Local Government Engineering Department
Government of the People's Republic of Bangladesh

'My Village-MY Town' Technical Assistance Project

Study -1

Survey Work Regarding Identifying and Conserving Fresh Water Sources in Rural Areas Established by the Department of Public Health Engineering

under

Feasibility and Review Study on Rural Water and Sanitation

December 2022

CEGIS
Center for Environmental and Geographic Information Services

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Acknowledgments

The Center for Environmental and Geographic Information Services (CEGIS), a Public Trust patronized by the Ministry of Water Resources (MoWR), expresses its sincere gratitude to the Local Government Engineering Department (LGED) for entrusting CEGIS with the study “Feasibility and Review Study on Rural Water and Sanitation.” The study has been carried out closely with the Local Government Engineering Department (LGED) and the Department of Public Health Engineering (DPHE).

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Executive Summary

Realization of the project "My Village-My Town" and the expansion of modern civic services to every village could encounter numerous challenges. In order to find innovative answers to problems that may arise, LGED and DPHE conducted several in-house investigations and sponsored a national workshop on September 12, 2019. This led to a strategy paper adopted by LGED and DPHE that suggests creating 30 guidelines, carrying out 36 feasibility studies, and starting a Pilot Village Investment Project by 2021. These exercises are designed to develop a sufficient, realistic, and long-term strategy for constructing civic facilities for a particular village to transform into a rural township. The creation of guidelines, feasibility analyses, and the planning of specialized development projects -all demand added effort, specialized skill, knowledge, and focused time. As a result, the suggested technical support project has been conceptualized to offer a strong foundation for the election manifesto commitment, gradually transforming into reality. The "My Village-My Town" project has been created in this context to enhance rural populations' access to safe drinking water. Human rights fundamental to our civilization include access to clean water and sanitary conditions. These issues are often considered essentially contributing to the national development agenda.

The project ‘My Village-My Town’ is an obvious way to narrow the parity distance and extend necessary facilities to the vast majority - the rural people. This study investigates the current water and sanitation status in the project area. It also suggests a way forward to facilitating appropriate policy-planning- design with a possible action plan.

The Centre for Environment & Geographic Information Service (CEGIS) is privileged to provide consultancy services for the ***Rural Water Supply and Sanitation*** part of the ‘My Village-My Town’ project. Following the project ToR, CEGIS will identify freshwater sources in rural areas and develop a priority assessment framework for developing water supply and sanitation. The study also provides feasibility for Surface Water availability in rural areas; water supply options in hill districts, arsenic-contaminated and disaster-prone regions, and support to rural activities for cleanliness at the individual and social level to ensure safe sanitation. The study further included Technical, Socio-Economic, and Environmental studies of water supply and sanitation systems in coastal, haor, Barind, and hill areas. Under these circumstances, understanding the local context and existing rural water supply & sanitation options is vital to carrying out this assignment.

The full feasibility study was divided into eight parts. The baseline study was designated as “Study-1”.

The baseline study was conducted from 1st July 2022 to 31st August 2022 in 35 villages in 15 districts. Among these 35 villages, 15 are termed Pilot villages where a full household survey was conducted. The rest of the 20 villages are designated as Sample villages where only 10% of the total number of households was surveyed.

The questionnaire was developed, and the survey was conducted through mobile Apps and online tools. Sixty enumerators were divided into 6 teams, each having approximately 10 members and an assigned supervisor. The enumerators installed the survey software app on their smartphones and conducted the survey. The survey data were saved and stored on the designated server. Necessary filtering and analysis were properly maintained.

Some key findings are presented here for a better understanding of the study area. The percentage of the surveyed males was 50.9% and females 49.1%. The percentage of married household heads in the survey area is 88.6% (total number of households 12,684). The average income of the people in the surveyed area is 14945 BDT. Moreover, the percentage of households with disabled members is 7%.

In terms of the area's water supply, the main source of drinking water is tube well as evidenced by 42% of the 12,684 households surveyed. The survey indicates that the quality of drinking water source is good (74.08%). Only 5.81% people use water purification methods to purify their drinking water while 94.18% do not need to do so. Pipe water supply system is available to only 6.8% of the households.

The study also reveals the sanitation condition of the area. Of the 12,684 households, 75.3% have access to toilets. Pit latrines are the most common (56.44%) toilet type here and only 21.2% of the people are satisfied with this type of toilet facility. The study further shows that 65.2% of the 12,684 households has containment facilities for sludge management.

With regard to hygiene practice and awareness, the study indicates that the practice of hand washing is prevalent among 78% of the 12,684 households. 75.2% of the households reported that public awareness activities were carried out in their area. 44.4% of the different local NGOs are involved in the public awareness activities conducted in the study area.

Hydro-geological investigations carried out under the study shows that the whole region is divided into four categories. The first can be termed as "High Risk for As and Salinity". The villages that fall in this category are Saikchail, Tipna, Datinakhali, Induria, and Beelchanda. The second region is "Tertiary rocks" and the villages in this category are Shimulbank, Baigaiya, and Chota Harina. The third region is termed as "Good aquifer within 300ft". The villages that fall in this category are Khordachampa, Sonadanga, Fulchari, and Pathordubi. Lastly, the fourth region is the "Deep aquifer", which include the villages of Charsharat, Hafizpur, and Dakhin demura.

Abbreviations and Acronyms

BBS	Bangladesh Bureau of Statistics
BCC	behavior change communication
BGS	British Geological Survey
BGS	British Geological Survey
BTM	Bangladesh Transverse Mercator
BWDB	Bangladesh Water Development Board
BWDB	Bangladesh Water Development Board
CEGIS	Center for Environmental and Geographic Information Services
CN	curve number
DEM	Digital Elevation Model
DPHE	Department of Public Health Engineering
DTW	Deep Tube well
EC	electrical conductivity
ECR	Environment Conservation Rules
ET	Evapotranspiration
GBM	Ganges-Brahmaputra-Meghna
GPS	Global Positioning System
GW	Groundwater
GWD	Global Water Depth
GWQ	Groundwater Quality
HH	House hold
HRU	Hydrological Response Units
HtR	Hard to reach
IEC	information, education, and communication
IPAM	Implementation Plan of Arsenic Mitigation
JMP	Joint Monitoring Programme
JMP	Joint Monitoring Programme
LGED	Local Government Engineering Department
LGIs	Local Government Institutions
MDG	Millennium Development Goals
MICS	Multiple Indicator Cluster survey

NGO	Non-governmental organizations
NWMP	National Water Management Plan
O&M	Operation and Maintenance
PCP	Precipitation
PER	Percolation
PET	Potential Evapotranspiration
PRECIS	Providing Regional Climate for Impact Studies
PSF	Pond Sand Filter
RW	Ring Well
RWHS	Rainwater Harvesting System
SACOSAN	South Asian Conference on Sanitation
SDG	Sustainable Development Goal
SSP	Sanitation Safety Plan
SST	sea surface temperature
STW	Shallow Tube well
STW	Sewage Treatment Works
SURQ	Surface Runoff
SW	Surface Water
SWAT	Soil and Water Assessment Tool
ToR	Terms of Reference
TV	Television
Tw	Tube well
U5MR	Under-five mortality
UN	United Nations
UNDP	United Nations Development Program
UNICEF	United Nations International Children's Emergency Fund
VIP	Ventilated Improved Pit
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organization
WSP	Water Safety Plan

1. Introduction

1.1 Background

The Government of Bangladesh, through its two implementing agencies, LGED and DPHE, has launched the "My Village-My Town" project, which aims to bridge the gaps between urban and rural areas by extending urban services to each village. The major goal of this project is to guide the country's transformation into 'Sonar Bangla,' – a society free of poverty, hunger, and corruption, along with rapid income growth and shared prosperity as visioned by the father of the nation Bangabandhu Sheikh Mujibur Rahman. In order to achieve this goal, the government adopted the Vision 2041 and the associated Perspective Plan 2041 (PP2041).

The *"My Village-My Town"* project is an ambitious, multifaceted, complex initiative. However, it is implementable. The government is engaged in implementing this project, including preparing a time-bound working plan, the Upazila Master Plan, and organizing national consultations *'to innovate creative working strategies'* in order to face the challenges in implementing the project and creating coordinated initiatives among the related organizations.'

Villages in Bangladesh have distinct characteristics. While one fishing community will need a fish landing facility or cold storage, another village with small cottage businesses will benefit from enhanced infrastructure with modern technology and equipment. A riverbank village requires embankments to protect lives and properties from flooding, while other settlements require improvements to their waterway communications. Each village with unique characteristics might deserve specific demands; however, every village should have certain standard amenities like power, digital systems, improved roads, marketplaces, health and education institutions, etc.

For this study project, DPHE-LGED selected 8 villages in 8 upazilas of 8 divisions and 7 other villages in selected haor, char, hill, coast, Barind, and midland beel areas, along with two adjoining economic zones. Beyond this, following principle-based preferences, another 25 villages were selected.

Following its mandate, the LGED will implement for the project, the planning process, infrastructural development, and capacity building & regulation for Local Government Institutions for essential service delivery to the citizens. This broader scope could be divided into six components, namely:

- Rural Road Connectivity
- Rural Growth Center and Hat Bazars
- Rural Water Supply and Sanitation
- Rural Waste Management
- Community Space and Recreation
- Upazila Physical Plan/Master Plan.

Among the six above-mentioned components, CEGIS was engaged only in the feasibility and review study of *"Rural Water Supply and Sanitation."* Accordingly, the study followed eight sub-study areas on the *rural water supply- sanitation domain,* which are as follows:

Study	Description of the Study
1	Survey work regarding identifying and conserving fresh water sources in rural areas established by the Department of Public Health Engineering
2	Developing a priority assessment framework for water supply and sanitation development
3,4,6 & 7	Feasibility study for water supply options, including surface water availability and sanitation in rural areas, hill districts, arsenic-contaminated areas, disaster-prone, and other problematic areas
5	Technical, socio-economic, and environmental study for water supply and sanitation system in coastal, haor, Barind, arsenic-contaminated, flood-prone, plain land, and hill areas
8	Feasibility study on rural activities for cleanliness at individual and social to ensure safe sanitation

However, this part of the study focused on identifying and conserving fresh water sources in rural areas established by the DPHE.

1.2 Objectives of the Study

The main objectives of this study were to assess the current status of WASH in the context of engineering and socio-economic aspects. However, the objective scope may be specified as follows:

- Conduct baseline engineering and socio-economic surveys in the proposed selected villages on water and sanitation situation/ coverage;
- Identify potential freshwater sources to provide water supply considering GW, SW, and rainwater;
- Identify potential areas for small and community-level piped water supply scheme;
- Conduct a secondary water quality assessment based on secondary data and verification of secondary data of the study area by water quality testing;
- Conduct hydro-geological investigation by drilling test wells in selected villages (three in each village at >300 meter depth) to identify a suitable aquifer for safe piped water supply.

1.3 Study Area

Study Location Selection Criteria

According to the Terms of Reference (ToR), thirty-five (35) villages were selected from 15 different districts (8 districts from 8 divisions and seven districts from remote regions) to conduct the study focusing on water supply, sanitation, and hygiene. The villages were selected considering nine given criteria. These included arsenic-contaminated areas, Barind areas, coastal areas, cyclone-prone areas, beel/char areas, haor, hilly areas, flood-prone areas, and plain land. A list of 35 villages is presented below. The villages, marked with asterisk, were picked from the piloting umbrella of the "My Village My Town" project, while the rest were selected for a sample survey.

Study Area				Coastal			Cyclone Prone	Barind	Beel/Char	Haor	Hill District	Plain Land	Flood Prone	As Contamination
				South-West	South-Central	South-East								
Dictrict	**Upazila**	**Union**	**Village**											
Cumilla	Manoharganj	Bipulasar	**Shekchail ***											■
Khulna	Dumuria	Kharnia	**Tipna ***				■							■
			Gonali				■							■
Satkhira	Shyamnagar	Labsa	Jabakhali	■			■							■
			Kalbari	■			■							■
			Banbibitala	■			■							■
			Chunar	■			■							■
			Datinakhali *	■			■							■
Sunamganj	Dakkhin Sunamganj (Shantiganj)	Shimulbank	Lalukhali							■				■
			Shimulbank *							■				■
Naogaon	Niamatpur	Hajinagar	**Khordachompa ***					■				■		
			Patail					■				■		
Chattogram	Mirsarai	Ichhakhali	**Charsharat ***			■								
Rajshahi	Bagmara	Sonadanga	**Sonadanga ***									■		
Gaibandha	Fulchhari	Gazaria	Ziadanga									■	■	
		Fulchhari	**Fulchari ***						■				■	
			Parul						■				■	
			Baje Fulchchari						■				■	
Barishal	Hijla	Memania	**Induria ***		■		■							
			Baduri		■		■							
Sylhet	Gowainghat	Rustampur	**Bagaiya ***							■				
		Bhushanchhara	**Chota Harina***								■			
Gopalganj	Muksudpur	Jalirpar	**Beelchanda ***									■		
			Baniarchar									■		
			Jolirpar									■		
Kurigram	Bhurungamari	Pathardubi	**Pathordubi ***									■	■	
			Maidam									■	■	
		Baladia	Sarkarpara									■	■	
			Uttar Baladia									■	■	
Narsingdi	Manohardi	Chalakchar	**Hafizpur ***									■		
			Chengain									■		
			Chalakchar									■		
Netrokona	Barhatta	Sahata	**Dakkhin Demura ***									■		
			Shahata									■		
			Kadam Deuli									■		
Total District = 15	**Total Upazila = 15**	**Total Union = 17**	**Total Village = 35**	**5**	**2**	**1**	**9**	**2**	**3**	**3**	**1**	**17**	**8**	**10**
* Selected pilot villages for "My Village My Town" Project.				South-West	South-Central	South-East	Cyclone Prone	Barind	Beel/Char	Haor	Hill District	Plain Land	Flood Prone	As Contamination
				Coastal										

Figure 1.1: Selection of Study Area

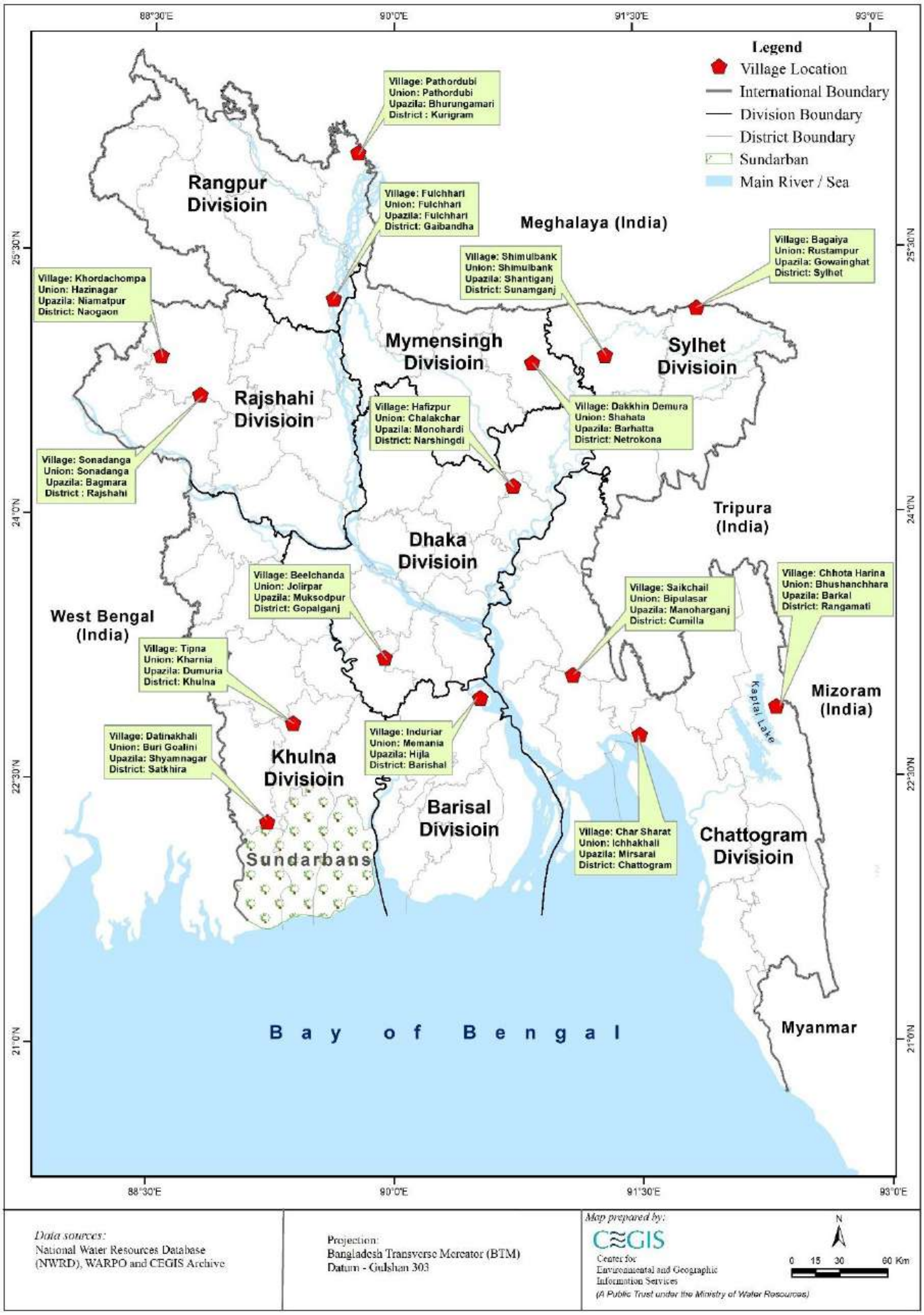

Figure 1.2: Study area location (villages)

1.4 Overall Approach

The baseline study followed the systematic steps of approaches and methodology. The primary activities of the study included the collection of water supply, sanitation, and hygiene data from the HHS. The major activities were systematically organized under different methodology steps and are diagrammatically presented in **Figure 1.3**. The methodology is described in different subsequent sections and presented in **Appendix I**.

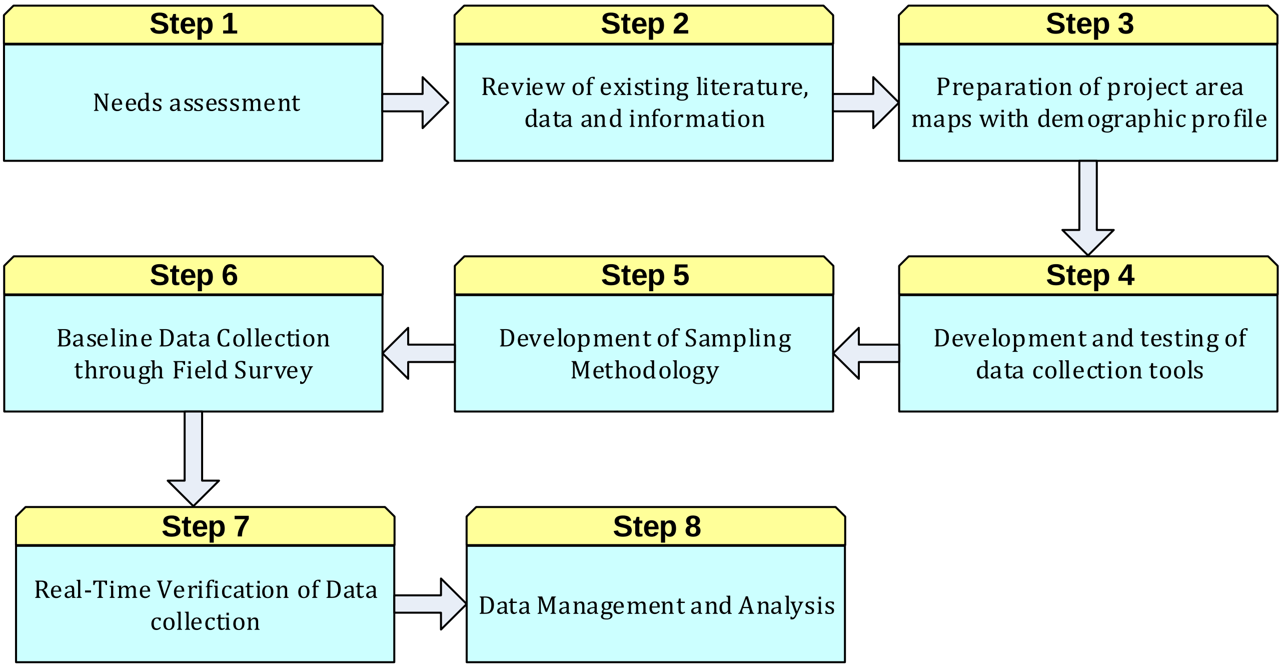

Figure 1.3: Flow diagram of the methodology

2. Overview of WASH in Bangladesh

2.1 Introduction

It is evident from the MICS 2019 survey report that Bangladesh met the Millennium Development Targets for drinking water by increasing progress from 68% to 87% between 1990 and 2015. Remarkable progress was made by reducing open defecation practices to around 1% by 2015 from 34% in 2003 and increasing access to improved sanitation to 64%[1]. In the era of the SDGs, 98.5% of the population has access to water from improved water sources. However, only 42.6% of the population has access to safely managed drinking water services[2]. In terms of sanitation, basic service coverage is 64.4% nationally. Safely managed sanitation coverage is 36.4% (estimated) for rural areas; but no data is available for urban areas[3].

The national Vision is to achieve universal access to safe & affordable drinking water for all and ensure access to adequate and equitable sanitation and hygiene by 2030[4]. Bangladesh aims to achieve this in three five-year phases. Phase-1: 2016 – 2020: Achieve universal coverage in rural and urban populations using various water supply options; Phase-2: 2021-2025: Sustain universal coverage in rural & urban populations by increasing service delivery standards; Phase-3: 2026-2030 continue to work for sustaining universal coverage in rural & urban areas.

A significant challenge Bangladesh faces is the gap between access and quality of WASH services. Access to improved water is 98.5% (not including arsenic contamination), while safely managed drinking water service coverage is only 42.6%. The progression from open defecation free (almost 1.5%) to universal access to safely managed sanitation is currently 36.4% in rural areas (Estimated MICS 2019). Other challenges are inadequately designed low-cost, low-tech solutions for specific environments such as flood and storm-prone coastal regions or water-scarce hilly environments, fecal sludge management, and safely managed sanitation options for densely populated areas of urban slums. Shared toilets commonly used in densely populated urban slums, are not considered improved toilets by the Joint Monitoring Programme Reports (JMP). Additional solutions are needed to extend and make affordable resilient services to people living in hard-to-reach (HtR) coastal and arsenic-prone areas. The weak capacity of local government institutions and timely fund mobilization are other sector development issues to tackle for achieving the SDGs in the WASH sector.

2.2 Drinking Water Facilities in Bangladesh

2.2.1 *Sources of Water Supply in Bangladesh*

The water sources in Bangladesh are surface water, groundwater, and rainwater. The Ganges-Brahmaputra-Meghna (GBM) river system discharges massive surface water through Bangladesh, which enters into the ground to form groundwater. About 93% of the stream flow through the country originates from outside Bangladesh (Khan, 1993). Rainfall within the country contributes to the total water available in Bangladesh, a part of which infiltrates into the ground to recharge existing

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[1] MICS 2019

[2] Household members with an improved drinking water source located on premises, free of E. coli, available when needed and <=50ppbArsenic

[3]MICS 2019

[4] Revision of the National Strategy for Water Supply and Sanitation (2014) expected to publish in 2021

groundwater and the remaining rainwater flows as surface run-off. These water sources available for developing water supplies have relative advantages and disadvantages in Bangladesh. Water availability in terms of quantity and quality, present situation, and problems associated with the sources are all discussed in the following sub-sections.

2.2.2 *Surface Water*

Surface water is abundant in the wet season in Bangladesh. An estimated 795,000 million cubic meters (Mm^3) of surface water is discharged through the Ganges-Brahmaputra system downstream of the Ganges and the Brahmaputra confluence. This is equivalent to 5.52 m deep water over a land area of 144,000 km^2. There are other rivers discharging surface water into the Bay of Bengal. The country's average annual rainfall of 2200 mm partly replenishes surface water sources. Each year, about one-third of Bangladesh is submerged in a typical flood, and the area submerged may increase to about two-thirds during severe floods. In the dry season, water scarcity persists in many areas. During this period, surface water is only available in part of the country's 22,155 km of major rivers, 1,922 km^2 of major standing water bodies, and about 1,475 km^2 of ponds. Surface water irrigation systems in the country compete for this available water in the dry season. The perennial water bodies are decreasing with the use of more and more surface water.

Traditionally, rural water supply has primarily relied on protected ponds before and during the early stages of tube well installation. There are around 1,288,222 ponds in Bangladesh, with an area of 0.114 ha per pond, and 21.5 ponds per mouza (BBS, 1997). About 17% of these ponds are derelict and probably dry up in the dry season. The bio-aquatic water quality in these ponds is inferior due to unhygienic sanitary practices. Many of these ponds are contaminated chemically and biochemically, making them unsuitable for fish culture. If one pond in a mouza could be protected from contamination, it could provide a source of drinking water with minimal treatment as well as water for other domestic uses without any treatment. The Government of Bangladesh has critically emphasized the development of protected pond-based water supply systems. The protected ponds should not receive surface discharge and only be replenished by rain and groundwater infiltration.

2.2.3 *Groundwater*

Groundwater is the central and essential source of water supply in Bangladesh. Except for a few hilly regions, water-bearing aquifers entirely underlie the country at depths varying from zero to 20m below the ground surface. These factors have made groundwater an attractive and easily accessible source and have led to a rapid proliferation in groundwater use over the last few decades. The soil is mainly stratified and formed by alluvial sand and silt deposits, having occasional clay lenses. The main constituent of the aquifer materials is the medium-grained sand deposited at the lower reach by the mighty rivers - the Ganges, the Brahmaputra, and the Meghna with their tributaries. Groundwater can be easily abstracted by installing wells to develop water supply systems. The water abstracted for various purposes is replenished in the monsoon.

Presently, 97% of the population relies on groundwater for potable supplies, which is also an important source for irrigation and industry. Groundwater levels across Bangladesh become depressed during the dry season, but the aquifers replenish fully during the monsoon. Exceptions occur beneath the major cities, especially Dhaka and in Barind areas, where large-scale abstraction has led to long-term water table drawdown. As a result, groundwater may contain minerals in varying concentrations depending on soil conditions. Arsenic contamination of groundwater is believed to be the result of some reactions in the adverse geo-environment.

In the context of high prevalence of diarrhoeal diseases, groundwater has received priority as a source of drinking water supply because it is generally free from pathogenic micro-organisms. Almost all rural and urban water supplies are groundwater based. Groundwater collected by tube wells is fit for consumption. Groundwater abstracted from shallow aquifers by hand tube wells has received acceptance in rural areas for drinking purposes. However, due to its high iron content, hardness, etc., people do not want to use hand tube well water for other domestic purposes like cooking, bathing, and washing. The high iron in groundwater makes the cooked food blackish, producing stains on utensils. The hard water requires more soap for washing.

The number of tube wells in Bangladesh is unknown, but estimates put the number at around 6–11 million. Most of these are private tube wells, which penetrate the shallow alluvial aquifers to depths typically of 10–60 m. Irrigation boreholes typically tap deeper aquifers in the 70–100m depth region. In some areas, notably the south and the Sylhet basin of north-east Bangladesh, deep tube wells abstract groundwater from 150 m depths or more. Deep tube wells have been installed in the south to avoid high salinity at shallower levels (BGS and DPHE, 2001). Shallow hand-dug wells occur in some areas, though they are much more uncommon than tube wells.

Key information on groundwater availability in Bangladesh:

- The groundwater storage reservoir determines the resource availability and the annual recharge volume.
- Key factors determining groundwater availability include the capacity of the country’s aquifers to store water, the characteristics governing groundwater's economic withdrawal for irrigation, and domestic and industrial needs.
- The recharge sources are rainfall, flooding, and stream flow in rivers.
- The quaternary alluvium of Bangladesh constitutes a huge aquifer with reasonably good transmission and storage properties.
- Heavy rainfall and inundation during the monsoon help the aquifers to recharge annually.
- The internal renewable water resources are 105 Km3 per year, and 84 Km3 of surface water is produced (estimated) internally as the stream flows from rainfall. The country's annual available groundwater recharge average is 21 Km3 (estimated).
- The total abstraction of water volume (annually) is 35.87 Km3 (estimated).
- The water used for agriculture is about 31.50 Km3 which is 88% of the total abstraction of water.
- The water used for domestic purposes is about 3.60 Km3 which amounts to 10% of total abstraction.
- The water used for industrial purposes is about 0.77 Km3 which is 2% of the total abstraction.
- The share of groundwater in total water abstraction is 79%, and the volume is 28.48 Km3.
- The share of surface water in total water abstraction is 21%, and the volume is 7.39 Km3.
- The volume of groundwater used for the irrigation/agriculture sector is 25.06 Km3.
- The volume of groundwater used for domestic purposes is 2.85 Km3.
- The volume of groundwater used in the industrial sector is 0.57 Km3. (source: online documents)

Groundwater Problems in Bangladesh

Groundwater is the primary source of water supply in the urban and rural areas of Bangladesh. Groundwater in Bangladesh is available in adequate quantity, but the availability of groundwater for drinking purposes has become a problem for the following reasons:

- arsenic in groundwater;
- excessive dissolved iron;
- salinity in the shallow aquifers in coastal areas;
- lowering of groundwater level;
- rock/stony layers in hilly areas;

2.2.4 *Rainwater*

Rainwater is one of the alternative sources of drinking water supply in Bangladesh. The spatial distribution of average rainfall is shown in **Figure 2.1**. The rainfall distribution in **Figure 2.1** shows that relatively higher precipitations occur in the eastern part of the country, and the highest rains occur in the northeastern and eastern parts of the coastal area. The average annual rainfall in Bangladesh varies from 1500 mm in the west-central part to over 3000 mm in the northeast and southeast. In Surma Valley and neighboring hills, rainfall is very high. In Sylhet, the rainfall average is 4180 mm; it is 5330 mm near the foot of the abrupt Meghalaya Plateau in Sunamganj; and 6400 mm in Lalakhal,, the highest in Bangladesh. Low rainfall, less than 1500 mm per year, occurs in the western part of the country. The coastal and hilly areas with greater fresh water source problems have higher rainfall, favorable for rainwater harvesting.

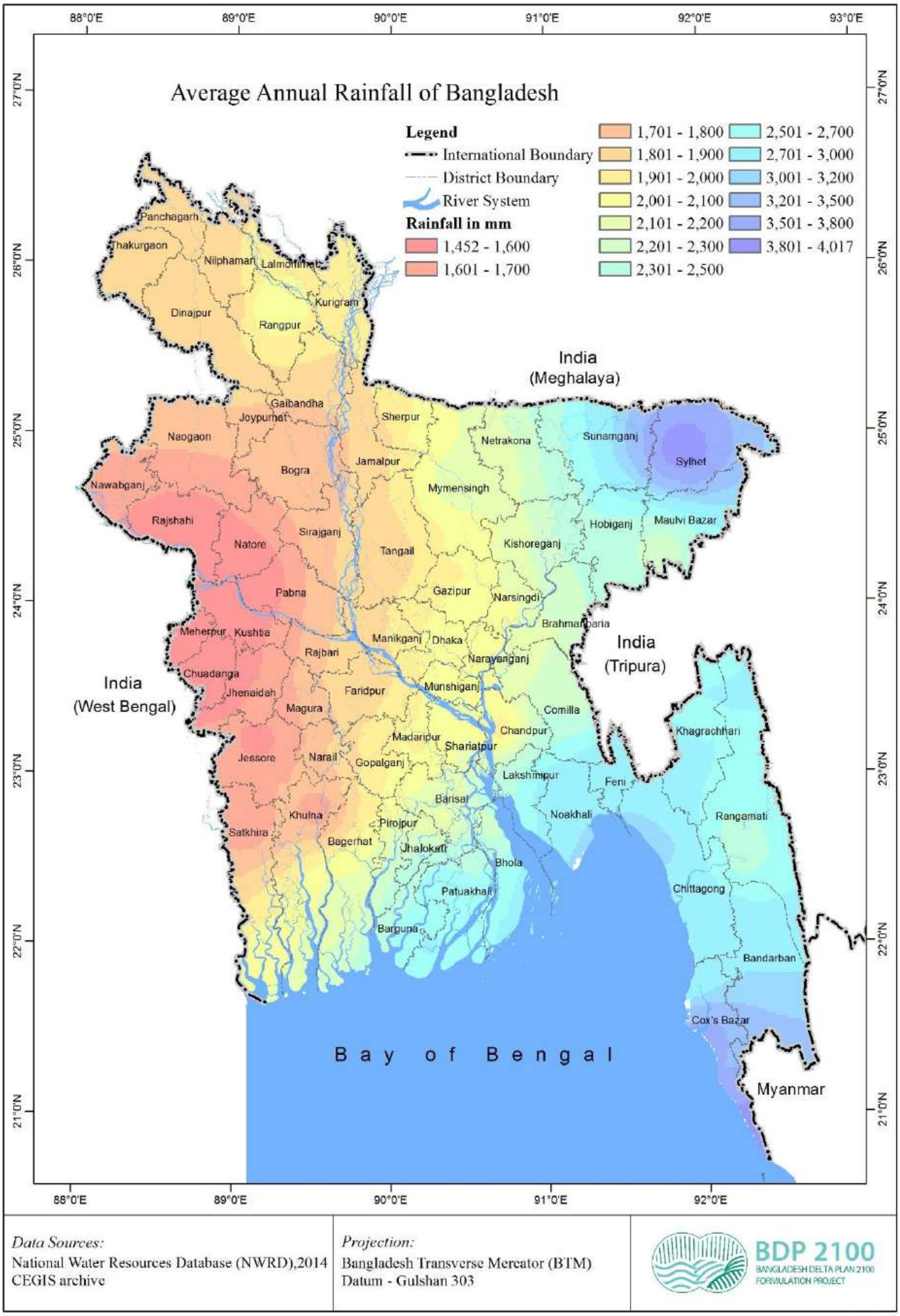


Figure 2.1: Average rainfall in Bangladesh

2.3 Narrative of Sanitation Facilities

In the 1980s and 1990s, the sanitation condition in the rural areas of Bangladesh was poor. In the 2000s, the United Nations (UN) declared the Millennium Development Goal (MDG) of halving the proportion of people without safe water supply and sanitation by 2015. As declared by the UN, access to safe water supply and sanitation is a fundamental need and a human right. Inadequate provision of safe drinking water and sanitation is directly and indirectly related to environmental pollution, water-sanitation-related infectious diseases, and health risks that are endemic in the region, affecting a large proportion of the population of Bangladesh.

The government was committed to the MDG's targets and formed task forces at national and local levels. Bangladesh led the South Asian Conference on Sanitation (SACOSAN) to improve sanitation in the region, and the Dhaka declaration became the region's guiding principle of sanitation improvement. October has was declared as Sanitation Month. A survey (2003) suggested that 33% of people used sanitary latrines, 25% used unsanitary latrines, and 42% practised open defecation. Bangladesh achieved 78.62% sanitation coverage in 2006. In 2008, the Government of Bangladesh launched the International Year of Sanitation country program. (Ref: Sanitation Journey since Independence, SACOSAN-VI Country Brochure: Bangladesh, Local Government Division, Government of Bangladesh).

According to the WHO/UNICEF Joint Monitoring Programme, by 2010, the national improved latrine coverage stood at 56%, with 25% sharing toilets, while the proportion of the population with access to improved drinking water was 81%. Nonetheless, challenges have remained and progress has been uneven. While coverage is high, the use of facilities and behavioral changes are not uniform. In some pockets of hard-to-reach areas, namely Barind, beel, char, coast, offshore island areas and saline zones, and haor and hilly areas WATSAN services (35.8%, Ref: Bangladesh Country Paper, SACOSAN VI) are not adequate by any standard. The poor water and sanitation coverage is due to adverse physical conditions and frequent occurrences of natural calamities like cyclones, floods, drought, erosion, and tidal surges that cause latrines damage, and a higher child mortality rate, accelerating the vicious cycle of poverty. In brief, challenges exist regarding sustainability, hygiene issues, and total sanitation coverage.

A well-coordinated effort by the government, non-government development agencies, and other development partners, as well as the introduction of the innovative Community-led Total Sanitation approaches, made it possible to bring down the proportion of open defecation from 43 percent in 2003 (SACOSAN 2008) to zero percent of the population (JMP 2017). However, despite this significant gain, challenges have remained, as about one-third of the people do not have access to safe and improved sanitation. Only about 64 percent of the population has access to improved sanitation facilities which eliminate the potential for contact with human fecal matter, mainly through water seals in toilets (MICS 2019). Besides, over 20% and over 15% of the population have access to shared toilets and unimproved sanitation facilities (largely open pit latrines), respectively (MICS 2019).

An improved sanitation facility hygienically separates human excreta from human contact. Improved sanitation facilities include flush or pour-flush to piped sewer systems, septic tanks or pit latrines, ventilated improved pit latrines, slabs, and composting toilets. **Table 2.1** shows the population using improved and unimproved sanitation facilities. It also shows the proportion who dispose of feces in fields, forests, bushes, open water bodies, beaches, or other open spaces, or with solid waste, a practice known as 'open defecation.' MICS 2019 found sanitation services as noted in **Table 2.1** below.

Table 2.1: Use of Basic and Limited Sanitation Services, %

Area	Users Of improved Sanitation Facilities				DK/Missing	Users Of improved Sanitation Facilities				DK/Missing	Open defection (no facility, bush, field)	Total
	Not shared	Shared By		Public Facility		Not shared	Shared By		Public Facility			
		5 facility households or less	More than 5 households				5 facility households or less	More than 5 households				
Bangladesh	64.4	17.9	2.2	0.1	0	9.7	3.7	0.5	0	0	1.5	100
Urban	64.7	20.1	5.5	0.3	0	5.6	2.5	0.9	0	0	0.4	100
Rural	64.3	17.3	1.3	0.1	0	10.8	4.1	0.4	0	0	1.9	100

Source: Progotir Pathey, MICS 2019

Table 2.1 presents the distribution of household population using improved and unimproved sanitation facilities, which are private, shared with other households, or public facilities. Those using improved shared or public sanitation facilities are classed as having a 'limited' service for the purpose of SDG monitoring. Households using improved sanitation facilities that are not shared with other households meet the SDG criteria for a 'basic' sanitation service, and may be considered 'safely managed' depending on how excreta are managed.

Table 2.2 below shows that 82.9% of the rural people use improved types of latrines, and 17.1% use unsanitary toilets.

Table 2.2: Improved Sanitation Coverage, 2019

Total	Improved Sanitation Facility							Unimproved Sanitation Facility				Open defecation (no facility, bush field)	Total	Percentage using improve sanitation
	Flush/Pour Flush to:				Ventilated improved pit latrine	Pit latrine with slab	Compositing toilet	Open drain	pit latrine without Slab/open pit	Hanging toilet/latrine	other			
	Piped sewer system	Septic tank	Pit latrine	Unknown										
Area	7.2	22.8	17.1	0.1	1	36.4	0.1	3.1	8.3	2.5	0	1.5	100	84.6
Urban	29.5	32.9	10.7	0.4	0.8	16.3	0	4.4	3.7	0.8	0	0.4	100	90.6
Rural	1.1	19.9	18.8	0.1	1	41.9	0.1	2.7	9.6	2.9	0	1.9	100	82.9
Division														
Barisal	0.6	14.1	3	0.1	2.4	55.3	0.1	0.8	21.7	1.2	0.1	0.7	100	75.5
Chattogram	2.2	28.8	13.4	0.1	0.8	34.5	0.1	5	11.7	2.1	0	1.4	100	79.9
Dhaka	26.8	18.3	15.3	0.3	1.1	25.3	0	4.8	6.4	1.4	0	0.2	100	87.2
Khulna	1	24.6	31.7	0	0.4	36.9	0	0.7	4.6	0.2	0	0.1	100	94.6
Mymensingh	0.8	16.3	19.7	0.2	0.5	41.8	0.5	3.2	11.1	4.3	0	1.6	100	79.8
Rajshahi	0	25.2	18.7	0.1	1.5	39.8	0	1.2	7.1	4.5	0	1.8	100	85.4
Rangpur	0.1	16.9	21.3	0	0.7	47.9	0	1.3	3.9	1.1	0.1	6.7	100	86.9
Sylhet	1.1	36.1	8.7	0	0.1	33.5	0	3.9	7.3	8.4	0	0.9	100	79.5

Source: Progotir Pathey, MICS 2019

A survey conducted in 2018 under the National Sanitation Project–III in different physiographic regions found types of sanitation-technological options as presented below:

Table 2.3: Types of latrines used in physiographic regions all over Bangladesh

Used Latrine	HH samples	Barind		Beel/Wetland		Char		Coast, offshore island and saline		Haor/Wetland		Hilly		Overall (%)
		n=	%	n=	%	n=	%	n=	%	n=	%	n=	%	
Unimproved pit	2855	142	34	159	71	619	56	637	61	276	38	1022	84	**60**
Water seal single pit	946	115	28	30	13	267	24	300	29	128	17	106	9	**20**
Water seal twin pit	63	17	4	0	0	34	3	4	0	3	0	5	0	**1**
VIP	70	37	9	0	0	12	1	0	0	2	0	19	2	**1**
VIDP	16	0	0	1	0	0	0	1	0	12	2	2	0	**0**
Eco-San Sanitation	10	0	0	0	0	1	0	2	0	7	1	0	0	**0**
Septic Tank	139	27	6	14	6	42	4	18	2	24	3	14	1	**3**
ROEC	38	7	2	0	0	0	0	9	1	3	0	19	2	**1**
Hanging latrine	371	3	1	13	6	16	1	50	5	273	37	16	1	**8**

Used Latrine	HH samples	Barind		Beel/Wetland		Char		Coast, offshore island and saline		Haor/Wetland		Hilly		Overall (%)
		n=	%	n=	%	n=	%	n=	%	n=	%	n=	%	
Open defecation	31	12	3	0	0	4	0	6	1	5	1	4	0	**1**
Improved pit	189	58	14	7	3	103	9	15	1	3	0	3	0	**4**
Total	4728	418	100	224	100	1098	100	1042	100	736	100	1210	100	**100**

Source: Progotir Pathey, MICS 2019

The quality of latrines depended on the affluence levels of the households. **Table 2.4** shows that almost all of the rich people use improved types of latrines. The better-off people are likely to use improved types of latrines.

Table 2.4: Latrine Types versus Affluence

Wealth Index Quintile	Improved Sanitation Facility							Unimproved Sanitation Facility				Open defecation (no facility, bush, field)	Total	Percentage using improved sanitation
	Flush/Pour Flush to:				Ventilated improved pit latrine	Pit latrine with slab	Compositing toilet	Open drain	pit latrine without Slab/ open pit	Hanging toilet/latrine	other			
	Piped sewer system	Septic tank	Pit latrine	Unknown										
Poorest	0	1.9	8.5	0.1	0.3	56.2	0.3	1.8	19.2	7.5	0	4.4	100.2	67.1
Second	0	3.7	17.1	0	0.7	57.7	0.1	2.4	12.5	3.2	0	2.6	100	79.2
Middle	0.3	13.9	26.7	0	1.2	45	0	3.4	7.6	1.2	0	0.7	100	87.1
Fourth	5.9	38	26	0.3	1.8	20.8	0	4.7	2.1	0.3	0	0.1	100	92.8
Richest	30	56.2		0.2	0.8	2.2	0	3.2	0.2	0.1	0	o	99.9	96.6

Source: Progotir Pathey, MICS 2019

2.4 Hygiene Practices

Good hygiene behavior is indispensable to keeping people clean and healthy and stopping the spread of diseases like coronavirus. Clean water, decent toilets, and good hygiene are vital for a dignified, healthy life. Yet, only 1% of water, sanitation, and health funding are spent on changing hygiene habits. In Bangladesh, 68.5 million people lack good hygiene at home. At WaterAid, they recognize the importance of good hygiene practices and incorporate them into their work.

Statistics can look stark. 1 in 5 people on the planet do not have a decent toilet. 1 in 10 do not have clean water close to home.

In Bangladesh, only 38% of healthcare facilities have essential hygiene services, with significant differences between government and non-government facilities, according to the latest Joint Monitoring Programme (JMP) report by WHO and UNICEF. Some 32% of government facilities have basic hygiene services, compared to 69% of non-government facilities, according to the JMP report. The report also highlights geographical disparities in Bangladesh. Access to safe water sources in healthcare facilities is more common in urban areas (90 %) than in rural areas (67 %). According to the report, half of the healthcare facilities worldwide lack essential hygiene services with water and soap or alcohol-based hand washing where patients receive care and use toilets in these facilities. Around 3.85 billion people use these facilities, putting them at greater risk of infection, including 688 million people receiving care at facilities with no hygiene services.

Hygiene facilities and practices in health care settings are non-negotiable. Their improvement is essential to pandemic recovery, prevention, and preparedness. Dr. Maria Neira, Director of WHO, Environment, Climate Change, and Health, said, *"In health care facilities, hygiene can't be secured without increased investments in basic measures, i.e., safe water, clean toilets, and safely managed health care waste."*

Some key statistics gathered by WaterAid on water, toilets, and hygiene throughout Bangladesh are given below:

In Bangladesh, 3.79 million people still do not have clean water, and 68 million people in the country —two in five—use contaminated water. One in two people in urban areas use contaminated water. 160.9 million people in Bangladesh have access to clean water close to home and 29.8 million people in Bangladesh do not have access to clean water on-premises.

75.4 million people in Bangladesh—one in two—do not have a decent toilet of their own, and 89.2 million people in the country—one in five—have a proper toilet of their own. Since 2000, the number of people with decent toilets of their own has increased by 125%. 36.2 million people—one in five—still have inadequate toilets. Only around 15.3 million people have improved sanitation facilities connected to sewers. 33.1 million people—one in five—use septic tanks. Almost 128 million people, or seven out of every ten, use latrines and other improved sanitation facilities.

68.5 million people in Bangladesh—two in five—lack good hygiene at home. Hand-washing facilities without soap and water are available to nearly 19 million people in urban areas (nine in twenty), and 39.4 million people in rural areas (seven in twenty).

3. Socio-Economic Setting

3.1 Introduction

The baseline study was conducted in 35 villages. Of these villages, 15 were selected as *pilot villages*, and the remaining 20 were considered *sample villages*. This section deals with socio-economic information such as demographic profile, gender and marital status of the HH head, occupation, income and expenditure, housing condition and tenancy, status of school going children and disabilities.

3.2 Demographic Profile

The demographic profile of the pilot villages has emerged from the primary survey; the pilot villages include 12,684 households of 58,043 population, of which 29,556 (51.2%) are male and 28,487 (48.8%) female. The average sex ratio in the study villages is 105.0, which refers to 105 males per 100 females while the sex ratio in Bangladesh in 2021 is 102.12 males per 100 females. The survey shows that the Pathordubi village of Kurigram district has the highest population (10,038), comprising 2469 households (HH), followed by Saikchail of Comilla and Hafizpur of Narsingdi. The average household size of Pathordubi is 4.07, which is close to the national average. On the other hand, Choto Harina of Rangamati has the lowest population (1081), comprising the lowest HH (215). The average HH size of this village is 5.03, which is higher than the national average of 4.2. The following table 3.1 presents the demographic data of the pilot villages.

Table 3.1: Demographic Profile of Pilot Villages

Village	Total HH	Total Population	Total Male	Total Female	Sex Ratio	Avg. HH
Induria	728	3392	1771	1621	109.3	4.66
Charsharat	941	4573	2425	2148	112.9	4.86
Saikchail	1652	8929	4659	4270	109.1	5.4
Fulchari	377	1583	803	780	102.9	4.2
Beelchanda	392	1582	811	771	105.2	4.04
Tipna	772	3270	1672	1598	104.6	4.24
Pathordubi	2469	10038	5086	4952	102.7	4.07
Khordachompa	459	1783	925	858	107.8	3.88
Hafizpur	1646	7126	3335	3791	88.0	4.33
Dakkhin Demura	373	1777	920	857	107.4	4.76
Sonadanga	709	2625	1357	1268	107.0	3.7
Chota Harina	215	1081	554	527	105.1	5.03
Datinakhali	568	2256	1146	1110	103.2	3.97
Shimulbank	462	2629	1360	1269	107.2	5.69
Bagaiya	921	5399	2732	2667	102.4	5.86
Total	**12684**	**58043**	**29556**	**28487**	**105.0**	**4.6**

Source: CEGIS Field Survey, 2022

Moreover, the age composition shows that the rate of the adult population for both males and females is the highest in the pilot and sample villages. On average, in the pilot villages, about 32% of both males and females are adults, whereas, in the sample villages, the number of female adults (about 34%) is higher than the males (32%). Because of lower infant and under-five mortality (U5MR), the percentage of children is also noticeable in the studied villages. The following **Table 3.2** and **Table 3.3** present the age structure of the studied villages.

