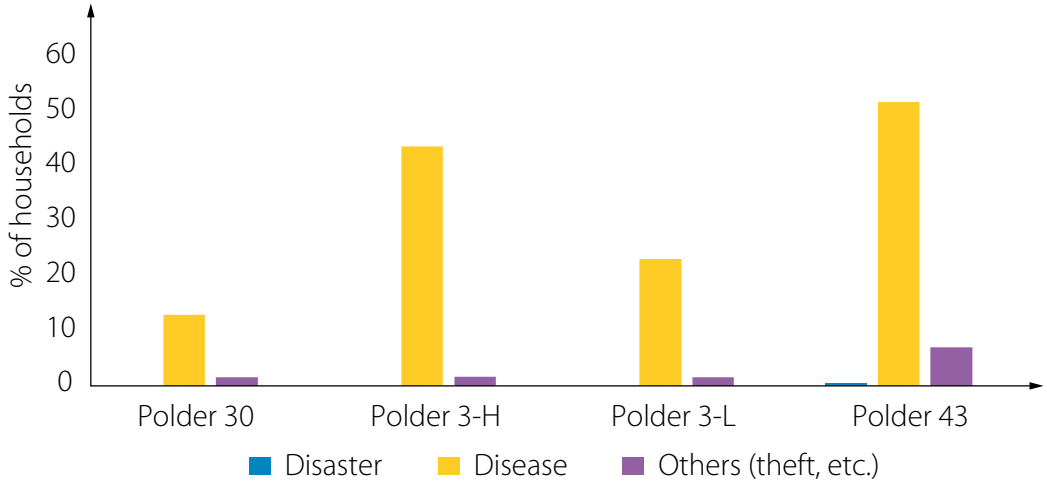


Figure 17. Major shocks for homestead poultry rearing.

(BDT/cattle/year)					
Landholding category	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	**3242 (±6838)**	**1843 (±4593)**	**2377 (±8063)**	**1250 (±5773)**	**2288 (±6549)**
Feed	3121 (±6698)	1648 (±4378)	2237 (±7924)	1163 (±5579)	2153 (±6392)
Veterinarian visits	101 (±314)	168 (±656)	97 (±247)	70 (±296)	108 (±402)
Medicine	2 (±17)	4 (±49)	1 (±16)	16 (±187)	5 (±91)
Other costs	18 (±251)	22 (±196)	42 (±249)	0.3 (±4)	21 (±209)
Small	**6364 (±8747)**	**2166 (±3292)**	**5404 (±8861)**	**1500 (±5200)**	**3796 (±7346)**
Feed	6095 (±8631)	2016 (±3179)	5212 (±8752)	1384 (±5015)	3617 (±7210)
Veterinarian visits	237 (±751)	149 (±286)	178 (±374)	99 (±295)	161 (±474)
Medicine	2 (±16)	1 (±4)	0	18 (±133)	7 (±40)
Other costs	30 (±225)	0	15 (±95)	0	11 (±124)
Marginal	**7976 (±11372)**	**5171 (±7286)**	**16370 (±36299)**	**2674 (±10388)**	**6277 (±16306)**
Feed	7392 (±9874)	5046 (±7100)	16213 (±36150)	2508 (±10213)	5987 (±15895)
Veterinarian visits	235 (±533)	125 (±270)	158 (±299)	158 (±550)	178 (±493)
Medicine	0	0	0	0	0
Other costs	349 (±2287)	0	0	7 (±44)	111 (±1272)

Note: figures in parentheses indicate standard deviation of respective cost.

Table 28. Per cattle cost of inputs for homestead livestock rearing.

production systems, the cost of inputs, such as feed for livestock production, accounts for more than 90% of total variable costs. There is no clear relationship between landholding category and cost of inputs. The households mainly follow a rural scavenging system in livestock rearing.

In contrast to poultry and other homestead farming, the cost of feed for cattle was much lower in Polder 43 than all other polders. This might be because Polder 43 is a freshwater zone where livestock feed is available in the crop field. The availability means that less feed is used from the market.

5.4.2. Income from livestock on homesteads

Milk production per cow showed little variation across the polders but consistently increased with the size of the farm (Table 29).

Though little variation was found in milk production per cow, the larger landholdings produced more milk compared to the smaller ones. Some of the larger landholdings may have more than one cow and so produced more milk (Table 30).

Households sell very few livestock per year, because there simply are not many of them on the homesteads (Table 31). The standard deviation

(L/cow/year)					
Landholding category	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	53 (±102)	40 (±89)	49 (±77)	49 (±123)	48 (±96)
Small	62 (±117)	101 (±159)	42 (±104)	42 (±90)	57 (±115)
Marginal	72 (±128)	132 (±161)	88 (±137)	86 (±149)	87 (±140)
Average	59 (±112)	67 (±124)	50 (±94)	55 (±117)	57 (±111)

Note: figures in the parentheses indicate standard deviation of respective production.

Table 29. Milk production from cow rearing on homesteads.

(L/household/year)					
Landholding category	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	38 (±114)	44 (±154)	60 (±158)	49 (±252)	47 (±171)
Small	105 (±296)	120 (±284)	68 (±243)	60 (±218)	82 (±256)
Marginal	97 (±198)	261 (±402)	115 (±239)	90 (±241)	115 (±255)
Average	62 (±188)	77 (±222)	66 (±192)	61 (±238)	65 (±211)

Note: figures in parentheses indicate the standard deviation of respective production.

Table 30. Per household milk production from cows.

(number/household/year)					
Landholding category	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	1 (±2)	1 (±2)	2 (±2)	1 (±1)	1 (±2)
Small	2 (±2)	1 (±2)	2 (±2)	1 (±2)	2 (±2)
Marginal	2 (±3)	2 (±2)	2 (±2)	1 (±2)	2 (±2)
Average	1 (±2)	1 (±2)	2 (±2)	1 (±2)	1 (±2)

Note: figures in parentheses indicate the standard deviation of respective sales.

Table 31. Livestock sales by households.

shows that some households sold livestock annually while some did not.

5.4.3. Shocks in livestock rearing on homesteads

In keeping with having low financial losses from livestock production, a larger proportion of households (24%) in Polder 30 also suffered losses in 2011 as a result of disease (Figure 18). In comparison to the total number of households in each category, landholding size appears to have relatively little effect on vulnerability to losses from shocks in livestock production.

5.5. Fruit production on homesteads

5.5.1. Area of homesteads used for fruit production

When compared to other forms of production, the average area taken up by fruit production was relatively large within all land classes among all polders. The average area for fruit production was higher in Polder 3 for functionally landless households. For small to medium households, however, the area was distributed irregularly, with maximum area allocated among marginal groups in Polder 43. There is a general positive correlation between land size and area for fruit production, with some variation in Polder 3. The average area for homestead fruit production among the three landholding categories was 1.4 dec for the functionally landless, 4.3 dec for small and 5.7 dec for marginal (Figure 19).

5.5.2. Variety of fruits produced on homesteads

There is a wide variety of fruit crops grown in each study area. Mango and coconut are the two most common, but jackfruit, sapodilla and guava are also produced. Betel nut is produced most frequently in Polder 43 but rarely at the other locations (Table 32).