Table 3.2: Age Structure of Population in Pilot Villages

Village	Adult (> 18 yrs)		Children Under 5 years		Children(5-18 years)	
	Female (%)	Male (%)	Boy (%)	Girl (%)	Boy (%)	Girl (%)
Induria	29.9	31.7	5.7	5.8	14.9	12.1
Charsharat	29.7	34.3	5.2	4.9	13.6	12.4
Saikchail	29.6	33.1	5.4	5.1	13.7	13.1
Fulchari	31.5	29.4	7.0	5.9	14.4	11.8
Beelchanda	35.2	35.1	3.8	3.6	12.4	9.9
Tipna	33.9	34.5	4.8	4.9	11.8	10.2
Pathordubi	35.4	33.9	5.0	4.5	11.8	9.5
Khordachompa	35.8	36.3	5.3	4.2	10.2	8.2
Hafizpur	36.0	29.0	4.5	4.7	13.3	12.5
Dakkhin Demura	30.2	30.3	6.0	4.9	15.5	13.2
Sonadanga	37.3	36.8	3.9	3.3	11.1	7.7
Chota Harina	30.6	31.5	5.2	4.8	14.5	13.3
Datinakhali	35.3	33.6	5.0	4.3	12.2	9.6
Shimulbank	27.0	28.8	5.2	5.9	17.7	15.3
Bagaiya	27.7	27.7	6.2	6.5	16.7	15.3

Source: CEGIS Field Survey, 2022

Table 3.3: Age Structure of Sample Villages

Village	Adult (> 18 yrs)		Children Under 5 years		Children(5-18 years)	
	Male (%)	Female (%)	Boy (%)	Girl (%)	Boy (%)	Girl (%)
Baduri	27.73	32.77	15.13	14.29	4.2	5.88
Baje Fulchchari	28.98	31.84	15.92	13.06	5.31	4.9
Parul	30.35	34.19	13.74	9.9	4.15	7.67
Ziadanga	34.38	30.63	18.75	6.88	5	4.38
Baniarchar	33.96	35.85	12.67	10.78	3.5	3.23
Jolirpar	32.4	33.37	13.35	10.32	6.31	4.25
Gonali	36.29	35.52	13.13	9.65	2.32	3.09
Maidam	33.33	37.82	11.22	5.77	6.41	5.45
Sarkarpara	32.31	35.49	12.92	9.42	5.26	4.6
Uttar Baladia	32.76	33.78	12.1	11	5.81	4.56
Patail	34.29	38.57	15.71	7.14	1.43	2.86

Village	Adult (> 18 yrs)		Children Under 5 years		Children(5-18 years)	
	Male (%)	Female (%)	Boy (%)	Girl (%)	Boy (%)	Girl (%)
Chalakchar	31.96	34.08	12.48	10.61	4.87	5.99
Chengain	30.94	35.43	10.31	12.56	7.62	3.14
Kadam Deuli	33.82	30.39	12.75	12.75	4.9	5.39
Shahata	31.39	33.67	12.66	10.63	5.82	5.82
Banbibitala	33.78	37.16	10.14	11.49	3.38	4.05
Chunar	33.01	34.95	13.11	7.28	6.8	4.85
Jabakhali	32.17	33.91	13.04	9.57	6.96	4.35
Kalbari	36.31	39.11	7.82	9.5	4.47	2.79

Source: CEGIS Field Survey, 2022

3.3 Gender and Marital Status of HH Head

In the surveyed villages, the majority of the HH heads are male. The following table shows that more than 90% of HH heads are male in every village except Hafizpur, Fulchori, and Beelchanda. The table also shows about 23% of female-headed HHs in Hafizpur village, followed by Fulchori (14.06%) and Beelchanda (12.76%). Most notably, in four villages, i.e., Induria, Charsharat, Pathordubi, and Hafizpur, a few third-gender-headed HHs were found.

Table 3.4: Sex of HH Heads in the Villages

District	Village	Male	Female	Third gender
Barishal	Induria	92.86	7.01	0.14
Chattogram	Charsharat	95.96	3.94	0.11
Cumilla	Saikchail	95.52	4.48	
Gaibandha	Fulchari	85.94	14.06	
Gopalganj	Beelchanda	87.24	12.76	
Khulna	Tipna	94.17	5.83	
Kurigram	Pathordubi	92.3	7.65	0.04
Naogaon	Khordachompa	93.03	6.97	
Narsingdi	Hafizpur	77.22	22.66	0.12
Netrakona	Dakkhin Demura	89.28	10.72	
Rajshahi	Sonadanga	93.23	6.77	
Rangamati	Chota Harina	96.28	3.72	
Satkhira	Datirnakhali	90.49	9.51	
Sunamganj	Shimulbank	91.77	8.23	
Sylhet	Bagaiya	91.75	8.25	

Source: CEGIS Field Survey, 2022

The marital status of the HH heads is presented in **Table 3.5**. It is observed that most of the HH heads are married and monogamous. The study, however, also found a few polygamous male HH heads in the studied villages. In the female-headed HHs, most of the heads are a widow.

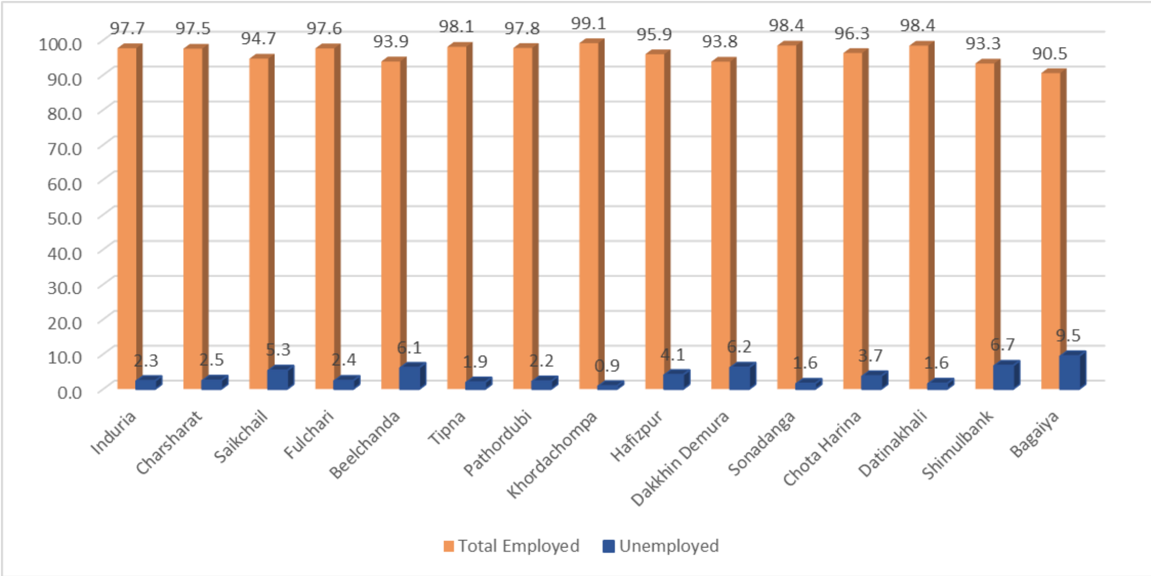
Table 3.5: Marital Status of HH heads

Village	Married (one wife)	Married (more than one wife)	Widow	Unmarried	Widower	Separated	Divorcee
Induria	91.9	1.0	5.2	0.7	0.4	0.8	
Charsharat	91.3	2.7	2.0	3.1	0.5	0.3	0.1
Saikchail	88.3	6.4	3.6	0.9	0.5	0.3	0.1
Fulchari	83.0	2.9	10.3	0.8	0.3	0.8	1.9
Beelchanda	87.5		8.2	2.3	0.5	1.3	0.3
Tipna	90.4	1.8	3.6	1.3	1.0	1.6	0.3
Pathordubi	89.3	2.6	6.3	0.3	0.5	0.6	0.6
Khordachompa	92.6		6.3	0.4		0.4	0.2
Hafizpur	83.2	5.4	8.9	1.3	0.7	0.2	0.2
Dakkhin Demura	85.0	3.2	9.4	1.3	0.3	0.3	0.5
Sonadanga	91.5	1.4	5.2	0.9	0.6	0.1	0.3
Chota Harina	89.3	6.1	2.3	1.4	0.5	0.5	
Datinakhali	89.6	0.5	5.1	1.2	0.5	1.6	1.4
Shimulbank	84.4	4.8	6.5	4.1	0.2		
Bagaiya	91.3	1.2	5.4	1.3	0.4	0.2	0.1

Source: CEGIS Field Survey, 2022

3.4 Occupation of the HH Head

Most (more than 90%) of the HH heads are employed in the pilot villages of the study area. They are involved in different occupations to earn their livelihoods. Agriculture is the main occupation, followed by day labor and private jobs. In Datinakhali of Shatkhira, Shimulbank of Shunamganj, Bagaiya of Sylhet, and Chota Harina of Rangamati, occupation of the majority of the HH heads is daily labor. Moreover, a significant number of HH heads run a business as their main means of livelihood. The secondary occupations of HH heads in the area are agriculture, followed by day labor and business (**Table 3.6**). The following figure (**Figure 3.1**) and tables (**Table 3.7 and Table 3.8**) present the occupations of HH heads in the pilot villages.



Source: CEGIS Field Survey, 2022

Figure 3.1: Employment Status in Pilot Villages

Table 3.6: Main Occupation of HH Heads

Village	Government Job	Private Job	Business	Agricultural	Day Laborer	Housewife	Transport Driving	Expatriates	Fisherman	Made Servant	Self-employed	Village Doctor	Others
Induria	0.7	13.1	12.0	35.4	23.6	2.8	4.7	0.3	2.3		2.1		0.8
Charsharat	1.8	8.2	10.2	44.2	21.9	1.4	3.2	1.3			0.7	0.1	4.6
Saikchail	1.8	5.6	15.3	13.4	20.2	3.4	5.7	21.3	0.2		1.7	0.2	6.0
Fulchari	1.1	1.3	5.6	47.5	30.2	2.7	2.9						6.4
Beelchanda	0.5	11.0	10.7	28.6	28.3	4.6	5.1		1.0		0.5	0.5	3.1
Tipna	1.7	5.6	16.6	31.0	20.6	1.3	14.6		0.1	0.9			5.7
Pathordubi	1.3	4.4	12.2	36.2	32.2	3.5	3.7	0.4	0.1	0.4	2.0	0.3	1.0
Khordachompa	1.5	2.8	9.8	39.9	36.6	2.4	3.7						2.4
Hafizpur	2.2	4.7	27.6	22.3	7.4	18.2	7.2	0.5	0.1	0.2	2.6	0.1	3.0
Dakkhin Demura	0.8	3.5	11.3	45.0	18.0	8.9	2.4		1.1	0.5	1.3	0.3	0.8
Sonadanga	1.7	6.1	9.3	48.0	23.4	3.8	3.5	0.3			1.0	0.1	1.3
Chota Harina	0.9	1.9	36.7	16.3	26.1	1.9	0.9		4.2	0.5	6.1		0.9
Datinakhali	0.7	3.9	13.6	10.2	48.9	0.7	6.3						14.1
Shimulbank	0.7	5.2	7.4	21.0	32.9	3.7	0.7	12.6	2.6	2.4	3.5	0.4	0.4
Bagaiya	0.7	2.3	18.1	15.3	37.2	5.5	3.7	1.1	0.4	0.5	4.5	0.8	0.4

Source: CEGIS Field Survey, 2022

In secondary occupations, people, especially from lower income groups, are involved in agricultural activities, day labor, small businesses, and driving vehicles for a minimum of 4 to a maximum 6 months in a year. The following table presents the status of secondary occupations in the pilot villages.

Table 3.7: Secondary Occupation of the HH Head

Village	Government job	Non-government	Business	Agricultural	Laborer	Housewife	Transport Driver	Fisherman	Self-employed	Village Doctor
Induria		4.2	7.8	51.6	33.8	0.7	0.7			0.7
Charsharat		0.5	17.2	34.3	37.9	1.0	4.6			
Saikchail	0.9	1.9	9.3	54.9	22.8		3.7			0.9
Fulchari		0.5	4.6	12.8	48.7	1.0	8.2			
Beelchanda			11.9	55.9	20.3	1.7				3.4
Tipna		0.6	13.9	48.2	27.8		7.4			1.1
Pathordubi		0.9	11.6	55.3	26.0	0.3	1.6		0.2	2.6
Khordachompa		1.2	20.6	55.3	18.2	0.6	3.5			
Hafizpur		0.1	19.1	70.3	5.0	1.6	1.0	0.1		2.3
Dakkhin Demura		2.0	12.2	50.3	34.0					
Sonadanga	0.5	2.1	12.8	50.3	29.7		2.1			2.6
Chota Harina (mouza)		2.8	8.3	50.0	27.8		2.8			
Datinakhali		1.0	9.0	21.0	36.0	7.0	15.0			
Shimulbank		2.5	5.1	53.2	38.0		1.3			
Bagaiya		0.8	9.9	33.9	36.4	2.5				

Source: CEGIS Field Survey, 2022

The occupational status of the sample villages is also similar to that of the pilot villages. Most of the population in most of these villages is involved in agriculture for their livelihoods. But Patail village of Naogaon, Uttar Baladia of Kurigram, Sharkarpara of Kurigram, and Baniarchar of Gaibandha present a different picture. The main occupation of most of the HH heads of those four villages is day labor. Business is also a favoured occupation in some of the sample villages.

Table 3.8: Occupational Status in Sample Villages

Village	Government job holder	Private job holder	Business	Agricultural	Laborer	Housewife	Vehicle Driver	Expatriates	Fisherman	Housemaid	Self-employed	Village Doctor	Others
Baduri	4.4		13.0	52.2	17.4	4.4	4.4						4.4
Baje Fulchchari			5.5	58.2	23.6	7.3							3.6
Parul		3.5	3.5	61.4	22.8		5.3						1.8

Village	Government job holder	Private job holder	Business	Agricultural	Laborer	Housewife	Vehicle Driver	Expatriates	Fisherman	Housemaid	Self-employed	Village Doctor	Others
Ziadanga			2.7	59.5	24.3	2.7	2.7						2.7
Baniarchar	1.2	11.9	10.7	25.0	36.9		9.5				2.4		2.4
Jolirpar	2.2	7.5	18.8	25.8	30.1	2.7	5.9				4.3	1.1	
Gonali		5.0	8.3	40.0	31.7		11.7			1.7			1.7
Maidam	1.4		18.1	36.1	20.8	4.2		1.4			9.7		
Sarkarpara		1.9	15.9	22.1	43.8	5.8	4.3			0.5	2.4		
Uttar Baladia	0.4	3.5	6.6	28.7	46.5	2.1	3.9			2.1	3.5		
Patail			17.7	11.8	64.7								5.9
Chalakchar		3.4	22.9	26.9	14.9	14.3	10.9			0.6	2.3	1.7	
Chengain	4.0	4.0	20.0	26.0	8.0	14.0	8.0				4.0		
Kadam Deuli	4.4	8.7	2.2	50.0	15.2	10.9	6.5						2.2
Shahata		6.9	11.0	53.4	9.6	12.3							4.1
Banbibitala			9.1	45.5	30.3		3.0						6.1
Chunar		2.2	26.7	13.3	44.4	2.2	8.9						
Jabakhali			16.0	16.0	52.0		4.0						12.0
Kalbari	2.4	4.8	26.2	9.5	45.2	2.4	2.4						7.1
Lalukhali				50.0	19.2			3.9	11.5		3.9		3.9

Source: CEGIS Field Survey, 2022

3.5 Income and Expenditure

The average monthly income of the HHs in the pilot villages is more than BDT 10,000. While analyzing monthly income-expenditure data, it is observed that the majority of the HHs are in a break-even situation, as the difference between the income amount and expenditure is minimal (on average, BDT 3,226, ranging from BDT 246 to BDT 6,284). Households in 8 out of 15 villages can save around BDT 1,000 to BDT 3,000; the remaining 6 villages, except Induria can save around BDT4,000 to BDT6,000; HHs in Induria village can save only BDT 246 from their incomes. It has been observed that the main sources of income of these HHs are agriculture and daily labor; their monthly income is low, and they are forced to be involved in secondary occupations to manage their livelihoods. However, the income of those involved in government & private jobs and businesses is much higher than that of other occupational groups. **Table 3.9** presents the average monthly incomes and expenditures in the pilot villages.

Table 3.9: Average monthly income and expenditure in pilot villages

Village	Average Monthly Income	Average Monthly Expenditure
Induria	13,467	13,221
Charsharat	17,374	14,140
Saikchail	21,354	15,663
Fulchari	11,920	7,791

Village	Average Monthly Income	Average Monthly Expenditure
Beelchanda	11,423	10,023
Tipna	17,398	12,712
Pathordubi	11,593	9,912
Khordachompa	14,010	9,603
Hafizpur	20,544	14,260
Dakkhin Demura	13,106	10,004
Sonadanga	10,896	9,540
Chota Harina	17,364	13,833
Datinakhali	11,035	8,367
Shimulbank	18,020	13,674
Bagaiya	14,667	13,044

Source: CEGIS Field Survey, 2022

The income and expenditure data from the sample villages show that the average HH monthly incomes in Baje Fulchari and Ziadanga of Gaibandha are less than BDT10,000. However, their average monthly expenditure is around BDT6000. Income and spending in the sample villages are more or less similar to that in the pilot villages. The average monthly income and expenditure data from the sample villages are presented in **Table 3.10**.

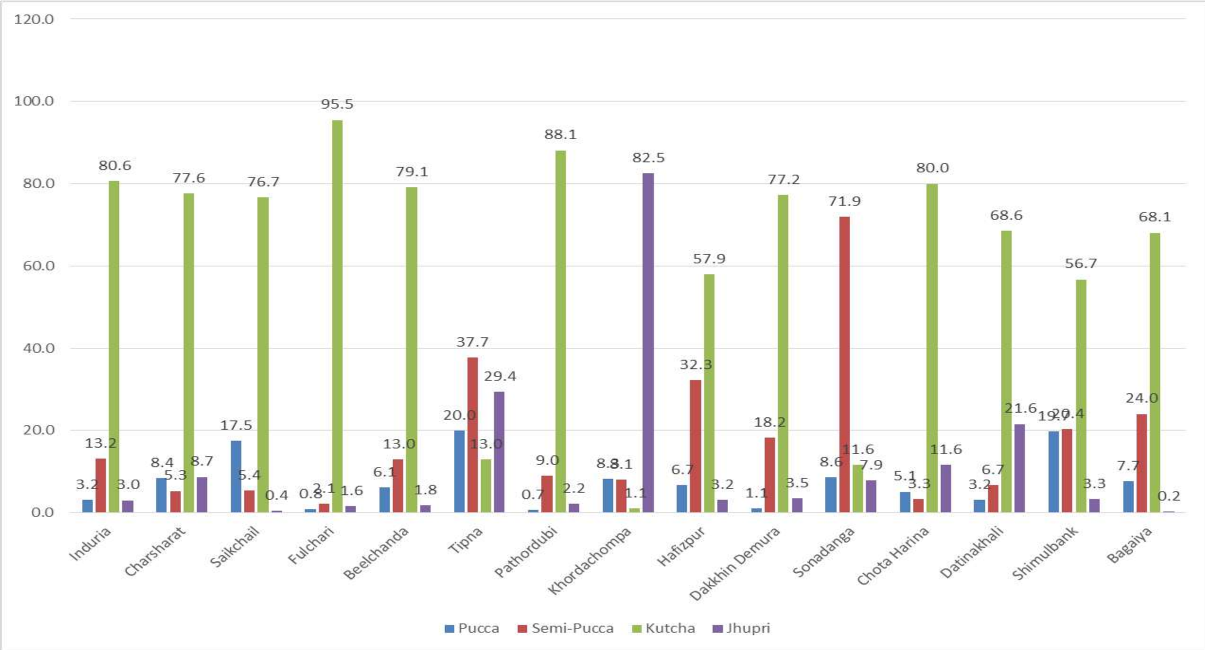
Table 3.10: Average Monthly Income and Expenditure in the Sample Villages

Village	Monthly Income	Monthly Expenditure
Baduri	14630	13264
Baje Fulchchari	9593	6000
Parul	13668	8008
Ziadanga	9151	5859
Baniarchar	11618	9806
Jolirpar	13602	10743
Gonali	14245	11858
Maidam	11244	9981
Sarkarpara	10958	9683
Uttar Baladia	10946	9526
Patail	13000	9028
Chalakchar	18862	13032
Chengain	22268	17182
Kadam Deuli	15848	11857
Shahata	16492	10869
Banbibitala	12806	9067
Chunar	10514	7688
Jabakhali	11872	9082
Kalbari	11690	9024
Lalukhali	19327	14142

Source: CEGIS Field Survey, 2022

3.6 Housing Condition and Housing Tenancy

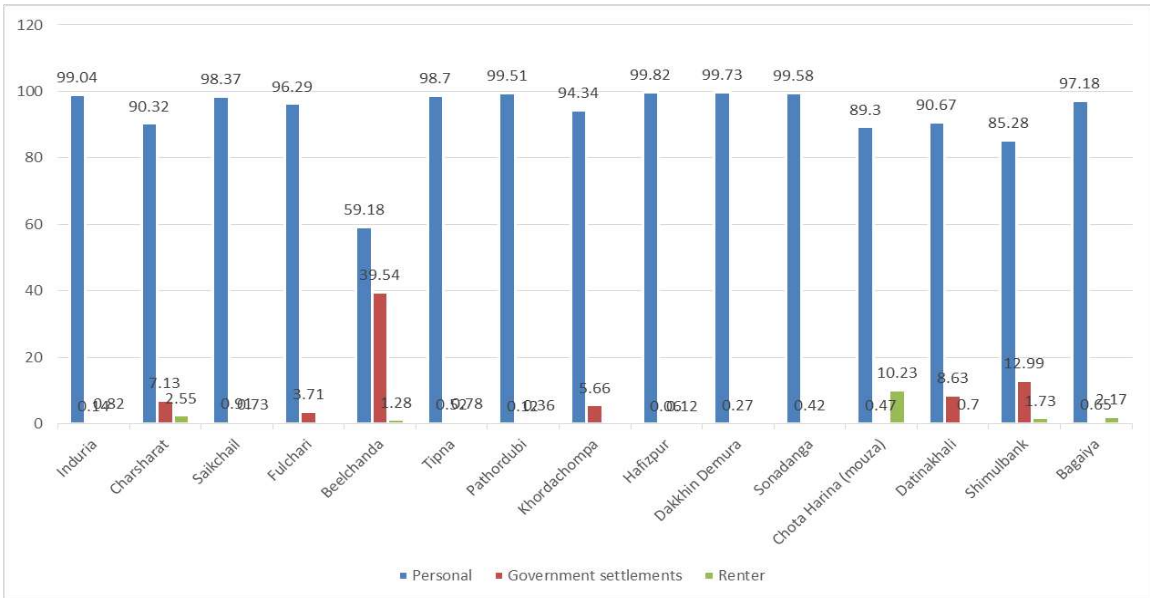
It can be noted from the average housing condition in the pilot villages that most houses there are *kutcha*. In Fulchori, about 95.5% of the houses are *kutcha*. On the other hand, in Tipna and Hafizpur, more than 30% of houses are semi-*pucca*. The following **Figure 3.2** shows the housing condition in the pilot villages.



Source: CEGIS Field Survey, 2022

Figure 3.2: Housing condition in pilot villages

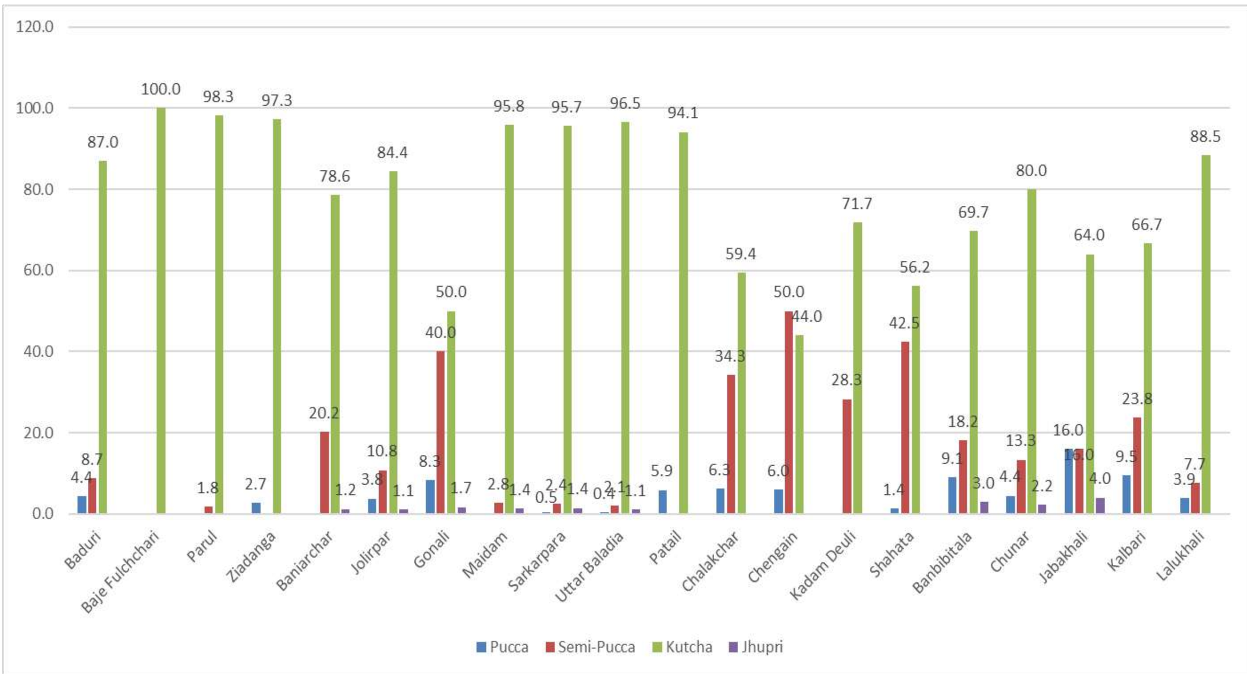
Very few houses are rented, and some are government settlements. However, most of the houses are owned by the HHs. In Beeelchanda village, 39.54% of the houses owned by the poor people are government-provided. The following **Figure 3.3** presents the housing tenancy in the pilot villages.



Source: CEGIS Field Survey, 2022

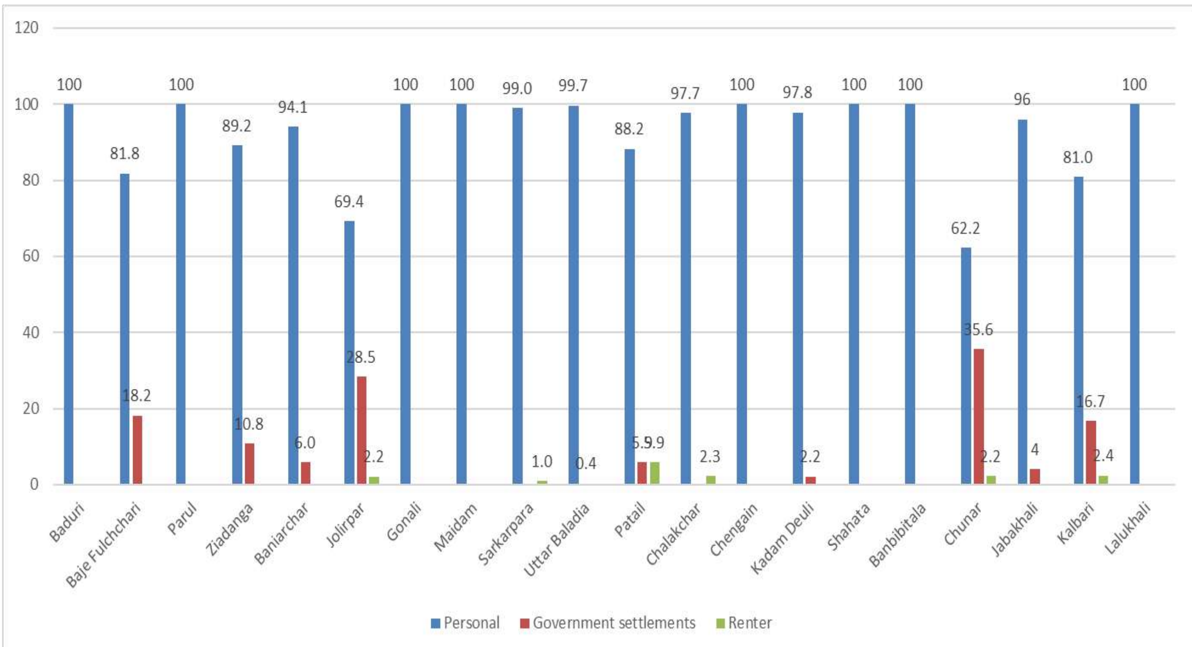
Figure 3.3: Housing tenancy in pilot villages

The housing conditions and tenancy in the sample villages are similar to that in the pilot villages. The majority of the houses are *kutcha* and owned by the HHs. The following **Figure 3.4** and **Figure 3.5** show the housing condition and tenancy in the sample villages.



Source: CEGIS Field Survey, 2022

Figure 3.4: Housing condition in sample villages

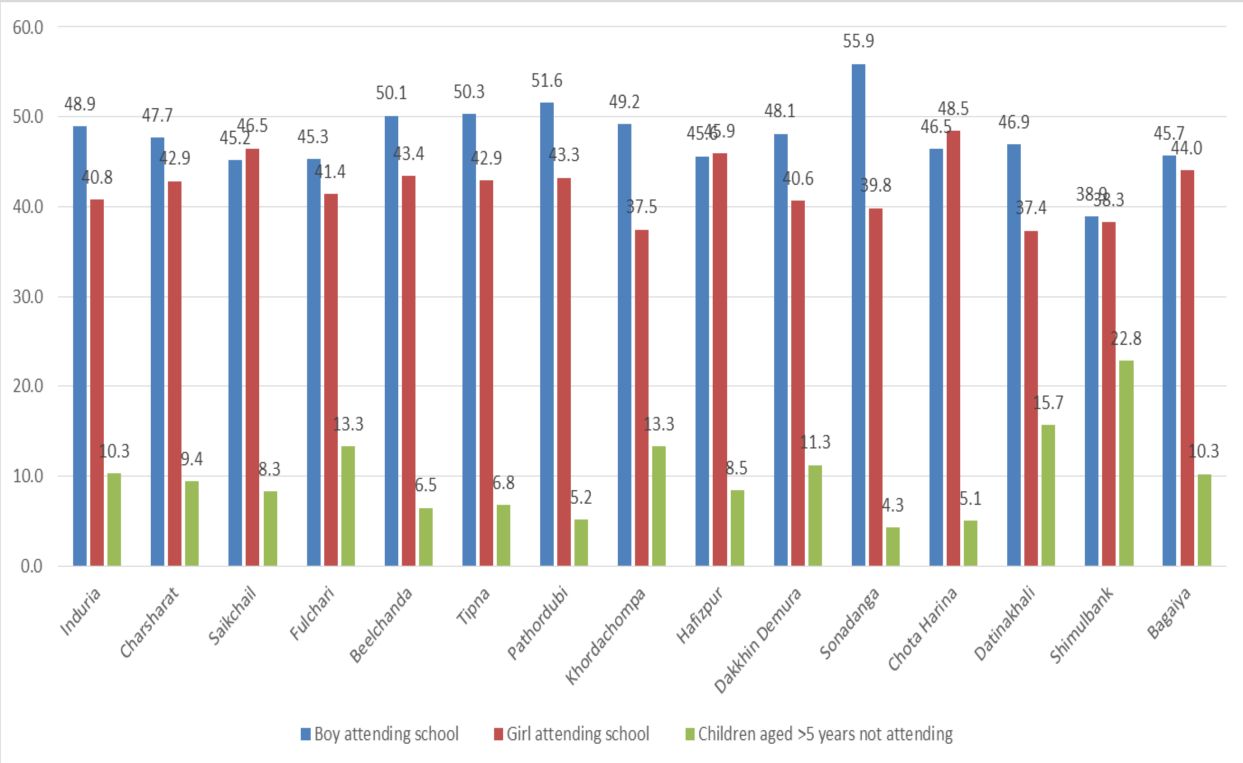


Source: CEGIS Field Survey, 2022

Figure 3.5: Housing tenancy in sample villages

3.7 Status of School-Going Children

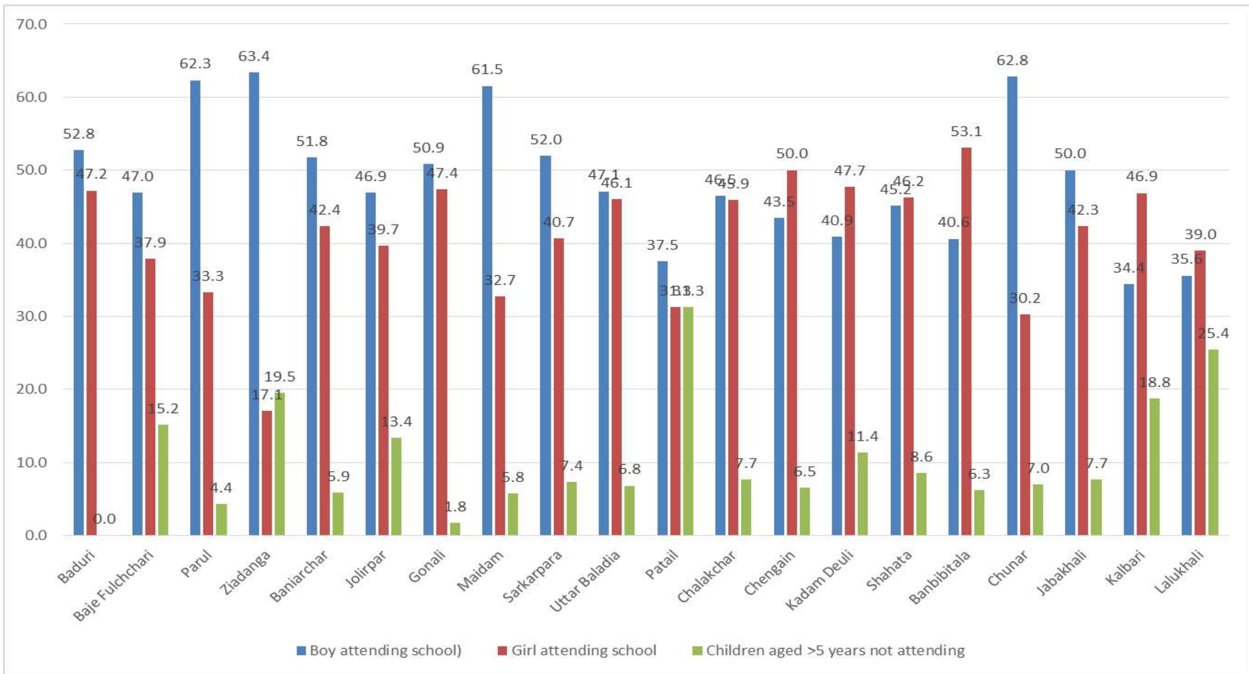
This study analyzes the status of school-going children of the ages of >5 years. The survey results confirm that nearly 50% of boys and girls attend school. The ratio of school-going boys is a little higher than that of girls in every pilot village except in Saikchail, Hafizpur, and Chota Harina. In these villages, the percentage of school attendance of girls is higher than that of boys. However, the variation in percentage points between girls and boys is minimal, while the percentage of children not attending school is comparatively lower. In this respect, the rates of children not attending school are relatively higher in Shimulbank, Datinakhali, Khordachompa, and Fulchari villages than in the other pilot villages.



Source: CEGIS Field Survey, 2022

Figure 3.6: Status of school attendance in pilot villages

On the other hand, the overall scenario of school-attending boys and girls in the sample villages is more or less similar to that of the pilot villages. However, the percentages of school-attending boys are much higher than girls in Parul, Ziadanga, Maidam, and Chunar villages than that in other sample villages. School attendance of girls is relatively much higher than boys in Kalbari, Banbibitala, Kadam Deuli, and Chengain sample villages. The following **Figure 3.7** presents the school attendance ratio of the children in the sample villages.

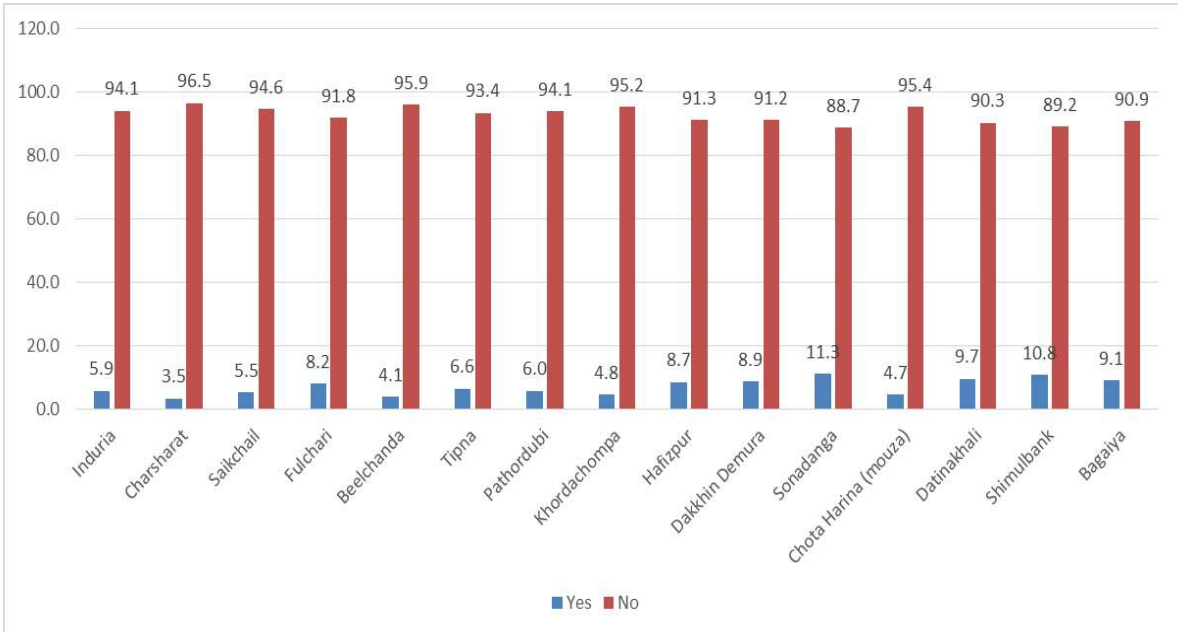


Source: CEGIS Field Survey, 2022

Figure 3.7: Status of school attendance in sample villages

3.8 Disability

Figure 3.8 shows that 3.5% to 11.3% of the HHs in the pilot villages have people with disabilities. The highest number of HHs with disabled members are seen in Sonadanga (11.3%) and Shimulbank (10.8%) villages. However on average, more than 90% of the HHs in the pilot villages do not have any family members with disabilities.



Source: CEGIS Field Survey, 2022

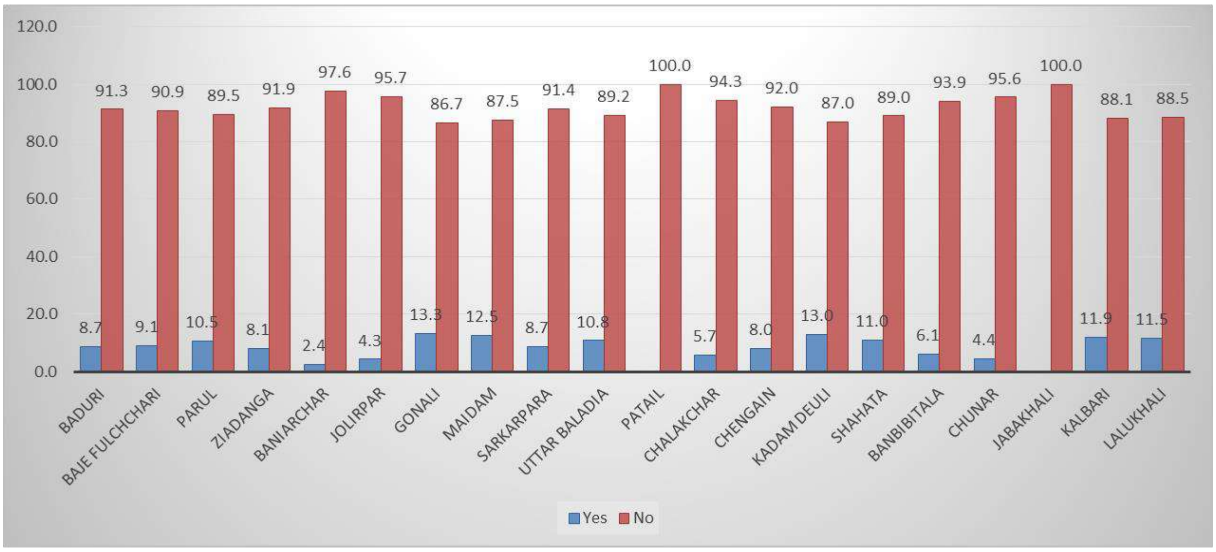
Figure 3.8: Status of people with disabilities in pilot villages

The study identified different disabilities in the studied villages and revealed that the percentage of physical disabilities was higher than any other type of disabilities. The following table (**Table 3.11**) presents the disability types found in the pilot villages.

Table 3.11: Types of disability in pilot villages

Village	Autism	Physical	Mental	Visual impairment	Speech impairment	intellectual impairment	Hearing impairment	Hearing-Visual impairment	Cerebral palsy	Down syndrome	Multiple disabilities	Others
Induria	2.3	34.9	4.7	7.0	23.3	11.6				2.3	14.0	
Charsharat	3.0	24.2	21.2	9.1	12.1	9.1	6.1		3.0	3.0	9.1	
Saikchail	5.6	34.4	14.4	13.3	14.4	5.6	3.3	1.1	3.3		4.4	
Fulchari	3.2	61.3	6.5	9.7	9.7	3.2			3.2		3.2	
Beelchanda		43.8	12.5	12.5	6.3	6.3		12.5		6.3		
Tipna	2.0	43.1	7.8	7.8	7.8	11.8	7.8				5.9	5.9
Pathordubi	2.7	48.3	16.3	8.8	9.5	4.1	5.4	2.0		1.4	1.4	
Khordachompa		40.9	22.7	9.1	9.1		18.2					
Hafizpur	2.8	30.1	7.0	17.5	14.7	8.4	11.2		0.7	1.4	2.1	4.2
Dakkhin Demura		36.4	6.1	9.1	18.2	24.2	6.1					
Sonadanga		41.3	8.8	16.3	3.8	7.5	20.0				2.5	
Chota Harina	20.0	50.0		10.0	10.0					10.0		
Datinakhali	7.3	49.1	5.5	14.6	10.9	5.5	7.3					
Shimulbank	12.0	40.0	12.0	14.0	8.0	4.0	4.0			2.0	4.0	
Bagaiya	2.4	34.5	11.9	23.8	8.3	8.3	3.6	1.2			6.0	

On the other hand, the scenario of disabled members in the HHs of the sample villages is similar to that of the pilot villages. Most of the HHs have no disabled members. In fact, in Patail and Jabakhali villages, there were no disabled persons at all. The following figure (**Figure 3.9**) shows the percentage of disabled persons in the sample villages.



Source: CEGIS Field Survey, 2022

Figure 3.9: Scenario of people with disabilities in sample villages

Physical disability is most common in the sample villages. Mental disability and visual impairment are also noticeable in the sample villages. The following table (**Table 3.12**) shows the types of disability in the sample villages.

Table 3.12: Types of disability in sample villages

Village	Autism	Physical	Mental	Visual impairment	Speech impairment	Intellectual impairment	Hearing impairment	Down syndrome	Multiple disabilities
Baduri				100.0					
Baje Fulchchari		40.0	20.0	20.0			20.0		
Parul	33.3		16.7	33.3	16.7				
Ziadanga		66.7		33.3					
Baniarchar		50.0	50.0						
Jolirpar		50.0		12.5	25.0	12.5			
Gonali		37.5		50.0	12.5				
Maidam		33.3	11.1		11.1	22.2		22.2	
Sarkarpara	5.6	33.3		11.1	11.1	16.7	11.1	5.6	5.6
Uttar Baladia		32.3	19.4	19.4	9.7		9.7	3.2	6.5
Chalakchar		80.0		10.0	10.0				
Chengain	25.0	25.0			50.0				
Kadam Deuli		50.0	16.7	16.7		16.7			
Shahata		37.5	12.5	37.5			12.5		
Banbibitala		50.0		50.0					
Chunar		50.0				50.0			
Kalbari	20.0	40.0	20.0				20.0		
Lalukhali		66.7	33.3						

4. Household Water Supply, Sanitation, and Hygiene Practices

4.1 Introduction

This section covers water availability, accessibility, water sources, household water treatment, water point maintenance, water quality, ownership of water sources, and problems faced in access to and collection of water in the project areas and also different practices (collection of water, water use for various purposes, expenditure for water, etc.) by the households. People's hygiene depends mostly on having necessary water supply for drinking, cooking, domestic work, and personal hygiene.

4.2 Water Supply

4.2.1 *Sources of Drinking Water (Pilot Villages)*

Hafizpur village

The baseline survey result shows that the primary source of drinking water for 72.8% of households in this village is personal tube well. About 13.9% of households collect drinking water from private motorized tube well; 11.7% from neighbor's tube well and 0.8% from neighbor's piped water supply. The remaining 0.8 % collect drinking water from other sources such as, government tube well and piped water supply (**Figure 4.1**).

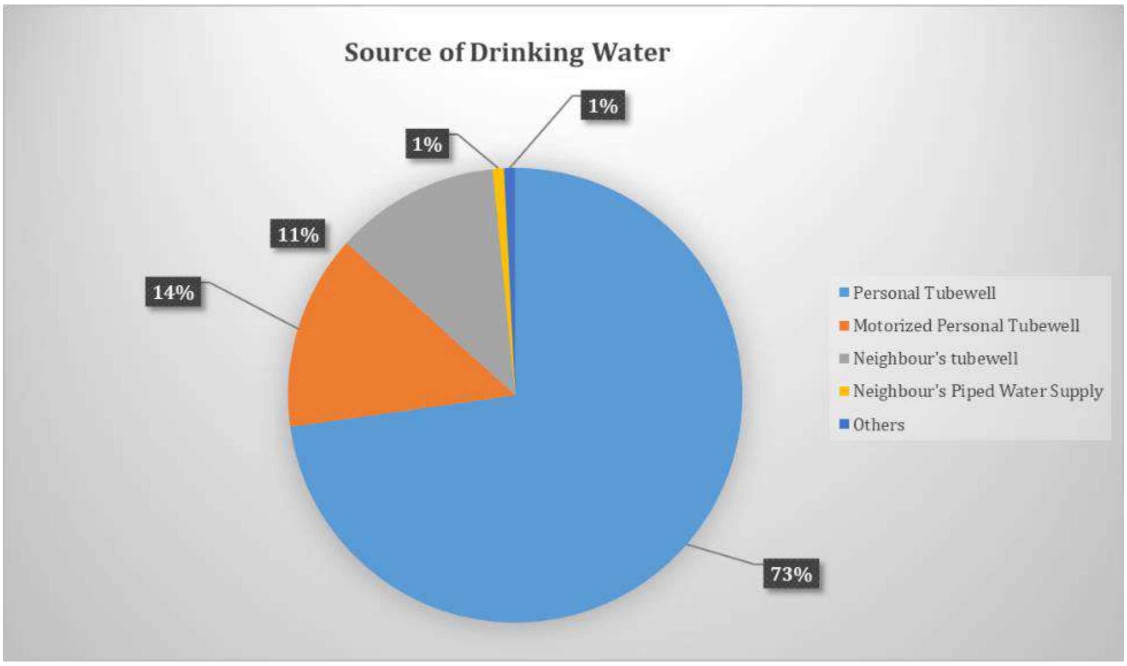


Figure 4.1: Main source of drinking water in Hafizpur village, Narsingdi

Saikchail village

According to the baseline survey results, private tube well is the primary source of drinking water for 50.7% of homes. Personal motorized tube well provides drinking water to about 11.6% of households, tube well of neighbors to 27.1% of households; government tube well to 8.3% of households; and piped water supply (neighbor's) to 1.8% of households. Other sources provide drinking water to the remaining 0.7% of households (**Figure 4.2**).