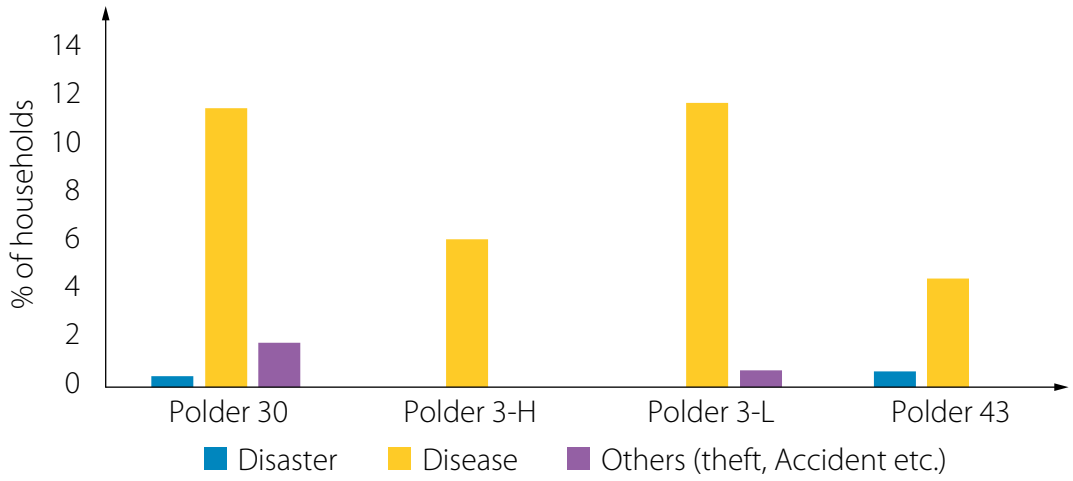


Figure 18. Shocks in household livestock production.

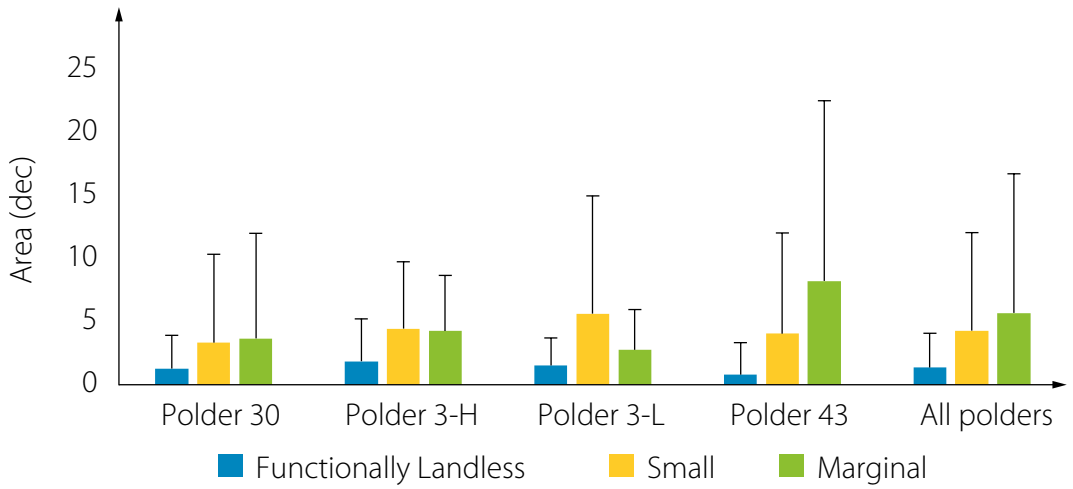


Figure 19. Average household area devoted to fruit production.

% of households					
Fruit	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Mango	20	21	22	11	19
Coconut	18	20	16	18	18
Guava	10	14	10	10	11
Sapodilla	12	13	11	2	9
Jackfruit	3	5	6	12	7
Betel leaf	4	1	2	9	4
Malabar plum	5	4	5	1	4
Plum	3	3	4	6	4
Banana	3	1	2	6	3
Lemon	3	2	2	5	3
Tamarind	4	2	2	1	3
Wood apple	3	4	5	2	2
Date	2	0.5	3	2	2
Lichi	2	2	2	1	2
Palm	2	1	2	2	2
Papaya	1	1	2	3	2
Amla	2	-	0.4	0.3	1
Elephant apple	1	0.5	1	-	1
Hog-plum	1	3	2	0.5	1
Ground nut	0.3	0.2	1	1	1
Betel nut	0.3	-	-	4	1
Velvet-apple	1	-	-	2	1
Others	1	0.5	1	2	1

Table 32. Fruit production within homesteads.

5.5.3. Inputs used in fruit production on homesteads

More than 90% of households did not use any inputs for fruit production (Table 33). Among the other 10%, in contrast to vegetable production, seeds were rarely required for fruit (Table 34). Whether seeds are required or not depends on the variety of fruit. Organic fertilizers were by far the most frequently used input. Inorganic fertilizers were rarely used.

Land size had little effect on the frequency of the use of inputs (Table 34), though functionally landless households were the only ones that required fruit seeds. This suggests that they are beginning to take up the production of fruit more frequently. The low financial outlay required for these inputs, particularly organic fertilizer, means that financial status has little effect on their use.

5.5.4. Fruit production on homesteads

Polder 43 was by far the most productive fruit producing location of all landholding categories, possibly as a result of more frequent organic fertilizer use. Productivity in polders 3-L and 3-H was generally similar but dropped down nearly half in Polder 30 (Table 35).

	% of households				
	Polder 30	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Inputs used	10	19	3	4	9
No inputs used	90	81	97	96	91

Table 33. Inputs used in homestead fruit production.

Photo credit: M. Yousuf Tushar/WorldFish

Harvesting pumpkins from homestead vegetable gardens.

(BDT/dec)					
Input	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	**41 (±338)**	**31 (±178)**	**1 (±10)**	**2 (±26)**	**21 (±209)**
Seed	38 (±337)	31 (±177)	0.8 (±10)	2.2 (±26)	19.7 (±209)
Organic fertilizer	2.6 (±28)	0.1 (±1)	0	0	0.8 (±16)
Inorganic fertilizer	0.5 (±7)	0	0	0	0.2 (±4)
Other costs	0	0.4 (±4)	0	0.3 (±3)	0.1 (±2)
Small	**25 (±149)**	**30 (±156)**	**89 (±763)**	**0**	**32 (±382)**
Seed	14.9 (±135)	12.6 (±49)	0	0	5.8 (±72)
Organic fertilizer	4.8 (±44)	6.5 (±44)	0	0	2.2 (±28)
Inorganic fertilizer	0	10.6 (±72)	0	0	1.6 (±28)
Other costs	5.4 (±49)	0	88.7 (±763)	0	22.3 (±371)
Marginal	**224 (±1346)**	**30 (±85)**	**0**	**2 (±14)**	**74 (±750)**
Seed	11.6 (±76)	24.6 (±84)	0	0.7 (±5)	6.7 (±51)
Organic fertilizer	212 (±1345)	2.5 (±10)	0	0.1 (±1)	66 (±749)
Inorganic fertilizer	0	0	0	1.7 (±13)	0.8 (±9)
Other costs	0	2.5 (±10)	0	0	0.3 (±3)

Note: figures in parentheses indicate the standard deviation of respective cost.