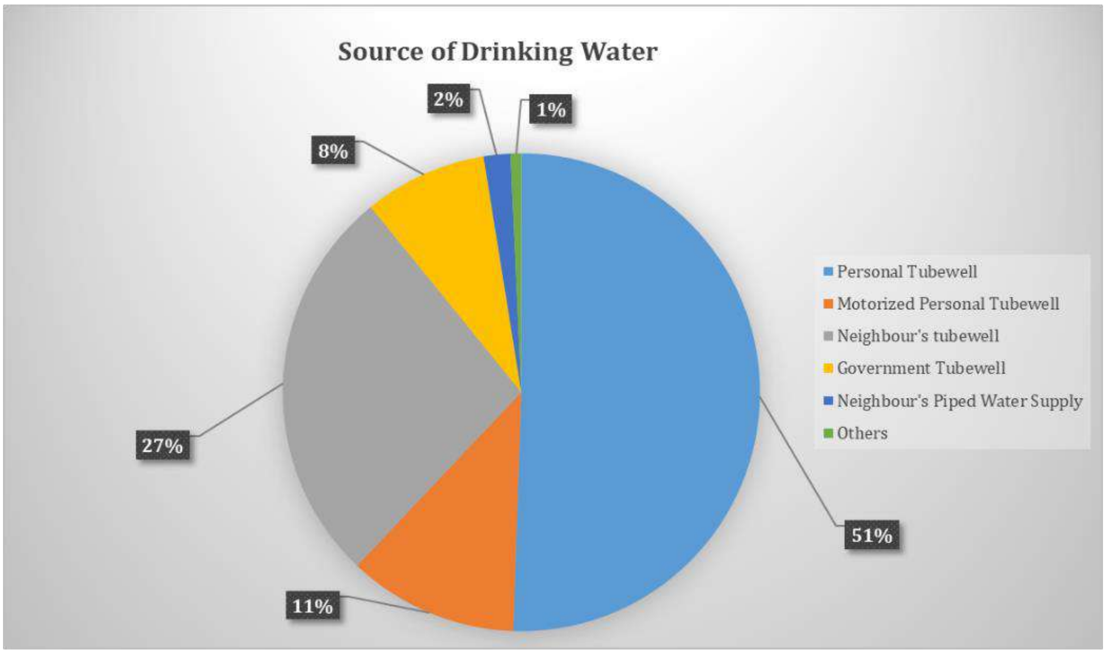


Figure 4.2: Main source of drinking water in Saikchail village, Comilla

Charsharat village

The baseline survey result shows that the primary source of drinking water for 35.9% of households is neighbor's tube well. Of about 30.3% of households collect drinking water from government tube well, 21.1% from personal tube well, and 4.6% from personal motorized tube well. The remaining sources are community tube well, piped water supply (neighbor's), NGO/project, and others (**Figure 4.3**).

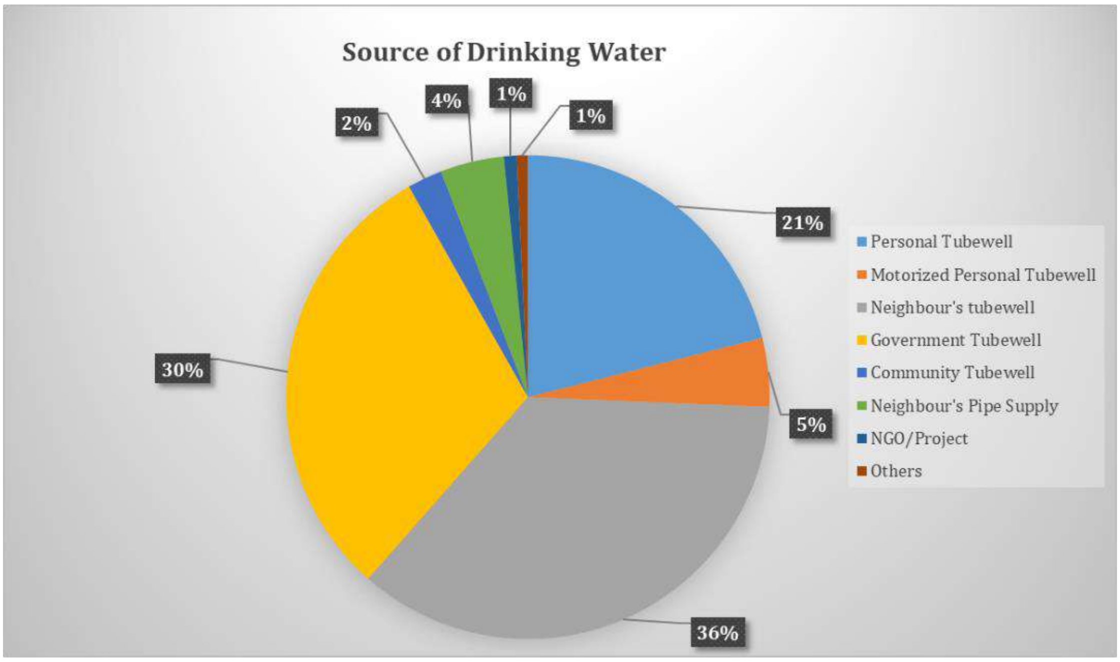


Figure 4.3: Main source of drinking water in Charsharat village, Mirsharai

Chota Harina village

The baseline survey results show that 8.38% of households get their drinking water mainly from the tube well. About 40.46% of families receive their drinking water from a ring well and 5.58% from a hand-dug well, while 16.74% of households get their drinking water from a pond or river, and 21.4% from a spring. The remaining households get their drinking water from private projects/ponds (3.72%) and other sources (3.72%), respectively (**Figure 4.4**).

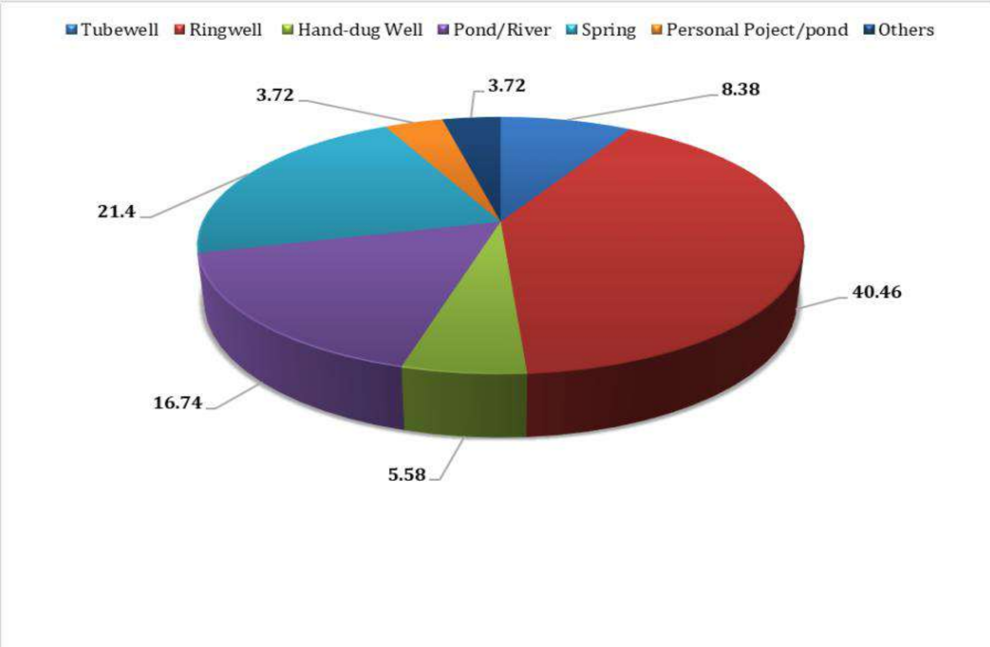


Figure 4.4: Main source of drinking water in Chota Harina village, Rangamati

Bagaiya village

According to the baseline survey findings, tubewells owned by neighbors provide drinking water to 53.9% of households. About 29.6% of families acquire their drinking water from a personal tube well and 8.1% from a personal motorized tube well. The study results also show that 2.8% of households get their drinking water from a pond/river, and 2.8% of families get theirs from a spring. The remaining households get their drinking water from a government tube well (2.0%), neighbor's piped water supply (2.3%), rainwater (1%), and personal projects (0.1%), respectively (**Figure 4.5**).

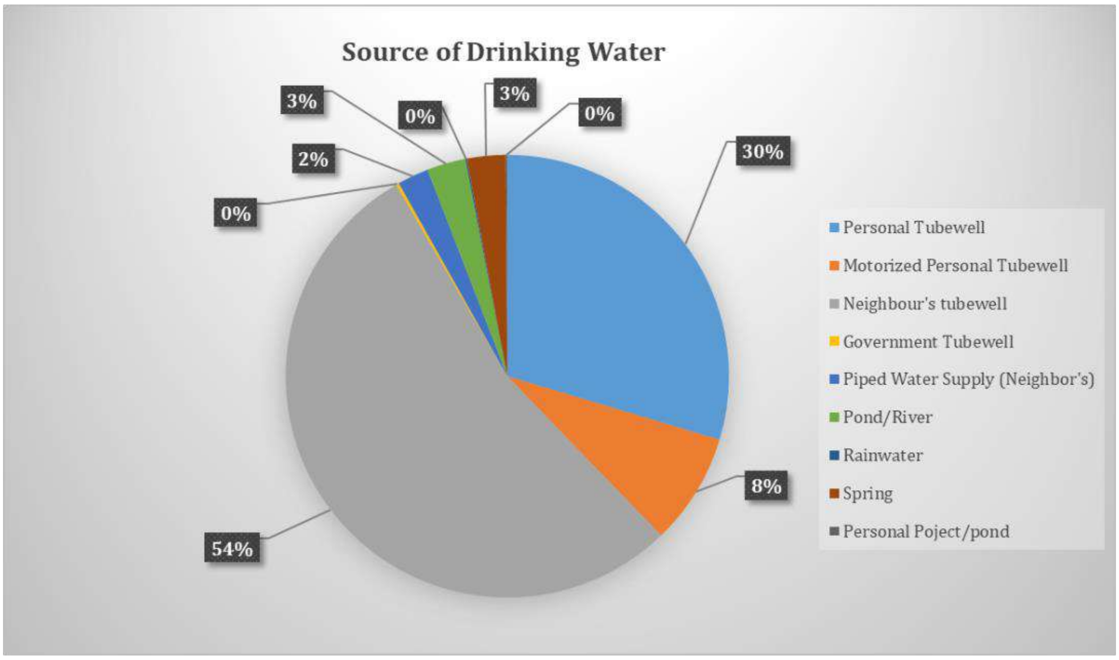


Figure 4.5: Main source of drinking water in Bagaiya village, Sylhet

Shimulbank village

The baseline survey result shows that the primary source of drinking water for 69.7% of households is the government tube well. About 10.2% of households collect drinking water from neighbors' tube wells and 11.0% from their own tube wells. The remaining HHs use community tube wells, personal motorized tube well, piped water supply (neighbor's), rainwater, personal project, NGO/project, and other sources (**Figure 4.6**).

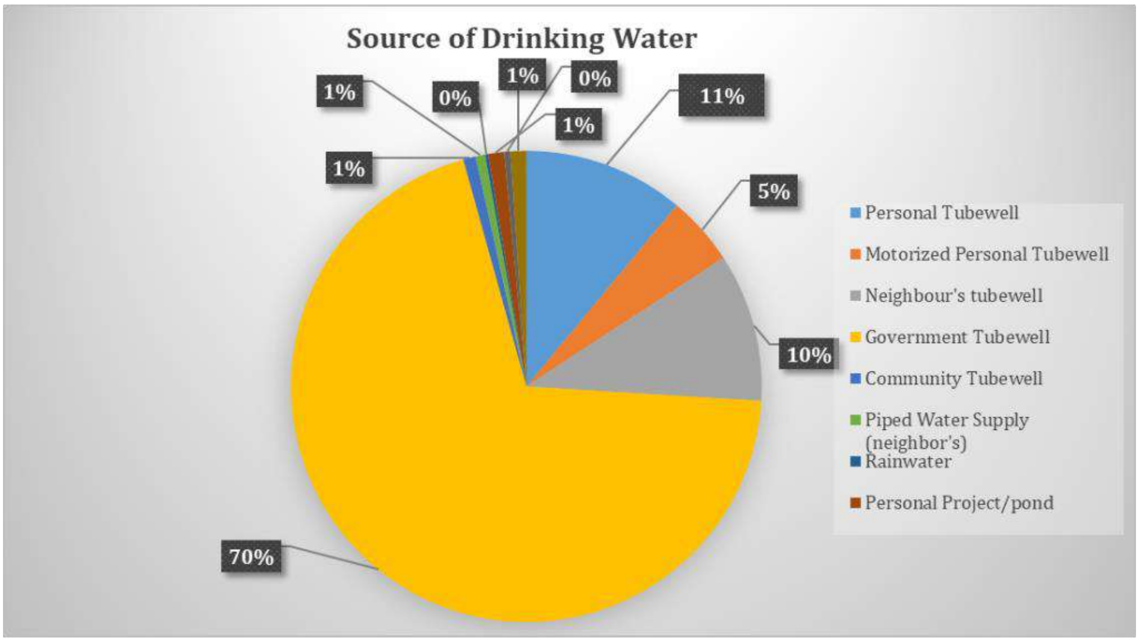


Figure 4.6: Main source of drinking water in Shimulbank village, Sunamganj

Dakkhin Demura village

The baseline survey results show that 45.6% of households get their drinking water mainly from personal tube wells. The remaining households get their drinking water from community tube wells, piped water supply, and other sources (**Figure 4.7**). About 40.5% of families get their drinking water from a neighbor's tube well, 4.6% from personal motorized tube wells, 4.3% from a government tube well, and 2.7%of households get their drinking water from piped water supply (neighbor's).

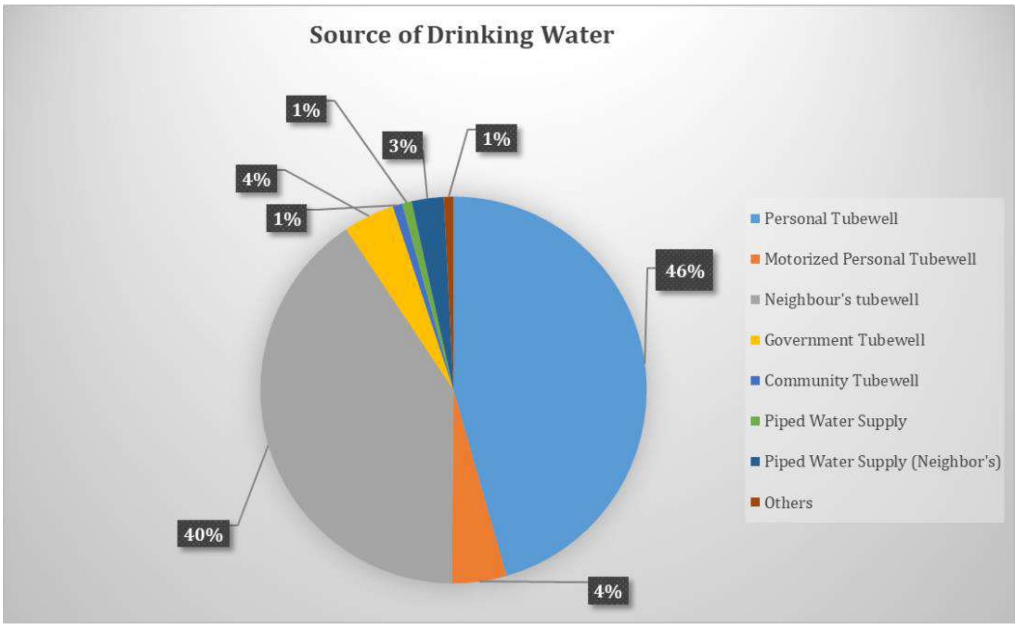


Figure 4.7: Main source of drinking water in Dakkhin Demura village, Netrokona

Beel Chanda village

According to the baseline survey, privately owned tubewells provide drinking water to 54.6% of households. About 28.3% of families acquire drinking water from neighbors, 5.9% from personal motorized tube well, and 3.6% from government tube well. The remaining households get their drinking water from a community tube well, piped water supply (neighbor's), pond/river, personal projects, and NGO, respectively (**Figure 4.8**).

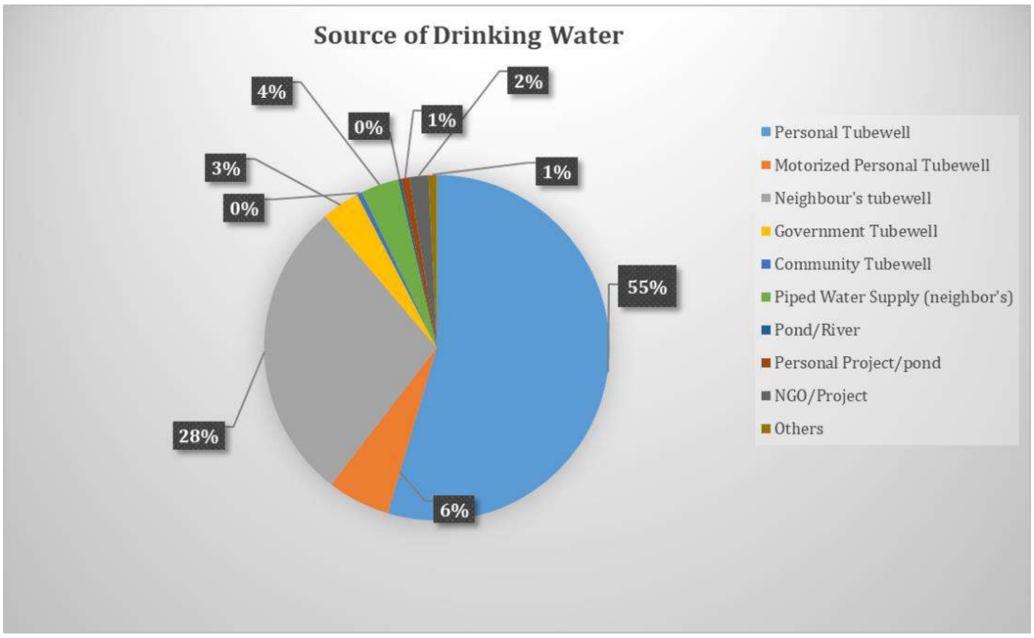


Figure 4.8: Main source of drinking water in Beel Chanda village, Gopalganj

Induria village

According to the baseline survey findings, tube wells owned by neighbors provide drinking water to 47.5% of households. About 29.8% of families acquire their drinking water from government tube well, 15.8% from personal tube well, and 4.9% from community tube well. The remaining households get their drinking water from NGO/project, personal motorized tube well, piped water supply (neighbor's), pond/river, personal project, and NGO, respectively (**Figure 4.9**).

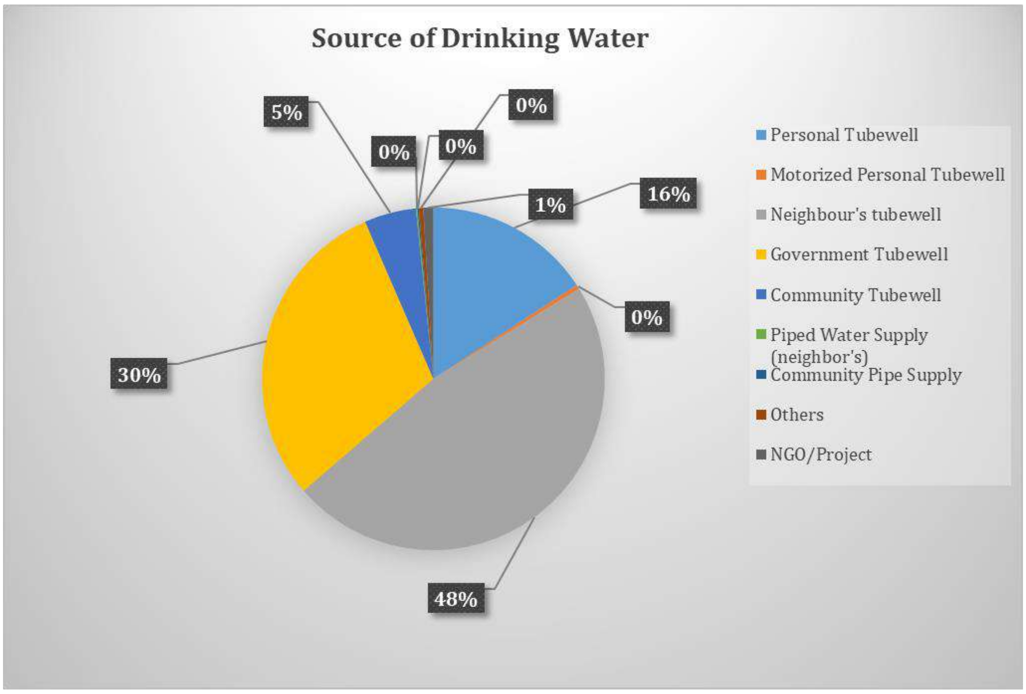


Figure 4.9: Main source of drinking water in Induria village, Barishal

Tipna village

The baseline survey result shows that the primary source of drinking water for 49.4% of households is government tube well. About 23.2% of household collect drinking water from a neighbor's tube well, 19.4% from a personal tube well, 3.9% from a community tube well, and the remaining 4.2 % from other sources (**Figure 4.10**).

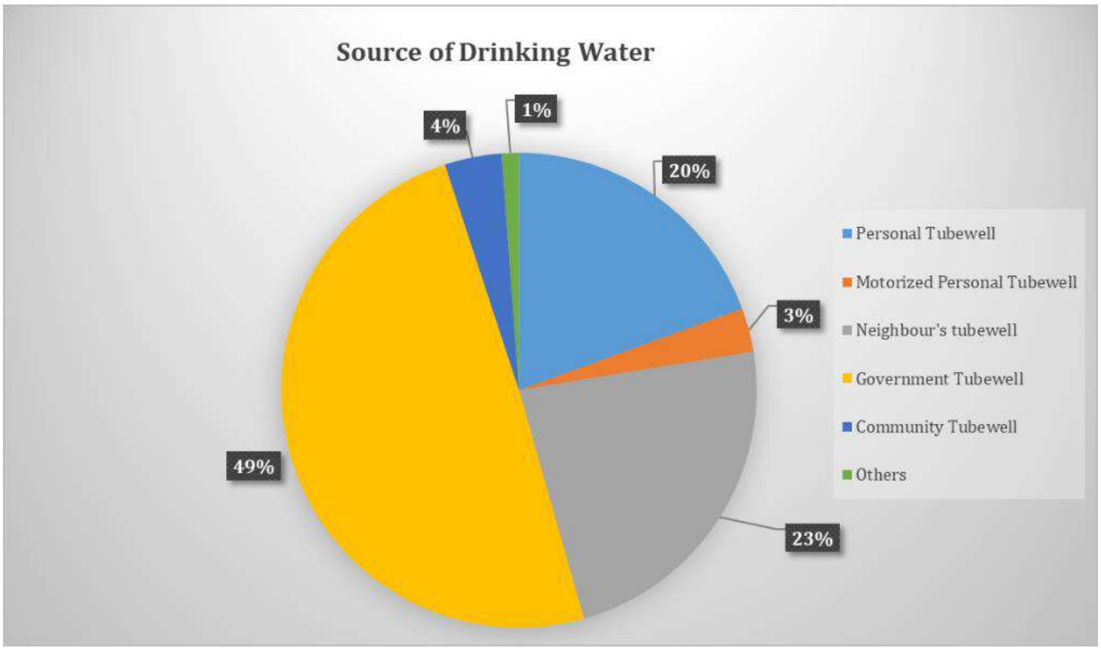


Figure 4.10: Main source of drinking water in Tipna village, Khulna

Datinakhali village

Rainwater provides drinking water to about 32.1% of households, neighbors provide to 8.6% of households; ponds or rivers to 1.9% of households; and personal tube well to 1.2% of households. According to the baseline survey results, NGOs & projects are the primary source of drinking water for 37.1% of homes. The remaining 18.7% get their drinking water from other sources including government tube well, community tube well, or from water sellers. (**Figure 4.11**).

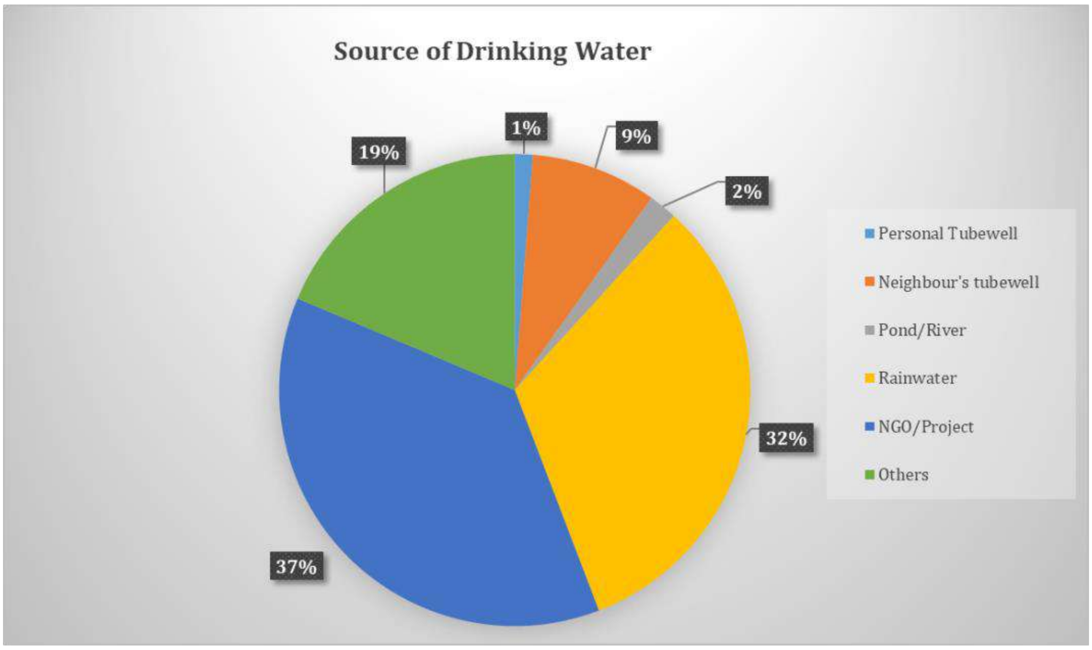


Figure 4.11: Main source of drinking water in Datinakhali village, Satkhira

SonadangaVillage

The baseline survey result shows that the primary source of drinking water for 35.1% of households is personal motorized tube well. About 29.2% of households collect drinking water from personal tube wells; 23.6% from neighbor's tube wells and 5.8% from neighbor's piped water supply. The remaining 6.4 % of households collect drinking water from others such as, government tube well and community tube well (**Figure 4.12**).

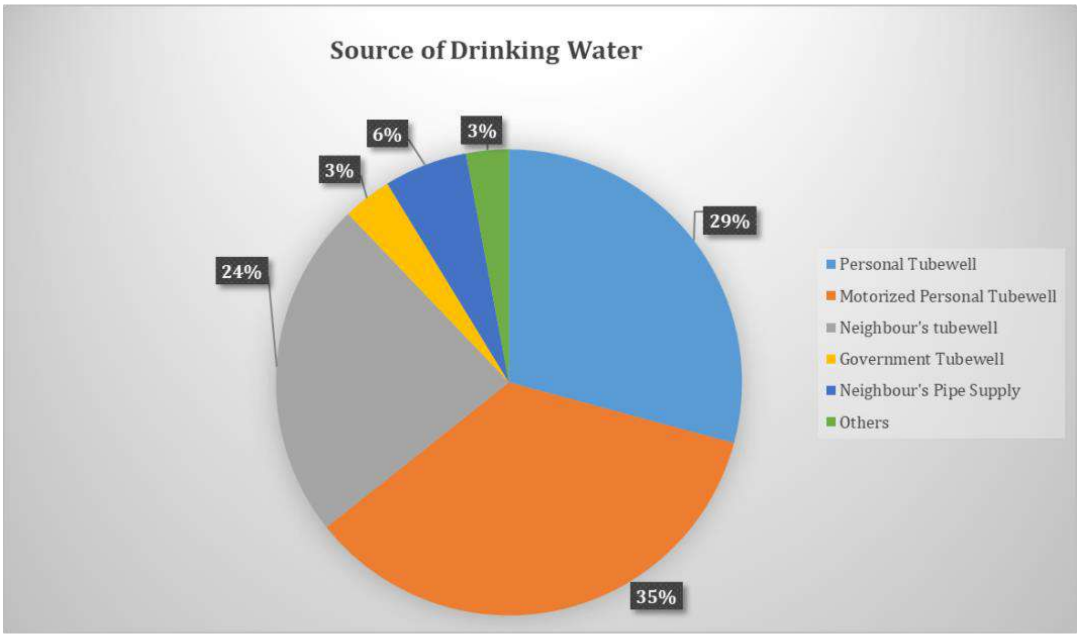


Figure 4.12: Main source of drinking water in Sonadanga village, Rajshahi

Khordachompa village

According to the baseline survey results, personal motorized tubewells are the primary source of drinking water for 27.5% of homes. Community-owned motorized tube well provides drinking water to about 21.8% of households, piped supply to 14.4% of households; neighbor's tube well to 11.8% of households; personal tube well to 8.1% of households, and community piped water supply to 5.23% of households. The remaining 11.3% get their drinking water from other sources (**Figure 4.13**).

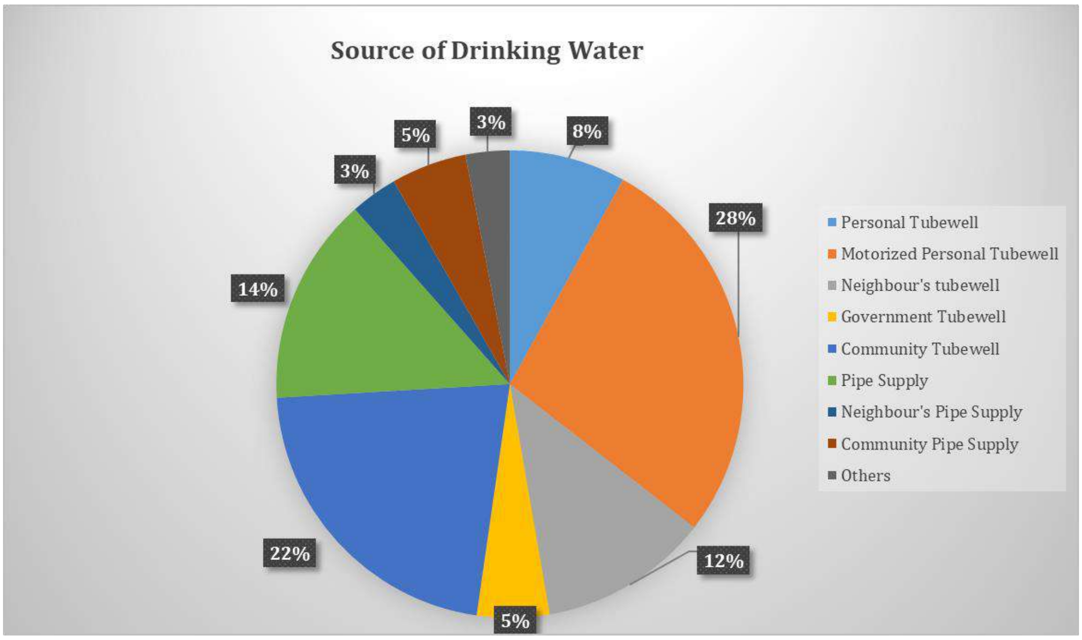


Figure 4.13: Main source of drinking water in Khordachompa village, Naogaon

Fulchari village

The baseline survey result shows that the primary source of drinking water for 66.3% of households is personal tube well. About 28.6% of households collect drinking water from neighbor's tube well; and 3.7% from the neighbor's piped supply. The remaining 1.3% get their drinking water from other sources (**Figure 414**).

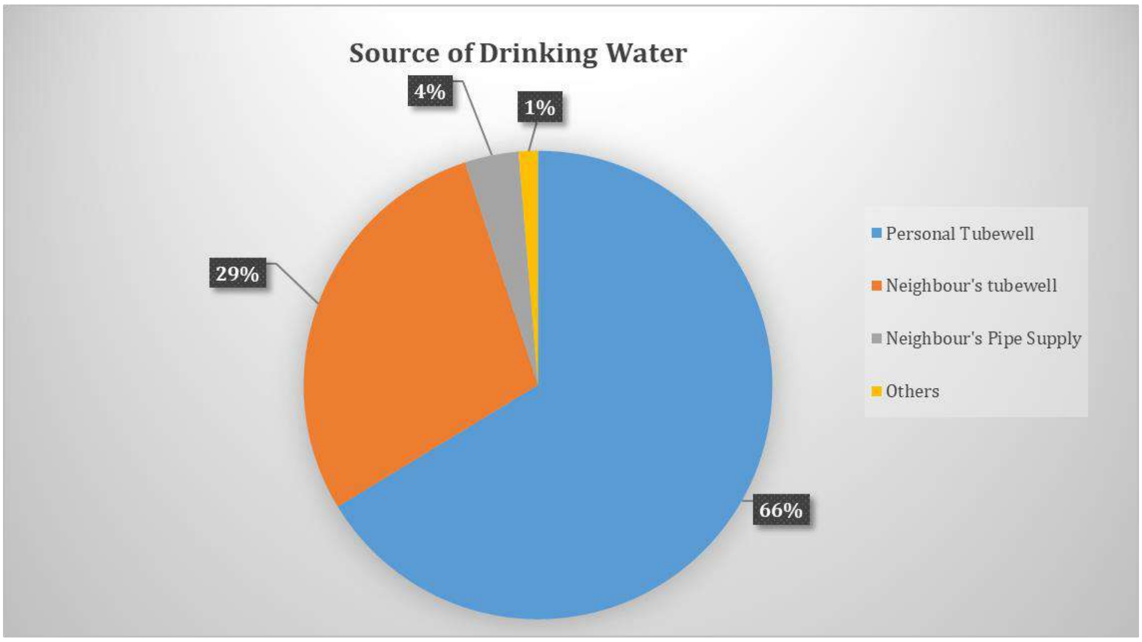


Figure 4.14: Main source of drinking water in Fulchari village, Gaibandha

Pathordubi village

The baseline survey result shows that the primary source of drinking water for 64.9% of households is personal tube well. About 21.1% of households collect drinking water from neighbor's tube well, 11.8% from personal motorized tube well, and 1.9% from a neighbor's piped water supply. The remaining 0.3% get their drinking water from other sources (**Figure 4.15**).

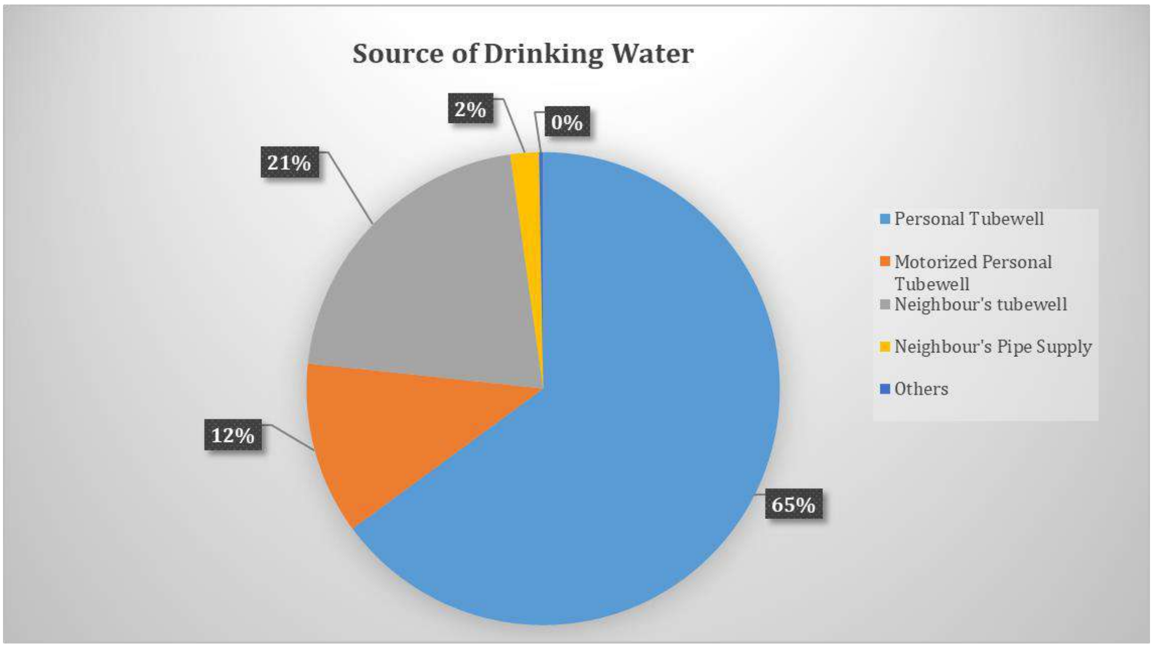


Figure 4.15: Main source of drinking water in Pathordubi village, Kurigram

4.2.2 *Sources of Drinking Water (Sample Villages)*

The baseline data show that the major drinking water sources in the sample villages are personal tube well, personal motorized tube well, neighbor's tube well, and government tube well. In sample villages in the Buri-Goalini union of Shyamnagar upazila under Satkhira district, most households receive drinking water from rainwater harvesting and other sources such as; NGOs, projects, and mosque tube well. The sample village-wise primary drinking water sources are presented in **Table 4.1-Table 4.10**.

Table 4.1: Main source of drinking water in sample villages, Narsingdi district

Village	Source of Drinking Water							
	Personal TW		Motorized Personal TW		Neighbor's TW		Piped Water Supply	
	number	%	n	%	n	%	n	%
Chalakchar	138	78.86	26	14.86	10	5.71	1	0.57
Chengain	38	76	10	20	2	4	-	-

Table 4.2: Main source of drinking water in sample village, Sunamganj district

Village	Source of Drinking Water							
	Personal TW		Motorized Personal TW		Neighbor's TW		Government TW	
	No.	%	No.	%	No.	%	No.	%
Lalukhali	3	11.5	1	3.85	5	19.23	17	65.38

Table 4.3: Main source of drinking water in sample villages, Netrokona district

Village	Source of Drinking Water													
	Personal TW		Motorized Personal TW		Neighbor's TW		Government TW		Pipe Supply		Neighbor's Piped Supply		Community Piped Supply	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Kadam Deuli	6	13.04	11	23.91	17	36.96	3	6.52	1	2.17	7	15.22	1	2.17
Shahata	32	43.84	5	6.85	20	27.4	16	21.92	-	-	-	-	-	-

Table 4.4: Main source of drinking water in sample villages, Gopalganj district

Village	Source of Drinking Water																	
	Personal TW		Motorized Personal TW		Neighbor's TW		Government TW		Community TW		Neighbor's Pipe Supply		Personal Project/pond		NGO/ Project		Others	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Baniarchar	27	32.1	1	1.19	40	47.6	-	-	6	7.14	6	7.14	0	0	0	0	4	4.76
Jolirpar	67	36	12	6.45	84	45.2	9	4.84	4	2.15	0	0	2	1.08	2	1.08	6	3.23

Table 4.5: Main source of drinking water in sample village, Barishal district

Village	Source of Drinking Water					
	Personal TW		Neighbor's TW		Government TW	
	No.	%	No.	%	No.	%
Baduri	5	21.74	12	52.17	6	26.09

Table 4.6: Main source of drinking water in sample village, Khulna district

Village	Source of Drinking Water							
	Personal TW		Neighbor's TW		Government TW		Community TW	
	No.	%	No.	%	No.	%	No.	%
Gonali	20	33.33	17	28.33	21	35	2	3.33

Table 4.7: Main source of drinking water in sample villages, Satkhira district

Village	Sources of Drinking Water													
	Personal TW		Neighbor's TW		Government TW		Piped Supply		Rainwater		NGO/Project		Others	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Banbibitala	1	3.03	4	12.12	2	6.06	1	3.03	10	30.3	0	0	15	45.4
Chunar	0	0	0	0	0	0	0	0	27	60	0	0	18	40
Jabakhali	0	0	0	0	0	0	0	0	14	56	1	4	10	40
Kalbari	0	0	0	0	0	0	0	0	13	30.95	0	0	29	69

Table 4.8: Main source of drinking water in sample village, Naogaon district

Village	Sources of Drinking Water													
	Motorized Personal TW		Neighbor's TW		Government TW		Community TW		Pipe Supply		Neighbor's Pipe Supply		Others	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Patail	2	11.76	2	11.76	4	23.53	2	11.76	2	11.76	1	5.88	4	23.53

Table 4.9: Main source of drinking water in sample villages, Gaibandga district

Village	Sources of Drinking Water			
	Personal TW		Neighbor's Pipe Supply	
	No.	%	No.	%
Baje Fulchchari	36	65.45	0	0
Parul	45	78.95	1	1.75
Ziadanga	23	62.16	0	0

Table 4.10: Main source of drinking water in sample villages, Kurigram district

Village	Sources of Drinking Water									
	Personal TW		Personal Motorized TW		Neighbor's TW		Government TW		Neighbor's Piped Supply	
	No.	%	No.	%	No.	%	No.	%	No.	%
Maidam	51	70.83	14	19.44	6	8.33	1	1.39	0	0
Sarkarpara	174	83.65	6	2.88	24	11.54	1	0.48	3	1.44
Uttar Baladia	247	86.36	10	3.5	26	9.09	0	0	3	1.05

4.2.3 *Functionality and Accessibility of Water*

Depth of Tube wells

Pilot Village

The baseline study revealed that 68.31% of the surveyed population used tube wells (0-150 ft.) and among them the highest percentage was seen in Fulchari (100%). Only 14.66% of those surveyed used tube wells (600–900 feet deep), with Tipna having the highest percentage (53.62%) among them. The highest percentage of tube well users (65.83%), who comprised about 8.36% of household respondents, were found to reside in Shimulbank. **Table 4.11** presents the details.

Table 4.11: Depth of tube wells (pilot village)

(1m=3.28ft)

Village	0- 150 ft.		150-300 ft.		300- 600 ft.		600-900 ft.		>900 ft.		Total
	n	%	n	%	N	%	n	%	n	%	n
Induria	58	15.55	3	0.8	8	2.14	200	53.62	104	27.88	373
Charsharat	37	6.75	16	2.92	291	53.1	177	32.3	27	4.93	548
Saikchail	860	73.82	115	9.87	60	5.15	127	10.9	3	0.26	1165
Fulchari	252	100	-	-	-	-	-	-	-	-	252
Beelchanda	32	12.65	162	64.03	37	14.62	21	8.3	1	0.4	253
Tipna	3	0.51	10	1.71	15	2.57	538	92.12	18	3.08	584
Pathordubi	1840	96.89	59	3.11	-	-	-	-	-	-	1899
Khordachompa	223	78.8	60	21.2	-	-	-	-	-	-	283
Hafizpur	1338	93.57	78	5.45	10	0.7	3	0.21	1	0.07	1430
Dakkhin Demura	170	82.52	16	7.77	3	1.46	16	7.77	1	0.49	206
Sonadanga	455	93.43	31	6.37	-	-	-	-	1	0.21	487
Chota Harina (mouza)	45	80.36	2	3.57	7	12.5	1	1.79	1	1.79	56

Village	0- 150 ft.		150-300 ft.		300- 600 ft.		600-900 ft.		>900 ft.		Total
	n	%	n	%	N	%	n	%	n	%	n
Induria	58	15.55	3	0.8	8	2.14	200	53.62	104	27.88	373
Datinakhali	3	30	7	70	-	-	-	-	-	-	10
Shimulbank	2	0.5	1	0.25	262	65.83	133	33.42	-	-	398
Bagaiya	348	99.43	2	0.57	-	-	-	-	-	-	350
Total	**5666**	**68.31**	**562**	**6.78**	**693**	**8.36**	**1216**	**14.66**	**157**	**1.89**	**8294**

Sample Village

The baseline study found that 78.28% of the surveyed population used tube wells (0-150 ft.), and among them the highest percentage was seen in Baje Fulchari, Parul, Uttar Baladia, Banbibitala, and Patail. Only 9.32% of those surveyed used tube wells (150-300 feet deep), with Jolirpar having the highest percentage (61.96%) among them. The biggest percentage of tube well users (100%), who comprised about 7.24% of household respondents, were found to reside in Gonali. **Table 4.12** presents the details.

Table 4.12: Depth of tube well (sample villages)

(1m=3.28ft)

Village	0- 150 ft.		150-300 ft.		300- 600 ft.		600-900 ft.		>900 ft.		Total
	n	%	n	%	n	%	n	%	n	%	n
Baduri	4	36.36	0	0	0	0	2	18.18	5	45.45	11
Baje Fulchchari	36	100	0	0	0	0	0	0	0	0	36
Parul	45	100	0	0	0	0	0	0	0	0	45
Ziadanga	22	95.65	0	0	1	4.35	0	0	0	0	23
Baniarchar	1	2.94	18	52.94	7	20.59	8	23.53	0	0	34
Jolirpar	10	10.87	57	61.96	12	13.04	12	13.04	1	1.09	92
Gonali	0	0	0	0	0	0	43	100	0	0	43
Maidam	64	96.97	2	3.03	0	0	0	0	0	0	66
Sarkarpara	180	99.45	1	0.55	0	0	0	0	0	0	181
Uttar Baladia	257	100	0	0	0	0	0	0	0	0	257
Patail	8	100	0	0	0	0	0	0	0	0	8
Chalakchar	158	96.34	6	3.66	0	0	0	0	0	0	164
Chengain	46	95.83	2	4.17	0	0	0	0	0	0	48
Kadam Deuli	5	25	12	60	3	15	0	0	0	0	20
Shahata	26	49.06	5	9.43	1	1.89	11	20.75	10	18.87	53
Banbibitala	3	100	0	0	0	0	0	0	0	0	3
Lalukhali	0	0	0	0	17	80.95	4	19.05	0	0	21
Total	**865**	**78.28**	**103**	**9.32**	**41**	**3.71**	**80**	**7.24**	**16**	**1.45**	**1105**

Distance Between Toilets and Water Sources

The baseline survey inquired whether there was a toilet around the water source and found that in the pilot villages, only 20.42% of the surveyed population said there was and 79.58% said there was none around the water source. **Table 4.13** presents the details.

Table 4.13: Distance between toilets and water sources (Pilot Villages)

Village	Yes		No		Total
	n	%	N	%	N
Induria	86	11.81	642	88.19	728
Charsharat	37	3.94	903	96.06	941
Saikchail	342	20.7	1310	79.3	1652
Fulchari	116	30.77	261	69.23	377
Beelchanda	20	5.1	372	94.9	392
Tipna	167	21.63	605	78.37	772
Pathordubi	606	24.54	1863	75.46	2469
Khordachompa	146	31.81	313	68.19	459
Hafizpur	702	42.65	944	57.35	1646
Dakkhin Demura	74	19.84	299	80.16	373
Sonadanga	214	30.18	495	69.82	709
Chota Harina (mouza)	0	0	215	100	215
Datinakhali	1	0.18	567	99.82	568
Shimulbank	42	9.09	420	90.91	462
Bagaiya	37	4.02	884	95.98	921
Total	**2590**	**20.42**	**10093**	**79.58**	**12684**

The result shows that in the sample villages, only 16.25% of the surveyed population said there was a toilet around the water source, and 83.75% said there was no toilet around the water source. **Table 4.14** presents the details.

Table 4.14: Distance between toilets and water sources (sample village)

Village	Yes		No		Total
	n	%	n	%	n
Baduri	5	21.74	18	78.26	23
Baje Fulchchari	12	21.82	43	78.18	55
Parul	6	10.53	51	89.47	57
Ziadanga	0	0	37	100	37
Baniarchar	1	1.19	83	98.81	84
Jolirpar	11	5.91	175	94.09	186
Gonali	16	26.67	44	73.33	60
Maidam	19	26.39	53	73.61	72
Sarkarpara	24	11.54	184	88.46	208
Uttar Baladia	49	17.13	237	82.87	286
Patail	4	23.53	13	76.47	17
Chalakchar	48	27.43	127	72.57	175
Chengain	22	44	28	56	50
Kadam Deuli	22	47.83	24	52.17	46
Shahata	18	24.66	55	75.34	73
Banbibitala	1	3.03	32	96.97	33
Chunar	0	0	45	100	45
Jabakhali	0	0	25	100	25

Village	Yes		No		Total
	n	%	n	%	n
Kalbari	0	0	42	100	42
Lalukhali	2	7.69	24	92.31	26
Total	**260**	**16.25**	**1340**	**83.75**	**1600**

Accessibility of Water Sources

Collection of HH Water (Pilot Villages)

According to the baseline study, it has been found that most female members of the family collect water for household needs. In some cases, the main male family member and female support members collect water for household needs (**Table 4.15**).