Table 34. Percentage of households that used various inputs for fruit production.

(kg/household)					
Landholding categories	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	12.3 (±39.2)	22.2 (±40.5)	19.8 (±39.1)	63.2 (±165.5)	27.4 (±86.8)
Small	30 (±94.5)	54.8 (±91.7)	50.9 (±93.0)	88.4 (±201.2)	59.3 (±142.8)
Marginal	26.4 (±41.2)	154.4 (±232.2)	68 (±86.0)	151.7 (±343.0)	103 (±251.9)
Average	18.5 (±58.4)	39.4 (±90.1)	32.2 (±65.3)	89.5 (±224.5)	45.8 (±136.7)

Note: figures in parentheses indicate the standard deviation of respective production.

Table 35. Average fruit production per household.

6. Field (out of homestead) production systems

6.1. Field crop land area

The average area of available land for field crops among households shows a similar trend that rises with landholding size in each polder (Table 36). However, households in the high saline area (Polder 3) have the smallest amount of field land compared to the other polders.

6.2. Common crops produced in fields

The most commonly produced crop in the non-homestead areas across all polders was paddy rice. It took up just over half of all non-homestead land in polders 30 and 43 and just under half in Polder 3. Second were pulses for polders 30 and 43, and fish production in ghers for Polder 3, particularly in the low-lying area. (Pulses were produced in only very small quantities in Polder 3.) Other crops such as maize, wheat and jute were only produced by a small percentage of landholdings (Figure 20).

(dec/household)					
Landholding categories	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	**37 (±80)**	**25 (±73)**	**12 (±35)**	**34 (±55)**	**28 (±65)**
Owned crop land	4 (±9)	2 (±7)	2 (±6)	5 (±10)	3 (±8)
Rented crop land	33 (±80)	23 (±73)	11 (±34)	28 (±52)	24 (±64)
Small	**101 (±133)**	**50 (±46)**	**61 (±95)**	**119 (±113)**	**91 (±111)**
Owned crop land	55 (±38)	41 (±34)	38 (±35)	60 (±36)	51 (±37)
Rented crop land	47 (±120)	9 (±28)	23 (±82)	59 (±114)	40 (±102)
Marginal	**174 (±85)**	**76 (±32)**	**116 (±129)**	**160 (±77)**	**149 (±91)**
Owned crop land	145 (±55)	68 (±66)	88 (±81)	135 (±50)	125 (±63)
Rented crop land	29 (±72)	9 (±35)	28 (±71)	24 (±58)	24 (±62)
Average	**70 (±107)**	**34 (±70)**	**34 (±74)**	**88 (±98)**	**61 (±94)**
Average owned field crop land area	35 (±55)	16 (±33)	18 (±38)	50 (±58)	32 (±51)
Average rented field crop land area	36 (±90)	19 (±64)	16 (±55)	38 (±82)	29 (±77)

Note: figures in parentheses indicate standard deviation of respective area.

Table 36. Average crop land area.

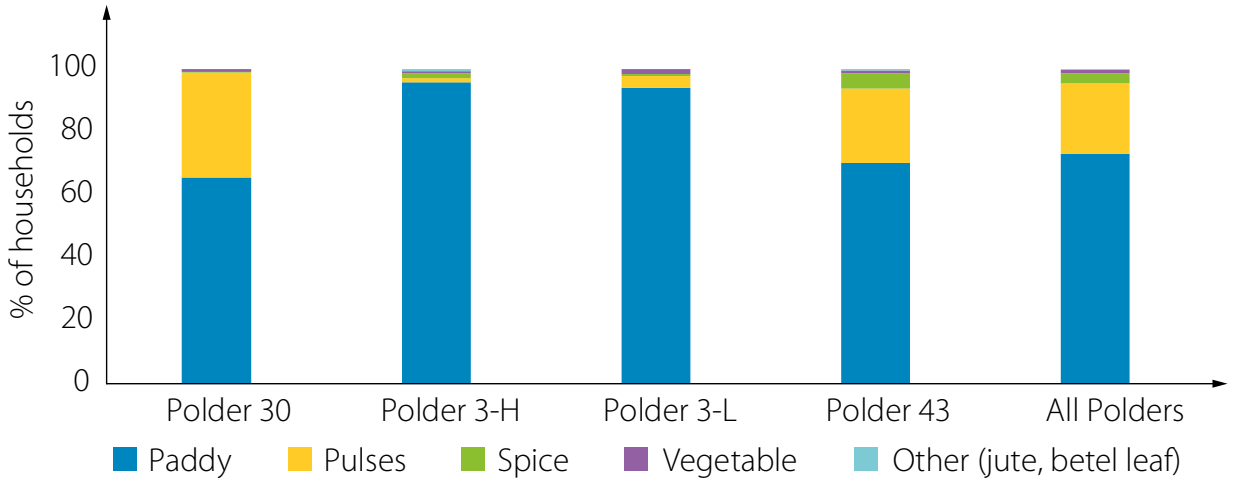


Figure 20. Percentage of households cultivating crops on non-homestead land.

7. Integration among different homestead farming components

As discussed earlier, the homestead farming system is a combination of five major components from the production systems of pond aquaculture, vegetables, livestock, poultry and fruit. Each of the five components is integrated with others. Pond water is used for livestock, vegetable and fruit production, while vegetable by-products and livestock manure are used for aquaculture. Poultry and livestock manure are also used in vegetable fields. Figure 21 details this integration in homestead farming systems.