Collection of HH Water (Sample Villages)

According to the baseline study, it has been found that most female members of the family collect water for household needs. In some cases, the main male family member and female support members collect water for household needs (**Table 4.16**).

Table 4.15: Collection of HH water (pilot villages)

Village	No need to carry (no.)	Main female member of the family (no.)	Main male member of the family (no.)	Female member who help with family work (no.)	Male member who help with family work (no.)	Other members of the family (no.)
Injuria	21	694	56	9	3	66
Charsharat	91	817	120	109	52	96
Saikchail	310	1348	49	144	33	265
Fulchari	11	363	111	23	12	38
Beelchanda	153	236	39	24	9	6
Tipna	15	749	95	21	25	83
Pathordubi	637	1837	493	215	20	138
Khordacho mpa	119	385	158	48	21	7
Hafizpur	347	1297	398	95	29	332
Dakkhin Demura	12	350	125	32	21	83
Sonadanga	341	443	122	38	18	14
Chota Harina (mouza)	24	173	52	17	16	30
Datinakhali	145	385	115	27	11	39
Shimulbank	32	427	23	40	11	47
Bagaiya	267	633	103	94	17	43

Table 4.16: Collection of HH water (sample villages)

District	Village	No need to carry	Main female member of the family	Main male member of the family	Female member who help with family work	Male member who help with family work	Other members of the family
Barishal	Baduri	1	21	4	0	0	2
Gaibandha	Baje Fulchchari	9	47	8	3	0	2
	Parul	2	54	13	5	3	5

District	Village	No need to carry	Main female member of the family	Main male member of the family	Female member who help with family work	Male member who help with family work	Other members of the family
	Ziadanga	5	32	5	10	2	1
Gopalganj	Baniarchar	14	69	11	6	7	1
	Jolirpar	48	133	19	17	3	1
Khulna	Gonali	0	60	6	0	0	7
Kurigram	Maidam	22	50	10	6	1	13
	Sarkarpara	62	146	36	21	3	33
	Uttar Baladia	96	190	39	27	2	36
Naogaon	Patail	1	16	6	1	0	0
Narsingdi	Chalakchar	52	123	39	2	2	49
	Chengain	19	31	7	3	0	20
Netrakona	Kadam Deuli	3	39	13	7	3	11
	Shahata	1	61	30	19	7	20
Satkhira	Banbibitala	9	18	16	0	1	0
	Chunar	20	22	11	0	0	1
	Jabakhali	4	17	11	0	3	0
	Kalbari	15	19	15	0	2	1
Sunamganj	Lalukhali	2	24	0	3	0	5

Problems Faced by Women while Collecting Water (Pilot Villages)

According to the baseline study results, women face problems during water collection except in the Induria and Chota Harina (mouza) villages (**Figure 4.16**). More than 50% of women involved in water collection in the Induria, and Chota Harina (mouza) villages have faced problems during water collection.

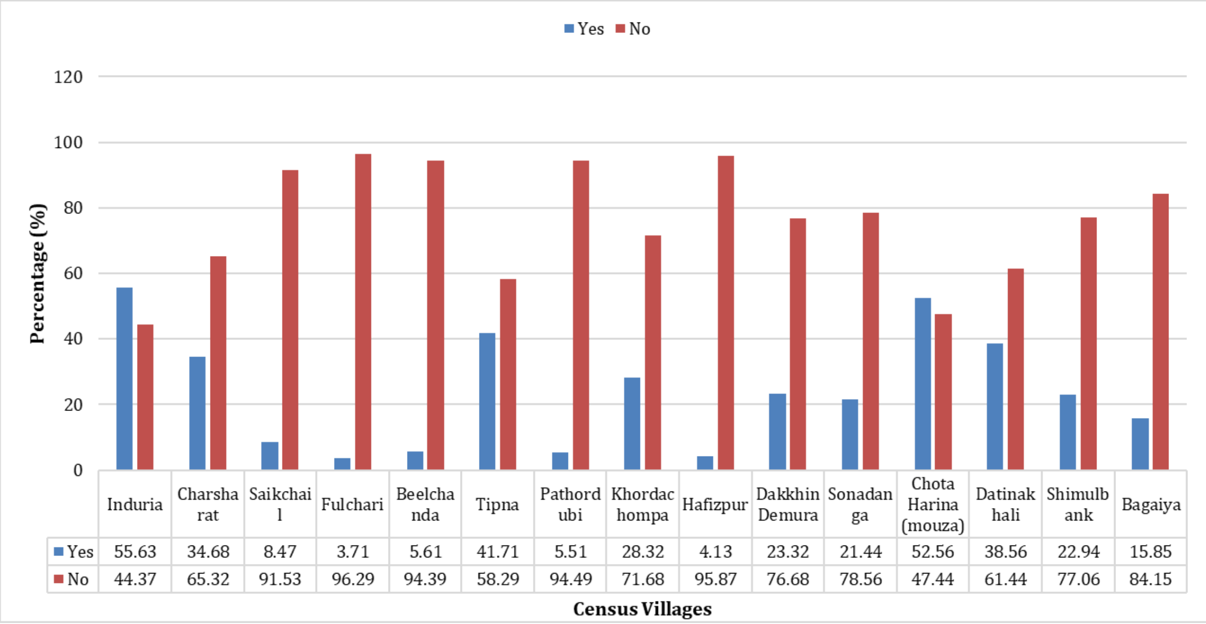


Figure 4.16: Problem faced by women while collecting water (pilot villages)

During water collection, the women members of HHs have to face various problems. The problems include difficulty in carrying water, less time to spend on household work, being harassed while fetching water from other places, and less time to care for young children and others (**Table 4.17**).

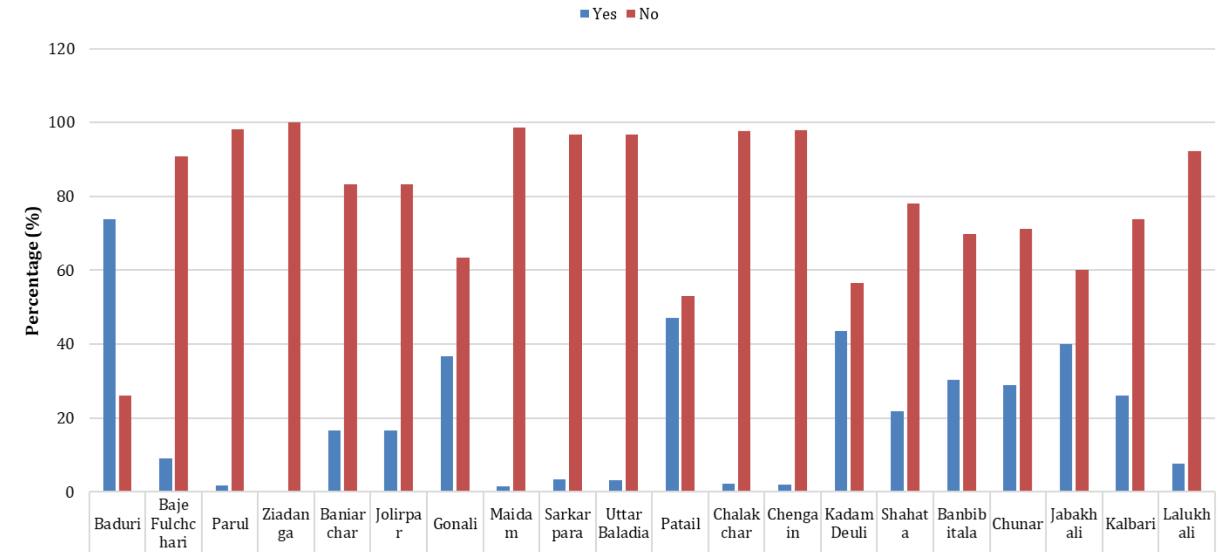
Table 4.17: Types of problem faced by women while collecting water (pilot villages)

Village	Cannot spend time on housework (%)	Very difficult to carry water (%)	Harassed while fetching water from other places (%)	Difficult to look after young children (%)	Others (%)
Induria	29.56	50.57	0.63	14.09	5.16
Charsharat	26.26	47.8	7.86	17.92	0.16
Saikchail	29.65	57.96	2.65	9.73	0
Fulchari	32	28	-	20	20
Beelchanda	33.33	45.83	4.17	16.67	0
Tipna	29.32	45.96	1.9	12.36	10.46
Pathordubi	32.89	48.25	-	18.42	0.44
Khordachompa	37.7	49.6	0.79	11.9	0
Hafizpur	8.7	60.87	2.17	9.78	18.48
Dakkhin Demura	18.55	54.03	1.61	11.29	14.52
Sonadanga	37.5	52.14	0.71	9.29	0.36
Chota Harina (mouza)	30.71	43.7	3.94	20.87	0.79
Datinakhali	31.07	46.26	2.04	19.05	1.59

Village	Cannot spend time on housework (%)	Very difficult to carry water (%)	Harassed while fetching water from other places (%)	Difficult to look after young children (%)	Others (%)
Shimulbank	27.31	45.81	8.37	17.62	0.88
Bagaiya	26.69	52.26	2.63	18.42	0

Problem Faced by Women while Collecting Water (Sample Villages)

According to the baseline study results, women do not face any problems during water collection except in the Baduri villages (**Figure 4.17**). Among the sample villages, the difficulty women face in water collection is highest in the Baduri village of Barishal district and lowest in Maidam village of Kurigram district.



	Baduri	Baje Fulchchari	Parul	Ziadanga	Baniarchar	Jolirpar	Gonali	Maidam	Sarkarpara	Uttar Baladia	Patail	Chalakchar	Chengain	Kadam Deuli	Shahata	Banbibitala	Chunar	Jabakhali	Kalbari	Lalukhali
Yes	73.91	9.09	1.75		16.67	16.67	36.67	1.39	3.37	3.15	47.06	2.29	2	43.48	21.92	30.3	28.89	40	26.19	7.69
No	26.09	90.91	98.25	100	83.33	83.33	63.33	98.61	96.63	96.85	52.94	97.71	98	56.52	78.08	69.7	71.11	60	73.81	92.31

Figure 4.17: Problems faced by women while collecting water (sample village)

While collecting water, women members of HHs have to face various problems. The problems include difficulty in carrying water, not having time for household work, being harassed while fetching water from other places, and less time to look after their young children and others (**Table 4.18**).

Table 4.18: Types of problem faced by women while collecting water (pilot villages)

Village	Cannot spend time on housework (%)	Very difficult to carry water (%)	Harassed while fetching water from other places (%)	Difficult to look after young children (%)	Others (%)
Baduri	29.41	50	2.94	8.82	8.82
Baje Fulchchari	14.29	14.29	-	42.86	28.57
Parul	-	-	-	100	-
Ziadanga	-	-	-	-	-
Baniarchar	33.33	38.89	22.22	5.56	0

Village	Cannot spend time on housework (%)	Very difficult to carry water (%)	Harassed while fetching water from other places (%)	Difficult to look after young children (%)	Others (%)
Jolirpar	25.81	41.94	8.06	22.58	1.61
Gonali	31.71	53.66	2.44	9.76	2.44
Maidam	50	50	-	-	-
Sarkarpara	33.33	58.33	-	8.33	-
Uttar Baladia	30.77	53.85	-	15.38	-
Patail	28.57	57.14	-	14.29	-
Chalakchar	33.33	22.22	11.11	33.33	-
Chengain	33.33	33.33	-	33.33	-
Kadam Deuli	16.67	41.67	19.44	13.89	8.33
Shahata	16.67	54.17	-	8.33	20.83
Banbibitala	38.46	34.62	7.69	19.23	-
Chunar	35.71	42.86	-	21.43	-
Jabakhali	43.75	50	-	6.25	-
Kalbari	42.11	47.37	-	10.53	-
Lalukhali	40	40	-	-	20

Time required for a single trip to collect water (Pilot and Sample Village)

The baseline data reveal that except for Datinakhali, for most households in the pilot villages, it takes 0–5 minutes for a single trip to collect water (**Figure 4.18**). In some places of Datinakhali, however, the HHs members required 15-30 minutes or more for a single trip to collect water. The baseline survey also found that it takes 5–15 minutes for some households to make a single journey to collect water. Similar conditions were observed in the sample villages (**Table 4.19**).

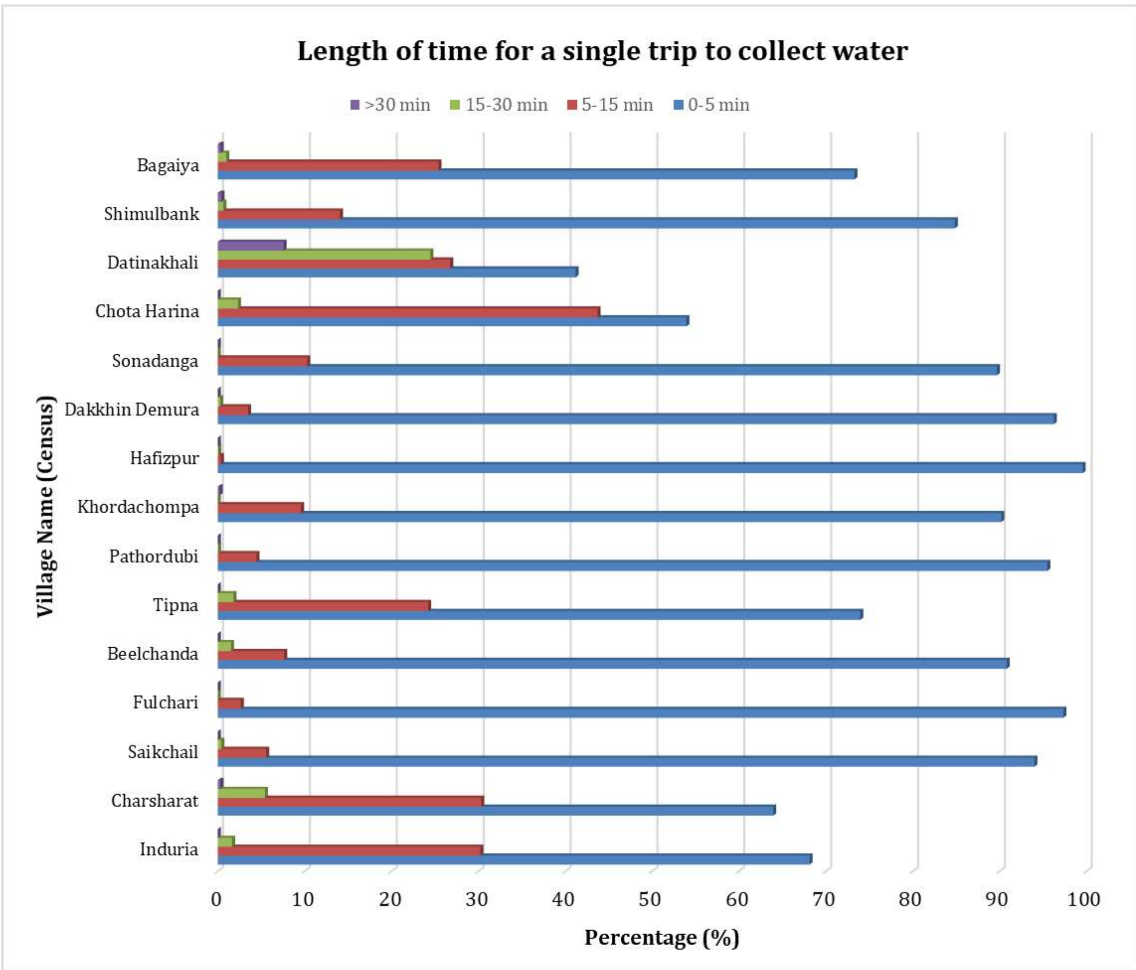


Figure 4.18: Time required for a single trip to collect water (pilot villages)

Table 4.19: Time required for a single trip to collect water (pilot villages)

District	Village	0-5 min (%)	5-15 min (%)	15-30 min (%)	>30 min (%)
Barishal	Baduri	52.17	43.48	4.35	-
Gaibandha	Baje Fulchchari	90.91	3.64	5.45	-
	Parul	92.98	5.26	1.75	-
	Ziadanga	100	-	-	-
Gopalganj	Baniarchar	69.05	30.95	-	-
	Jolirpar	77.96	17.2	4.84	-
Khulna	Gonali	73.33	23.33	3.33	-
Kurigram	Maidam	98.61	1.39	-	-
	Sarkarpara	97.6	2.4	-	-
	Uttar Baladia	98.95	1.05	-	-
Naogaon	Patail	82.35	17.65	-	-
Narsingdi	Chalakchar	99.43	-	-	0.57
	Chengain	100	-	-	-
Netrakona	Kadam Deuli	69.57	28.26	2.17	-
	Shahata	87.67	5.48	5.48	1.37

District	Village	0-5 min (%)	5-15 min (%)	15-30 min (%)	>30 min (%)
Satkhira	Banbibitala	36.36	27.27	15.15	21.21
	Chunar	53.33	15.56	17.78	13.33
	Jabakhali	48	24	24	4
	Kalbari	40.48	11.9	28.57	19.05
Sunamganj	Lalukhali	88.46	11.54	-	-

Use of Alternative Sources of Water for Domestic Purposes (Pilot Village)

The alternative water sources for domestic use in the surveyed households were not remarkably different from each other. **Figure 4.19** shows the alternative water sources for domestic work in the pilot villages.

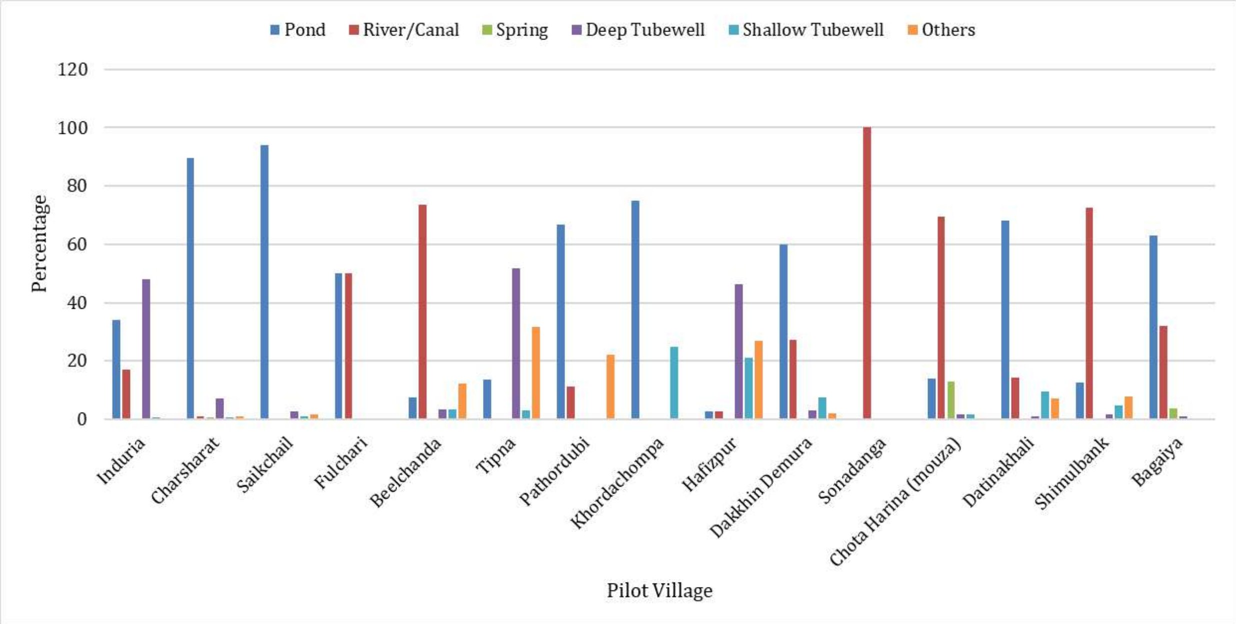


Figure 4.19: Alternative sources of water for domestic purposes in pilot villages

Use of Alternate Sources of Water for Domestic Purposes (Sample Village)

The alternative water sources for domestic use in the surveyed households were not remarkably different from each other. **Figure 4.20** shows the alternative water sources for domestic work in the sample villages.

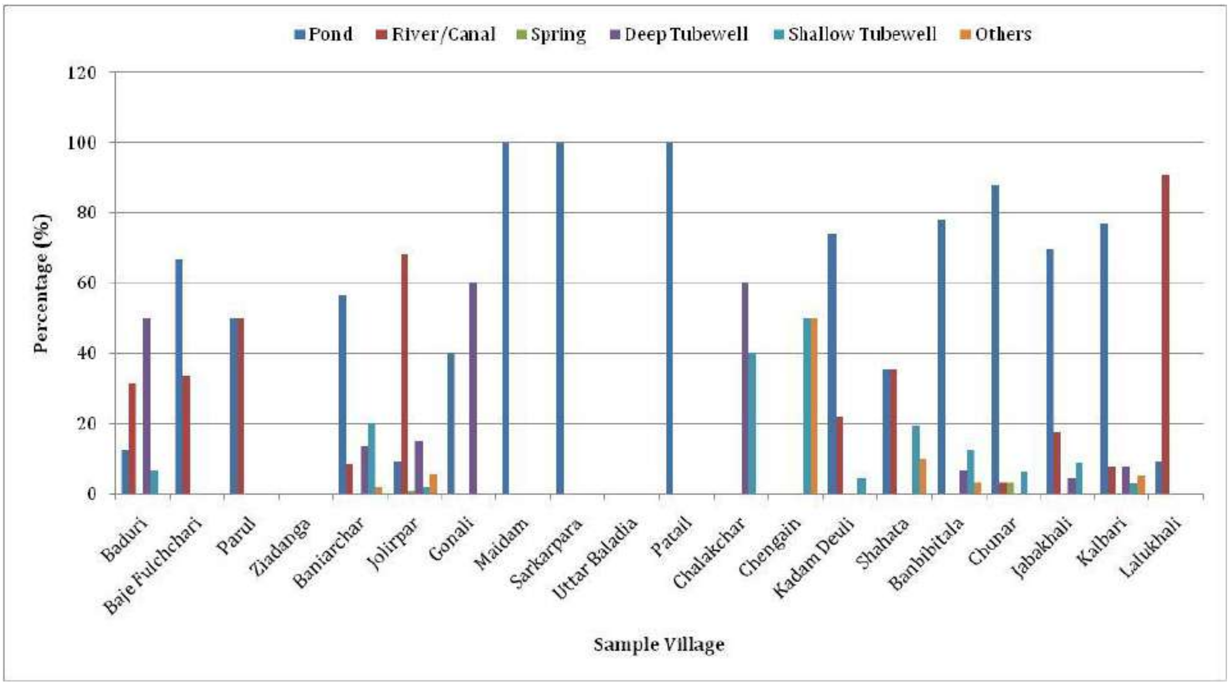


Figure 4.20: Alternative sources of water for domestic purposes (sample villages)

Types of Containers Used to Carry Water (Pilot Village)

During the baseline survey, household respondents were asked which containers they used to carry water. Only 56.04% of the surveyed population were reported to use pitchers for carrying water, and the highest proportion among them resided in Induria (98.76%). Only 36.4% of the studied population used jugs to carry water, and the highest proportion among them were in Hafizpur (93.62%). About 7.25% of the household respondents used buckets for carrying water, and the highest proportion among them lived in Khordachompa (61.66%). **Table 4.20** presents the details.

Table 4.20: Types of containers used to carry water (pilot village)

Village	Pitcher		Jug		Bucket		Bottle		Others		Total
	n	%	n	%	n	%	n	%	n	%	n
Induria	719	98.76	9	1.24	-	-	-	-	-	-	728
Charsharat	882	93.83	51	5.43	7	0.74	-	-	-	-	941
Saikchail	1342	81.23	303	18.34	7	0.42	-	-	-	-	1652
Fulchari	39	10.34	330	87.53	8	2.12	-	-	-	-	377
Beelchanda	318	81.12	71	18.11	-	-	3	0.77	-	-	392
Tipna	699	90.54	61	7.9	5	0.65	-	-	7	0.91	772
Pathordubi	372	15.07	1819	73.67	276	11.18	2	0.08	-	-	2469
Khordachompa	141	30.72	34	7.41	283	61.66	-	-	1	0.22	459
Hafizpur	84	5.1	1541	93.62	19	1.15	1	0.06	1	0.06	1646
Dakkhin Demura	205	54.96	165	44.24	3	0.8	-	-	-	-	373
Sonadanga	313	44.15	90	12.69	306	43.16	-	-	-	-	709
Chota Harina (mouza)	203	94.42	9	4.19	3	1.4	-	-	-	-	215
Datinakhali	535	94.19	9	1.58	1	0.18	1	0.18	22	3.87	568
Shimulbank	437	94.59	25	5.41	-	-	-	-	-	-	462
Bagaiya	818	88.82	102	11.07	1	0.11	-	-	-	-	921

Village	Pitcher		Jug		Bucket		Bottle		Others		Total
	n	%	n	%	n	%	n	%	n	%	n
Total	**7107**	**56.04**	**4619**	**36.42**	**919**	**7.25**	**7**	**0.06**	**31**	**0.24**	**12684**

Types of Containers Used to Carry Water (Sample Village)

During the baseline study, household respondents were asked whether they used containers to carry water. It was found that 38.88% of the surveyed population used pitchers for carrying water and among them, the highest percentage was found in Baduri (100%). Only 52.8% of those surveyed used jugs to bring water, the highest percentage of them being in Chalakchar (94.86%). About 6.6% of the household respondents used buckets for carrying water, the highest proportion of them living in Patail (41.18%). **Table 4.21** presents the details.

Table 4.21: Types of containers used to carry water (sample villages)

Village	Pitcher		Jug		Bucket		Bottle		Others		Total
	n	%	n	%	n	%	n	%	N	%	n
Baduri	23	100	-	-	-	-	-	-	-	-	23
Baje Fulchchari	7	12.73	48	87.27	-	-	-	-	-	-	55
Parul	6	10.53	51	89.47	-	-	-	-	-	-	57
Ziadanga	4	10.81	33	89.19	-	-	-	-	-	-	37
Baniarchar	76	90.48	7	8.33	-	-	1	1.19	-	-	84
Jolirpar	174	93.55	11	5.91	1	0.54	-	-	-	-	186
Gonali	57	95	2	3.33	1	1.67	-	-	-	-	60
Maidam	8	11.11	50	69.44	14	19.44	-	-	-	-	72
Sarkarpara	18	8.65	155	74.52	35	16.83	-	-	-	-	208
Uttar Baladia	20	6.99	235	82.17	31	10.84	-	-	-	-	286
Patail	7	41.18	3	17.65	7	41.18	-	-	-	-	17
Chalakchar	7	4	166	94.86	2	1.14	-	-	-	-	175
Chengain	3	6	47	94	-	-	-	-	-	-	50
Kadam Deuli	36	78.26	9	19.57	1	2.17	-	-	-	-	46
Shahata	37	50.68	23	31.51	13	17.81	-	-	-	-	73
Banbibitala	25	75.76	1	3.03	-	-	-	-	7	21.21	33
Chunar	36	80	-	-	-	-	-	-	9	20	45
Jabakhali	19	76	-	-	-	-	-	-	6	24	25
Kalbari	36	85.71	1	2.38	-	-	1	2.38	4	9.52	42
Lalukhali	23	88.46	3	11.54	-	-	-	-	-	-	26
Total	**622**	**38.88**	**845**	**52.8**	**105**	**6.6**	**2**	**0.13**	**26**	**1.63**	**1600**

4.2.3.1 Availability of Water by Season

Pilot Village

The survey revealed that out of the fifteen (15) pilot villages, water was extracted from available sources the year in more than 90% of the households in nine (09) pilot villages. On the other hand, in four (04) pilot villages, about 70-80% of the households, in Dakkhin Demura, 60.05% of the households, and in Chota Harina (mouza), 50.7% of the households reported that water was abstracted from available sources all year-round **Figure 4.21**.

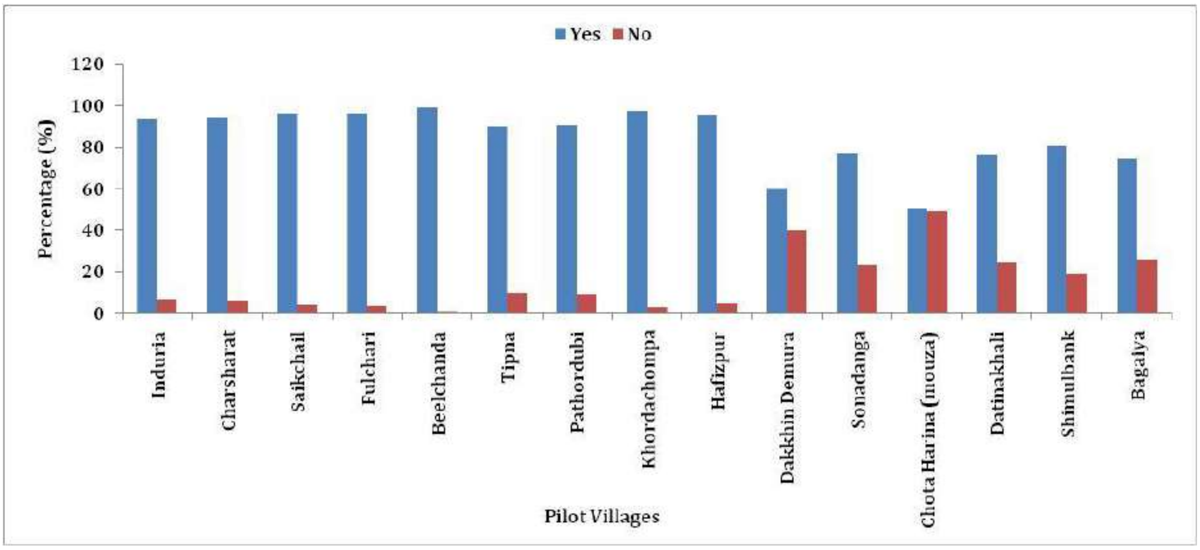


Figure 4.21: Availability of water extracted from source (pilot villages)

Most households in the pilot villages responded that water shortage was observed from February to May (**Figure 4.22**). 46.54% of the households reported that lowering of the water table was linked with water shortage but that drying up of rivers, ponds, canals, and other sources (29.23%), sinking of tube wells during floods (6.97%), insufficient rainfall (15.23%), and other reasons (2%) were also responsible for the water shortage (**Figure 4.23**).

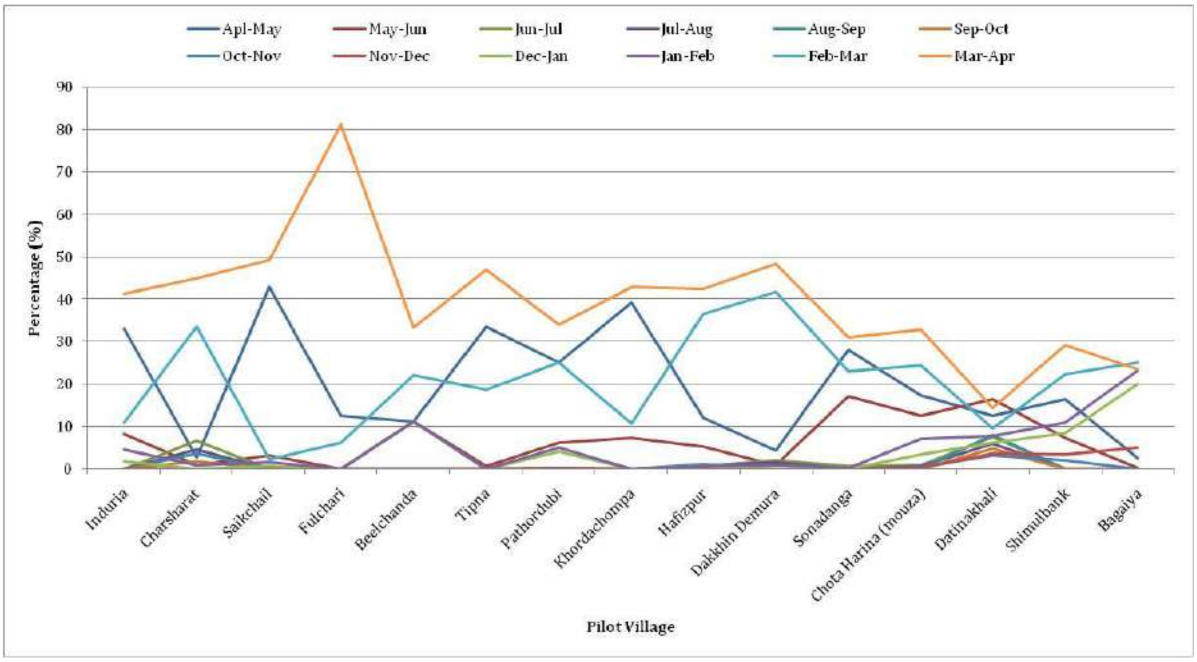


Figure 4.22: Availability of water by season (pilot villages)

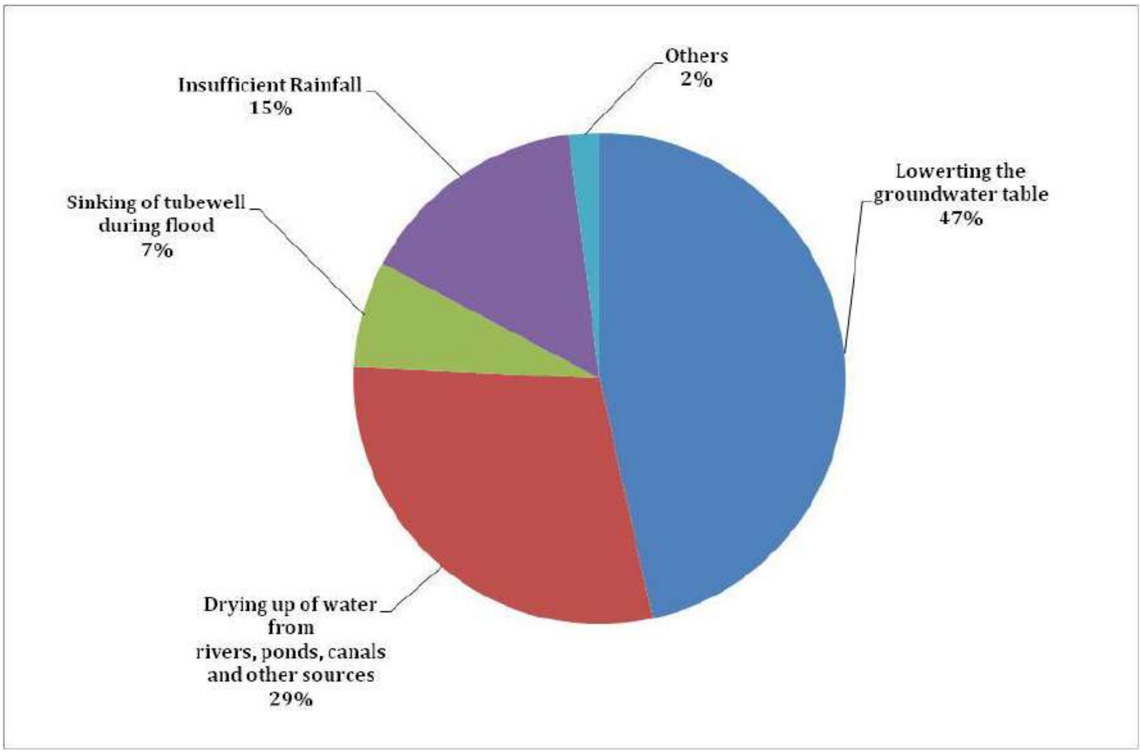


Figure 4.23: Reasons for scarcity of water (pilot villages)

Sample Villages

The survey revealed that in six (06) sample villages out of 20, more than 90% of the households reported that they extracted water from sources available throughout the year. The same response was gathered from 80% of households in eight (08) sample villages. In Baduri, 100% of the households said that they extracted water from sources available throughout the year (**Figure 4.24.)**

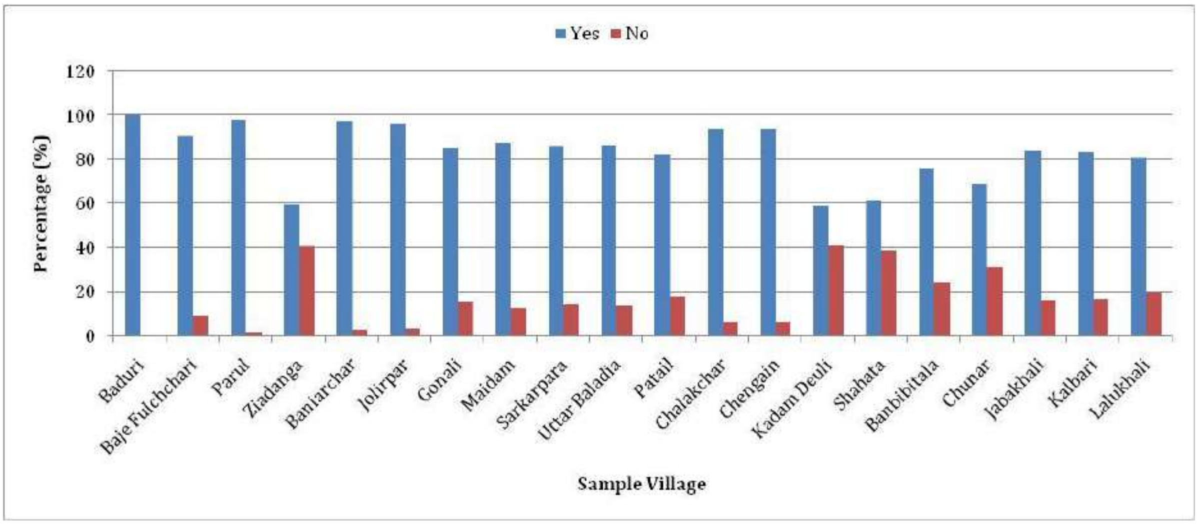


Figure 4.24: Availability of water extracted from source (sample villages)

Most households in the sample villages said water shortage was experienced from February to May **(Table 4.22)**. The households also reported that *lowering of the water table (44%), drying up of rivers, ponds, canals, and other sources (26%), sinking of tube wells during floods (6.97%), insufficient rainfall (6%) and other reasons (1%)* (**Figure 4.25**) were also causes of the water shortage.

Table 4.22: Non-availability of water by season (sample village)

Sample Village	Apr-May	May-Jun	Jun-Jul	Jul-Aug	Aug-Sep	Sep-Oct	Oct-Nov	Nov-Dec	Dec-Jan	Jan-Feb	Feb-Mar	Mar-Apr
Baduri												
Baje Fulchchari	-	-	-	-	-	-	-	-	-	-	-	100
Parul	-	-	-	-	-	-	-	-	-	-	-	100
Ziadanga	-	-	-	-	-	-	-	-	-	-	-	100
Baniarchar	-	-	-	-	-	-	-	-	-	-	50	50
Jolirpar	13.04	13.04	8.7	-	-	-	4.35	8.7	13.04	13.04	13.04	13.04
Gonali	28.57	-	-	-	-	-	-	-	-	-	7.14	64.29
Maidam	30.77	-	-	-	-	-	-	-	-	3.85	30.77	34.62
Sarkarpara	29.07	-	-	-	-	-	-	-	3.49	3.49	30.23	33.72
Uttar Baladia	28.95	5.26	-	-	-	-	-	-	2.63	3.51	26.32	33.33
Patail	42.86	14.29	-	-	-	-	-	-	-	-	-	42.86
Chalakchar	22.58	-	-	-	-	-	-	-	3.23	3.23	35.48	35.48
Chengain	14.29	-	-	-	-	-	-	-	-	-	42.86	42.86
Kadam Deuli	8.33	-	-	-	-	-	-	-	-	-	12.5	79.17
Shahata	7.84	5.88	-	-	-	1.96	-	-	-	-	29.41	52.94
Banbibitala	17.5	20	5	-	-	-	7.5	7.5	7.5	7.5	7.5	20
Chunar	21.82	14.55	1.82	-	-	-	3.64	3.64	3.64	9.09	16.36	25.45
Jabakhali	14.29	10.71	7.14	-	3.57	3.57	7.14	10.71	10.71	10.71	10.71	10.71
Kalbari	22.58	16.13	-	-	-	-	3.23	6.45	6.45	6.45	16.13	22.58
Lalukhali	8.33	-	-	-	-	-	-	-	8.33	8.33	33.33	41.67

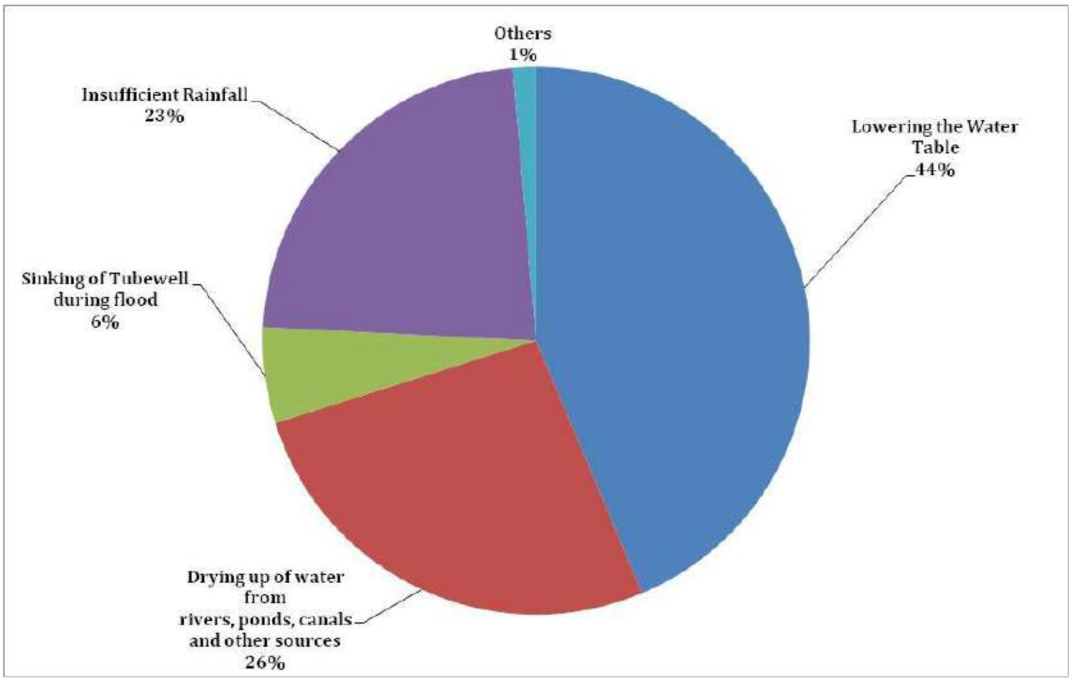


Figure 4.25: Reasons for scarcity of water (sample village)

4.2.3.2 *Maintenance Cost of Water Sources*

Pilot Village

Respondents were asked about the maintenance cost of water sources. 59.78% of the respondents said that household owners bore the maintenance cost, their number the highest in Pathordubi village. Around 6.54% of the households replied that the committees paid the maintenance cost of water sources (their number the highest in Shimulbank); and 18.21% of the respondents said that neighbors bore it (their number the highest in Pathordubi village). The details are in **Table 4.23**.

Table 4.23: Maintenance cost of water sources (pilot villages)

Village	Owner	Committee	DPHE	UP	NGO	Voluntary Organization	Neighbor	Personal Project	Others	Total
Induria	179	67	6	21	-	15	328	-	105	721
Charsharat	256	210	9	8	11	1	69	-	378	942
Saikchail	1119	128	-	12	1	-	335	-	51	1646
Fulchari	319	-	-	0	3	-	-	-	48	370
Beelchanda	247	-	-	10	7	-	79	3	48	394
Tipna	278	22	4	0	-	11	50	-	444	809
Pathordubi	1929	11	-	4	-	-	497	-	6	2447
Khordachompa	395	5	-	0	-	2	-	-	61	463
Hafizpur	1455	5	1	0	-	-	148	-	42	1651
Dakkhin Demura	205	11	3	0	-	-	101	-	58	378
Sonadanga	514	12	2	5	2	1	122	-	50	708
Chota Harina (mouza)	39	25	1	0	-	1	45	8	78	197
Datinakhali	176	11	-	2	27	12	-	-	330	558

Village	Owner	Committee	DPHE	UP	NGO	Voluntary Organization	Neighbor	Personal Project	Others	Total
Shimulbank	77	320	-	3	2	3	45	5	7	462
Bagaiya	376	1	-	2	-	-	485	-	43	907
Total	**7564**	**828**	**26**	**67**	**53**	**46**	**2304**	**16**	**1749**	**12653**
Percentage (%)	**59.78**	**6.54**	**0.21**	**0.53**	**0.42**	**0.36**	**18.21**	**0.13**	**13.82**	**100**

Sample Villages

Respondents were asked about the maintenance cost of the water sources. 71.3% of the respondents said that household owners bore the maintenance cost of water sources, their number the highest in Uttar Baladia village. About 11.97% of the households said that their neighbors paid for the maintenance, their number the highest in Jolirpar. The details are in **Table 4.24**

Table 4.24: Maintenance cost of water sources (sample villages)

Village	Owner	Committee	DPHE	UP	NGO	Voluntary Organization	Neighbor	Personal Project	Others	Total
Baduri	11	1	1	2	-	-	6	1	2	24
Baje Fulchchari	46	-	-	-	-	-	-	-	10	56
Parul	55	-	-	-	-	-	-	-	3	58
Ziadanga	34	-	-	-	-	-	-	-	4	38
Baniarchar	32	6	-	-	-	-	30	-	16	84
Jolirpar	81	8	5	0	1	4	77	2	7	185
Gonali	22	1	-	-	-	3	14	-	20	60
Maidam	65	2	-	1	0	-	4	-	-	72
Sarkarpara	183	3	-	1	0	-	20	-	-	207
Uttar Baladia	260	1	-	-	-	-	23	-	-	284
Patail	9	-	-	-	-	-	-	-	8	17
Chalakchar	165	-	-	-	-	-	10	-	-	175
Chengain	48	-	-	-	-	-	2	-	-	50
Kadam Deuli	17	-	1	-	-	-	-	-	28	46
Shahata	41	-	8	1	-	-	-	-	24	74
Banbibitala	12	-	1		5	3	-	-	11	32
Chunar	25	-	-	-	-	3	-	-	13	41
Jabakhali	15	-	-	-	-	4		1	5	25
Kalbari	13	-	-	-	-	9		0	20	42
Lalukhali	4	17	-	-	-	-	5	-	-	26
Total	**1138**	**39**	**16**	**5**	**6**	**26**	**191**	**4**	**171**	**1596**
(%)	**71.30**	**2.44**	**1.00**	**0.31**	**0.38**	**1.63**	**11.97**	**0.25**	**10.71**	**100**

4.2.4 *Quality of Drinking Water Source*

Pilot Villages

Respondents were inquired about the quality of water sources. 74.08% of the respondents, most of them from Khordachompa (96.26%) village, said that the quality of water sources was good, while around 15.08% of the surveyed households, most from Dakkhin Demura (58.98%) village, reported that the quality was bad; and 22.79% of the respondents said that the quality was acceptable. The details are presented in **table 4.26**.

Respondents were asked about the main reasons for poor water quality. In reply, they cited the main reasons as iron (44.32%), odor (18.15%), turbidity (11.26%), bad taste (10.76%), arsenic (9.81%), salinity (5.51%) and others (0.18%) respectively. **Table 4.25** shows the details.