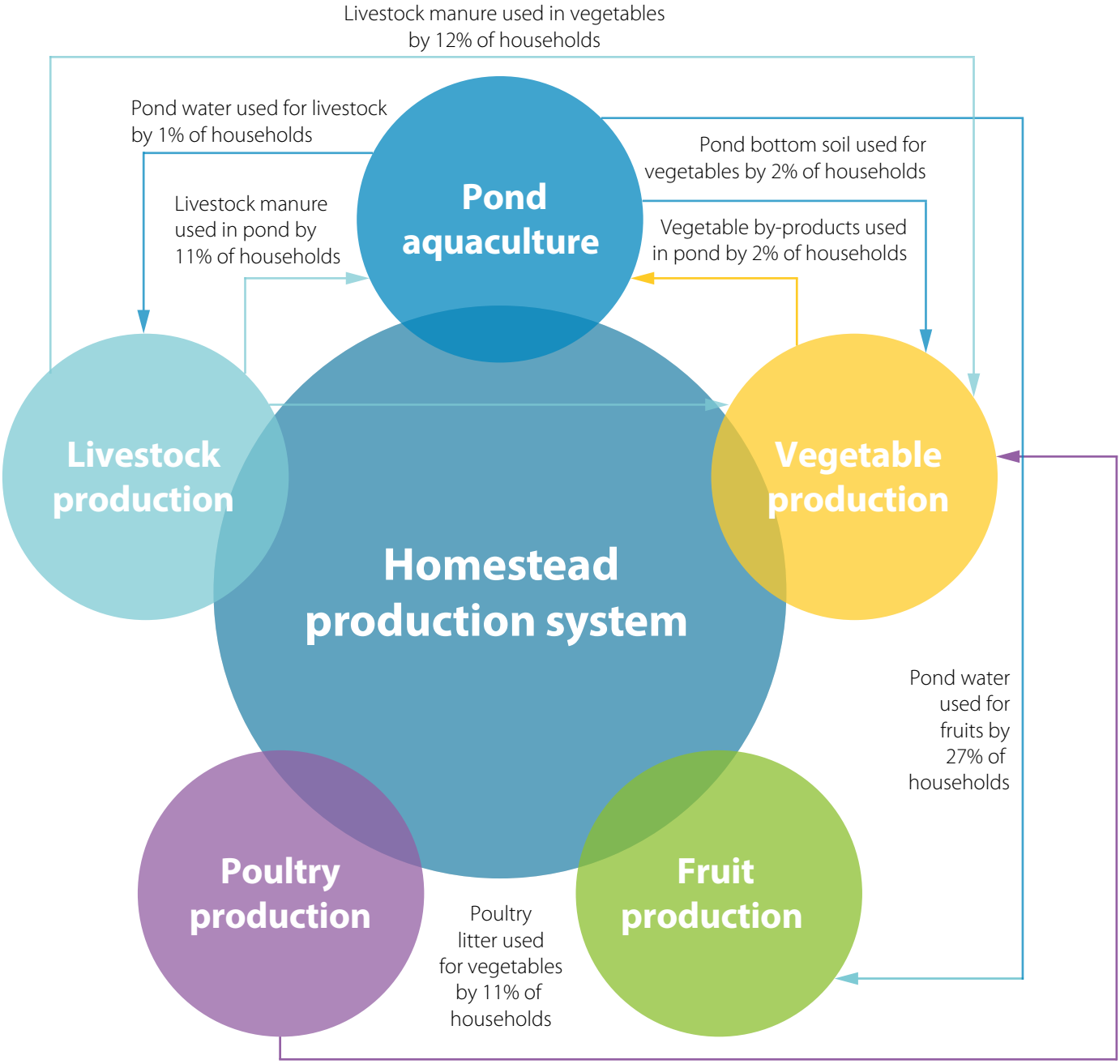


Figure 21. Integration among different homestead components.

8. Income from homestead farming

Again, the homestead farming system can be categorized into homesteads with a pond and those without one. Household income was positively correlated with presence of a pond on the homestead area. Figures of income distribution for households with a pond (Figure 22) and without a pond (Figure 23) are shown separately. The contribution of income from pond aquaculture increased as a share of farm income (40% to 53%) to total household income.

All homestead farming components were profitable. Pond aquaculture was highly profitable in high (Polder 3-L) (BDT 5104/household/year) and medium (Polder 30) saline areas (BDT 4725/household/year) compared to low saline areas (Polder 43). Livestock rearing earned the most profit (BDT 12,673/household/year) because the cost of inputs was low since livestock mainly depend on natural food (Figure 24).

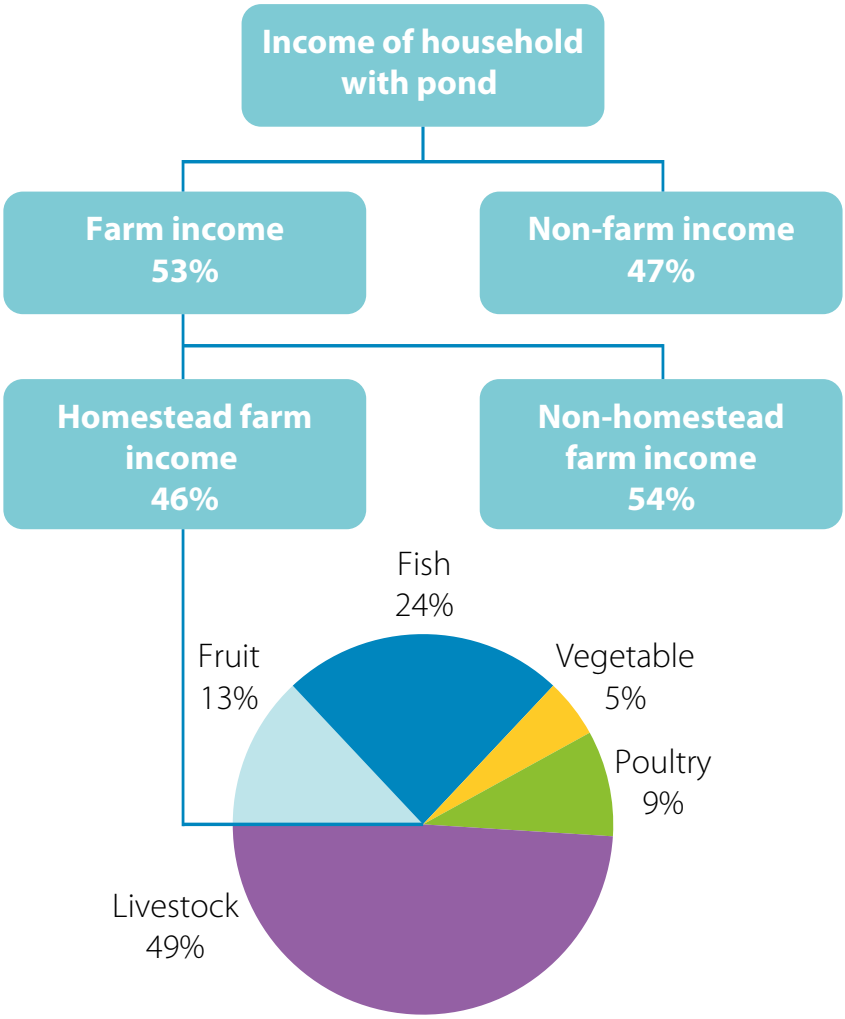


Figure 22. Income distribution for households with a pond.