Table 4.25: Reasons for poor water quality (pilot villages)

Water Quality	%	Max.	Min.
Arsenic	9.81	Saikchail	Fulchari, Khordachompa, Datinakhali
Bad Taste	10.76	Fulchari	Khordachompa, Datinakhali
Iron	44.32	Hafizpur	Datinakhali
Odor	18.15	Khordachompa	Tipna
Others	0.18	Charsharat	Saikchail, Fulchari, Beelchanda, Tipna, Pathordubi, Khordachompa, Datinakhali, Shimulbank, Bagaiya Sonadanga
Salinity	5.51	Datinakhali	Fulchari, Beel canda, Khordachompa, Dakkhin Demura, Sonadanga
Turbidity	11.26	Chota Harina (mouza)	Hafizpur

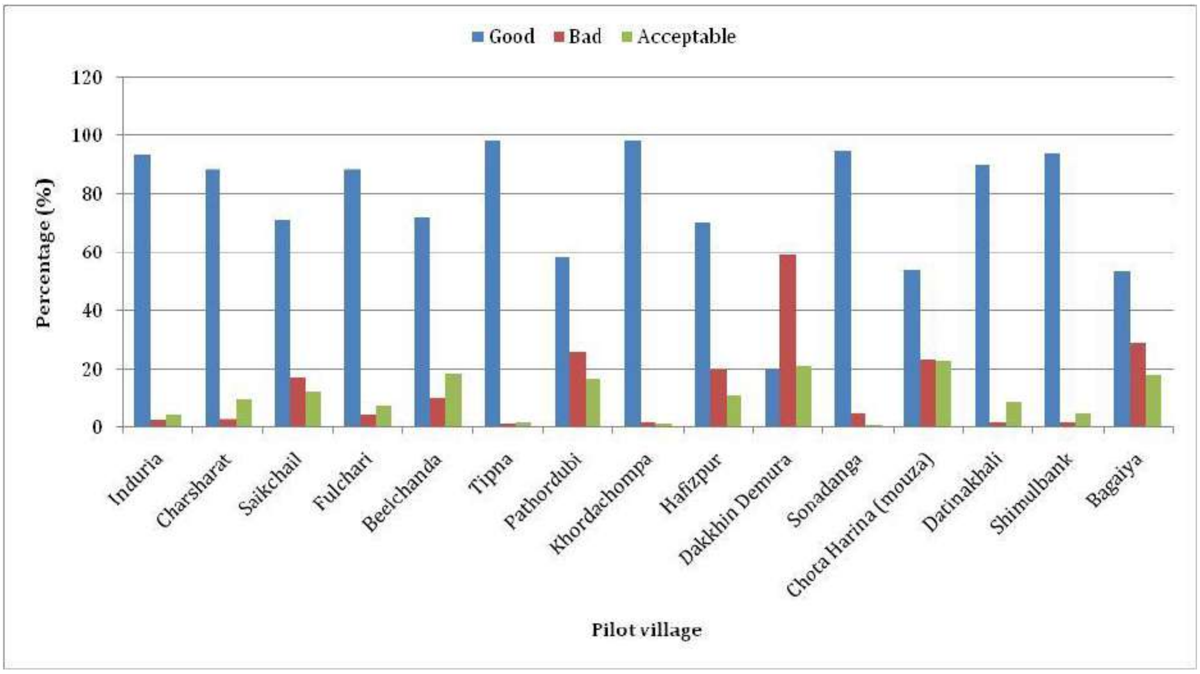


Figure 4.26: Quality of drinking water (pilot villages)

Sample Villages

Respondents were asked about the quality of water sources. In reply, 60.94% of the respondents said that the quality of water sources was good, their number the highest in Jolirpar (70.43%) village. Around 26.19% of the households replied that the quality of water sources was bad, their number the highest in Uttar Baladia (46.15%) village, and 12.88% of the respondents said that the quality of water sources was acceptable. The details are presented in **Figure 4.27**.

Respondents were asked about the main reasons for poor water quality. They said that the main reasons were iron (54.12%), odor (16.86%), turbidity (10.98%), bad taste (11.37%), arsenic (6.27%), salinity (0.26%) and others (0.13%) respectively. **Table 4.26** shows the details.

Table 4.26: Reasons for poor water quality (sample villages)

Water Quality	%	Max	Min
Arsenic	6.27	Jolirpar	Parul, Ziadanga, Baniarchar, Gonali, Patail, Kadam Deuli, Banbibitala, Chunar, Jabakhali, Kalbari, Lalukhali
Bad Taste	11.37	Kadam deuli	Gonali, Patail, Banbibitala, Chunar, Jabakhali, Kalbari, Lalukhali
Iron	54.12	Ziadanga	Gonali, Patail, Banbibitala, Chunar, Jabakhali, Kalbari
Odor	16.86	Lalukhali	Ziadanga, Gonali, Patail, Banbibitala, Chunar, Jabakhali, Kalbari, Lalukhali
Others	0.13	Lalukhali	Rest of 19 village
Salinity	0.26	Baduri and Uttar Baladia	Rest of 18 village
Turbidity	10.98	Baduri	Ziadanga, Gonali, Maidam, PatailBanbibitala, Chunar, Jabakhali, Kalbari, Lalukhali

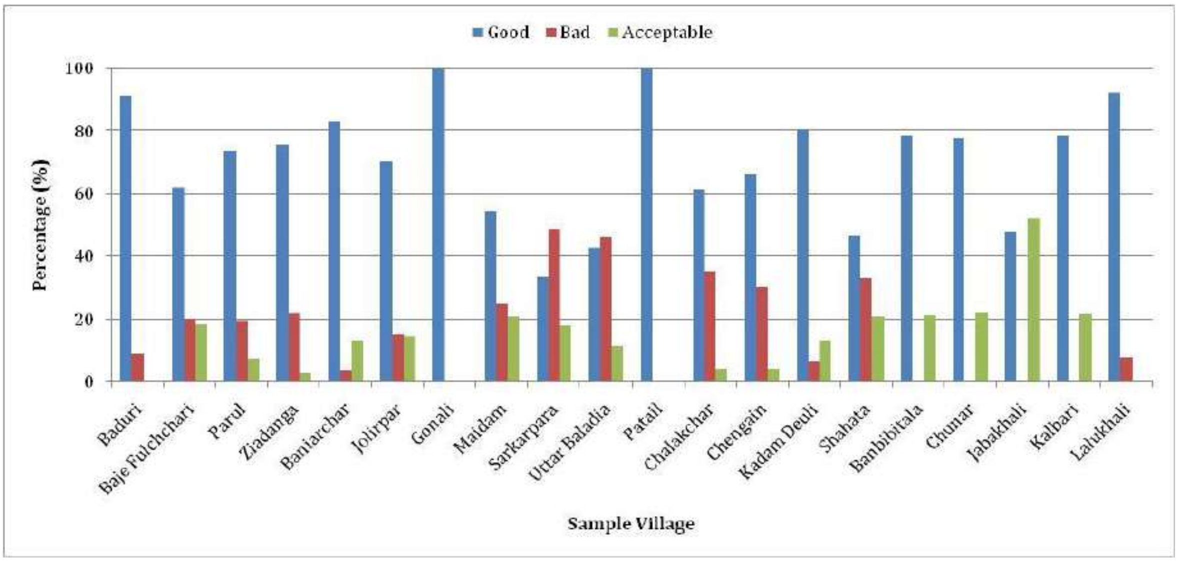


Figure 4.27: Quality of drinking water (sample villages)

4.2.5 *Water Treatment Practices*

Pilot Villages

In general, the purification of drinking water before consumption is not a common practice in the surveyed households. More than 94% of the households in the pilot villages reported using the water directly after it was collected, except in Chota Harina (mouza) and Bagaiya (**Figure 4.28**).

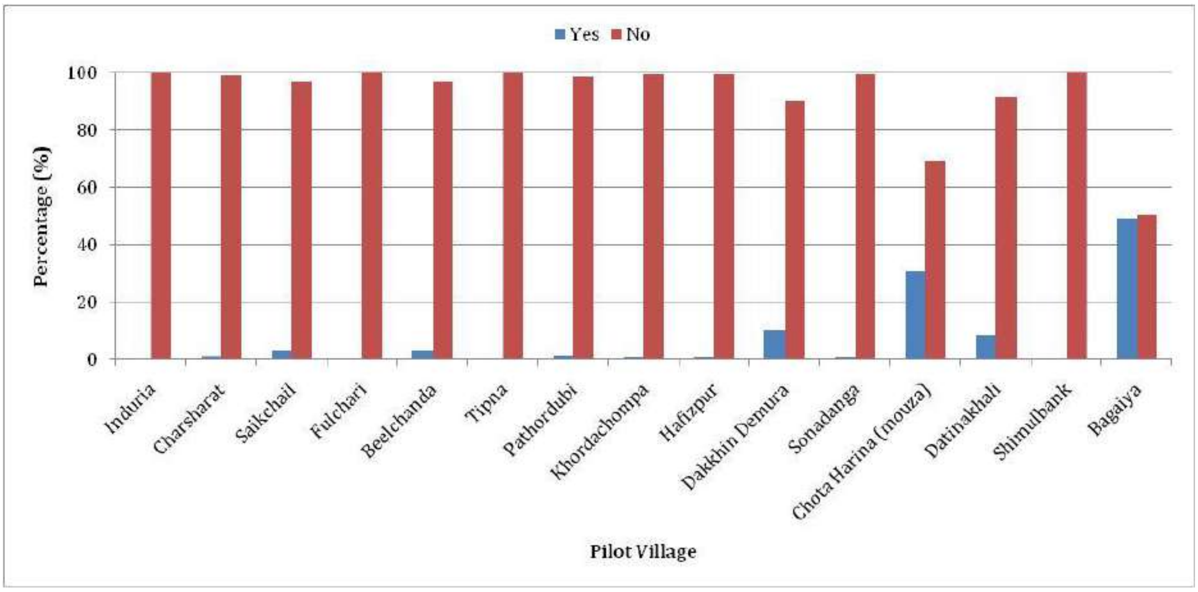


Figure 4.28: Purification of drinking water (pilot villages)

According to the respondents, only 5.81% of the households always treated water before use. Filtering (65.29%) is the commonly adopted method. The rest of the households practise different treatment methods, such as adding alum to water (6.27%), boiling (10.19%), chlorination (0.9%), settlement (16.8%), and others (0.56%) (**Figure 4.29**).

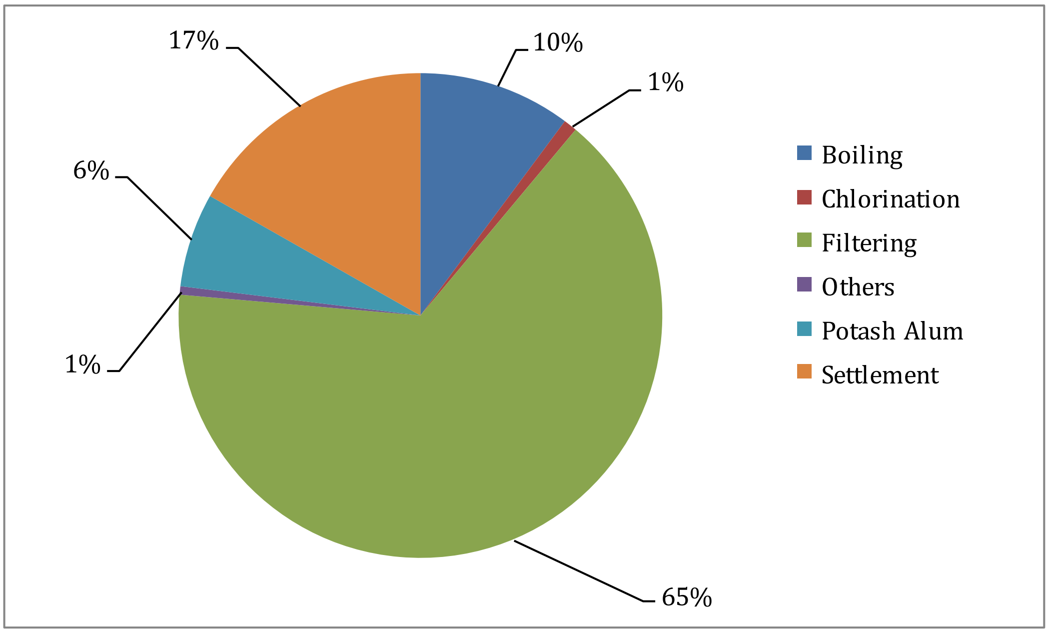


Figure 4.29: Water treatment practice (pilot villages)

Sample Villages

Among the surveyed population, drinking water purification before consumption is not a common practice. More than 96% of the households in the sample villages reported drinking water directly after it is collected from water sources, except in Jabakhali (**Figure 4.30**).

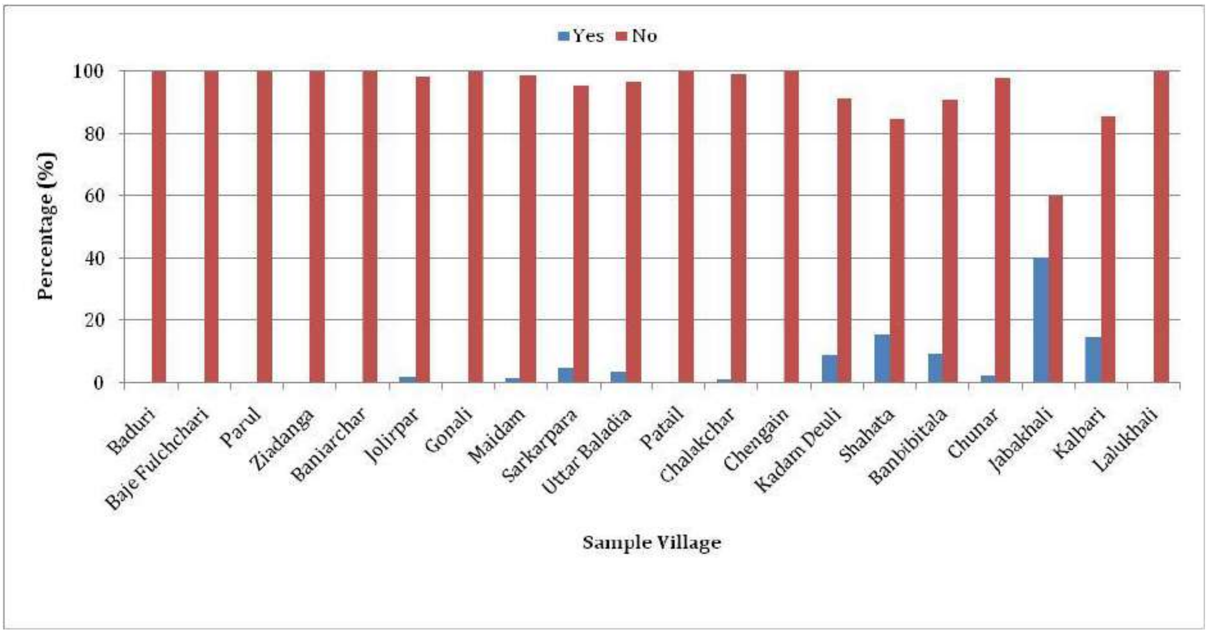


Figure 4.30: Purification of drinking water (sample villages)

According to the respondents, only 3.69% of the household always treat their drinking water before consumption. Filtering (53.33%) is the commonly adopted method. The rest of the households practice different treatment methods, such as adding alum to water (11.67%), boiling (8.33%), and settlement (26.67%) (**Figure 4.31**).

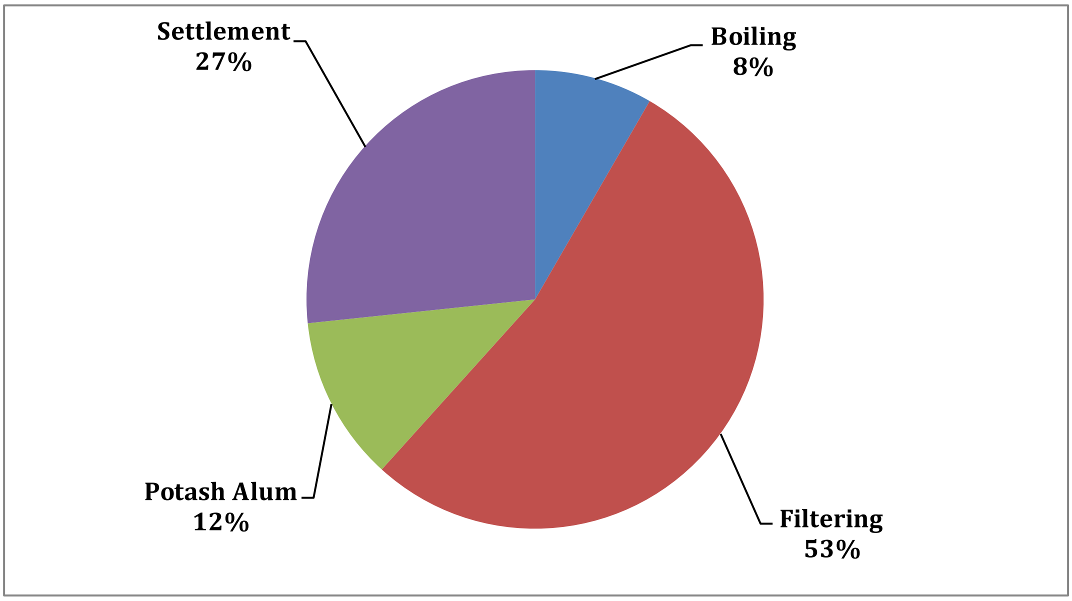


Figure 4.31: Water treatment practice (sample villages)

4.2.6 *Percentage of Satisfied and Dissatisfied Respondents (Water for Drinking and Cooking)*

Pilot Villages

During the baseline survey, the respondents were asked whether they were satisfied or dissatisfied with the water used for drinking purposes. Most of the respondents (79.48%) reported being satisfied, while 20.52% said they were dissatisfied. In Chota Harina (mouza) and Datinakhali village, the satisfaction level was 40% and 44.54%, respectively (**Figure 4.32**).

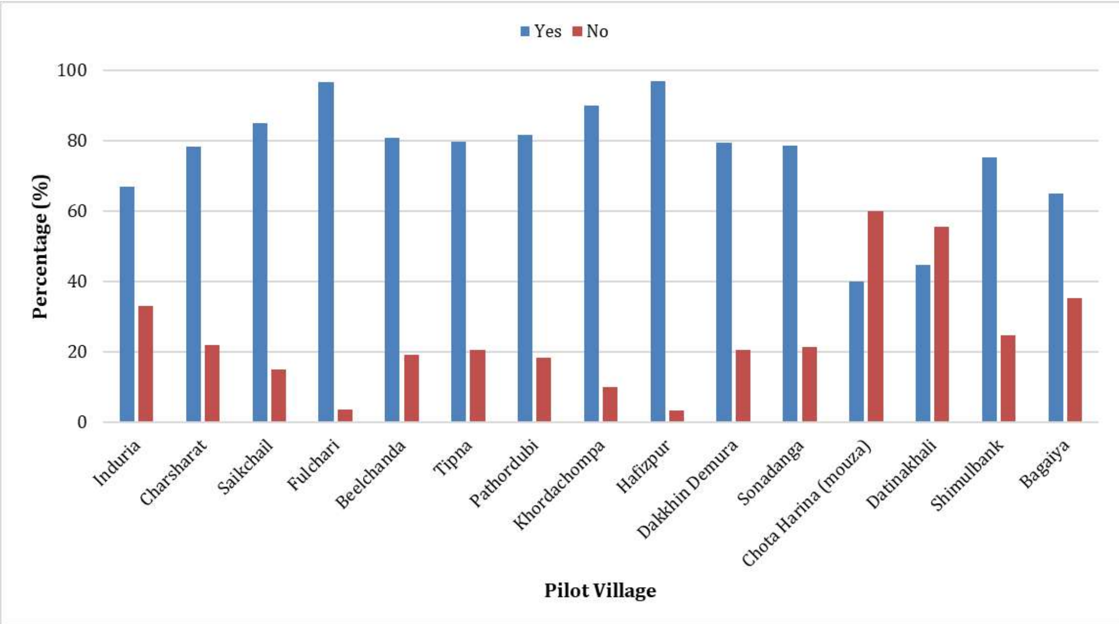


Figure 4.32: Satisfaction and dissatisfaction over drinking water (pilot villages)

During the baseline survey, the respondents were asked if they were satisfied or dissatisfied with the water they used for cooking purposes. Most respondents (78.62%) reported being satisfied, but 21.38% said they were dissatisfied. In Chota Harina (mouza) and Datinakhali village, 46.51% and 41.37% reported to be satisfied with their drinking water, respectively (**Figure 4.33**).

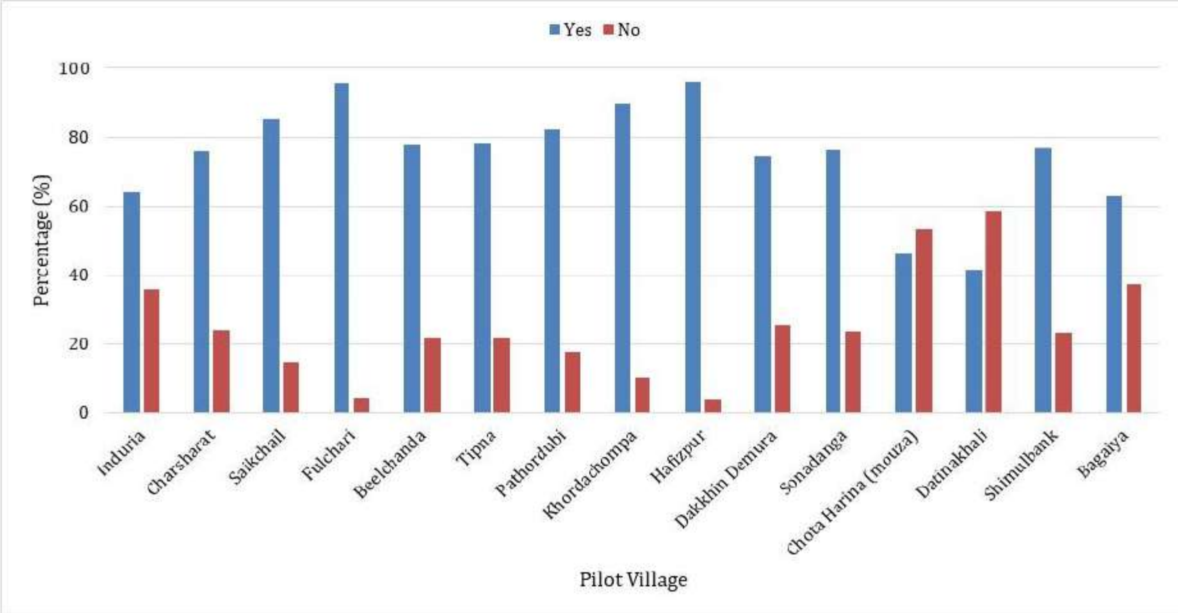


Figure 4.33: Satisfaction and dissatisfaction over water for cooking purposes (pilot villages

Sample Villages

The baseline survey asked if the respondents were satisfied with the water used for drinking purposes. Most respondents (76.88%) reported being satisfied, while 23.13% said they were dissatisfied. Less than 50% of the respondents in the sample village of Satkhira district expressed satisfaction (**Figure 4.34**).

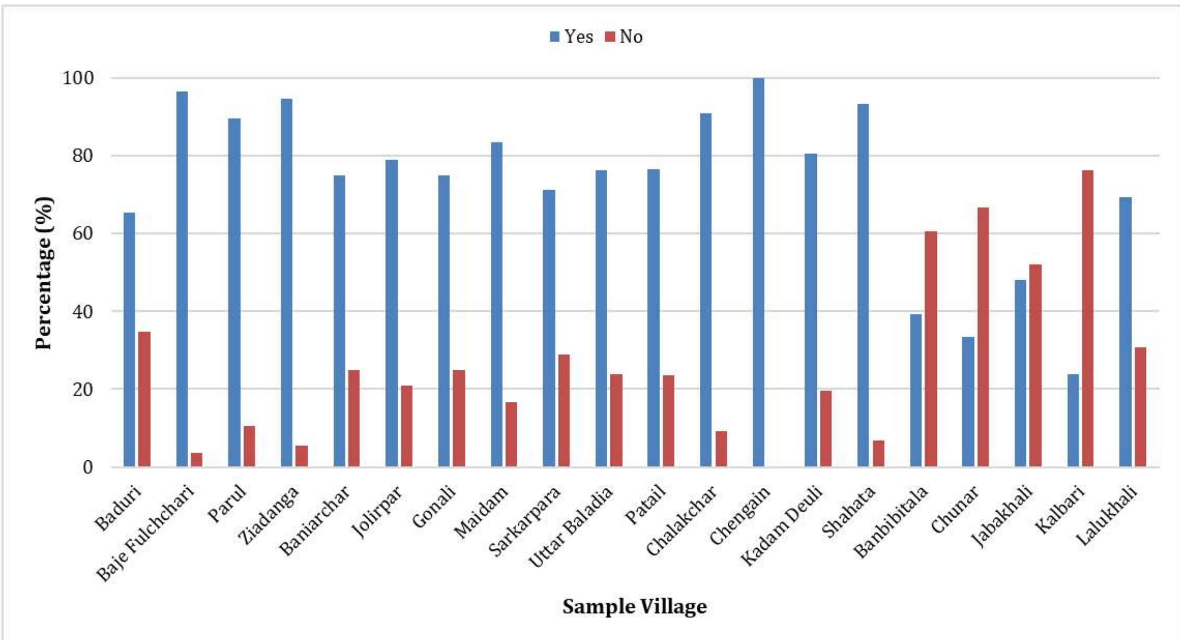


Figure 4.34: Satisfaction and dissatisfaction over drinking water (sample villages)

During the baseline survey, the respondents were asked if they were satisfied or dissatisfied with the water used for cooking purposes. Most respondents (75.88%) reported being satisfied, while 24.13% said they were dissatisfied. In the sample village of Satkhira district, less than 53% were satisfied with the water used for cooking in their area (**Figure 4.35**).

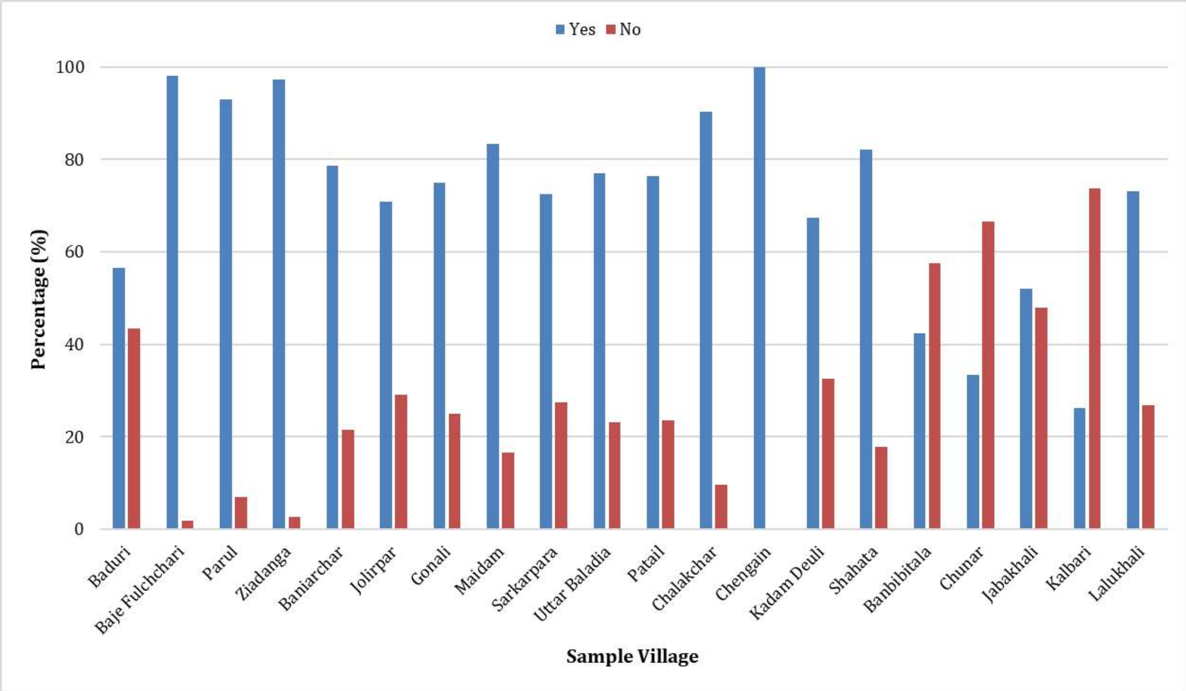


Figure 4.35: Satisfaction and dissatisfaction over water for cooking purposes (sample villages)

4.2.7 *Current Water Demand*

The following tables and graphs reflect the current water demand in the study area. They indicate the water availability for drinking and cooking, an increase in safe water usage given a reliable and safe drinking water supply, the utilization of that excess water, and daily water usage. The parameters require a strict application to determine the current demand of the pilot and sample villages.

Pilot Villages

The table below presents the extent of water availability in the pilot villages—the highest available drinking water is in Hafizpur, Narsingdi (96.84%). The lowest percentage was noted in Chota Harina, Rangamati (40%). The average rate of available drinking water in the pilot villages is 75.87%. An average of 24.13% of the households in all the pilot villages do not have access to sufficient drinking water.

Table 4.27: Drinking water availability (pilot villages)

District	Village	Yes		No	
		n	%	n	%
Barishal	Induria	487	66.9	241	33.1
Chattogram	Charsharat	735	78.19	205	21.81
Cumilla	Saikchail	1404	84.99	248	15.01
Gaibandha	Fulchari	364	96.55	13	3.45
Gopalganj	Beelchanda	317	80.87	75	19.13
Khulna	Tipna	614	79.53	158	20.47
Kurigram	Pathordubi	2015	81.61	454	18.39

District	Village	Yes		No	
		n	%	n	%
Naogaon	Khordachompa	413	89.98	46	10.02
Narsingdi	Hafizpur	1594	96.84	52	3.16
Netrakona	Dakkhin Demura	296	79.36	77	20.64
Rajshahi	Sonadanga	557	78.56	152	21.44
Rangamati	Chota Harina (mouza)	86	40	129	60
Satkhira	Datinakhali	253	44.54	315	55.46
Sunamganj	Shimulbank	348	75.32	114	24.68
Sylhet	Bagaiya	597	64.82	324	35.18

A look at the graph (**Figure 4.36**) gives a clear picture of the current drinking water situations in the pilot villages.

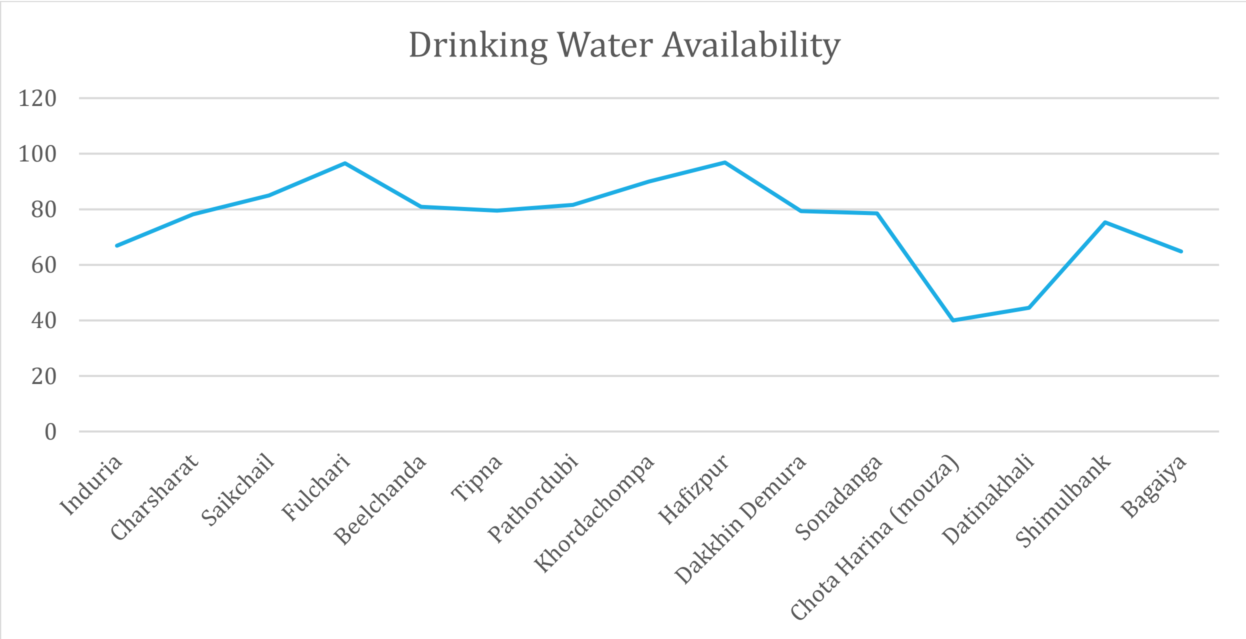


Figure 4.36: Drinking water availability graph

The table presented below shows the availability of water for cooking. Around 96.11% of the households in Hafizpur have sufficient water for cooking. In comparison, 58.63% of the households in Chota Harina do not have access to sufficient amounts of water for cooking purposes.

Table 4.28: Water availability for cooking purposes

District	Village	Yes		No	
		n	%	n	%
Barishal	Induria	466	64.01	262	35.99
Chattogram	Charsharat	714	75.96	226	24.04
Cumilla	Saikchail	1411	85.41	241	14.59
Gaibandha	Fulchari	361	95.76	16	4.24

District	Village	Yes		No	
		n	%	n	%
Gopalganj	Beelchanda	306	78.06	86	21.94
Khulna	Tipna	604	78.24	168	21.76
Kurigram	Pathordubi	2029	82.18	440	17.82
Naogaon	Khordachompa	412	89.76	47	10.24
Narsingdi	Hafizpur	1582	96.11	64	3.89
Netrakona	Dakkhin Demura	278	74.53	95	25.47
Rajshahi	Sonadanga	541	76.3	168	23.7
Rangamati	Chota Harina (mouza)	100	46.51	115	53.49
Satkhira	Datinakhali	235	41.37	333	58.63
Sunamganj	Shimulbank	355	76.84	107	23.16
Sylhet	Bagaiya	578	62.76	343	37.24

The graph below shows the water availability for cooking purposes. The graph has an increasing slope from Induria to Fulchari village, meaning that water availability for cooking is increasing in that area. A general outline of the chart shows that it is in a decreasing trend till it reaches Datina Khali. After that, the graph has an increasing slope.

Figure 4.37: Water availability for cooking purposes

The following table shows people's willingness to increase water usage given more safe and drinkable water. 90.85% of the households in Datinakhali have consented to increase their water use, while 67.56% of the households in Hafizpur responded that they did not need more water than currently available.

Table 4.29: Increase in water usage if more water is available

District	Village	Yes		No	
		n	%	n	%
Barishal	Induria	507	69.64	221	30.36
Chattogram	Charsharat	366	38.94	574	61.06

District	Village	Yes		No	
		n	%	n	%
Cumilla	Saikchail	582	35.23	1070	64.77
Gaibandha	Fulchari	182	48.28	195	51.72
Gopalganj	Beelchanda	115	29.34	277	70.66
Khulna	Tipna	507	65.67	265	34.33
Kurigram	Pathordubi	1170	47.39	1299	52.61
Naogaon	Khordachompa	197	42.92	262	57.08
Narsingdi	Hafizpur	534	32.44	1112	67.56
Netrakona	Dakkhin Demura	191	51.21	182	48.79
Rajshahi	Sonadanga	319	44.99	390	55.01
Rangamati	Chota Harina (mouza)	168	78.14	47	21.86
Satkhira	Datinakhali	516	90.85	52	9.15
Sunamganj	Shimulbank	217	46.97	245	53.03
Sylhet	Bagaiya	438	47.56	483	52.44

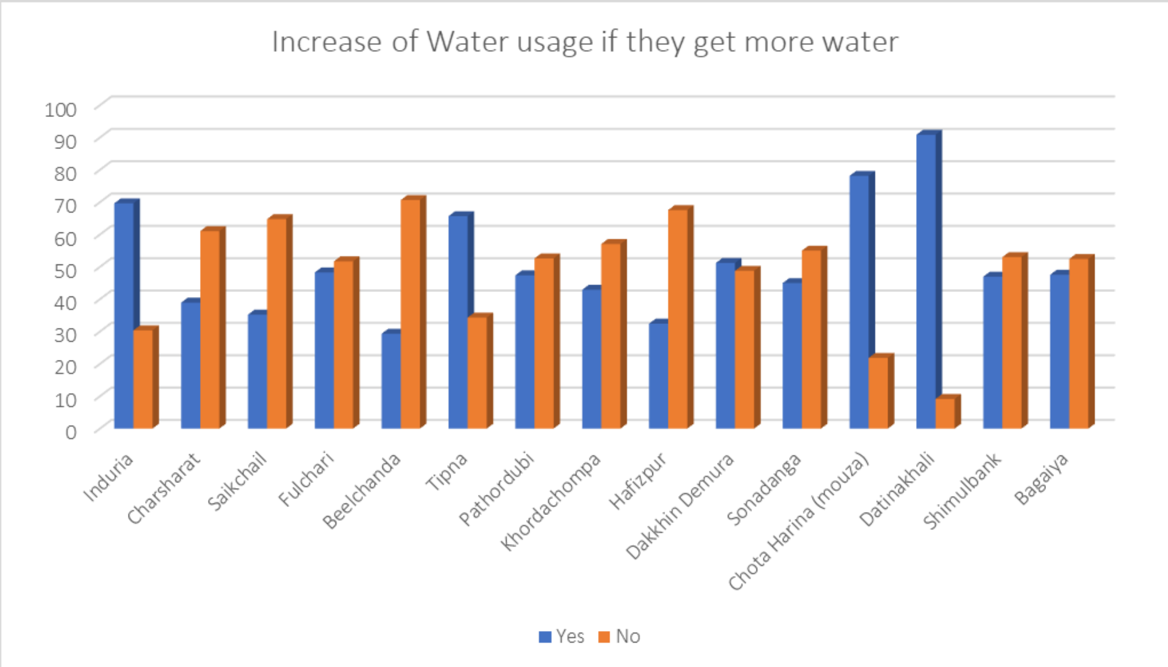


Figure 4.38: Increase in water usage if more water is available (sample villages)

The following table shows in which locations people want to increase water usage. The highest demand for increase in *drinking water* usage is in Datinakhali, Satkhira (28.53%); *for cooking water in* Datinakhali (28.89%); water for cleaning purposes in Shimulbank, Sunamganj (27.63%), water for gardening (17.98%), for *watering cattle* in Parhordubi village (22.09%), and water for *bathing* in Hafizpur (29.8%).

Table 4.30: Purposes of increased water use (sample villages)

District	Village	Cleanliness		Cooking		Drinking		Gardening		Others		Taking bath		Watering cattle	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%
Barishal	Induria	396	25.83	238	15.53	232	15.13	121	7.89	-	-	391	25.51	155	10.11
Chattogram	Charsharat	336	24.49	272	19.83	189	13.78	170	12.39	-	-	255	18.59	150	10.93
Cumilla	Saikchail	532	27.21	302	15.45	303	15.5	264	13.5	-	-	382	19.54	172	8.8
Gaibandha	Fulchari	145	21.45	98	14.5	46	6.8	105	15.53	1	0.15	135	19.97	146	21.6
Gopalganj	Beelchanda	88	26.35	65	19.46	63	18.86	34	10.18	-	-	69	20.66	15	4.49
Khulna	Tipna	430	26.74	226	14.05	207	12.87	40	2.49	3	0.19	447	27.8	255	15.86
Kurigram	Pathordubi	848	20.03	368	8.69	359	8.48	761	17.98	-	-	962	22.73	935	22.09
Naogaon	Khordachompa	183	21.94	155	18.59	96	11.51	62	7.43	-	-	183	21.94	155	18.59
Narsingdi	Hafizpur	399	25.79	116	7.5	85	5.49	241	15.58	2	0.13	461	29.8	243	15.71
Netrakona	Dakkhin Demura	141	20.8	144	21.24	110	16.22	61	9	-	-	154	22.71	68	10.03
Rajshahi	Sonadanga	264	22.51	192	16.37	110	9.38	98	8.35	-	-	296	25.23	213	18.16
Rangamati	Chota Harina (mouza)	164	23.3	109	15.48	120	17.05	84	11.93	1	0.14	142	20.17	84	11.93
Satkhira	Datinakhali	430	24.84	500	28.89	494	28.54	42	2.43	-	-	229	13.23	36	2.08
Sunamganj	Shimulbank	197	27.63	110	15.43	96	13.46	63	8.84	-	-	169	23.7	78	10.94
Sylhet	Bagaiya	341	24.25	327	23.26	307	21.83	112	7.97	-	-	281	19.99	38	2.7

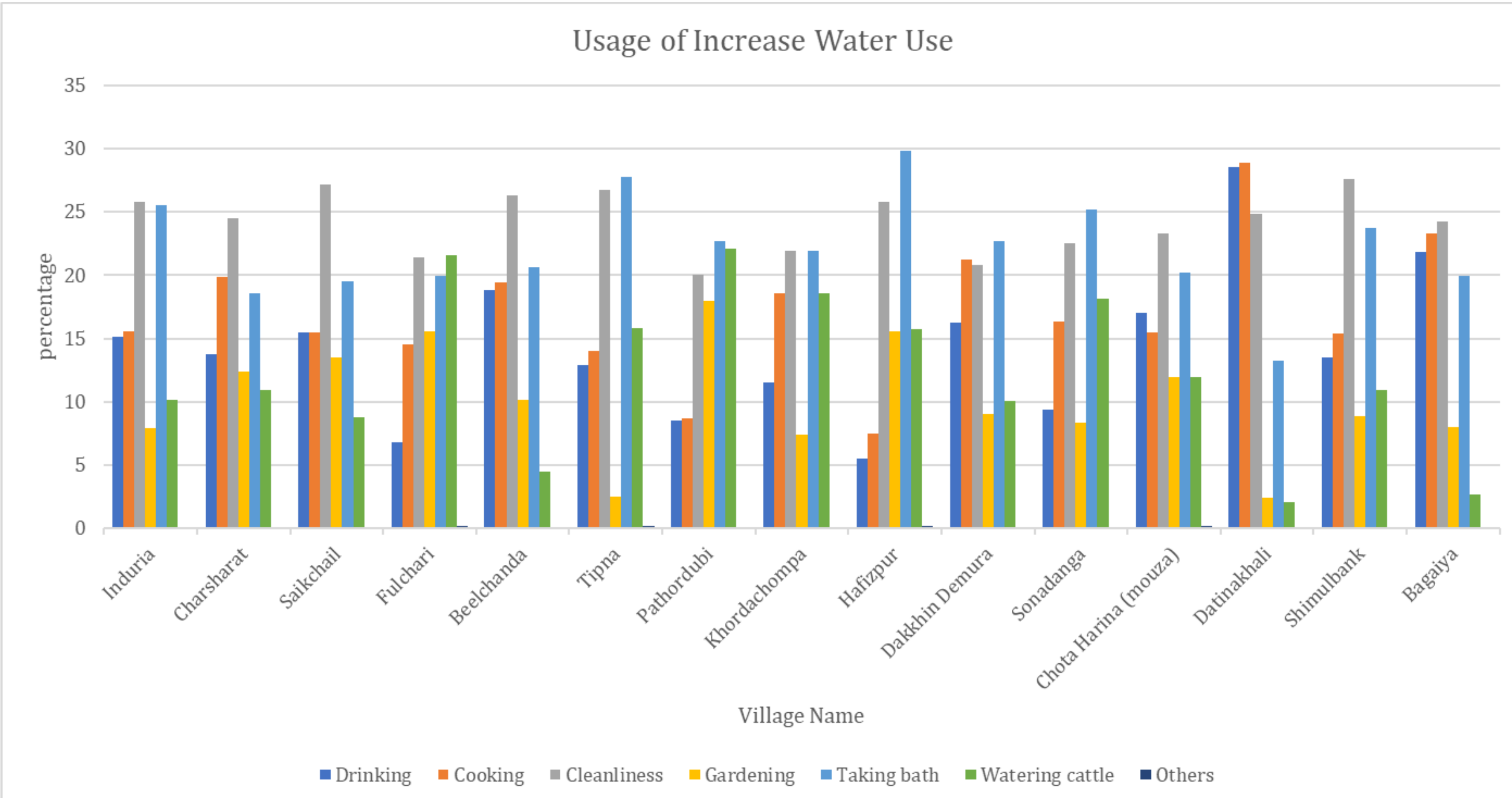


Figure 4.39: Purposes of increased water use

The daily water use demand of the pilot villages can be calculated from the table below. The highest demand (16.08%) for increase of 0-5 L water usage is in Hafizpur of Narsingdi, for increase of 5-8L in Dakhin Demura (31%), increase of 8-10 L in Chota Harina of Rangamati (31.31%), increase of 10-15L in Saikchail (35.94%) and increase of more than 15 L in Tipna (56.31%).

Table 4.31: Amount of daily water use (pilot villages)

District	Village	0-5 L		5-8 L		8-10 L		10-15 L		>15 L	
		n	%	n	%	n	%	n	%	n	%
Barishal	Induria	11	1.51	39	5.36	112	15.38	211	28.98	355	48.76
Chattogram	Charsharat	41	4.38	118	12.61	207	22.12	255	27.24	315	33.65
Cumilla	Saikchail	84	5.09	203	12.3	331	20.06	593	35.94	439	26.61
Gaibandha	Fulchari	27	7.18	66	17.55	53	14.1	114	30.32	116	30.85
Gopalganj	Beelchanda	17	4.34	24	6.12	65	16.58	121	30.87	165	42.09
Khulna	Tipna	53	6.89	62	8.06	87	11.31	134	17.43	433	56.31
Kurigram	Pathordubi	90	3.65	421	17.06	639	25.89	753	30.51	565	22.89
Naogaon	Khordachompa	15	3.28	39	8.52	107	23.36	131	28.6	166	36.24
Narsingdi	Hafizpur	264	16.08	485	29.54	413	25.15	297	18.09	183	11.14
Netrakona	Dakkhin Demura	33	8.89	115	31	114	30.73	69	18.6	40	10.78
Rajshahi	Sonadanga	16	2.26	59	8.35	156	22.07	240	33.95	236	33.38
Rangamati	Chota Harina (mouza)	4	1.87	12	5.61	67	31.31	49	22.9	82	38.32
Satkhira	Datinakhali	7	1.24	42	7.42	84	14.84	176	31.1	257	45.41
Sunamganj	Shimulbank	10	2.16	26	5.63	53	11.47	158	34.2	215	46.54
Sylhet	Bagaiya	11	1.2	36	3.91	121	13.15	274	29.78	478	51.96

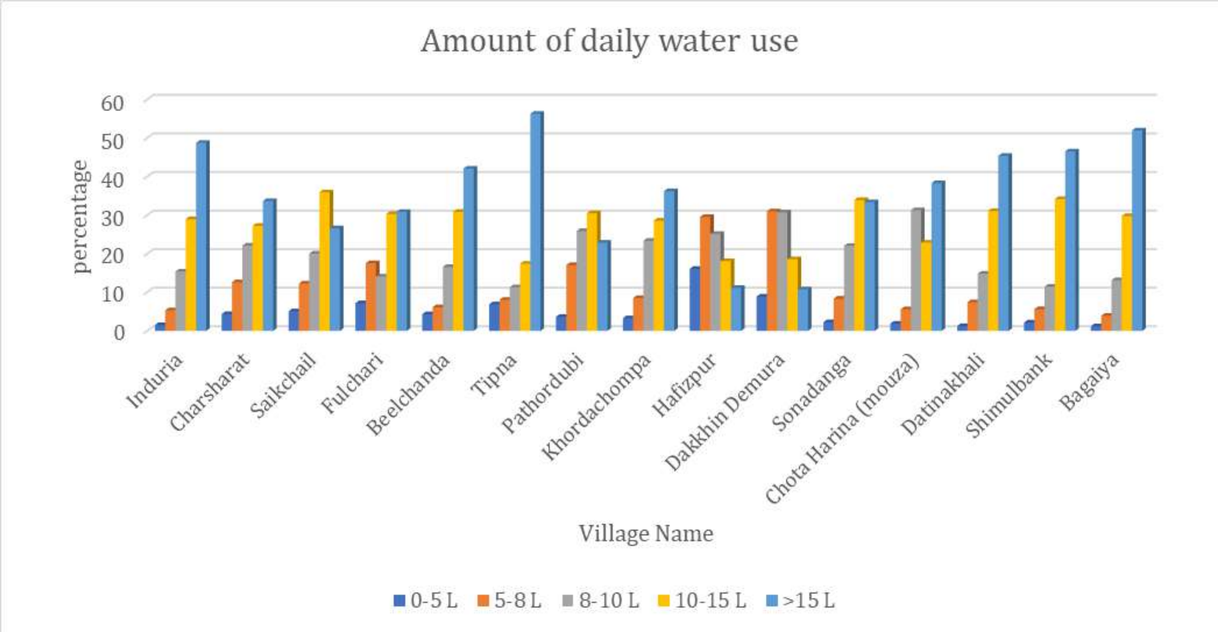


Figure 4.40: Daily water use (sample villages)

Sample Villages

Only 10% of the total households in the sample villages were covered by the survey. The following data present the survey results.