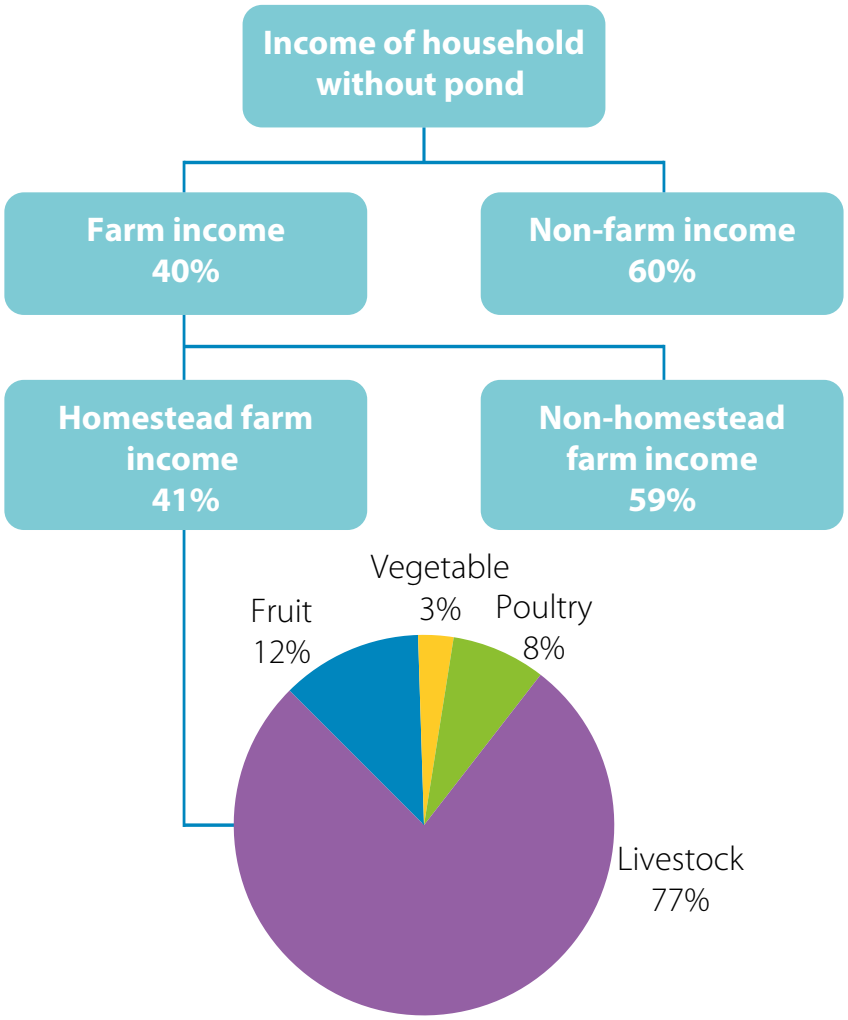


Figure 23. Income distribution for households without a pond.

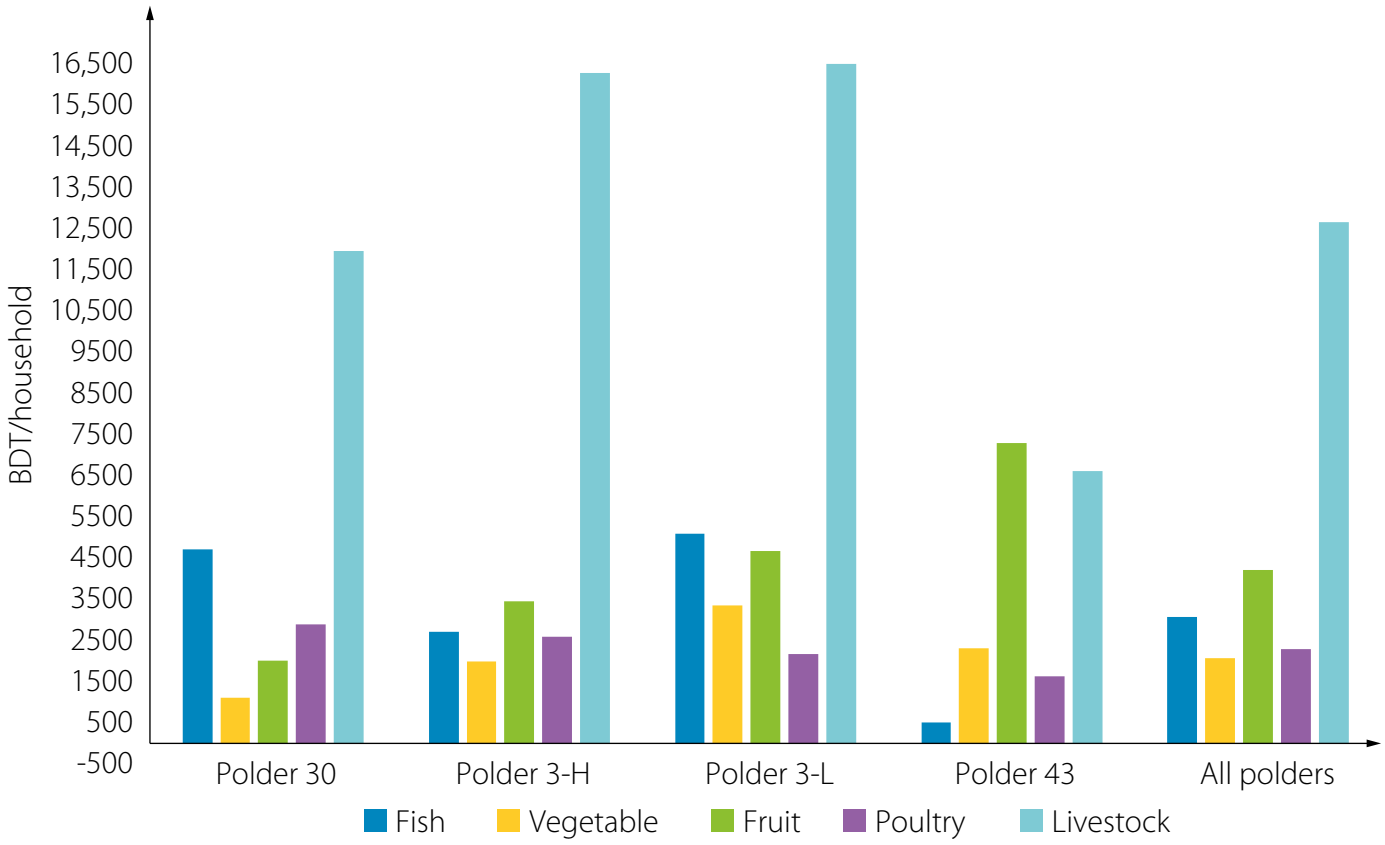


Figure 24. Gross margin from different homestead production systems.

9. Nutrition

Increased food consumption helps improve nutrition among household members. Food consumption was positively correlated with household production. The consumption from a household's own production mainly includes fish, livestock, poultry, fruit and vegetables.

9.1. Fish consumption from a household's own pond

Larger landholdings have larger ponds, so they produce more fish and also eat more fish. This explains why fish consumption increased with larger landholdings (Figure 25). Additionally, the higher the income of a household, the less important is selling fish for income generation. The average quantity of fish consumption was highest in high saline areas (Polder 3-H) and lowest in low saline areas (Polder 43). Per household annual fish consumption ranged from 27 to 38 kg, with some variation in each landholding category (Figure 25).

9.2. Source of fish consumed by household

For sources of consumed fish, there was a greater variation between households with and without ponds on their homestead. Those that have a pond consumed about 40% of total fish consumption from their own pond and bought the same amount from the market (Table 37), while households without a pond bought the majority of the fish that they ate (60%) from the market. Households without ponds were more involved in catching fish in open water than those that have ponds.