According to the study, while 96.36% of the households in Baje Fulchari reported that they had enough drinking water available to them, 76.19% of the households in Kalbari reported that there was not enough drinking water available in their areas. The following table shows the data on drinking water availability.

Table 4.32: Availability of drinking water (pilot villages)

District	Village	Yes		No	
		n	%	n	%
Barishal	Baduri	15	65.22	8	34.78
Gaibandha	Baje Fulchchari	53	96.36	2	3.64
	Parul	51	89.47	6	10.53
	Ziadanga	35	94.59	2	5.41
Gopalganj	Baniarchar	63	75	21	25
	Jolirpar	147	79.03	39	20.97
Khulna	Gonali	45	75	15	25
Kurigram	Maidam	60	83.33	12	16.67
	Sarkarpara	148	71.15	60	28.85
	Uttar Baladia	218	76.22	68	23.78
Naogaon	Patail	13	76.47	4	23.53
Narsingdi	Chalakchar	159	90.86	16	9.14
	Chengain	50	100	-	-
Netrakona	Kadam Deuli	37	80.43	9	19.57
	Shahata	68	93.15	5	6.85
Satkhira	Banbibitala	13	39.39	20	60.61

District	Village	Yes		No	
		n	%	n	%
	Chunar	15	33.33	30	66.67
	Jabakhali	12	48	13	52
	Kalbari	10	23.81	32	76.19
Sunamganj	Lalukhali	18	69.23	8	30.77

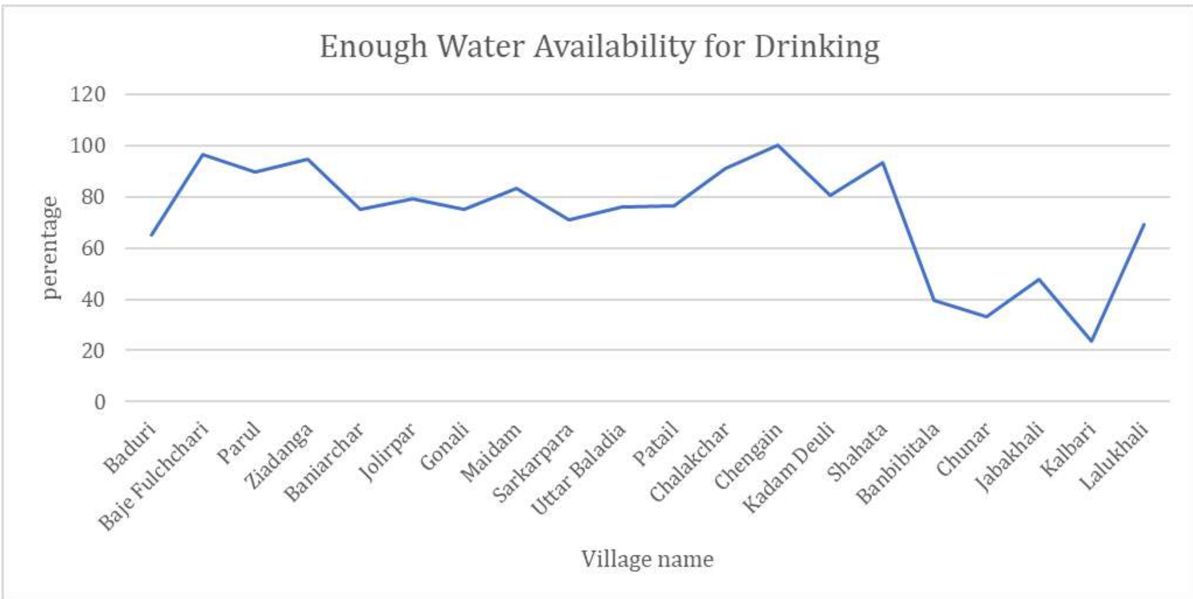


Figure 4.41: Availability of drinking water (sample villages)

The table below presents the availability of water for cooking purposes. The found that 98.18% of the households in Baje Fulchari had enough water available for cooking purposes, but that 43.48% of the households in Baduri did not have enough water in their areas.

Table 4.33: Availability of water for cooking purposes (sample villages)

District	Village	Yes		No	
		n	%	n	%
Barishal	Baduri	13	56.52	10	43.48
Gaibandha	Baje Fulchchari	54	98.18	1	1.82
	Parul	53	92.98	4	7.02
	Ziadanga	36	97.3	1	2.7
Gopalganj	Baniarchar	66	78.57	18	21.43
	Jolirpar	132	70.97	54	29.03
Khulna	Gonali	45	75	15	25
Kurigram	Maidam	60	83.33	12	16.67
	Sarkarpara	151	72.6	57	27.4
	Uttar Baladia	220	76.92	66	23.08
Naogaon	Patail	13	76.47	4	23.53
Narsingdi	Chalakchar	158	90.29	17	9.71
	Chengain	50	100	-	-
Netrakona	Kadam Deuli	31	67.39	15	32.61
	Shahata	60	82.19	13	17.81

District	Village	Yes		No	
		n	%	n	%
Satkhira	Banbibitala	14	42.42	19	57.58
	Chunar	15	33.33	30	66.67
	Jabakhali	13	52	12	48
	Kalbari	11	26.19	31	73.81
Sunamganj	Lalukhali	19	73.08	7	26.92

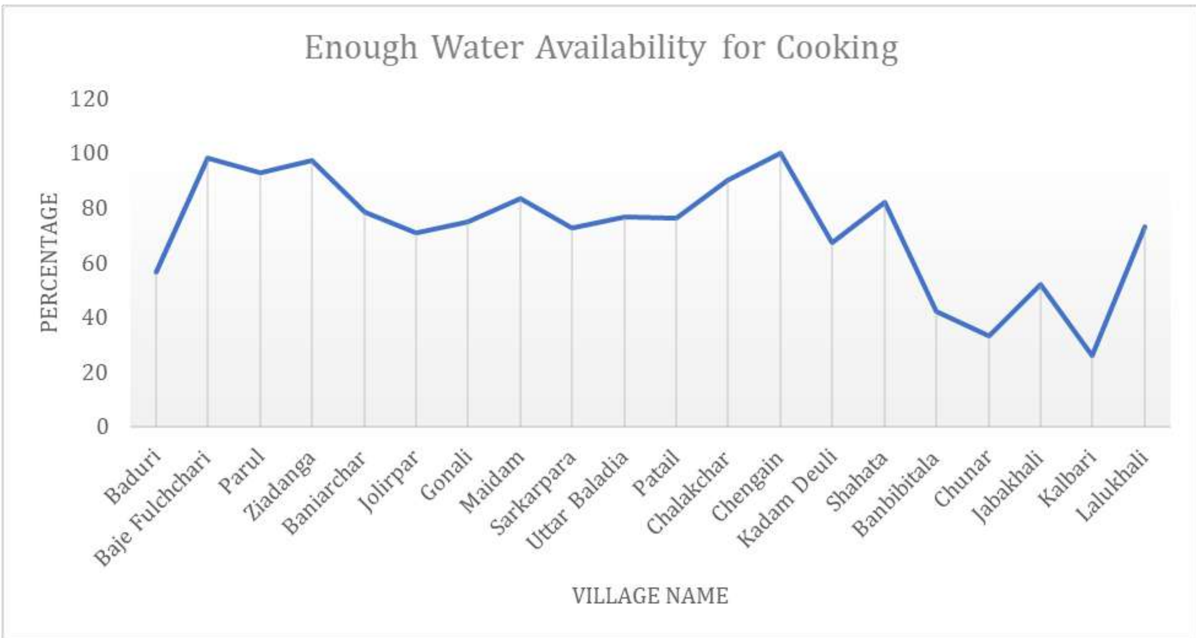


Figure 4.42: Availability of water for cooking (sample villages)

The study gathered information about whether the households would use more water if more water was available. The results of the survey are presented by the data below.

The survey found that 97.62% of the households in Kalbari thought they would use more water if more water was available, but that 75.68% of the households in Ziadanga of Gaibandha did not think increased water availability would have any effect on their current water use.

Table 4.34: Increase of water usage if more water is available (sample villages)

District	Village	Yes		No	
		n	%	n	%
Barishal	Baduri	18	78.26	5	21.74
Gaibandha	Baje Fulchchari	32	58.18	23	41.82
	Parul	24	42.11	33	57.89
	Ziadanga	9	24.32	28	75.68
Gopalganj	Baniarchar	31	36.9	53	63.1
	Jolirpar	77	41.4	109	58.6
Khulna	Gonali	35	58.33	25	41.67
Kurigram	Maidam	29	40.28	43	59.72
	Sarkarpara	96	46.15	112	53.85
	Uttar Baladia	148	51.75	138	48.25

District	Village	Yes		No	
		n	%	n	%
Naogaon	Patail	13	76.47	4	23.53
Narsingdi	Chalakchar	82	46.86	93	53.14
	Chengain	16	32	34	68
Netrakona	Kadam Deuli	36	78.26	10	21.74
	Shahata	45	61.64	28	38.36
Satkhira	Banbibitala	27	81.82	6	18.18
	Chunar	38	84.44	7	15.56
	Jabakhali	24	96	1	4
	Kalbari	41	97.62	1	2.38
Sunamganj	Lalukhali	13	50	13	50

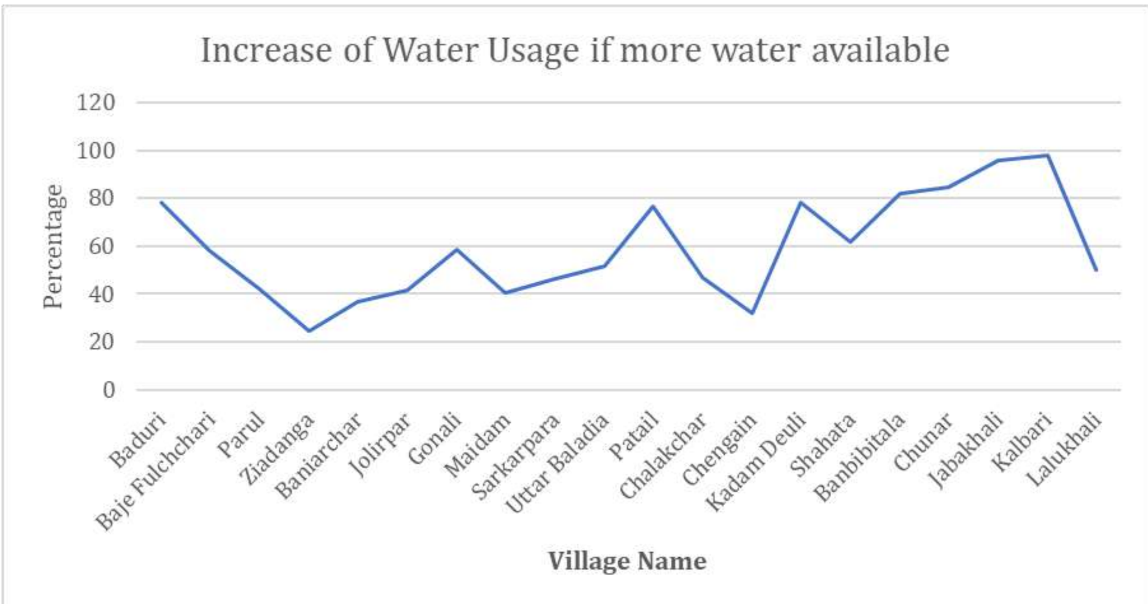


Figure 4.43: Increase of water usage if more water is available (sample villages)

The following table presents the areas where households want to increase their water usage.

The table shows that 29.55% of the households in Lalukhali would use more water for the purpose of cleaning. In Kalbari, 24.29% of the households would use more water for the purpose of cooking, and 26.43% for the purpose of drinking. However, in Ziadanga, 18.75% of the households would use more water for gardening, while in Kadam Deuli 30.36% of the households would use it for bathing, and in Parul 22.73% of the households would use it for watering cattle.

Table 4.35: Areas of increased water use (sample villages)

District	Village	Cleanliness		Cooking		Drinking		Gardening		Others		Bathing		Watering cattle	
		n	%	n	%	n	%	n	%	n	%	n	%	n	%
Barishal	Baduri	11	20.37	8	14.81	8	14.81	5	9.26	-	-	14	25.93	8	14.81
Gaibandha	Baje Fulchchari	28	19.31	22	15.17	12	8.28	23	15.86	-	-	32	22.07	28	19.31
	Parul	21	23.86	12	13.64	3	3.41	14	15.91	-	-	18	20.45	20	22.73
	Ziadanga	9	28.12	4	12.5	1	3.12	6	18.75	-	-	7	21.88	5	15.62
Gopalganj	Baniarchar	24	27.27	17	19.32	20	22.73	5	5.68	-	-	15	17.05	7	7.95
	Jolirpar	69	31.36	50	22.73	30	13.64	10	4.55	-	-	53	24.09	8	3.64
Khulna	Gonali	35	28.23	15	12.1	15	12.1	7	5.65	-	-	33	26.61	19	15.32
Kurigram	Maidam	21	19.81	11	10.38	11	10.38	13	12.26	-	-	27	25.47	23	21.7
	Sarkarpara	65	18.16	48	13.41	47	13.13	55	15.36	-	-	79	22.07	64	17.88
	Uttar Baladia	85	16.63	59	11.55	58	11.35	76	14.87	-	-	126	24.66	107	20.94
Naogaon	Patail	12	21.05	13	22.81	9	15.79	-	-	-	-	13	22.81	10	17.54
Narsingdi	Chalakchar	64	25.5	21	8.37	15	5.98	46	18.33	-	-	59	23.51	46	18.33
	Chengain	10	29.41	1	2.94	-	-	6	17.65	-	-	10	29.41	7	20.59
Netrakona	Kadam Deuli	33	29.46	23	20.54	13	11.61	3	2.68	-	-	34	30.36	6	5.36
	Shahata	35	24.31	34	23.61	12	8.33	9	6.25	-	-	37	25.69	17	11.81
Satkhira	Banbibitala	22	24.72	19	21.35	22	24.72	6	6.74	-	-	17	19.1	3	3.37
	Chunar	32	24.81	31	24.03	33	25.58	9	6.98	1	0.78	20	15.5	3	2.33
	Jabakhali	19	25	16	21.05	18	23.68	2	2.63	-	-	15	19.74	6	7.89
	Kalbari	36	25.71	34	24.29	37	26.43	6	4.29	1	0.71	24	17.14	2	1.43
Sunamganj	Lalukhali	13	29.55	8	18.18	6	13.64	2	4.55	-	-	13	29.55	2	4.55

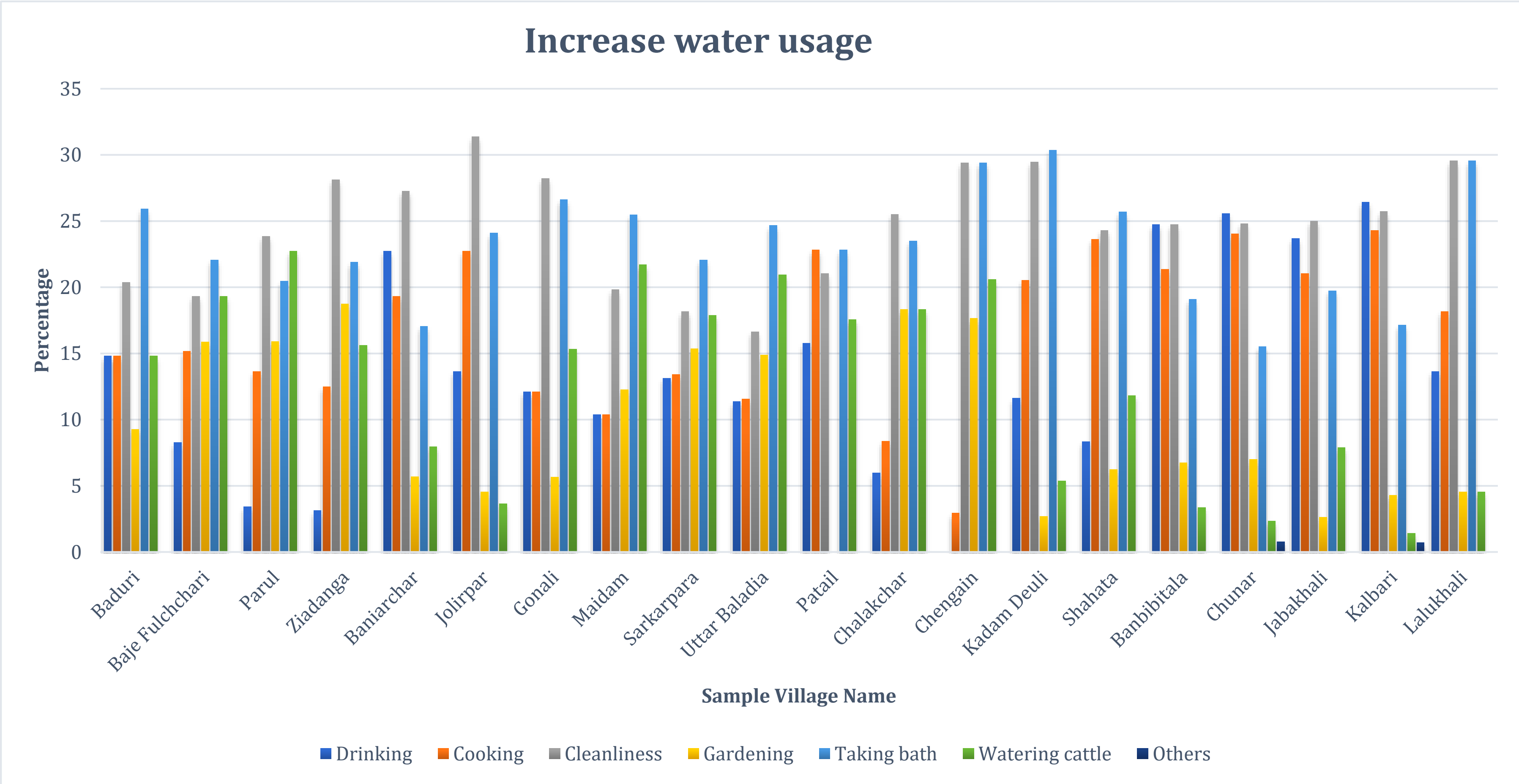


Figure 4.44: Areas of increased water use (sample villages)

The table below presents the daily water use in the ***sample villages***. The table shows that 11.11 % of the households in Ziadanga use 0-5L of water, 23.91% of the households in Kadam Deuli use 5-8L, 30.43% of the households in Baduri use 8-10 L, 47.06% of the households in Patail use 10-15L and 68.33% of the household in Gonali use more than 15L.

Table 4.36: Daily water use (sample villages)

District	Village	0-5 L		5-8 L		8-10 L		10-15 L		>15 L	
		n	%	n	%	n	%	n	%	n	%
Barishal	Baduri	1	4.35	-	-	7	30.43	3	13.04	12	52.17
Gaibandha	Baje Fulchchari	2	3.64	5	9.09	6	10.91	11	20	31	56.36
	Parul	2	3.57	6	10.71	3	5.36	10	17.86	35	62.5
	Ziadanga	4	11.11	7	19.44	-	-	3	8.33	22	61.11
Gopalganj	Baniarchar	1	1.19	2	2.38	5	5.95	18	21.43	58	69.05
	Jolirpar	4	2.15	13	6.99	32	17.2	49	26.34	88	47.31
Khulna	Gonali	1	1.67	1	1.67	5	8.33	12	20	41	68.33
Kurigram	Maidam	2	2.78	8	11.11	14	19.44	22	30.56	26	36.11
	Sarkarpara	7	3.37	19	9.13	51	24.52	56	26.92	75	36.06
	Uttar Baladia	5	1.75	19	6.64	67	23.43	94	32.87	101	35.31
Naogaon	Patail	-	-	-	-	2	11.76	8	47.06	7	41.18
Narsingdi	Chalakchar	13	7.43	63	36	50	28.57	36	20.57	13	7.43
	Chengain	3	6	23	46	12	24	11	22	1	2
Netrakona	Kadam Deuli	3	6.52	11	23.91	8	17.39	14	30.43	10	21.74
	Shahata	3	4.11	7	9.59	22	30.14	22	30.14	19	26.03
Satkhira	Banbibitala	-	-	2	6.06	3	9.09	8	24.24	20	60.61
	Chunar	1	2.22	2	4.44	8	17.78	8	17.78	26	57.78
	Jabakhali	-	-	1	4	3	12	5	20	16	64
	Kalbari	-	-	3	7.14	8	19.05	10	23.81	21	50
Sunamganj	Lalukhali	-	-	1	3.85	1	3.85	9	34.62	15	57.69

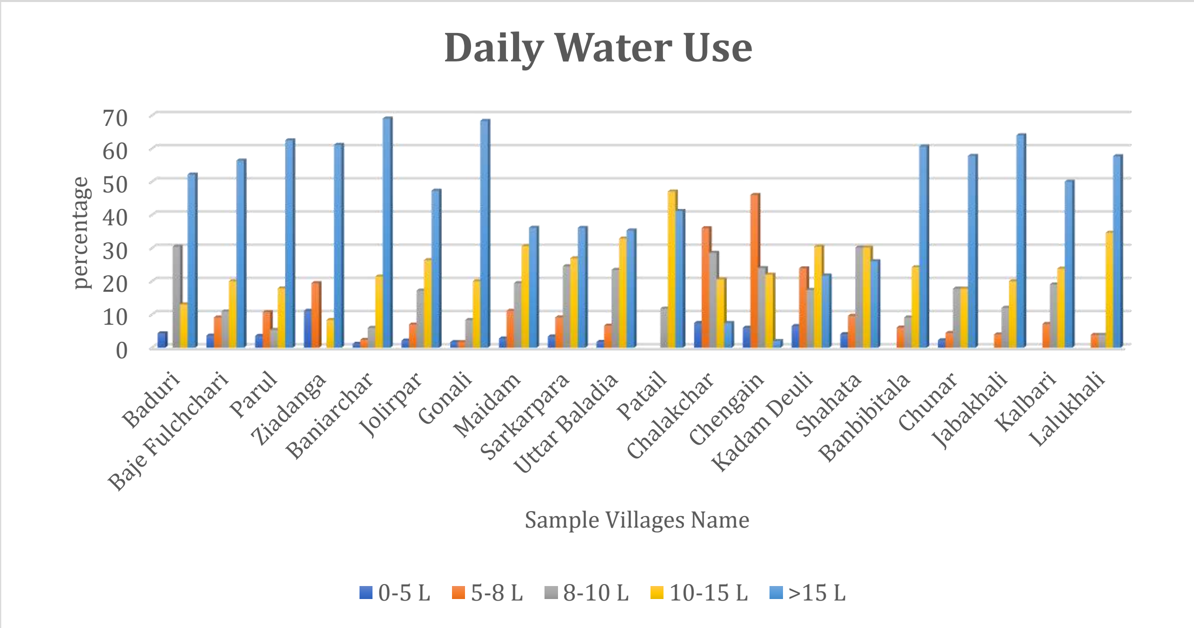


Figure 4.45: Daily water use (sample villages)

4.2.8 *Piped Water Supply System*

Pilot Villages

A study was carried out regarding piped water supply availability in the pilot and sample villages. It was found that piped water supply availability was below 20% and even below 5% in the pilot villages except for the Khordachampa village of Naogaon where its availability was 85.84%.

Table 4.37: Piped water supply availability (pilot villages)

District	Village	Yes		No	
		n	%	n	%
Barishal	Induria	13	1.79	715	98.21
Chattogram	Charsharat	20	2.13	920	97.87
Cumilla	Saikchail	64	3.87	1588	96.13
Gaibandha	Fulchari	7	1.86	370	98.14
Gopalganj	Beelchanda	9	2.3	383	97.7
Khulna	Tipna	8	1.04	764	98.96
Kurigram	Pathordubi	78	3.16	2391	96.84
Naogaon	Khordachompa	394	85.84	65	14.16
Narsingdi	Hafizpur	34	2.07	1612	97.93
Netrakona	Dakkhin Demura	6	1.61	367	98.39
Rajshahi	Sonadanga	127	17.91	582	82.09
Rangamati	Chota Harina (mouza)	28	13.02	187	86.98
Satkhira	Datinakhali	12	2.11	556	97.89
Sunamganj	Shimulbank	27	5.84	435	94.16
Sylhet	Bagaiya	31	3.37	890	96.63

The graph below shows the scarcity of piped water supply in pilot villages.

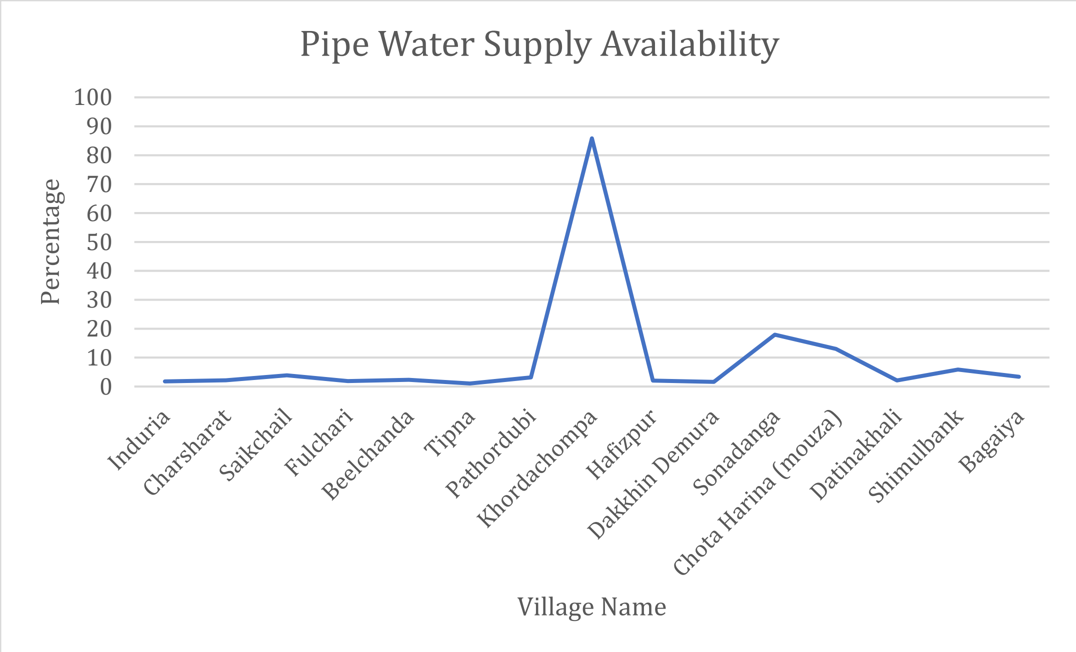


Figure 4.46: Piped water supply availability (pilot villages)

Sample Villages

In the sample villages, where only 10% of the total households were covered by the survey, piped water supply availability was studied. The situation in the sample villages is almost the same as in the pilot villages. Piped water supply is not much available in those areas. Among the sample villages, only the Patail village of Naogaon has 58.82% availability of piped water, which means some households do have access to piped water in that village. Its availability in the rest of the villages is below 15%.

Table 4.38: Piped water supply availability (sample villages)

District	Village	Yes		No	
		n	%	n	%
Barishal	Baduri	-	-	23	100
Gaibandha	Baje Fulchchari	3	5.45	52	94.55
	Parul	1	1.75	56	98.25
	Ziadanga	2	5.41	35	94.59
Gopalganj	Baniarchar	4	4.76	80	95.24
	Jolirpar	4	2.15	182	97.85
Khulna	Gonali	3	5	57	95
Kurigram	Maidam	1	1.39	71	98.61
	Sarkarpara	6	2.88	202	97.12
	Uttar Baladia	10	3.5	276	96.5
Naogaon	Patail	10	58.82	7	41.18
Narsingdi	Chalakchar	6	3.43	169	96.57
	Chengain	1	2	49	98
Netrakona	Kadam Deuli	-	-	46	100
	Shahata	-	-	73	100

District	Village	Yes		No	
		n	%	n	%
Satkhira	Banbibitala	4	12.12	29	87.88
	Chunar	3	6.67	42	93.33
	Jabakhali	1	4	24	96
	Kalbari	1	2.38	41	97.62
Sunamganj	Lalukhali	2	7.69	24	92.31

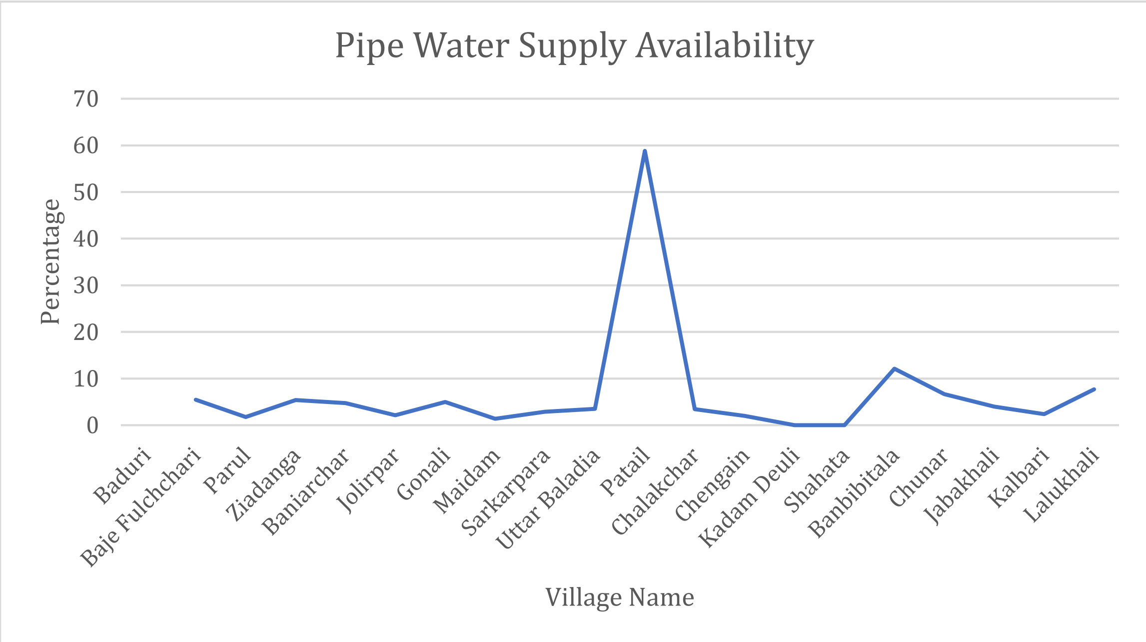


Figure 4.47: Piped water supply availability (sample villages)

4.2.9 *Suggestions for Improving Water Supply System*

Pilot Villages

During the baseline survey, the respondents were asked for suggestions for improving the water supply system in their areas. Most of the respondents (30.18%) proposed improving the water supply system, with 23.90% putting forward the suggestion of improving arsenic-free tube wells, 19.54% wanting to improve region-based deep tubewells, and the rest wanting to elevate installation of tubewells, water supply by the government and non-government organizations during disasters etc. Improvements were also proposed by 47.53% of the people of Beelchanda and 44.98% of the people of Hafizpur village (**Figure 4.48**).

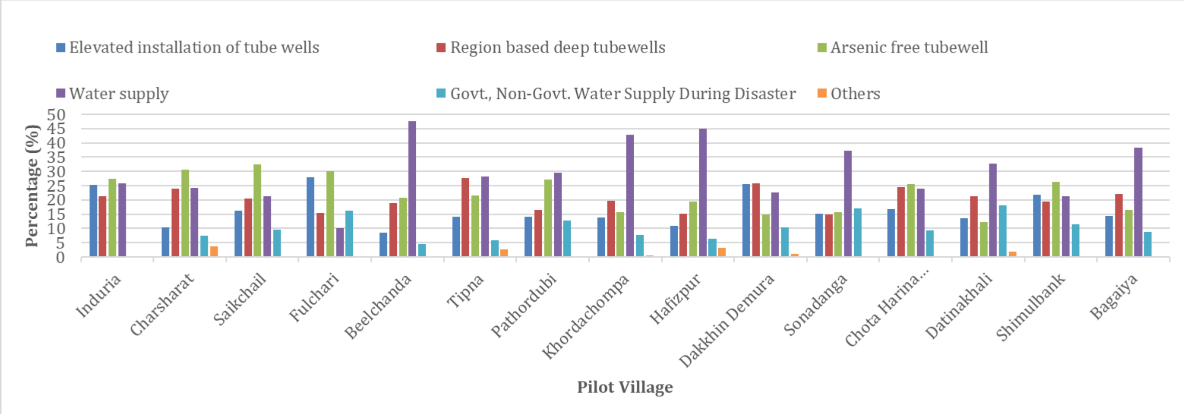


Figure 4.48: Suggestions for improving water supply system (pilot villages)

Sample Villages

During the baseline survey, the respondents were asked for suggestions for improving the water supply system in their areas. Most of the respondents (30.70%) proposed to improve the water supply system, with 22.63% wanting to improve arsenic-free tube wells and 42.62% of the people of Baniarchar wanting to improve the water supply system in their area (**Figure 4.49**).

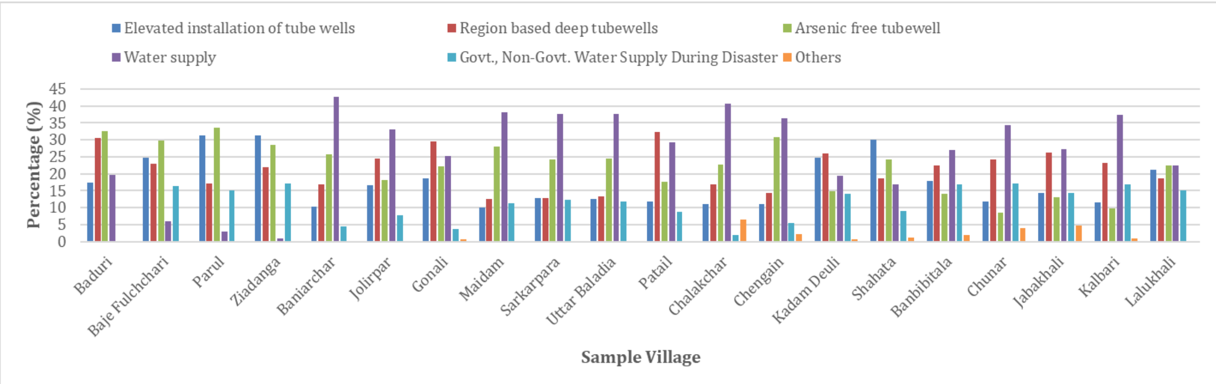


Figure 4.49: Suggestions for improving water supply system (sample villages)

4.3 Sanitation and Sludge Management

4.3.1 *Sanitation Practice*

The study results show that among the 12,684 households studied in total, 75.34% have latrines. Among those, the most common is pit latrine (43.40%), VIP latrine (15.30 %), and flush latrine (9.19%). The study results further reveal that the sanitary conditions in the Fulchari village of Gaibandha, the Khordchampa village of Naogaon and the Shimulbank village of Sunamganj are not good and need to improve much.

Table 4.39: Availability of toilet facilities (pilot villages)

District	Village	Yes		No		Total Households
		n	%	n	%	
Barishal	Induria	605	83.1	123	16.9	728
Chattogram	Charsharat	714	75.96	226	24.04	941
Cumilla	Saikchail	1250	75.67	402	24.33	1652
Gaibandha	Fulchari	220	58.36	157	41.64	377
Gopalganj	Beelchanda	327	83.42	65	16.58	392

District	Village	Yes		No		Total Households
		n	%	n	%	
Khulna	Tipna	583	75.52	189	24.48	772
Kurigram	Pathordubi	1829	74.08	640	25.92	2469
Naogaon	Khordachompa	274	59.69	185	40.31	459
Narsingdi	Hafizpur	1432	87	214	13	1646
Netrakona	Dakkhin Demura	273	73.19	100	26.81	373
Rajshahi	Sonadanga	562	79.27	147	20.73	709
Rangamati	Chota Harina (mouza)	181	84.19	34	15.81	215
Satkhira	Datinakhali	379	66.73	189	33.27	568
Sunamganj	Shimulbank	276	59.74	186	40.26	462
Sylhet	Bagaiya	651	70.68	270	29.32	921
	Total	**9556**	**75.34**	**3127**	**24.65**	**12684**

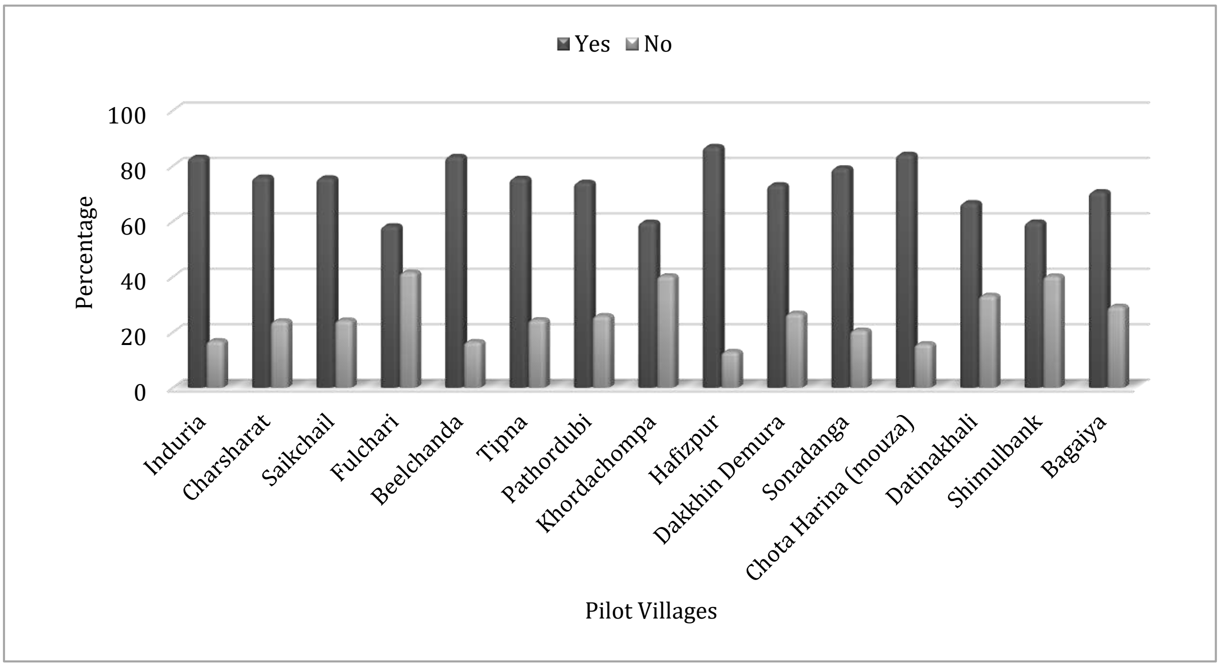


Figure 4.50: Availability of toilet facilities (pilot villages)

Table 4.40: Types of toilet facility (pilot villages)

District	Village	Double Pit Latrine		Flash Latrine		Not Available		Open Latrine		Others		Pit Latrine		Septic Tank Latrine		VIP Latrine		Total Household
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Barishal	Induria	21	3.44	26	4.26	1	0.16	1	0.16	1	0.16	496	81.18	46	7.53	19	3.11	728
Chattogram	Charsharat	6	0.83	65	8.99	3	0.41	0	0	2	0.28	526	72.75	26	3.6	95	13.14	941
Cumilla	Saikchail	65	4.71	176	12.76	-	-	2	0.15	1	0.07	586	42.49	177	12.84	372	26.98	1652
Gaibandha	Fulchari	-	-	33	14.8	-	-	-	-	-	-	189	84.75	-	-	1	0.45	377
Gopalganj	Beelchanda	1	0.3	86	26.22	-	-	-	-	-	-	210	64.02	18	5.49	13	3.96	392
Khulna	Tipna	21	3.51	86	14.38	1	0.17	-	-	2	0.33	346	57.86	107	17.89	35	5.85	772
Kurigram	Pathordubi	4	0.21	208	11.16	1	0.05	1	0.05	-	-	1283	68.87	48	2.58	318	17.07	2469
Naogaon	Khordachompa	-	-	57	20.8	0	0	0	0	1	0.36	33	12.04	24	8.76	159	58.03	459
Narsingdi	Hafizpur	17	1.09	157	10.03	1	0.06	1	0.06	1	0.06	604	38.59	357	22.81	427	27.28	1646
Netrakona	Dakkhin Demura	2	0.7	8	2.82	-	-	10	3.52	5	1.76	176	61.97	11	3.87	72	25.35	373
Rajshahi	Sonadanga	1	0.18	68	11.95	-	-	-	-	-	-	198	34.8	50	8.79	252	44.29	709
Rangamati	Chota Harina (mouza)	-	-	20	10.99	-	-	19	10.44	-	-	102	56.04	7	3.85	34	18.68	215
Satkhira	Datinakhali	7	1.85	47	12.4	-	-	-	-	-	-	292	77.04	18	4.75	15	3.96	568
Sunamganj	Shimulbank	15	5.24	33	11.54	-	-	21	7.34	1	0.35	116	40.56	59	20.63	41	14.34	462
Sylhet	Bagaiya	3	0.44	96	14.12	-	-	6	0.88	3	0.44	348	51.18	136	20	88	12.94	921
Total		**163**	**1.29**	**1166**	**9.19**		**-**	**-**	**0.48**	**17**	**0.13**	**5505**	**43.40**	**1084**	**8.55**	**1941**	**15.30**	**12684**

The study also indicates that the idea of community toilets is rare in rural areas. The pie chart below shows that only 6 villages, Khordachompa of Naogaon, Chota Harina of Rangamati, Datinakhali of Satkhira, Induriya of Barisal, Charsharat of Chittagong, and Fulchari of Gaibandha have community toilets. In most cases, people seem to prefer personal toilets, as seen in the table above.

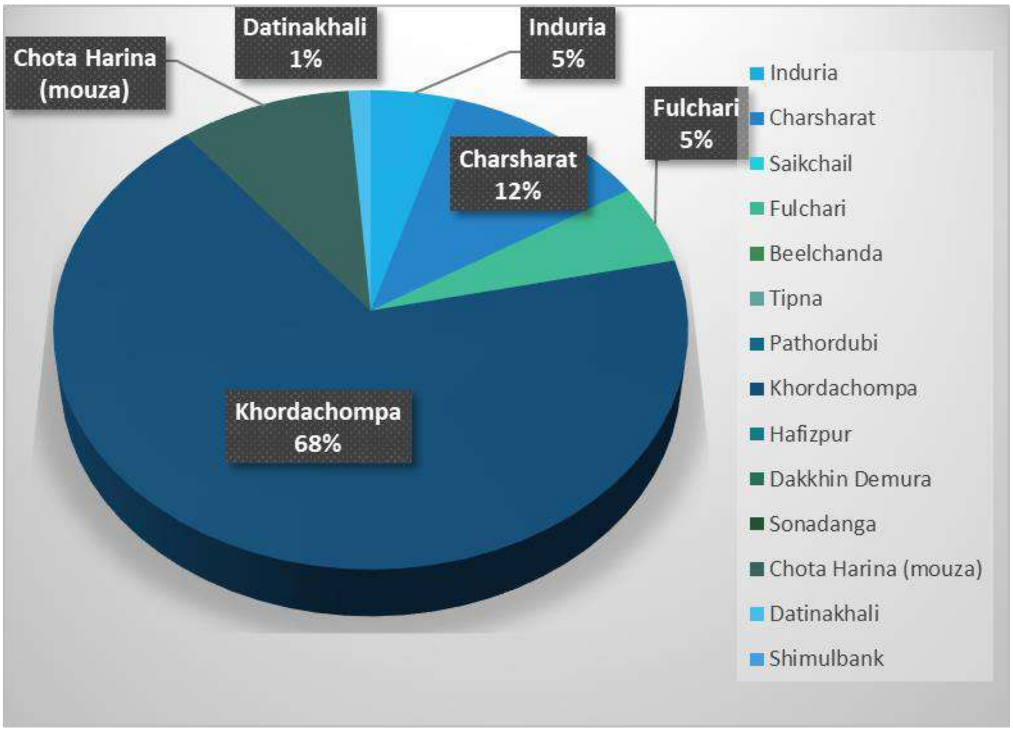


Figure 4.51: Prevalence of community toilets (pilot villages)

People's awareness of the usefulness of community toilets is gradually increasing. The study findings strongly suggest that the old latrines in the pilot villages should be replaced with new sanitary latrines. The single-pit latrines could be converted to double-pit toilets for hygienic purposes. In the Simulbank village of Sunamganj, septic tank latrines were recommended.

4.3.2 *Available Sanitation facilities*

The pilot area included 15 villages, and the survey on sanitation facilities was carried out in 15 of those villages having a total of 12684 households. On the other hand, there were 20 sample villages and only 10% of the households in those villages were covered by the survey.

Types of Toilet Facilities

The bar chart below shows that except for Khordachampa and Sonadanga, the percentage of pit latrines is the highest in most of the pilot villages. Khordachampa has the highest percentage of VIP latrines (58.03%). Flush latrines can also be seen but the percentage is negligible. The highest percentage of flush latrines can be seen in Beelchanda of Gopalganj (26.22%). Septic tanks are also used in Saikchail, Tipna, Hafizpur, Shimulbank, and Bagaiya.

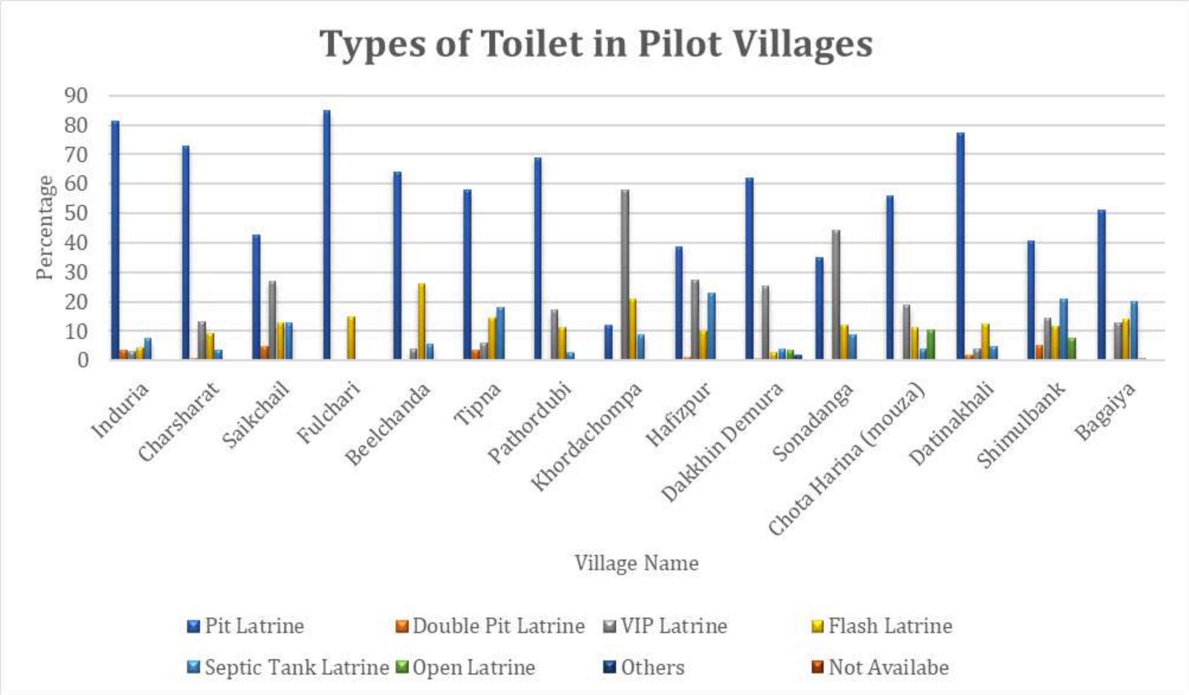


Figure 4.52: Types of toilet facilities (pilot villages)

In a total of 1600 households in the sample villages that were surveyed, the percentage of pit latrines was the highest (56.44%), following which there were VIP latrines (11.63%) and flush latrines (9.56%). Pit latrines were the most common in all the sample villages with Sarkar Para having the highest percentage (76.92%). The lowest percentage of pit latrines were in Patail (11.76%). The highest percentage (46.58%) of VIP latrines was found in Shahata, Chalakchar (37.14%), and Patail (29.41%). Septic tank was found to be most common in Chengain (30%).