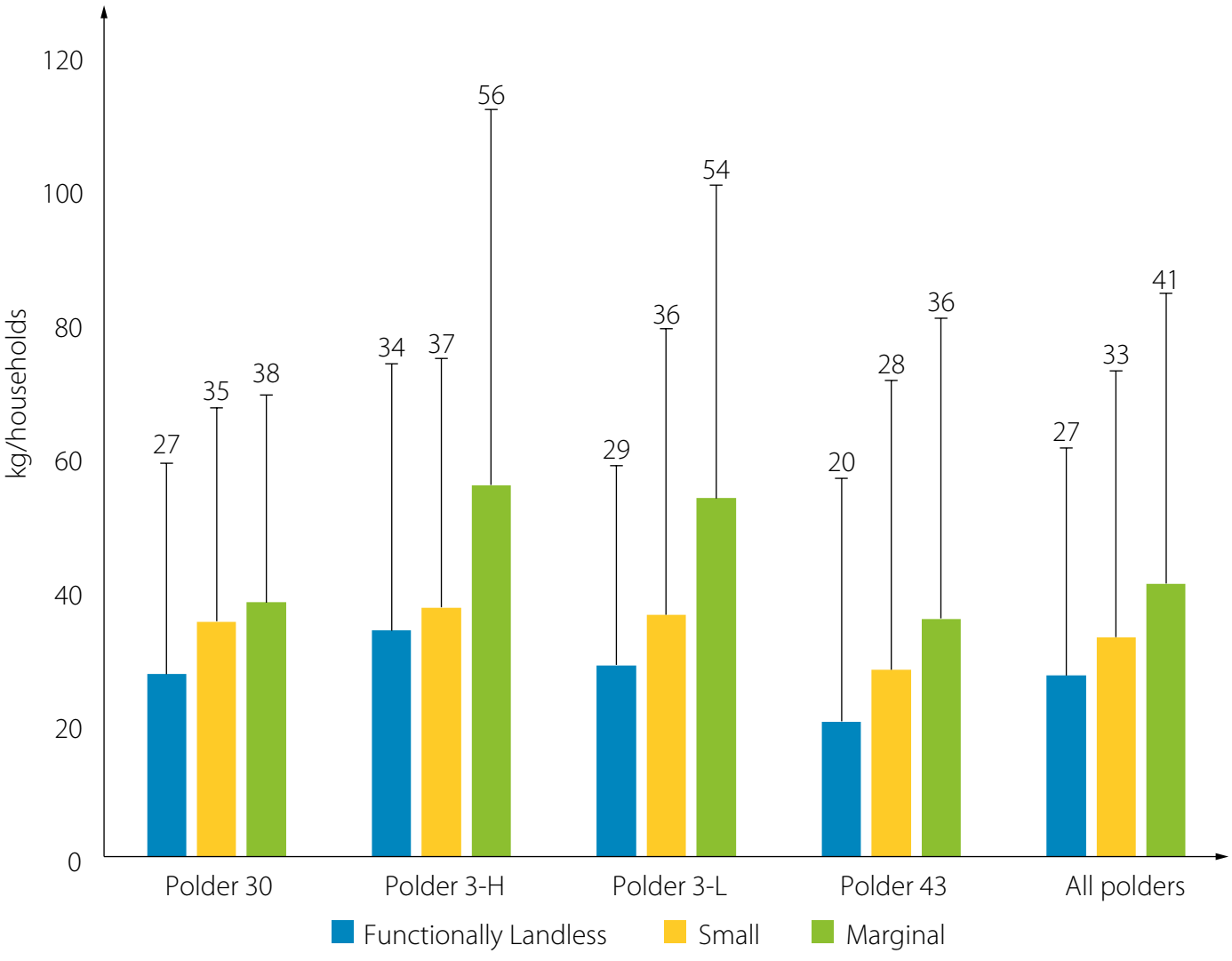


Figure 25. Quantity of fish consumed per household.

9.3. Vegetable consumption from homestead

Overall, households in Polder 3-L consumed the highest quantity of vegetables (46 kg/household) while those in Polder 3-H ate the lowest (21 kg/household). The standard deviations represent the high amount of variation between households, though there is a general pattern of increasing vegetable consumption with larger landholdings (Table 38).

In Polder 30, production in households lacking a pond almost matched that of pond-owning households. It is important to compare vegetable consumption by pond ownership because of the relatively high prevalence of vegetable cropping on pond dikes.

% of fish consumed					
Fish consumption source	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Households with a pond					
Own pond	38	42	44	35	39
Market	36	42	41	40	39
Self-caught (rice field)	3	2	4	2	3
Self-caught (open water body)	19	2	8	21	15
Other sources	4	12	4	2	4
Households without a pond					
Market	55	72	67	57	60
Self-caught (open water body)	26	8	20	31	24
Other sources	18	19	13	12	16

Table 37. Sources of consumed fish for homesteads with and without a pond.

(kg/household)					
Landholding categories	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	18 (±51)	14 (±63)	27 (±72)	17 (±87)	19 (±68)
Small	45 (±86)	38 (±101)	76 (±143)	36 (±118)	48 (±115)
Marginal	65 (±105)	37 (±67)	86 (±140)	66 (±144)	65 (±125)
Average	31 (±72)	21 (±74)	46 (±105)	34 (±112)	33 (±93)

Note: figures in parentheses indicate standard deviation of respective consumption.

Table 38. Household consumption of vegetables from homestead.

9.4. Consumption of eggs and meat from poultry reared on homesteads

The households in Polder 3 ate more eggs from poultry reared on their homestead than at any other location, with a great variation between households in the same land category (Table 41). On average, functionally landless households in Polder 3 ate about 70 eggs while those in Polder 43 ate significantly fewer (27 eggs). Egg consumption increased with larger landholdings. Poultry meat consumption was substantially higher in Polder 43 among all landholdings categories (Table 39).

9.5. Milk consumption from livestock reared on homesteads

Almost all households with livestock consumed milk, but few of them ate meat from livestock. Functionally landless households in Polder 3-L consumed an average of 22 L of milk (per household) annually. This was the maximum consumption among landless households. Although there was a huge variation in milk consumption between the households, annual per household milk consumption was 19 kg. This trend of higher consumption was observed with increased landholdings almost in all cases (Table 40). Milk consumption for some of the marginal households in Polder 3-H was exceptionally high.

	Polder 30	Polder 3-H	Polder 3-L	Polder 43	All polders
Poultry egg (number/household)					
Functionally landless	55 (±106)	65 (±117)	77 (±115)	27 (±62)	56 (±105)
Small	84 (±131)	206 (±791)	101 (±140)	49 (±96)	94 (±323)
Marginal	90 (±157)	175 (±261)	189 (±150)	85 (±168)	110 (±178)
Poultry meat (kg/household)					
Functionally landless	3.5 (±15)	3.8 (±15.4)	2.4 (±3.4)	4.5 (±11.2)	3.5 (±12.4)
Small	4.4 (±10.5)	3.2 (±3.9)	6.8 (±30)	11.6 (±25.7)	7.3 (±22.1)
Marginal	3.5 (±6.3)	3.1 (±3.3)	4.9 (±5)	12.6 (±18.7)	7.7 (±13.9)
Average of poultry eggs (number/household)	67 (±121)	104 (±391)	91 (±128)	46 (±104)	74 (±201)
Average of poultry meat (kg/household)	3.7 (±13.1)	3.6 (±13.1)	3.9 (±16.7)	8.5 (±19.2)	5.1 (±16)

Note: figures in the parentheses indicate standard deviation of respective consumption.

Table 39. Eggs and meat from poultry reared on homesteads (2011).

(L/household/year)					
Landholding category	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	17 (±52)	10 (±34)	22 (±58)	8 (±35)	15 (±47)
Small	19 (±45)	27 (±60)	24 (±60)	18 (±47)	21 (±52)
Marginal	32 (±70)	77 (±79)	20 (±44)	25 (±65)	32 (±68)
Average	19 (±53)	19 (±49)	22 (±57)	15 (±47)	19 (±52)

Note: figures in parentheses indicate standard deviation of respective milk consumption.

Table 40. Amount of milk consumed from livestock reared on homesteads (2011).

9.6. Consumption of fruit grown on homesteads

Overall, more than 80% of households consumed fruits produced on their homestead land. There was not much variation in the number of households who consumed fruit from homesteads among the polders. The distribution between polders and landholding sizes was relatively even, though possibly more weighted toward the larger landholdings in the low saline zone (Polder 43) (Figure 26).

The average number of pieces of fruit consumed annually per household was 252, with larger landholdings consuming the most (472). Households in the low saline area (Polder 43) ate the most fruit. Positive correlation exists between increased consumption and increased landholding size (Table 41). The larger landholdings ate about three times more fruit than those who were functionally landless.

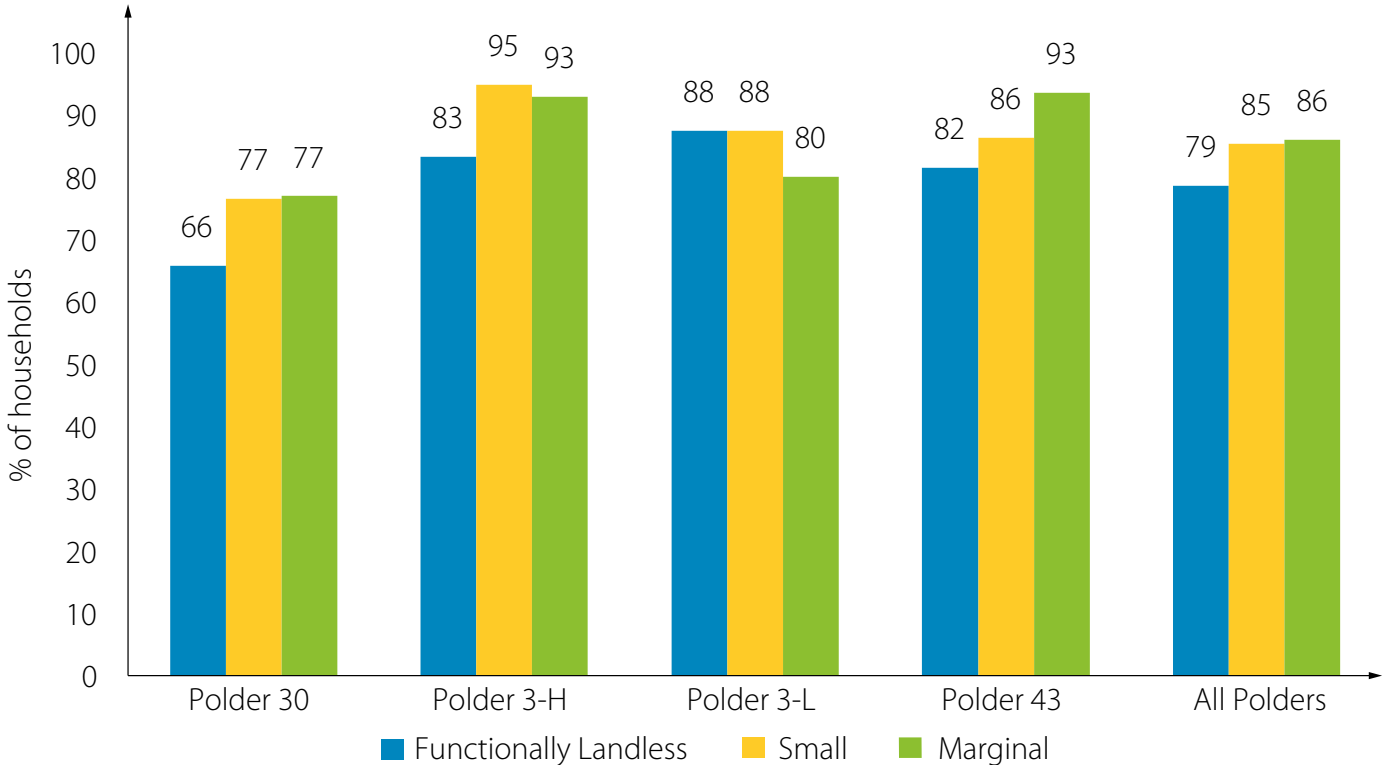


Figure 26. Percentage of household fruit consumption from the homestead (2011).

(number/household/year)					
Landholding category	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Functionally landless	91 (±231)	132 (±249)	143 (±244)	324 (±805)	164 (±440)
Small	203 (±892)	309 (±496)	301 (±452)	487 (±1097)	342 (±854)
Marginal	143 (±227)	657 (±948)	483 (±678)	647 (±1230)	472 (±948)
Average	125 (±486)	211 (±428)	213 (±370)	445 (±1010)	252 (±666)

Note: figures in parentheses indicate standard deviation of respective consumption.

Table 41. Fruit consumed by households produced in a home garden (2011).

10. Labor by gender in homestead farming systems

In terms of division of labor by gender in agricultural activities on homesteads, there was little variation between polders and landholding categories. The exception was aquaculture in Polder 3-H, where there was less participation from households. Participation among adult males and females was equally weighted across the polders as well as landholdings (Table 42). There was very little participation from children. Participation from the functionally landless in farming activities was much lower than the other two landholding categories. This might be a result of a lack of land for farming.

% of households					
Participation in agriculture	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Adult male					
Functionally landless	69	38	64	51	57
Small	99	76	91	90	90
Marginal	95	63	100	84	87
Adult female					
Functionally landless	65	30	64	51	54
Small	95	63	84	85	84
Marginal	88	56	100	79	82
Child male					
Functionally landless	2	7	1	10	5
Small	7	11	5	13	10
Marginal	5	6	6	13	9
Child female					
Functionally landless	4	3	3	8	4
Small	5	4	1	13	7
Marginal	5	0	6	13	8
Average adult male	**80**	**48**	**74**	**71**	**70**
Average adult female	**75**	**40**	**72**	**68**	**66**
Average child male	**4**	**8**	**3**	**12**	**7**
Average child female	**4**	**3**	**2**	**11**	**5**

Table 42. Labor by gender in agricultural activities on homesteads except pond aquaculture.

In aquaculture activities, female participation was highest in Polder 30, and women were only slightly less involved compared to men. Children, both boys and girls, were less involved in aquaculture than agriculture. There was gradual increase of labor among larger landholdings, but the situation was not always sequential. There was no difference in labor involvement between small and marginal landholdings in homestead aquaculture activities (Table 43). Involvement in other activities might have caused this.