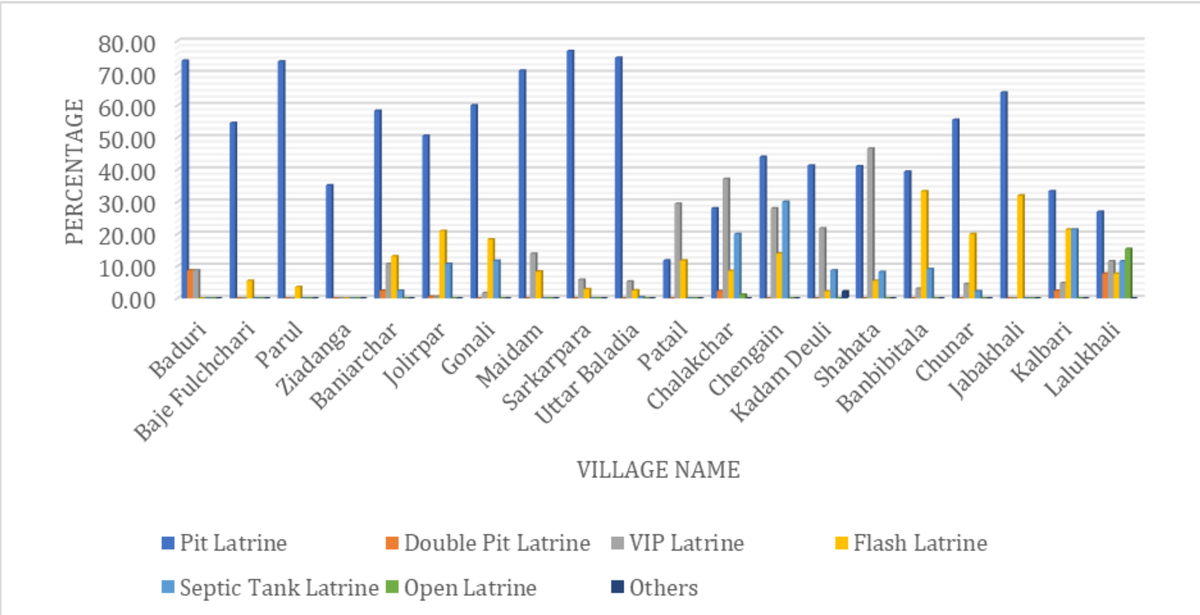


Figure 4.53: Types of toilet facilities (sample villages)

Table 4.41: Types of toilet facility (sample villages)

District	Village	Double Pit Latrine		Flush Latrine		Open Latrine		Others		Pit Latrine		Septic Tank Latrine		VIP Latrine		Total no. of Surveyed Households
		n	%	n	%	n	%	n	%	n	%	N	%	n	%	
Barishal	Baduri	2	8.70	-	-	-	-	-	-	17	73.91	-	-	2	8.70	23
Gaibandha	Baje Fulchari	-	-	3	5.45	-	-	-	-	30	54.55	-	-	-	-	55
	Parul	-	-	2	3.51	-	-	-	-	42	73.68	-	-	-	-	57
	Ziadanga	-	-	0	0	-	-	-	-	13	35.14	-	-	-	-	37
Gopalganj	Baniarchar	2	2.38	11	13.10	-	-	-	-	49	58.33	2	2.38	9	10.71	84
	Jolirpar	1	0.54	39	20.97	-	-	-	-	94	50.54	20	10.75	1	0.54	186
Khulna	Gonali	-	-	11	18.33	-	-	-	-	36	60	7	11.67	1	1.67	60
Kurigram	Maidam	-	-	6	8.33	-	-	-	-	51	70.83	-	-	10	13.89	72
	Sarkarpara	-	-	6	2.88	-	-	-	-	160	76.92	-	-	12	5.77	208
	Uttar Baladia	-	-	7	2.45	-	-	-	-	214	74.83	1	0.35	15	5.24	286
Naogaon	Patail	-	-	2	11.76	-	-	-	-	2	11.76	-	-	5	29.41	17
Narsingdi	Chalakchar	4	2.29	15	8.57	2	1.14	-	-	49	28	35	20	65	37.14	175
	Chengain	-	-	7	14	-	-	-	-	22	44	15	30	14	28	50
Netrakona	Kadam Deuli	-	-	1	2.17	-	-	1	2.17	19	41.30	4	8.70	10	21.74	46
	Shahata	-	-	4	5.48	-	-	-	-	30	41.10	6	8.22	34	46.58	73
Satkhira	Banbibitala	-	-	11	33.33	-	-	-	-	13	39.39	3	9.09	1	3.03	33
	Chunar	-	-	9	20	-	-	-	-	25	55.56	1	2.22	2	4.44	45
	Jabakhali	-	-	8	32	-	-	-	-	16	64	-	-	-	-	25
	Kalbari	1	2.38	9	21.43	-	-	-	-	14	33.33	9	21.43	2	4.76	42
Sunamganj	Lalukhali	2	7.69	2	7.69	4	15.38	-	-	7	26.92	3	11.54	3	11.54	26
	Total	12	0.75	153	9.56	6	0.38	1	0.063	903	56.44	106	6.63	186	11.63	1600

Current Toilet Conditions

Current toilet conditions in the pilot villages were observed to be poor. The table shows that among 12,684 households in the pilot villages, only 31.18% of the toilet facilities were clean, 34.63% were dirty but usable (nevertheless unhygienic), 9.18% were dirty and unusable, and 0.36% were abandoned.

Table 4.42: Toilet facility condition (pilot villages)

District	Village	Clean		Dirty but Usable		Dirty, Unusable, but still Used		Abandoned		Total no. of Households
		n	%	n	%	n	%	n	%	
Barishal	Induria	83	11.4	447	61.40	71	9.75	4	0.55	728
Chattogram	Charsharat	248	26.38	399	42.45	67	7.13	-	-	941
Cumilla	Saikchail	591	35.77	600	36.32	58	3.51	1	0.06	1652
Gaibandha	Fulchari	66	17.51	125	33.16	28	7.43	1	0.27	377
Gopalganj	Beelchanda	155	39.54	127	32.40	40	10.20	5	1.28	392
Khulna	Tipna	190	24.61	291	37.69	98	12.69	4	0.52	772
Kurigram	Pathordubi	629	25.48	1025	41.51	172	6.97	3	0.12	2469
Naogaon	Khordachompa	184	40.09	70	15.25	18	3.92	2	0.44	459
Narsingdi	Hafizpur	677	41.13	494	30.01	257	15.61	4	0.24	1646
Netrakona	Dakkhin Demura	88	23.59	134	35.92	48	12.87	3	0.80	373
Rajshahi	Sonadanga	353	49.79	162	22.85	46	6.49	1	0.14	709
Rangamati	Chota Harina (mouza)	69	32.09	79	36.74	32	14.88	1	0.47	215
Satkhira	Datinakhali	156	27.46	149	26.23	70	12.32	4	0.70	568
Sunamganj	Shimulbank	131	28.35	90	19.48	53	11.47	2	0.43	462
Sylhet	Bagaiya	334	36.26	200	21.72	106	11.51	11	1.19	921
Total		3954	31.18	4392	34.63	1164	9.18	46	0.36	12684

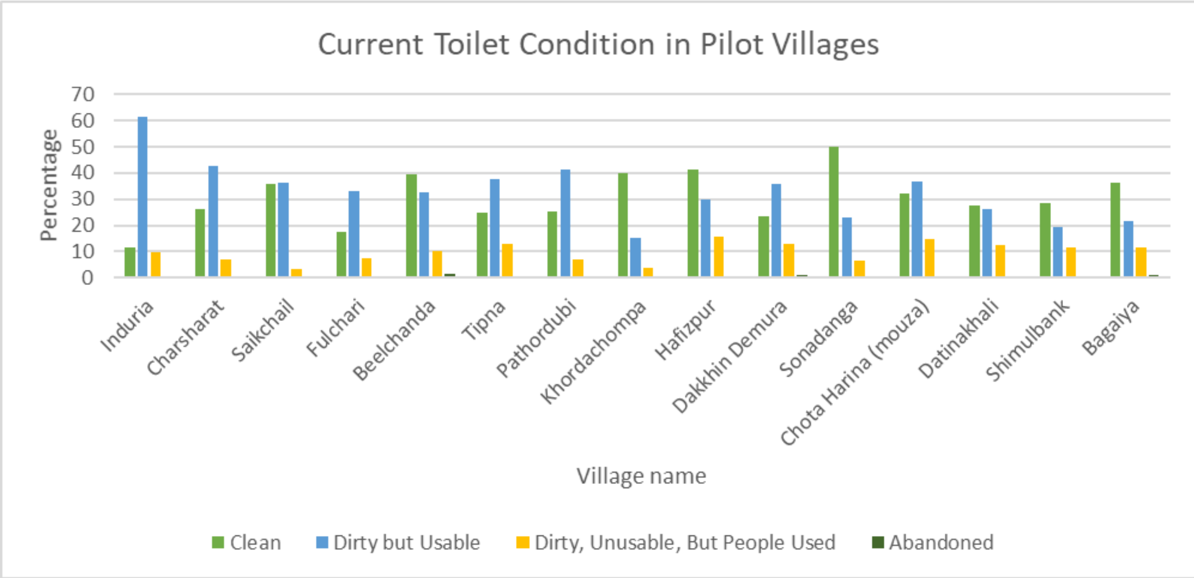


Figure 4.54: Current toilet condition (pilot villages)

In the sample villages, a total of 1600 households were surveyed. The survey found that only 31.5% of the household toilets were clean, 42% were dirty and unhygienic but usable, 9.13% were unusable, and 0.63% were abandoned. The graph and table below show the poor conditions of toilet facilities in the surveyed villages more clearly.

Table 4.43: Current conditions of toilet facilities (sample villages)

District	Village	Clean		Dirty but Usable		Dirty, Unusable, but still Used		Abandoned		Total no. of Surveyed Households
		n	%	n	%	n	%	n	%	
Barishal	Baduri	5	21.74	15	65.22	1	4.35	-	-	23
Gaibandha	Baje Fulchari	4	7.273	25	45.45	4	7.27	-	0.00	55
	Parul	11	19.3	27	47.37	5	8.77	1	1.75	57
	Ziadanga	3	8.108	10	27.03	-	0.00	-	0.00	37
Gopalganj	Baniarchar	29	34.52	24	28.57	19	22.62	1	1.19	84
	Jolirpar	67	36.02	62	33.33	22	11.83	3	1.61	186
Khulna	Gonali	17	28.33	33	55.00	5	8.33	-	0.00	60
Kurigram	Maidam	21	29.17	42	58.33	3	4.17	-	0.00	72
	Sarkarpara	48	23.08	118	56.73	10	4.81	-	0.00	208
	Uttar Baladia	65	22.73	163	56.99	8	2.80	1	0.35	286
Naogaon	Patail	9	52.94	-	0.00	-	0.00	-	0.00	17
Narsingdi	Chalakchar	77	44	63	36.00	15	8.57	1	0.57	175
	Chengain	24	48	11	22.00	13	26.00	-	-	50
Netrakona	Kadam Deuli	19	41.3	7	15.22	7	15.22	-	-	46
	Shahata	42	57.53	21	28.77	7	9.59	-	-	73
Satkhira	Banbibitala	14	42.42	9	27.27	4	12.12	1	3.03	33

District	Village	Clean		Dirty but Usable		Dirty, Unusable, but still Used		Abandoned		Total no. of Surveyed Households
		n	%	n	%	n	%	n	%	
	Chunar	17	37.78	12	26.67	8	17.78	-	-	45
	Jabakhali	7	28	10	40.00	7	28.00	-	-	25
	Kalbari	19	45.24	10	23.81	4	9.52	1	2.38	42
Sunamganj	Lalukhali	6	23.08	10	38.46	4	15.38	1	3.85	26
	Total	504	31.5	672	42.00	146	9.13	10	0.63	1600

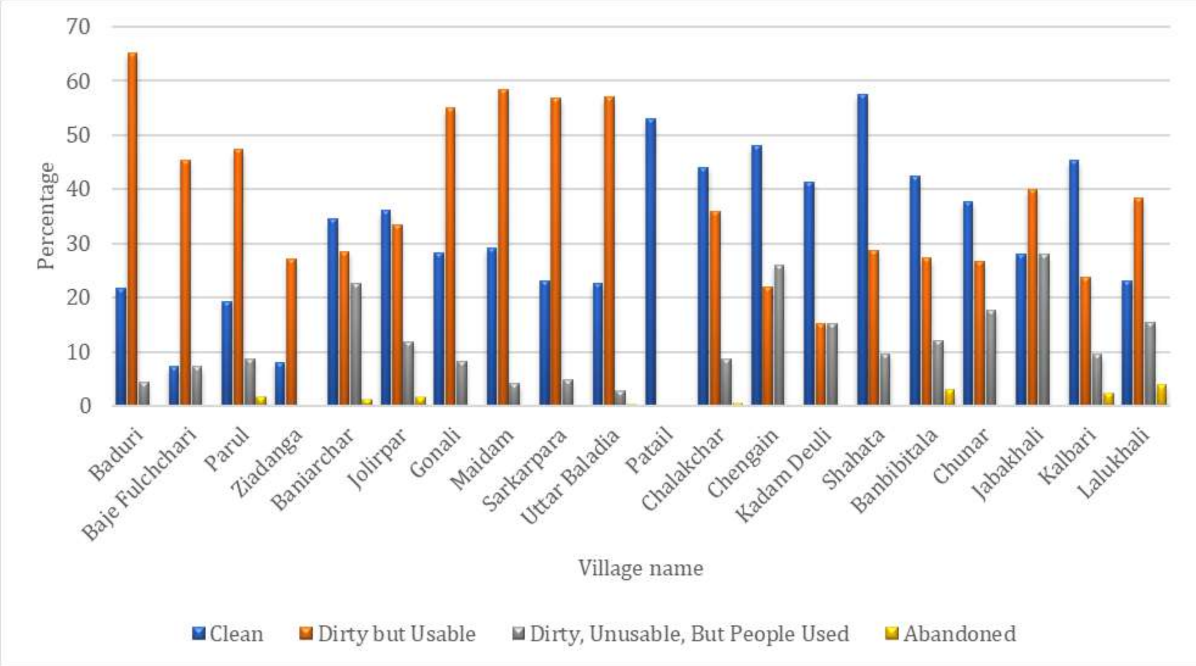


Figure 4.55: Current conditions of toilet facilities (sample villages)

Toilet Facilities

The table below shows that among the 12684 households, only 18.57% have a hand wash system in the toilet facility, 13.52% have toilet paper/hand tissue paper, 22.52% have soap, 7.51 % have a water supply system, 2.43% have covered dustbins, and 12.46% have other facilities. Only 0.15% of the total number of households in the sample villages have the special facilities required for people with disabilities.

Table 4.44: Toilet facilities (pilot villages)

District	Village	Dustbin with lid available		Hand wash system available		Others		Soap available		Tissue available		Water system available for hand wash		Special facilities for the disable		Total Household
		n	%	n	%	n	%	N	%	n	%	n	%	n	%	
Barishal	Induria	3	0.41	100	13.74	24	3.30	95	13.05	79	10.85	19	2.61	-	-	728
Chattogram	Charsharat	17	1.81	109	11.58	341	36.24	142	15.09	113	12.01	97	10.31	1	0.11	941
Cumilla	Saikchail	52	3.15	333	20.16	104	6.30	436	26.39	431	26.09	167	10.11	3	0.18	1652
Gaibandha	Fulchari	-	-	46	12.20	119	31.56	49	13.00	10	2.65	16	4.24	2	0.53	377
Gopalganj	Beelchanda	7	1.79	180	45.92	29	7.40	95	24.23	39	9.95	18	4.59	1	0.26	392
Khulna	Tipna	16	2.07	175	22.67	216	27.98	255	33.03	129	16.71	84	10.88	-	-	772
Kurigram	Pathordubi	22	0.89	219	8.87	83	3.36	342	13.85	197	7.98	52	2.11	1	0.04	2469
Naogaon	Khordachompa	32	6.97	102	22.22	85	18.52	170	37.04	53	11.55	38	8.28	-	-	459
Narsingdi	Hafizpur	74	4.50	310	18.83	227	13.79	469	28.49	321	19.50	255	15.49	5	0.30	1646
Netrakona	Dakkhin Demura	3	0.80	30	8.04	71	19.03	48	12.87	33	8.85	14	3.75	2	0.54	373
Rajshahi	Sonadanga	62	8.74	225	31.73	66	9.31	301	42.45	57	8.04	77	10.86	1	0.14	709
Rangamati	Chota Harina (mouza)	1	0.47	53	24.65	1	0.47	56	26.05	41	19.07	8	3.72	-	-	215
Satkhira	Datinakhali	4	0.70	110	19.37	211	37.15	100	17.61	40	7.04	13	2.29	1	0.18	568
Sunamganj	Shimulbank	5	1.08	91	19.70	3	0.65	97	21.00	87	18.83	19	4.11	1	0.22	462
Sylhet	Bagaiya	10	1.09	273	29.64	1	0.11	202	21.93	85	9.23	75	8.14	1	0.11	921
	Total	**308**	**2.43**	**2356**	**18.57**	**1581**	**12.46**	**2857**	**22.52**	**1715**	**13.52**	**952**	**7.51**	**19**	**0.15**	**12684**

The various toilet facilities available in many rural areas can be grouped generally. Among the 1,600 households surveyed, 20.56% have soap, 19.31% have a hand wash system, 9.06% have toilet paper/hand tissue, and 11.06% have other facilities. The graph below gives a comparative picture. The Shahata village seems to have more sanitary toilets than others, whereas Maidam, Sarkarpara, and Uttar Baldia are in the worse off in terms of toilet facilities. The graph shows that their sanitation facilities are far below the hygiene line.

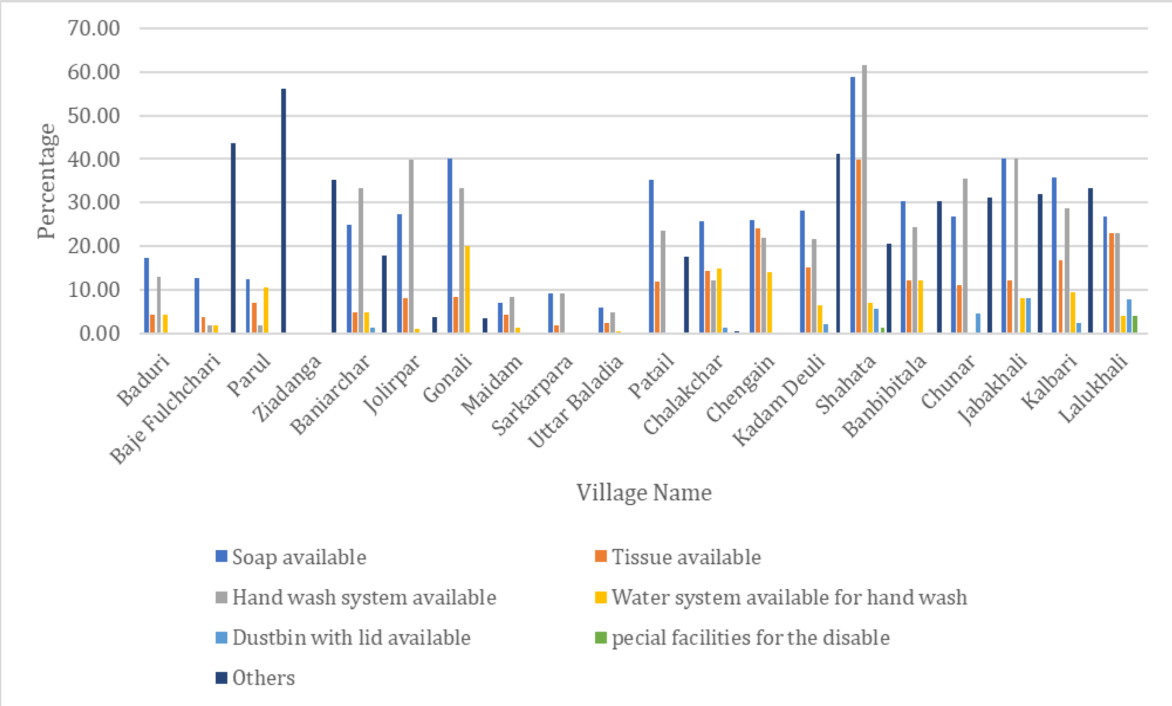


Figure 4.56: Toilet facilities (sample villages)

Table 4.45: Toilet facilities (sample villages)

District	Village	Covered dustbin available		Hand wash system available		Others		Soap available		Tissue available		Water supply system available for hand wash		Special facilities for the disabled		Total no. of surveyed Households
		n	%	n	%	n	%	n	%	n	%	n	%	n	%	
Barishal	Baduri	-	-	3.00	13.04	-	-	4.00	17.39	1.00	4.35	1.00	4.35	-	-	23
Gaibandha	Baje Fulchari	-	-	1.00	1.82	24.00	43.64	7.00	12.73	2.00	3.64	1.00	1.82	-	-	55
	Parul	-	-	1.00	1.75	32.00	56.14	7.00	12.28	4.00	7.02	6.00	10.53	-	-	57
	Ziadanga	-	-	-	-	13.00	35.14	-	-	-	-	-	-	-	-	37
Gopalganj	Baniarchar	1.00	1.19	28.00	33.33	15.00	17.86	21.00	25.00	4.00	4.76	4.00	4.76	-	-	84
	Jolirpar	-	-	74.00	39.78	7.00	3.76	51.00	27.42	15.00	8.06	2.00	1.08	-	-	186
Khulna	Gonali	-	-	20.00	33.33	2.00	3.33	24.00	40.00	5.00	8.33	12.00	20.00	-	-	60
Kurigram	Maidam	-	-	6.00	8.33	-	-	5.00	6.94	3.00	4.17	1.00	1.39	-	-	72
	Sarkarpara	-	-	19.00	9.13	-	-	19.00	9.13	4.00	1.92	-	-	-	-	208
	Uttar Baladia	-	-	14.00	4.90	-	-	17.00	5.94	7.00	2.45	1.00	0.35	-	-	286
Naogaon	Patail	-	-	4.00	23.53	3.00	17.65	6.00	35.29	2.00	11.76	0.00	0.00	-	-	17
Narsingdi	Chalakchar	2.00	1.14	21.00	12.00	1.00	0.57	45.00	25.71	25.00	14.29	26.00	14.86	-	-	175
	Chengain	-	-	11.00	22.00	-	-	13.00	26.00	12.00	24.00	7.00	14.00	-	-	50
Netrakona	Kadam Deuli	1.00	2.17	10.00	21.74	19.00	41.30	13.00	28.26	7.00	15.22	3.00	6.52	-	-	46
	Shahata	4.00	5.48	45.00	61.64	15.00	20.55	43.00	58.90	29.00	39.73	5.00	6.85	1.00	1.37	73
Satkhira	Banbibitala	-	-	8.00	24.24	10.00	30.30	10.00	30.30	4.00	12.12	4.00	12.12	-	-	33
	Chunar	2.00	4.44	16.00	35.56	14.00	31.11	12.00	26.67	5.00	11.11	-	-	-	-	45
	Jabakhali	2.00	8.00	10.00	40.00	8.00	32.00	10.00	40.00	3.00	12.00	2.00	8.00	-	-	25
	Kalbari	1.00	2.38	12.00	28.57	14.00	33.33	15.00	35.71	7.00	16.67	4.00	9.52	-	-	42
Sunamganj	Lalukhali	2.00	7.69	6.00	23.08	-	-	7.00	26.92	6.00	23.08	1.00	3.85	1.00	3.85	26
	Total	15.00	0.94	309.00	19.31	177.00	11.06	329.00	20.56	145.00	9.06	80.00	5.00	2.00	0.13	1600

4.3.3 *Sanitation Service Levels*

Money Spent on the Development of Toilets

People spend money on developing their toilets in order to improve their sanitary levels. Their willingness to spend for that purpose indicates their awareness and demand alongside financial capability. Data on money spent for the purpose were collected from both pilot and sample villages.

The table below indicates the amount of BDT spent or the willingness to spend on developing/improving toilets and sanitary facilities. 62.72% of the households decided to spend 0-2000 BDT in the Sonadanga village of Rajshahi, which is the highest percentage in the 0-2000 BDT range. The highest percentage (54.19%) spending in the 2000 – 5000 BDT range is in the Induria village of Barishal, while the highest percentage (23.64%) spending in the range of 5000 – 10000 BDT is in Dakhin Demura. The percentage of those willing to pay more than 10000 BDT on developing/improving toilets is 15.91% in Dakhin Demura of Netrokona.

Table 4.46: Money spent on development of toilet facilities (pilot villages)

District	Village	0-2000 BDT		2000-5000 BDT		5000-10000 BDT		>10000 BDT	
		n	%	n	%	n	%	n	%
Barishal	Induria	133	30.93	233	54.19	40	9.3	24	5.58
Chattogram	Charsharat	243	41.75	268	46.05	65	11.17	6	1.03
Cumilla	Saikchail	317	34.12	497	53.5	94	10.12	21	2.26
Gaibandha	Fulchari	64	31.84	99	49.25	25	12.44	13	6.47
Gopalganj	Beelchanda	84	36.21	68	29.31	51	21.98	29	12.5
Khulna	Tipna	132	27.79	238	50.11	71	14.95	34	7.16
Kurigram	Pathordubi	661	38.77	571	33.49	267	15.66	206	12.08
Naogaon	Khordachompa	110	53.14	65	31.4	19	9.18	13	6.28
Narsingdi	Hafizpur	313	31.18	341	33.96	203	20.22	147	14.64
Netrakona	Dakkhin Demura	49	22.27	84	38.18	52	23.64	35	15.91
Rajshahi	Sonadanga	244	62.72	76	19.54	29	7.46	40	10.28
Rangamati	Chota Harina (mouza)	71	46.41	74	48.37	7	4.58	1	0.65
Satkhira	Datinakhali	184	61.95	92	30.98	17	5.72	4	1.35
Sunamganj	Shimulbank	101	52.88	72	37.7	11	5.76	7	3.66
Sylhet	Bagaiya	302	69.75	117	27.02	11	2.54	3	0.69

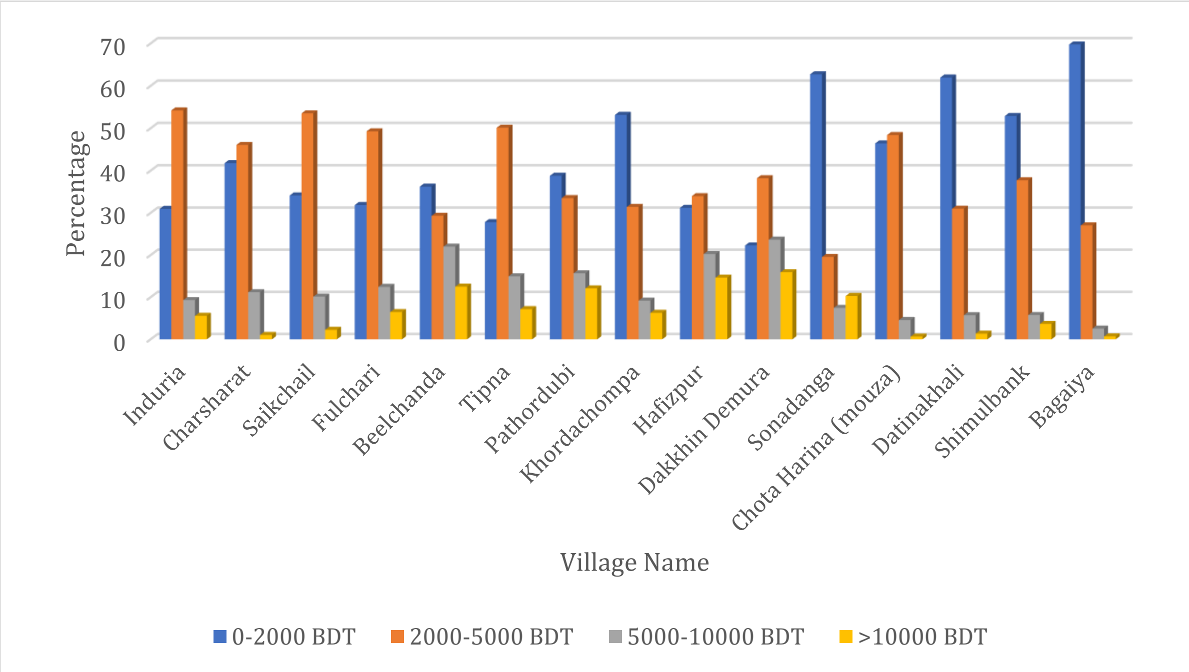


Figure 4.57: Money spent on development of toilet facilities (pilot villages)

Toilet Cleaning Responsibility

The table presents the people responsible for sanitary work and cleaning in their families. As can be seen, in almost every village, the main female members of the family are responsible for this kind of work. The scenario is the same in both sample and pilot villages.

Table 4.47: Persons responsible for cleaning toilet in household (pilot villages)

District	Village	Female member who helps with family chores		Main female member of the family		Main male member of the family		Male member who helps with family chores		Other members of the family	
		n	%	n	%	n	%	n	%	n	%
Barishal	Induria	4	0.56	513	72.05	141	19.8	41	5.76	13	1.83
Chattogram	Charsharat	101	10.84	582	62.45	72	7.73	66	7.08	111	11.91
Cumilla	Saikchail	179	10.7	1175	70.23	52	3.11	38	2.27	229	13.69
Gaibandha	Fulchari	20	6.01	188	56.46	110	33.03	10	3	5	1.5
Gopalganj	Beelchanda	17	4.31	244	61.93	126	31.98	4	1.02	3	0.76
Khulna	Tipna	16	2.25	511	71.77	114	16.01	28	3.93	43	6.04
Kurigram	Pathordubi	175	6.65	1599	60.75	767	29.14	33	1.25	58	2.2
Naogaon	Khordachompa	46	10.55	244	55.96	116	26.61	23	5.28	7	1.61
Narsingdi	Hafizpur	81	4.46	1322	72.76	233	12.82	12	0.66	169	9.3
Netrakona	Dakkhin Demura	15	4.3	248	71.06	57	16.33	4	1.15	25	7.16
Rajshahi	Sonadanga	40	5.07	502	63.62	193	24.46	31	3.93	23	2.92
Rangamati	Chota Harina (mouza)	18	7.69	151	64.53	30	12.82	16	6.84	19	8.12

District	Village	Female member who helps with family chores		Main female member of the family		Main male member of the family		Male member who helps with family chores		Other members of the family	
		n	%	n	%	n	%	n	%	n	%
Satkhira	Datinakhali	13	2.64	284	57.61	160	32.45	9	1.83	27	5.48
Sunamganj	Shimulbank	39	11.64	241	71.94	14	4.18	8	2.39	33	9.85
Sylhet	Bagaiya	66	7.94	452	54.39	291	35.02	16	1.93	6	0.72

More than 55% of households in every area reported that the main female members of the family were responsible for cleaning the toilet. Only 1-30% of household toilet cleaning responsibility fell on the main male members. This trend can be observed in the bar chart below.

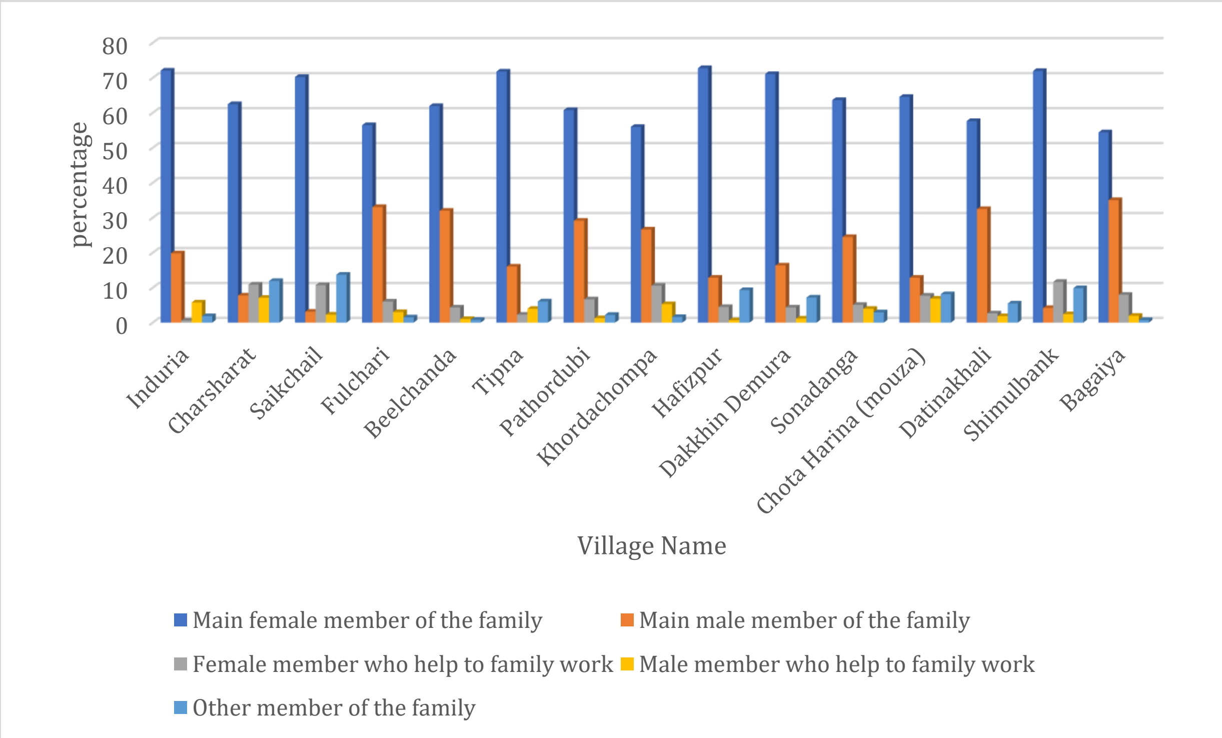


Figure 4.58: Persons responsible for cleaning toilet in household (pilot villages)

The same scenario can be seen in the case of sample villages. T**able 4.48** gives a clear idea about it.

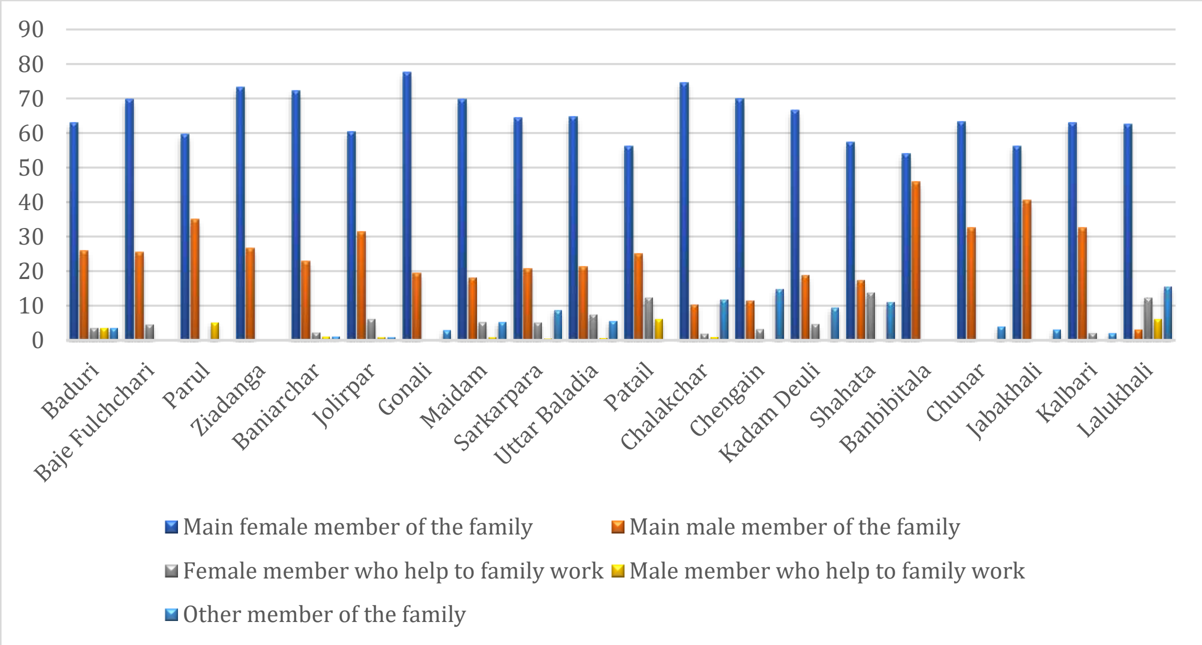


Figure 4.59: Persons responsible for cleaning toilet in household (sample villages)

Table 4.48: Persons responsible for cleaning toilet in household (sample villages)

District	Village	Female member who helps with family chores		Main female member of the family		Main male member of the family		Male member who helps with family chores		Other members of the family	
		n	%	n	%	n	%	N	%	n	%
Barishal	Baduri	1	3.7	17	62.96	7	25.93	1	3.7	1	3.7
Gaibandha	Baje Fulchari	2	4.65	30	69.77	11	25.58	-	-	-	-
	Parul	-	-	34	59.65	20	35.09	3	5.26	-	-
	Ziadanga	-	-	11	73.33	4	26.67	-	-	-	-
Gopalganj	Baniarchar	2	2.41	60	72.29	19	22.89	1	1.2	1	1.2
	Jolirpar	13	6.28	125	60.39	65	31.4	2	0.97	2	0.97
Khulna	Gonali	-	-	52	77.61	13	19.4	-	-	2	2.99
Kurigram	Maidam	5	5.38	65	69.89	17	18.28	1	1.08	5	5.38
	Sarkarpara	14	5.19	174	64.44	56	20.74	2	0.74	24	8.89
	Uttar Baladia	27	7.56	231	64.71	76	21.29	3	0.84	20	5.6
Naogaon	Patail	2	12.5	9	56.25	4	25	1	6.25	-	-
Narsingdi	Chalakchar	4	1.99	150	74.63	21	10.45	2	1	24	11.94
	Chengain	2	3.33	42	70	7	11.67	-	-	9	15
Netrakona	Kadam Deuli	2	4.76	28	66.67	8	19.05	-	-	4	9.52
	Shahata	15	13.89	62	57.41	19	17.59	-	-	12	11.11
Satkhira	Banbibitala	-	-	20	54.05	17	45.95	-	-	-	-
	Chunar	-	-	31	63.27	16	32.65	-	-	2	4.08
	Jabakhali	-	-	18	56.25	13	40.62	-	-	1	3.12
	Kalbari	1	2.17	29	63.04	15	32.61	-	-	1	2.17

District	Village	Female member who helps with family chores		Main female member of the family		Main male member of the family		Male member who helps with family chores		Other members of the family	
		n	%	n	%	n	%	N	%	n	%
Sunamganj	Lalukhali	4	12.5	20	62.5	1	3.12	2	6.25	5	15.62

Sewerage Line Situation

The study also revealed the sewerage situation in the study area. Compared to the other sample villages, the sewerage line in the Baje Fulchari village is in a much better condition (90.91%). Compared to the pilot villages, the sewerage lines in the villages of Charsharat, Chota Harina, and Saikchail are in a much better condition. The sewerage line situation in the sample villages is presented in the table below:

Table 4.49: Sewerage line situation (sample villages)

District	Village	Cracks in Sewerage Line		No Cracks	
		n	%	n	%
Barishal	Baduri	2	9.52	19	90.48
Gaibandha	Baje Fulchari	3	9.09	30	90.91
	Parul	6	13.64	38	86.36
	Ziadanga	2	15.38	11	84.62
Gopalganj	Baniarchar	12	16.44	61	83.56
	Jolirpar	16	10.39	138	89.61
Khulna	Gonali	3	5.45	52	94.55
Kurigram	Maidam	3	4.55	63	95.45
	Sarkarpara	4	2.27	172	97.73
	Uttar Baladia	1	0.42	236	99.58
Naogaon	Patail	-	-	9	100
Narsingdi	Chalakchar	10	6.41	146	93.59
	Chengain	1	2.08	47	97.92
Netrakona	Kadam Deuli	5	15.15	28	84.85
	Shahata	11	15.71	59	84.29
Satkhira	Banbibitala	4	14.29	24	85.71
	Chunar	8	21.62	29	78.38
	Jabakhali	7	29.17	17	70.83
	Kalbari	7	20.59	27	79.41
Sunamganj	Lalukhali	3	14.29	18	85.71

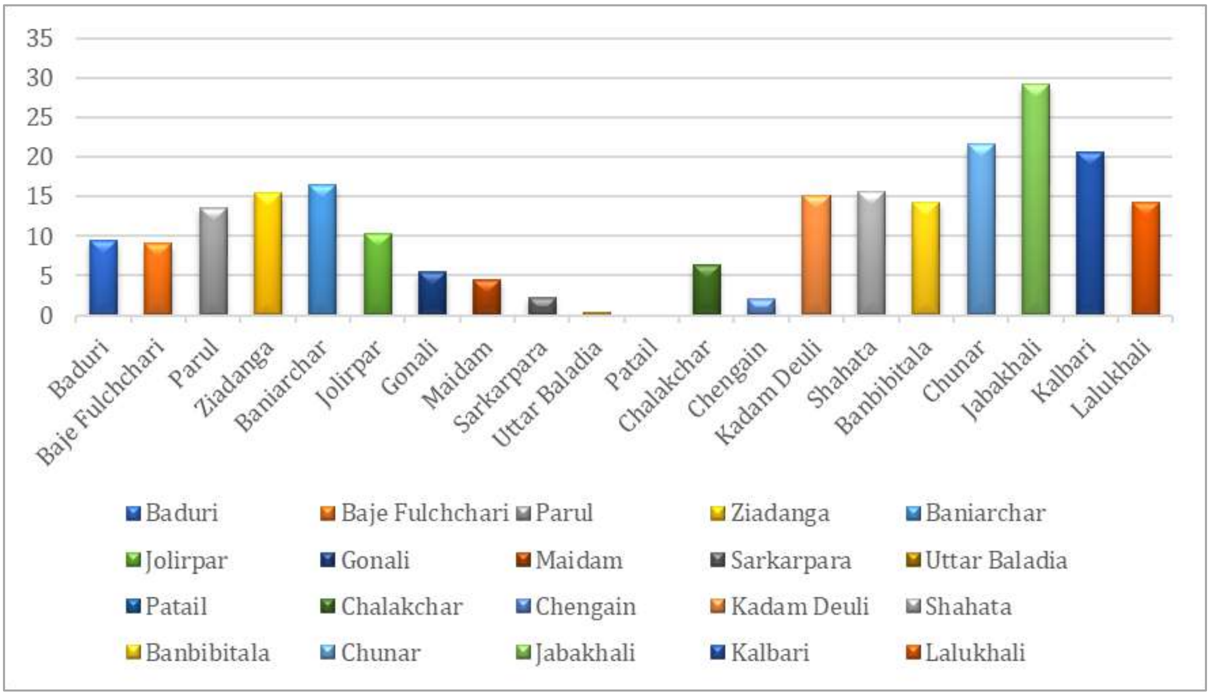


Figure 4.60: Faulty sewerage line (sample villages)

The sewerage line situation in the pilot villages can be noted from the graph and table below.

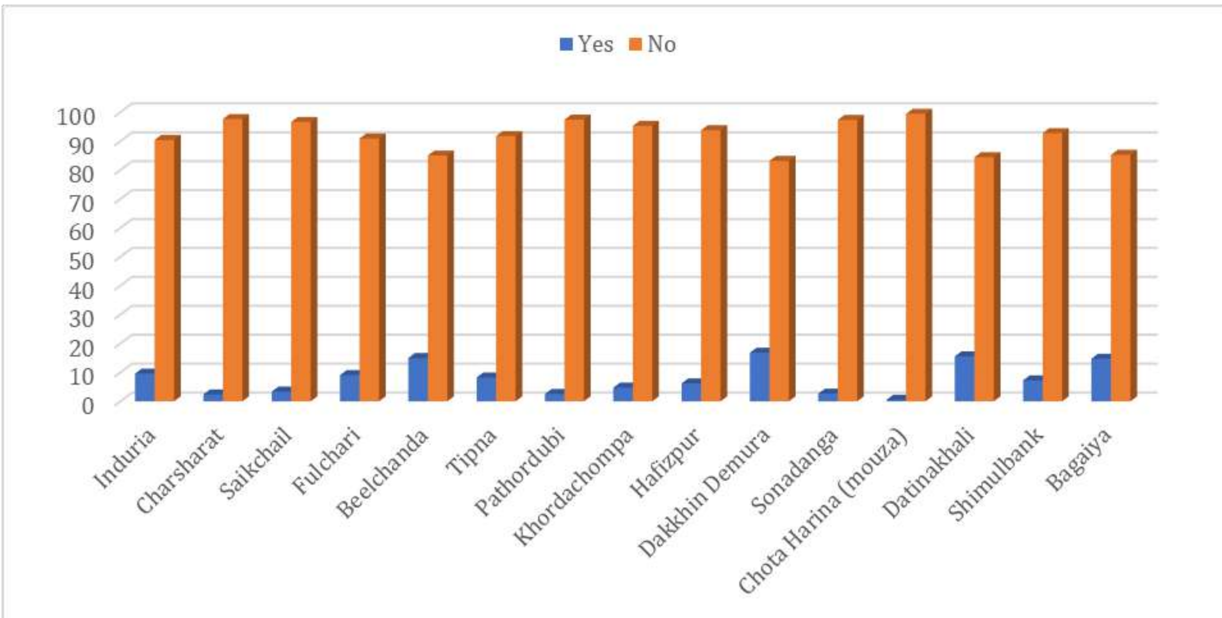


Figure 4.61: Faulty sewerage line (pilot villages)

Table 4.50: Sewerage line situation (pilot villages)

District	Village	Cracks in Sewerage Line		No Cracks	
		n	%	n	%
Barishal	Induria	58	9.59	547	90.41
Chattogram	Charsharat	17	2.38	697	97.62
Cumilla	Saikchail	42	3.36	1208	96.64
Gaibandha	Fulchari	20	9.09	200	90.91
Gopalganj	Beelchanda	49	14.98	278	85.02
Khulna	Tipna	48	8.23	535	91.77
Kurigram	Pathordubi	47	2.57	1782	97.43
Naogaon	Khordachompa	13	4.74	261	95.26
Narsingdi	Hafizpur	89	6.22	1343	93.78
Netrakona	Dakkhin Demura	46	16.85	227	83.15
Rajshahi	Sonadanga	15	2.67	547	97.33
Rangamati	Chota Harina (mouza)	1	0.55	180	99.45
Satkhira	Datinakhali	59	15.57	320	84.43
Sunamganj	Shimulbank	20	7.25	256	92.75
Sylhet	Bagaiya	96	14.75	555	85.25

4.3.4 *Satisfaction Level regarding Sanitation Facility*

Satisfaction level of households in the study areas regarding sanitation facilities is presented in the below table. The table indicates the extent of the surveyed people's willingness to improve their sanitation facilities. It is clear that more than 70% of the people in all of the pilot villages wanted to improve their sanitation facilities, which indicates that they were not entirely satisfied with the current condition of the facilities.