% of households					
Participation in aquaculture	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
Adult male					
Functionally landless	36	26	39	14	30
Small	66	78	72	33	57
Marginal	67	69	71	29	50
Adult female					
Functionally landless	33	10	21	14	21
Small	55	30	30	31	37
Marginal	49	31	41	27	36
Child male					
Functionally landless	2	3	1	3	2
Small	1	4	1	7	4
Marginal	2	6	0	5	4
Child female					
Functionally landless	0	0	0	1	0
Small	1	0	0	6	3
Marginal	2	0	0	6	4
Average adult male	**47**	**41**	**51**	**24**	**40**
Average adult female	**40**	**16**	**25**	**23**	**27**
Average child male	**2**	**3**	**1**	**5**	**3**
Average child female	**1**	**0**	**0**	**4**	**1**

Table 43. Labor by gender in aquaculture activities on homesteads.

Among different activities for aquaculture, the major events were purchasing fingerlings, stocking and harvesting. Both male and female household members participated almost equally, with slight variation among the polders. Participation was highest in feeding among females, and selling for males. Males were hired mostly for excavating and preparing ponds (Table 44).

	% of family male labor				% of family female labor				% of hired male labor			
	Polder 30	Polder 3-H	Polder 3-L	Polder 43	Polder 30	Polder 3-H	Polder 3-L	Polder 43	Polder 30	Polder 3-H	Polder 3-L	Polder 43
Applying fertilizer	4	4	3	4	1	0	1	3	0	1	4	0
Buying fry/fingerlings	18	17	19	16	16	10	30	10	0	1	0	2
Buying inputs (fertilizer, insecticide, etc.)	1	2	3	1	1	0	4	0	0	0	0	0
Collecting organic manure	2	4	1	5	3	25	0	7	0	0	0	1
Dike cropping	2	0	0	1	5	0	0	3	1	0	0	0
Disease checking	2	1	0	1	0	0	0	0	0	0	0	0
Feed preparation	2	1	1	3	4	2	0	5	2	0	4	1
Feeding	6	4	7	8	11	6	13	19	1	1	0	1
Guarding	3	5	2	7	3	0	0	16	1	0	0	0
Harvesting fingerlings/fish	19	19	21	17	28	27	36	10	3	6	25	19
Marketing fingerlings/fish	1	3	1	1	0	4	0	0	0	0	4	1
Pond excavation	2	1	0	1	2	0	0	0	72	57	42	52
Pond preparation	4	6	2	6	3	10	0	4	19	27	0	13
Releasing fingerlings	18	16	22	16	16	12	11	12	0	0	8	2
Selling fingerlings/fish	4	9	7	5	1	0	2	3	3	6	4	4
Using insecticide and pesticide	1	1	0	0	1	0	0	0	0	0	0	0
Using lime	9	6	9	7	4	4	2	6	0	1	8	3
Water quality management	2	1	1	1	2	0	1	0	0	0	0	0

Table 44. Labor distribution by gender in aquaculture activities.

11. Food security

Overall, 81% of households in the study area were able to eat three meals per day in 2011. The highest level of starvation was observed among the functionally landless group in Polder 43, where 20% people did not (Table 45). Functionally landless households were more vulnerable than the other landholding categories.

Only 29% of households were able to produce 9- to 12-months worth of food from their own production, while about 46% of households could not even manage 3 months. Functionally landless households were highly vulnerable to food insufficiency in their own homestead production. About 60% of households could feed their family from their own production for 6 months a year (Table 46). This might be because they have cultivable land and do not have much purchase capacity.

Photo credit: Mohammad Mahabubur Rahman/WorldFish

Husband and wife holding fish harvested from homestead pond.

% of household members					
Landholding categories	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
No	**15**	**15**	**19**	**27**	**19**
Functionally landless	19	20	26	43	26
Small	6	4	4	16	9
Marginal	12	0	12	6	8
Yes	**85**	**85**	**81**	**73**	**81**
Functionally landless	81	80	74	57	74
Small	94	96	96	84	91
Marginal	88	100	88	94	92

Table 45. Percentage of household members able to eat three meals per day.

% of households					
Number of months	**Polder 30**	**Polder 3-H**	**Polder 3-L**	**Polder 43**	**All polders**
<3 months	**49**	**54**	**57**	**40**	**49**
Functionally landless	68	67	70	63	67
Small	17	20	34	22	23
Marginal	12	38	35	19	21
3–5 months	**11**	**12**	**12**	**7**	**10**
Functionally landless	11	11	11	6	10
Small	13	20	18	8	13
Marginal	9	6	0	5	6
6–8 months	**14**	**14**	**11**	**23**	**16**
Functionally landless	8	11	8	14	10
Small	28	26	15	29	25
Marginal	16	13	24	32	24
9–12 months	**26**	**19**	**20**	**31**	**25**
Functionally landless	13	11	12	17	13
Small	42	35	34	40	38
Marginal	63	44	41	44	50

Table 46. Households able to feed their family from their own production.

12. Major gaps of this study

The survey unfortunately did not focus much on gender in non-aquaculture homestead farming activities. It also lacked detailed information regarding nutrition and food security. During the survey, no specific standard was developed to identify better farming practices, so none was reported as improved.

Fish, vegetables and fruit trees linked in a circular production model of food from homestead farming.

13. Research questions for further work

Several questions need to be answered for future research:

a. How do households without a pond get their water for household activities?

b. How efficiently are inputs used for homestead food production?

c. To what extent are women involved in non-aquaculture homestead farming activities?

d. Does involving women in farming activities increase homestead food production and improve women's decision-making power for harvesting and consuming the products?

e. Does improved homestead farm production increase the intake of a balanced diet and fulfill the nutritional requirements of household members?

f. Does access to a market influence the consumption or selling of homestead products?

g. Do general and nutritional education influence the intake of a balanced diet?

h. How can integration among different homestead farming components be increased?

i. How much food security depends on household food production?

j. Would this be affected if saltwater intrudes farther into this region, and would households have to switch farming practices to be more similar to the other polders?

k. In terms of aquaculture, the effect on polders is strongly significant. Why is this? Is it related to environmental issues or management practices? Are there things that can be learned from these comparisons?

14. Conclusions

The survey revealed a net positive return from household aquaculture and fruit gardening. However, if we ignore a homestead's own labor involved in homestead farming, all components are profitable. Land use efficiency in homesteads is much higher than field land, which increases production and income. Women's participation in homestead aquaculture is impressive. Homestead production contributes more to household consumption and less to selling. Integration among different farming components in homesteads helps reduce input use and increase production. Salinity is a problem in homestead farming production. The current work provides evidence on the effect of salinity on different farming practices. The low salinity region (Polder 43) apparently places a greater emphasis on the production of cattle and poultry in particular. Low salinity means that things such as drinking water are cheaper and more readily available. In terms of aquaculture, the effect on polders is strongly significant. Fish farming is useful for nutritional benefits because many of the households consume fish that they produce.

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