Table 4.51: Willingness to improve sanitation facility (pilot villages)

District	Village	Yes		No	
		n	%	N	%
Barishal	Induria	431	71.24	174	28.76
Chattogram	Charsharat	594	83.19	120	16.81
Cumilla	Saikchail	933	74.64	317	25.36
Gaibandha	Fulchari	204	92.73	16	7.27
Gopalganj	Beelchanda	236	72.17	91	27.83
Khulna	Tipna	477	81.82	106	18.18
Kurigram	Pathordubi	1707	93.33	122	6.67
Naogaon	Khordachompa	217	79.2	57	20.8
Narsingdi	Hafizpur	1016	70.95	416	29.05
Netrakona	Dakkhin Demura	222	81.32	51	18.68
Rajshahi	Sonadanga	396	70.46	166	29.54
Rangamati	Chota Harina (mouza)	154	85.08	27	14.92
Satkhira	Datinakhali	302	79.68	77	20.32
Sunamganj	Shimulbank	194	70.29	82	29.71
Sylhet	Bagaiya	448	68.82	203	31.18

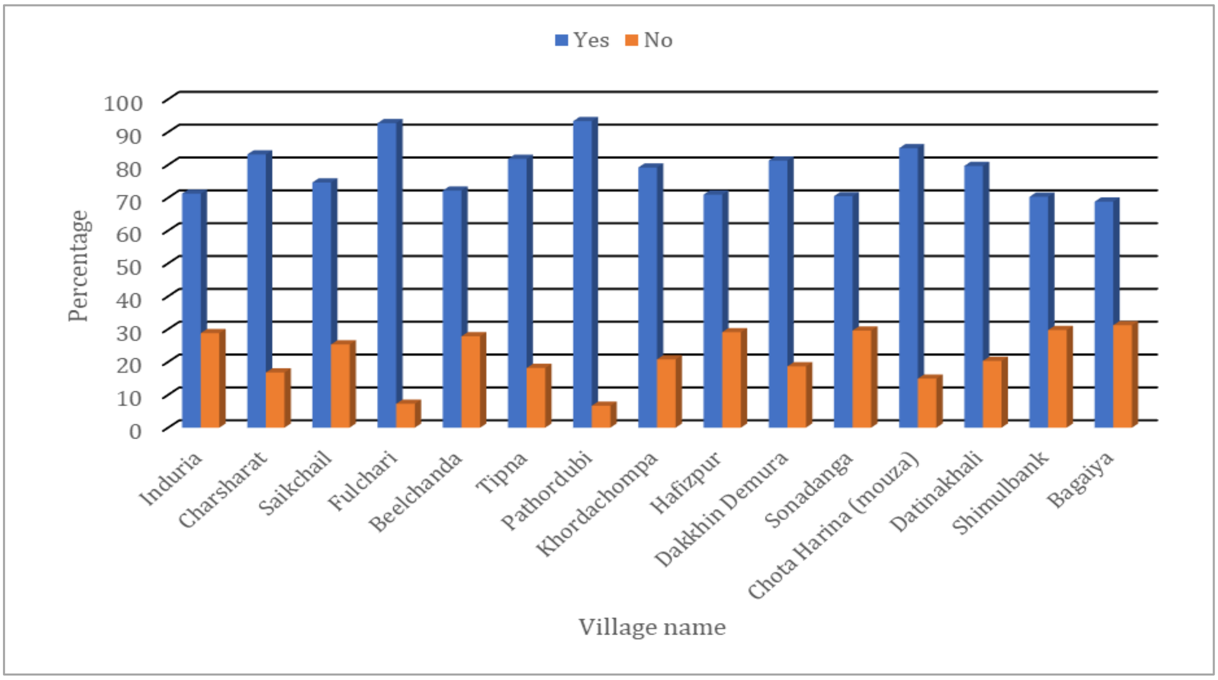


Figure 4.62: Willingness to improve sanitation facility (pilot villages)

4.3.5 *Sludge Management*

Sludge management is an acute problem in rural areas. Generally, the sludge is collected from the pits or tank latrines and discharged untreated into the environment, creating a great risk to sanitation and hygiene. Sludge containment, methodology of clearing it, and its place of disposal were the primary concern of this part of the study. The study results reveal the management of sludge through containment surveys. The table below shows whether sludge containment is practiced in the rural environment, especially in the pilot and sample villages.

Table 4.52: Practice of sludge containment (pilot villages)

District	Village	Yes		No	
		n	%	n	%
Barishal	Induria	564	77.47	164	22.53
Chattogram	Charsharat	594	63.19	346	36.81
Cumilla	Saikchail	1160	70.22	492	29.78
Gaibandha	Fulchari	9	2.39	368	97.61
Gopalganj	Beelchanda	288	73.47	104	26.53
Khulna	Tipna	476	61.66	296	38.34
Kurigram	Pathordubi	1802	72.99	667	27.01
Naogaon	Khordachompa	268	58.39	191	41.61
Narsingdi	Hafizpur	1359	82.56	287	17.44
Netrakona	Dakkhin Demura	209	56.03	164	43.97
Rajshahi	Sonadanga	428	60.37	281	39.63
Rangamati	Chota Harina (mouza)	157	73.02	58	26.98
Satkhira	Datinakhali	92	16.2	476	83.8
Sunamganj	Shimulbank	222	48.05	240	51.95
Sylhet	Bagaiya	646	70.14	275	29.86

Table 4.53: Practice of sludge containment (sample villages)

District	Village	Yes		No	
		n	%	N	%
Barishal	Baduri	20	86.96	3	13.04
Gaibandha	Baje Fulchari	-	-	55	100
	Parul	-	-	57	100
	Ziadanga	-	-	37	100
Gopalganj	Baniarchar	71	84.52	13	15.48
	Jolirpar	126	67.74	60	32.26
Khulna	Gonali	55	91.67	5	8.33
Kurigram	Maidam	66	91.67	6	8.33
	Sarkarpara	175	84.13	33	15.87
	Uttar Baladia	236	82.52	50	17.48
Naogaon	Patail	7	41.18	10	58.82
Narsingdi	Chalakchar	156	89.14	19	10.86
	Chengain	49	98	1	2
Netrakona	Kadam Deuli	19	41.3	27	58.7
	Shahata	52	71.23	21	28.77
Satkhira	Banbibitala	14	42.42	19	57.58
	Chunar	18	40	27	60
	Jabakhali	10	40	15	60
	Kalbari	20	47.62	22	52.38
Sunamganj	Lalukhali	15	57.69	11	42.31

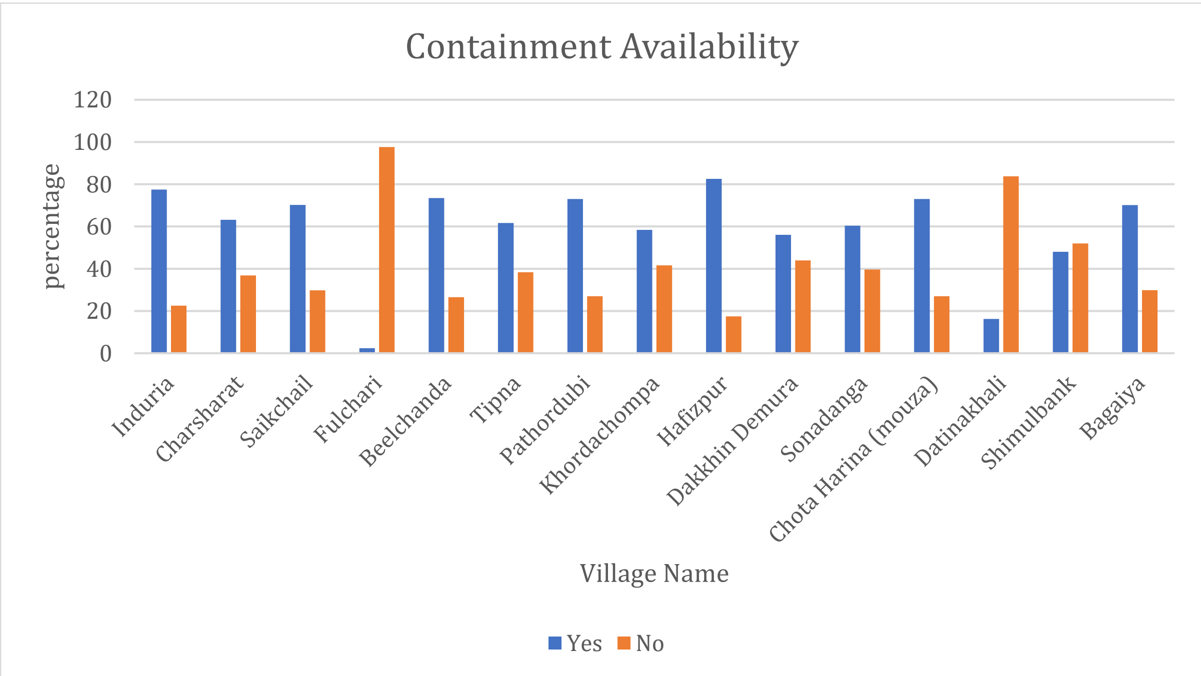


Figure 4.63: Practice of sludge containment (pilot villages)

The graph presents data on sludge containment (pit/tank for sludge) collected from the study. As only 10% of the total households in the sample villages were covered, all households of Baje Fulchari, Parul, and Ziadanga could not be covered in the survey.

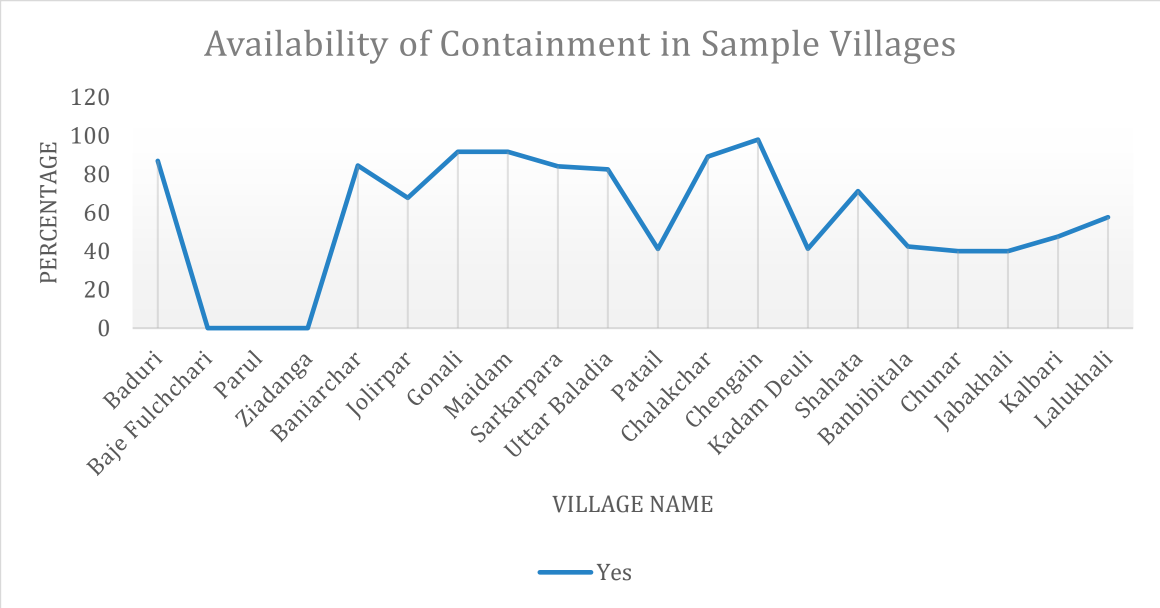


Figure 4.64: Containment availability in Sample Villages

Pit/Tank Emptying System

The survey enumerators conducted an intensive interview to study the emptying method of the latrine pits and tanks. The respondents were questioned about how their toilets were emptied. The data collected revealed that around more than 80% of the people in most of the villages used bucket and rope to empty the pit/tank except in Khordachompa (34.35%) and Sonadanga (48.17%) village. the manual pump method was used the most in only the Saikchail village (7.14%), but in the other areas, only 0-4% used this method. Electric pump method, on the other hand, is used in Khordachompa (64.35%), Sonadanga (50.79%), and Saikchail (10.49%). In the rest of the areas, the bucket and rope method is the most common. The picture is almost the same in the sample villages.

Table 4.54: Pit/tank emptying system (pilot villages)

District	Village	Bucket and Rope		Manual Pump		Electric Pump	
		n	%	n	%	n	%
Barishal	Induria	320	98.77	4	1.23	0	0
Chattogram	Charsharat	518	96.28	8	1.49	12	2.23
Cumilla	Saikchail	762	82.38	66	7.14	97	10.49
Gaibandha	Fulchari	6	100	0	0	0	0
Gopalganj	Beelchanda	192	100	0	0	0	0
Khulna	Tipna	331	96.22	11	3.2	2	0.58
Kurigram	Pathordubi	824	98.8	3	0.36	7	0.84
Naogaon	Khordachompa	79	34.35	3	1.3	148	64.35
Narsingdi	Hafizpur	667	93.55	20	2.81	26	3.65
Netrakona	Dakkhin Demura	148	100	0	0	0	0
Rajshahi	Sonadanga	92	48.17	2	1.05	97	50.79
Rangamati	Chota Harina (mouza)	76	98.7	0	0	1	1.3
Satkhira	Datinakhali	55	96.49	2	3.51	0	0

District	Village	Bucket and Rope		Manual Pump		Electric Pump	
		n	%	n	%	n	%
Sunamganj	Shimulbank	90	95.74	1	1.06	3	3.19
Sylhet	Bagaiya	311	95.69	12	3.69	2	0.62

Table 4.55: Pit/tank emptying system (sample villages)

District	Village	Bucket on and Rope		Manual Pump		Electric Pump	
		n	%	n	%	n	%
Barishal	Baduri	7	100	0	0	0	0
Gopalganj	Baniarchar	49	100	0	0	0	0
	Jolirpar	97	97	2	2	1	1
Khulna	Gonali	45	97.83	0	0	1	2.17
Kurigram	Maidam	25	96.15	1	3.85	0	0
	Sarkarpara	64	100	0	0	0	0
	Uttar Baladia	67	100	0	0	0	0
Naogaon	Patail	3	100	0	0	0	0
Narsingdi	Chalakchar	78	90.7	5	5.81	3	3.49
	Chengain	27	87.1	2	6.45	2	6.45
Netrakona	Kadam Deuli	11	100	0	0	0	0
	Shahata	36	100	0	0	0	0
Satkhira	Banbibitala	9	100	0	0	0	0
	Chunar	16	100	0	0	0	0
	Jabakhali	9	100	0	0	0	0
	Kalbari	8	80	2	20	0	0
Sunamganj	Lalukhali	5	100	0	0	0	0

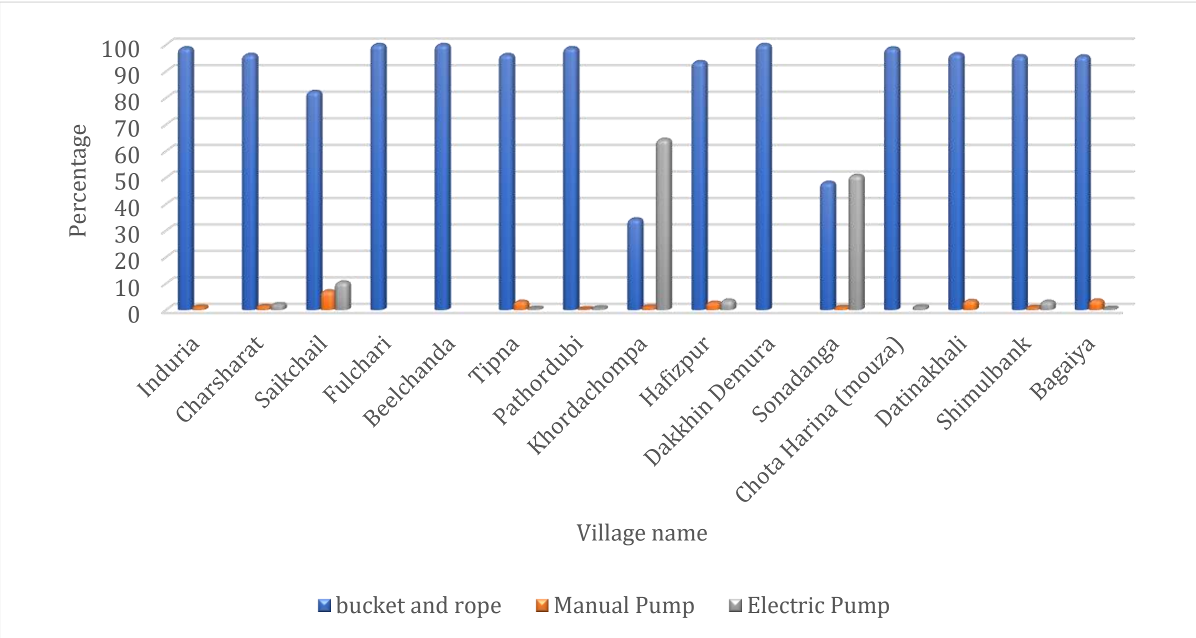


Figure 4.65: Pit/tank emptying system (pilot villages)

Sludge Disposal Practices

The extensive study has revealed the sludge disposal situation in the pilot and sample villages. The table shows that over 60% of the households in the pilot villages used dug holes to dispose of sludge. A few exceptions are Charsharat (40.84%), Dakhin Demura (47.62%), and Shimulbank (45.74%). The people in those villages do not appear to be hygenic in their practice of sludge disposal. Sludge is disposed of in nearby water bodies by 54.58% of the households in Charsharat, 47.62% of the households in Dakhin Demura, and 54.26% of the households in Shimulbank.

The sludge disposal situation in the sample villages (10% of the total households) appears to be as unsanitary as in the pilot villages.

Table 4.56: Sludge disposal practices (pilot villages)

District	Village	Transport to treatment plant		Carry to desludging unit		in dug holes		in drains		in nearby water bodies		in open fields	
		n	%	n	%	n	%	N	%	n	%	n	%
Barishal	Induria	1	0.31	-	-	264	81.48	-	-	59	18.21	-	-
Chattogram	Charsharat	-	-	4	0.73	223	40.84	12	2.2	298	54.58	9	1.65
Cumilla	Saikchail	1	0.11	-	-	563	60.54	5	0.54	354	38.06	7	0.75
Gaibandha	Fulchari	-	-	-	-	4	66.67	-	-	2	33.33	-	-
Gopalganj	Beelchanda	-	-	-	-	170	88.54	1	0.52	20	10.42	1	0.52
Khulna	Tipna	-	-	-	-	336	96.83	5	1.44	6	1.73	-	-
Kurigram	Pathordubi	-	-	1	0.12	660	79.04	2	0.24	161	19.28	11	1.32
Naogaon	Khordachompa	-	-	-	-	173	75.55	7	3.06	31	13.54	18	7.86
Narsingdi	Hafizpur	-	-	-	-	482	67.41	2	0.28	186	26.01	45	6.29
Netrakona	Dakkhin Demura	-	-	-	-	70	47.62	-	-	70	47.62	7	4.76
Rajshahi	Sonadanga	-	-	-	-	120	62.5	1	0.52	66	34.38	5	2.6
Rangamati	Chota Harina (mouza)	-	-	-	-	58	76.32	-	-	5	6.58	13	17.11
Satkhira	Datinakhali	-	-	-	-	48	85.71	-	-	8	14.29	-	-
Sunamganj	Shimulbank	-	-	-	-	43	45.74	-	-	51	54.26	-	-
Sylhet	Bagaiya	-	-	-	-	263	81.17	1	0.31	59	18.21	1	0.31

Table 4.57: Sludge disposal practices (sample villages)

District	Village	in dug holes		in drains		in nearby water bodies		in open fields	
		n	%	n	%	n	%	n	%
Barishal	Baduri	6	85.71	-	-	1	14.29	-	-
Gopalganj	Baniarchar	46	95.83	-	-	2	4.17	-	-
	Jolirpar	94	94	1	1	5	5	-	-
Khulna	Gonali	46	100	-	-	-	-	-	-
Kurigram	Maidam	20	76.92	-	-	6	23.08	-	-
	Sarkarpara	49	76.56	-	-	12	18.75	3	4.69
	Uttar Baladia	53	79.1	-	-	10	14.93	4	5.97
Naogaon	Patail	1	33.33	-	-	2	66.67	-	-
Narsingdi	Chalakchar	76	88.37	-	-	5	5.81	5	5.81
	Chengain	22	70.97	-	-	5	16.13	4	12.9
Netrakona	Kadam Deuli	9	81.82	-	-	0	0	2	18.18
	Shahata	27	75	-	-	8	22.22	1	2.78
Satkhira	Banbibitala	9	100	-	-	-	-	-	-
	Chunar	16	100	-	-	-	-	-	-
	Jabakhali	7	77.78	-	-	2	22.22	-	-
	Kalbari	9	90	1	10	-	-	-	-
Sunamganj	Lalukhali	2	40	-	-	3	60	-	-

The current level of satisfaction in sludge management

The table below shows the current satisfaction level with sludge management facility in terms of whether there is willingness among households to upgrade their sludge management systems. The table shows that in the pilot villages, more than 55% of households agreed to improve their current facilities, which indicates that they were not satisfied with the facilities. However, in Fulchari village of Gaibandha only 37.69% showed the willingness to improve their existing facilities.

Table 4.58: Households willing to improve sludge management system (pilot villages)

District	Village	Yes		No	
		n	%	N	%
Barishal	Induria	502	68.96	226	31.04
Chattogram	Charsharat	717	76.93	215	23.07
Cumilla	Saikchail	1195	73	442	27
Gaibandha	Fulchari	127	37.69	210	62.31
Gopalganj	Beelchanda	261	66.92	129	33.08
Khulna	Tipna	584	76.44	180	23.56
Kurigram	Pathordubi	2044	82.92	421	17.08
Naogaon	Khordachompa	305	67.78	145	32.22
Narsingdi	Hafizpur	1125	68.47	518	31.53
Netrakona	Dakkhin Demura	265	71.24	107	28.76
Rajshahi	Sonadanga	451	63.88	255	36.12
Rangamati	Chota Harina (mouza)	181	84.58	33	15.42
Satkhira	Datinakhali	320	56.44	247	43.56
Sunamganj	Shimulbank	335	72.67	126	27.33
Sylhet	Bagaiya	593	64.46	327	35.54

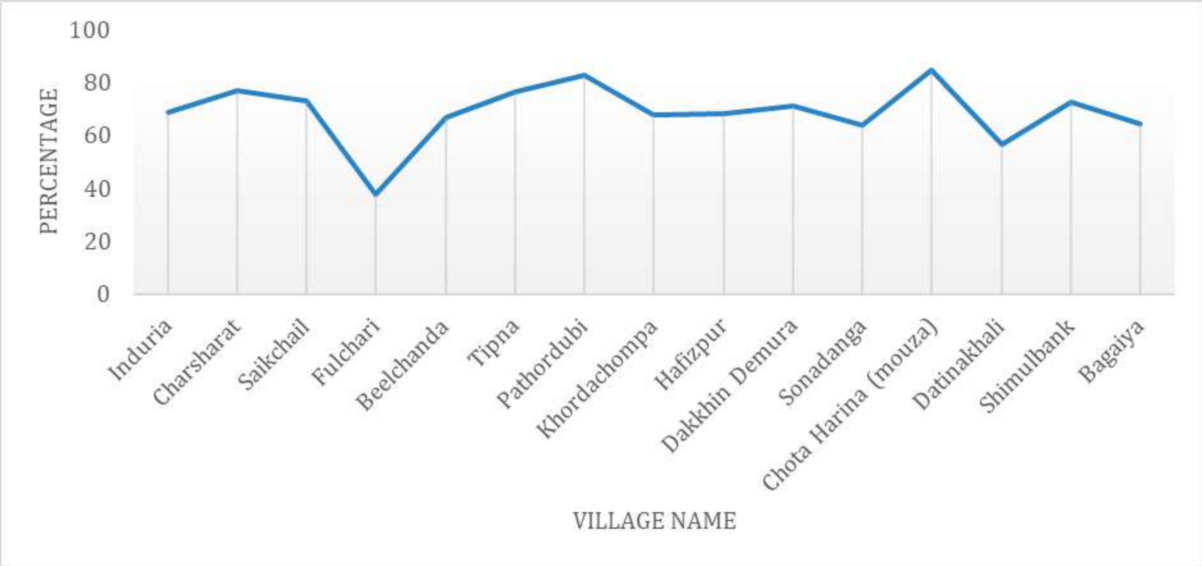


Figure 4.66: Willingness to improve sludge management (pilot villages)

The following table shows data gathered from the sample villages. The data, which reflect the interest or its lack in sludge management, cover only 10% of the total households of the sample villages.

Table 4.59: Households willing to improve sludge management system (sample villages)

District	Village	Yes		No	
		n	%	n	%
Barishal	Baduri	13	56.52	10	43.48
Gaibandha	Baje Fulchari	5	9.26	49	90.74
	Parul	11	22	39	78
	Ziadanga	3	8.57	32	91.43
Gopalganj	Baniarchar	52	61.9	32	38.1
	Jolirpar	119	64.32	66	35.68
Khulna	Gonali	39	65	21	35
Kurigram	Maidam	60	83.33	12	16.67
	Sarkarpara	165	79.33	43	20.67
	Uttar Baladia	249	87.06	37	12.94
Naogaon	Patail	15	88.24	2	11.76
Narsingdi	Chalakchar	113	64.57	62	35.43
	Chengain	33	66	17	34
Netrakona	Kadam Deuli	31	67.39	15	32.61
	Shahata	58	79.45	15	20.55
Satkhira	Banbibitala	20	60.61	13	39.39
	Chunar	30	66.67	15	33.33
	Jabakhali	21	84	4	16
	Kalbari	25	59.52	17	40.48
Sunamganj	Lalukhali	17	65.38	9	34.62

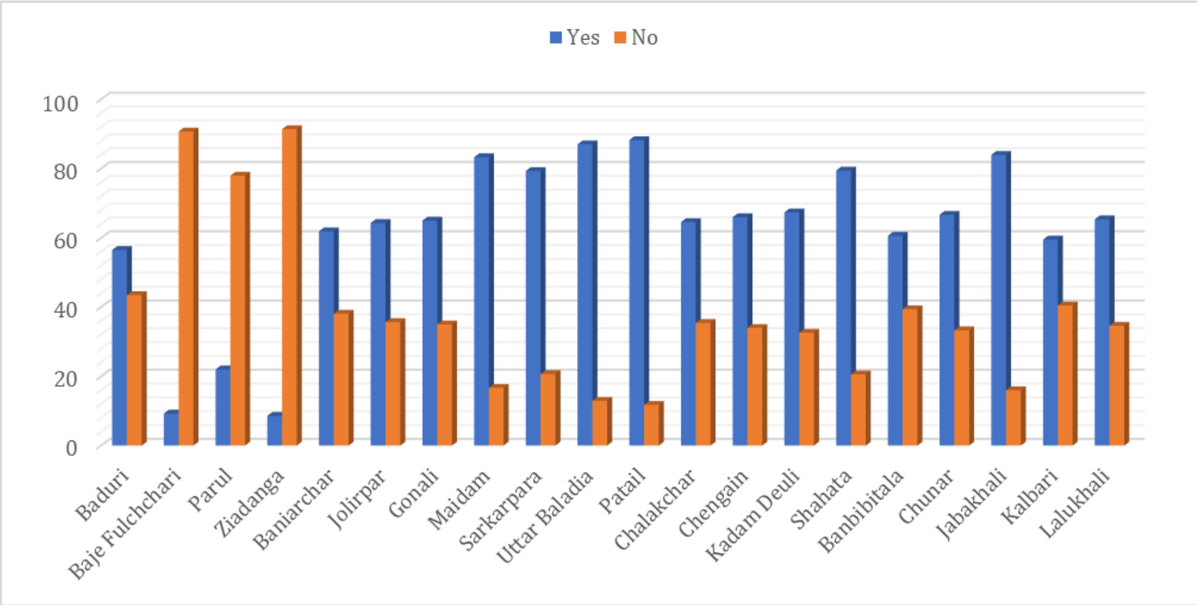


Figure 4.67: Willingness to improve sludge management (sample villages)

Scope for Improvement

In the case of pilot villages, more than 70% of the households agreed that there was scope for improving sludge management in their areas. Only in Fulchari, Gainbandha people seemed less interested (around 61% of the households) in improving sludge management.

Table 4.60: Scope for improving sludge management (pilot villages)

District	Village	Yes		No	
		n	%	n	%
Barishal	Induria	623	85.81	103	14.19
Chattogram	Charsharat	767	82.3	165	17.7
Cumilla	Saikchail	1509	93.26	109	6.74
Gaibandha	Fulchari	131	38.76	207	61.24
Gopalganj	Beelchanda	327	84.06	62	15.94
Khulna	Tipna	568	74.54	194	25.46
Kurigram	Pathordubi	2258	91.83	201	8.17
Naogaon	Khordachompa	368	81.78	82	18.22
Narsingdi	Hafizpur	1566	95.6	72	4.4
Netrakona	Dakkhin Demura	356	95.96	15	4.04
Rajshahi	Sonadanga	664	94.72	37	5.28
Rangamati	Chota Harina (mouza)	202	94.39	12	5.61
Satkhira	Datinakhali	389	68.73	177	31.27
Sunamganj	Shimulbank	407	88.86	51	11.14
Sylhet	Bagaiya	867	94.34	52	5.66

In sample villages where only 10% of the total households were surveyed, it was noted that more than 70% of those households, except for the households in Baje Fulchari village, thought that there was scope for improving sludge management.

Table 4.61: Scope for improving sludge management (sample villages)

District	Village	Yes		No	
		n	%	n	%
Barishal	Baduri	19	82.61	4	17.39
Gaibandha	Baje Fulchari	20	37.04	34	62.96
	Parul	18	36	32	64
	Ziadanga	14	40	21	60
Gopalganj	Baniarchar	78	93.98	5	6.02
	Jolirpar	164	89.13	20	10.87
Khulna	Gonali	44	74.58	15	25.42
Kurigram	Maidam	68	94.44	4	5.56
	Sarkarpara	197	94.71	11	5.29
	Uttar Baladia	277	97.54	7	2.46
Naogaon	Patail	16	94.12	1	5.88
Narsingdi	Chalakchar	167	95.98	7	4.02
	Chengain	50	100	-	-
Netrakona	Kadam Deuli	45	100	-	-
	Shahata	67	93.06	5	6.94
Satkhira	Banbibitala	28	84.85	5	15.15
	Chunar	38	84.44	7	15.56
	Jabakhali	21	84	4	16
	Kalbari	31	73.81	11	26.19
Sunamganj	Lalukhali	24	92.31	2	7.69

4.4 Hygiene

4.4.1 *Current Awareness of Hygiene*

More than 65% of the households clean their toilets with a mop once or twice daily, and around 20-30% of the households clean and mop the floor of their houses twice daily or once a week. The following table indicates the percentage of households aware of the need for a clean environment and the method of keeping it clean and hygienic.

Table 4.62: Method and duration of cleaning (pilot villages)

District	Village	Cleaning with mop once or twice daily		Other ways (specify)		Mopping once or twice daily or once a week	
		n	%	N	%	n	%
Barishal	Induria	610	77.12	-	-	181	22.88
Chattogram	Charsharat	873	86.44	-	-	137	13.56
Cumilla	Saikchail	1576	86.21	3	0.16	249	13.62
Gaibandha	Fulchari	322	69.25	1	0.22	142	30.54
Gopalganj	Beelchanda	379	91.99	-	-	33	8.01
Khulna	Tipna	712	76.07	34	3.63	190	20.3
Kurigram	Pathordubi	2350	76.8	-	-	710	23.2
Naogaon	Khordachompa	452	79.58	1	0.18	115	20.25
Narsingdi	Hafizpur	1545	64.92	138	5.8	697	29.29
Netrakona	Dakkhin Demura	358	88.83	13	3.23	32	7.94
Rajshahi	Sonadanga	696	75.98	-	-	220	24.02

District	Village	Cleaning with mop once or twice daily		Other ways (specify)		Mopping once or twice daily or once a week	
		n	%	N	%	n	%
Rangamati	Chota Harina (mouza)	211	92.14	-	-	18	7.86
Satkhira	Datinakhali	457	72.77	21	3.34	150	23.89
Sunamganj	Shimulbank	454	89.9	-	-	51	10.1
Sylhet	Bagaiya	879	91.37	3	0.31	80	8.32

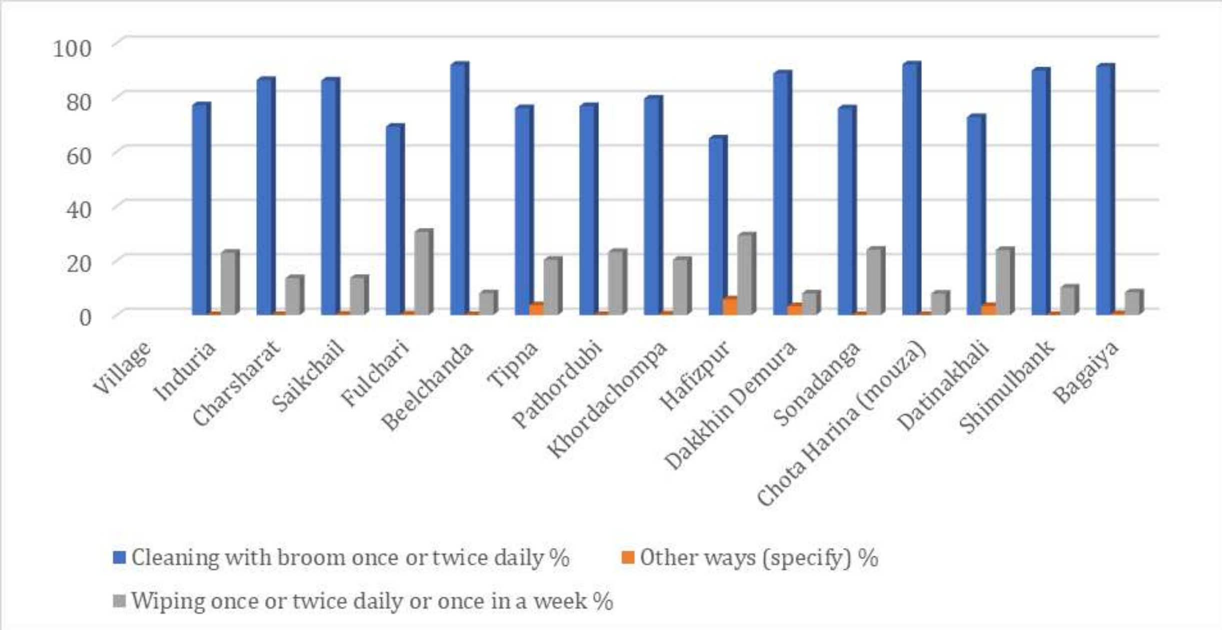


Figure 4.68: Method and duration of cleaning (pilot villages)

Hand washing is also a part of hygiene. The following table and chart present data on hand washing after using the toilet and the hand washing facility locations. The study looked into hand washing habit, time, and place in different scenarios to help determine whether the household surroundings in the pilot villages were hygienic. The table shows that more than 55% of the households do not have any specific place to wash hands, which makes their surroundings unhygienic. Around 7-30% of the households use the toilet facility itself as a hand washing site.

Table 4.63: Handwashing facility location for after defecation (pilot villages)

District	Village	Anywhere outside the toilet facility		Inside the toilet facility		In a room		No hand washing facility		Outside of toilet but inside of toilet block	
		n	%	n	%	n	%	N	%	n	%
Barishal	Induria	647	88.27	60	8.19	-	-	1	0.14	25	3.41
Chattogram	Charsharat	822	85.18	91	9.43	9	0.93	22	2.28	21	2.18
Cumilla	Saikchail	1286	75.2	289	16.9	27	1.58	16	0.94	92	5.38
Gaibandha	Fulchari	363	93.32	12	3.08	3	0.77	2	0.51	9	2.31
Gopalganj	Beelchanda	254	60.91	147	35.25	5	1.2	1	0.24	10	2.4
Khulna	Tipna	576	67.69	132	15.51	19	2.23	-	-	124	14.57

District	Village	Anywhere outside the toilet facility		Inside the toilet facility		In a room		No hand washing facility		Outside of toilet but inside of toilet block	
		n	%	n	%	n	%	N	%	n	%
Kurigram	Pathordubi	2252	89.29	178	7.06	31	1.23	9	0.36	52	2.06
Naogaon	Khordachom pa	317	62.16	105	20.59	4	0.78	7	1.37	77	15.1
Narsingdi	Hafizpur	1180	62.07	307	16.15	36	1.89	109	5.73	269	14.15
Netrakona	Dakkhin Demura	285	65.37	34	7.8	2	0.46	97	22.2 5	18	4.13
Rajshahi	Sonadanga	450	56.04	264	32.88	2	0.25	8	1	79	9.84
Rangamati	Chota Harina (mouza)	159	71.62	38	17.12	3	1.35	1	0.45	21	9.46
Satkhira	Datinakhali	481	78.59	73	11.93	24	3.92	18	2.94	16	2.61
Sunamganj	Shimulbank	343	70.87	79	16.32	10	2.07	22	4.55	30	6.2
Sylhet	Bagaiya	570	58.64	351	36.11	9	0.93	17	1.75	25	2.57

The following table shows the habit of regular hand washing among households. The Saikchail village has the highest percentage of practising this habit (86.44%). On the other hand, the Dakhin Demura village has the lowest rate (56.03%) of the practice among the surveyed villages.

Table 4.64: Habit of regular hand washing (pilot villages)

District	Village	Yes		No	
		n	%	N	%
Barishal	Induria	512	70.33	216	29.67
Chattogram	Charsharat	783	83.3	157	16.7
Cumilla	Saikchail	1428	86.44	224	13.56
Gaibandha	Fulchari	277	73.47	100	26.53
Gopalganj	Beelchanda	337	85.97	55	14.03
Khulna	Tipna	607	78.63	165	21.37
Kurigram	Pathordubi	1868	75.66	601	24.34
Naogaon	Khordachompa	333	72.55	126	27.45
Narsingdi	Hafizpur	1252	76.06	394	23.94
Netrakona	Dakkhin Demura	209	56.03	164	43.97
Rajshahi	Sonadanga	518	73.06	191	26.94
Rangamati	Chota Harina (mouza)	173	80.47	42	19.53
Satkhira	Datinakhali	459	80.81	109	19.19
Sunamganj	Shimulbank	345	74.68	117	25.32
Sylhet	Bagaiya	792	85.99	129	14.01

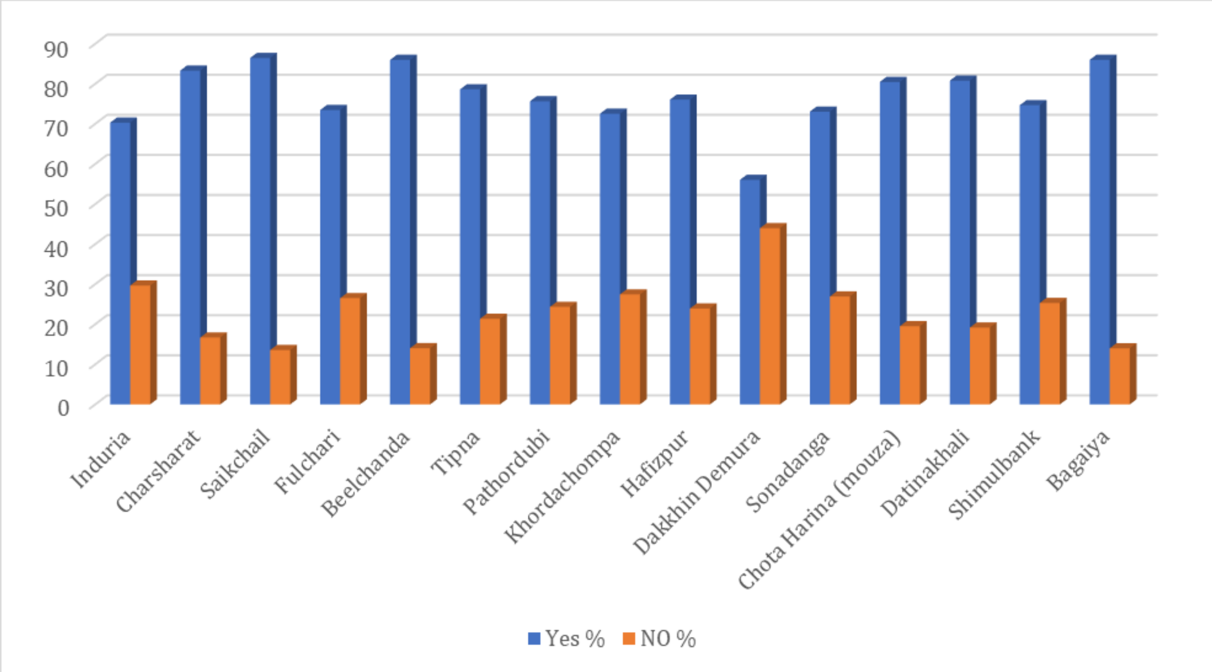


Figure 4.69: Habit of regular hand washing (pilot villages)

The table below shows that soap or soapy water for hand washing is quite common among households. More than 75% of the households have a rough idea of the need for using soapy water or soap for hand washing. The highest percentage of households practising this habit was in Sonadanga village (97.6%), and the lowest was in Fulchari village (76.92%).

Table 4.65: Using soap or soapy water (pilot villages)

District	Village	Yes		No	
		n	%	N	%
Barishal	Induria	628	86.26	100	13.74
Chattogram	Charsharat	885	94.15	55	5.85
Cumilla	Saikchail	1555	94.13	97	5.87
Gaibandha	Fulchari	290	76.92	87	23.08
Gopalganj	Beelchanda	370	94.39	22	5.61
Khulna	Tipna	680	88.08	92	11.92
Kurigram	Pathordubi	2237	90.6	232	9.4
Naogaon	Khordachompa	440	95.86	19	4.14
Narsingdi	Hafizpur	1318	80.07	328	19.93
Netrakona	Dakkhin Demura	327	87.67	46	12.33
Rajshahi	Sonadanga	692	97.6	17	2.4
Rangamati	Chota Harina (mouza)	195	90.7	20	9.3
Satkhira	Datinakhali	517	91.02	51	8.98
Sunamganj	Shimulbank	404	87.45	58	12.55
Sylhet	Bagaiya	864	93.81	57	6.19

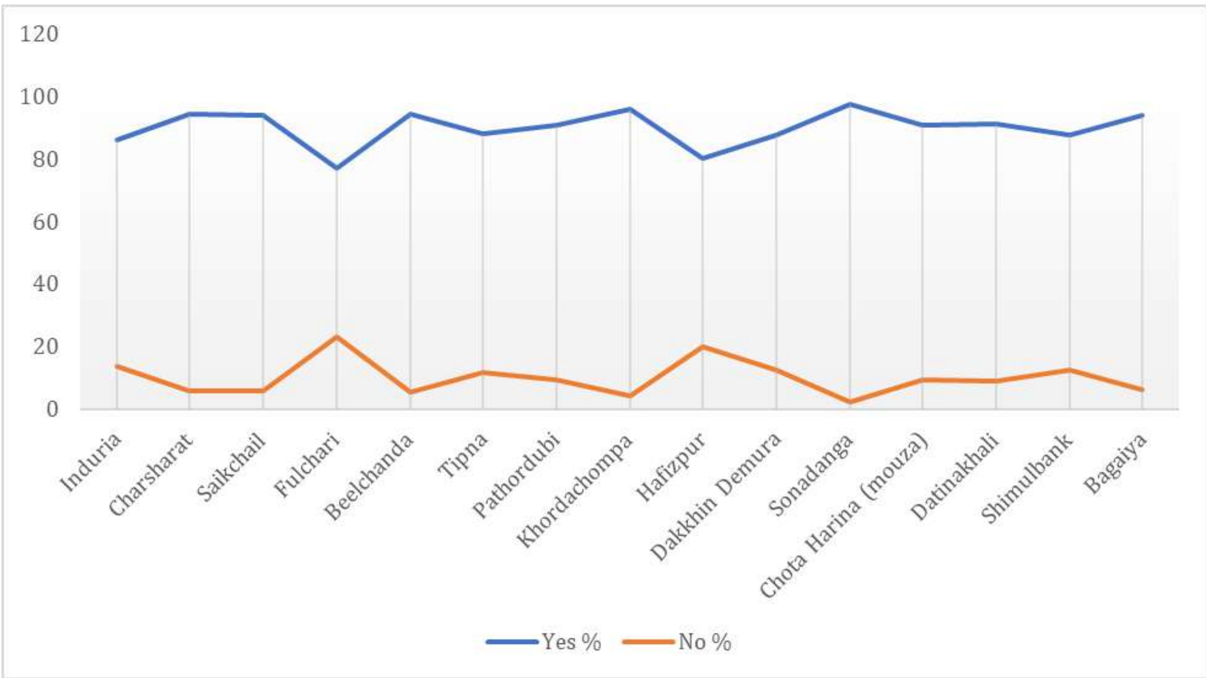


Figure 4.70: Using soap or soapy water (pilot villages)

The following table shows whether people wash their hands for reasons other than after defecation. It appears that 30-35% of the households wash their hands before taking a meal. 20-25% of the people wash hands after completion of work outside the home, 25-30% wash hands before cooking, and 10-25% wash hands before feeding children.

Table 4.66: Washing hands for reasons other than after defecation (pilot villages)

District	Village	After completion of work outside of home		Before cooking		Before feeding children		Before meals		Others (specify)	
		n	%	n	%	n	%	n	%	n	%
Barishal	Induria	495	25.45	540	27.76	198	10.18	706	36.3	6	0.31
Chattogram	Charsharat	667	24.74	747	27.71	378	14.02	904	33.53	0	0
Cumilla	Saikchail	1259	23.89	1514	28.73	855	16.23	1640	31.13	1	0.02
Gaibandha	Fulchari	158	17.89	160	18.12	195	22.08	370	41.9	0	0
Gopalganj	Beelchanda	259	24.74	276	26.36	136	12.99	370	35.34	6	0.57
Khulna	Tipna	518	23.48	623	28.24	245	11.11	741	33.59	79	3.58
Kurigram	Pathordubi	1825	26.1	1726	24.68	1094	15.64	2348	33.58	0	0
Naogaon	Khordachompa	358	30.68	280	23.99	146	12.51	383	32.82	0	0
Narsingdi	Hafizpur	1087	25.31	1041	24.24	537	12.5	1491	34.71	139	3.24
Netrakona	Dakkhin Demura	165	23.27	174	24.54	66	9.31	277	39.07	27	3.81
Rajshahi	Sonadanga	607	32.22	411	21.82	235	12.47	630	33.44	1	0.05
Rangamati	Chota Harina (mouza)	152	22.13	197	28.68	124	18.05	214	31.15	0	0
Satkhira	Datinakhali	338	22.02	397	25.86	253	16.48	522	34.01	25	1.63
Sunamganj	Shimulbank	318	22.28	404	28.31	244	17.1	460	32.24	1	0.07
Sylhet	Bagaiya	583	22.67	648	25.19	466	18.12	865	33.63	10	0.39

4.4.2 *Health Service Facilities for Maintaining Hygiene*

In rural areas, people mostly use soap to wash and clean their houses and surroundings. 71.04% of the households in Bagaiya of Sylhet wash their hands regularly with soap before meals, 72.64% of the households of Fulchari village washed their hands sometimes, and 32.08% of the households in Dakhin Demura never used soap to wash hands before meals. The following table shows whether people use soap to wash their hands before meals.

Table 4.67: Using soap to wash hands before meal (pilot villages)

District	Village	Never		Regularly		Sometimes	
		n	%	n	%	n	%
Barishal	Induria	37	4.7	395	50.13	356	45.18
Chattogram	Charsharat	15	1.55	488	50.57	462	47.88
Cumilla	Saikchail	61	3.3	1046	56.66	739	40.03
Gaibandha	Fulchari	12	2.99	98	24.38	292	72.64
Gopalganj	Beelchanda	46	9.83	293	62.61	129	27.56
Khulna	Tipna	11	1.33	463	55.99	353	42.68
Kurigram	Pathordubi	13	0.44	1302	44.11	1637	55.45
Naogaon	Khordachompa	15	2.99	246	49.1	240	47.9
Narsingdi	Hafizpur	323	17.46	450	24.32	1077	58.22
Netrakona	Dakkhin Demura	137	32.08	20	4.68	270	63.23
Rajshahi	Sonadanga	15	1.7	513	58.3	352	40
Rangamati	Chota Harina (mouza)	18	7.69	119	50.85	97	41.45
Satkhira	Datinakhali	17	2.86	380	63.87	198	33.28
Sunamganj	Shimulbank	57	11.56	238	48.28	198	40.16
Sylhet	Bagaiya	30	2.99	714	71.04	261	25.97

It appears that 89.36% of the households in Bagaiya are in the habit of cleaning both hands with soap. On the other hand, 35.66 % of the households in Dakhin Demura do not practise this habit. The following table shows the household data on the practice of cleaning both hands with soap.

Table 4.68: Households practicing cleaning of both hands with soap (pilot villages)

District	Village	Yes		No	
		n	%	N	%
Barishal	Induria	527	72.39	201	27.61
Chattogram	Charsharat	785	83.51	155	16.49
Cumilla	Saikchail	1457	88.2	195	11.8
Gaibandha	Fulchari	252	66.84	125	33.16
Gopalganj	Beelchanda	345	88.01	47	11.99
Khulna	Tipna	627	81.22	145	18.78
Kurigram	Pathordubi	1941	78.61	528	21.39
Naogaon	Khordachompa	353	76.91	106	23.09
Narsingdi	Hafizpur	1292	78.49	354	21.51
Netrakona	Dakkhin Demura	240	64.34	133	35.66
Rajshahi	Sonadanga	620	87.45	89	12.55
Rangamati	Chota Harina (mouza)	173	80.47	42	19.53
Satkhira	Datinakhali	485	85.39	83	14.61

District	Village	Yes		No	
		n	%	N	%
Sunamganj	Shimulbank	346	74.89	116	25.11
Sylhet	Bagaiya	823	89.36	98	10.64

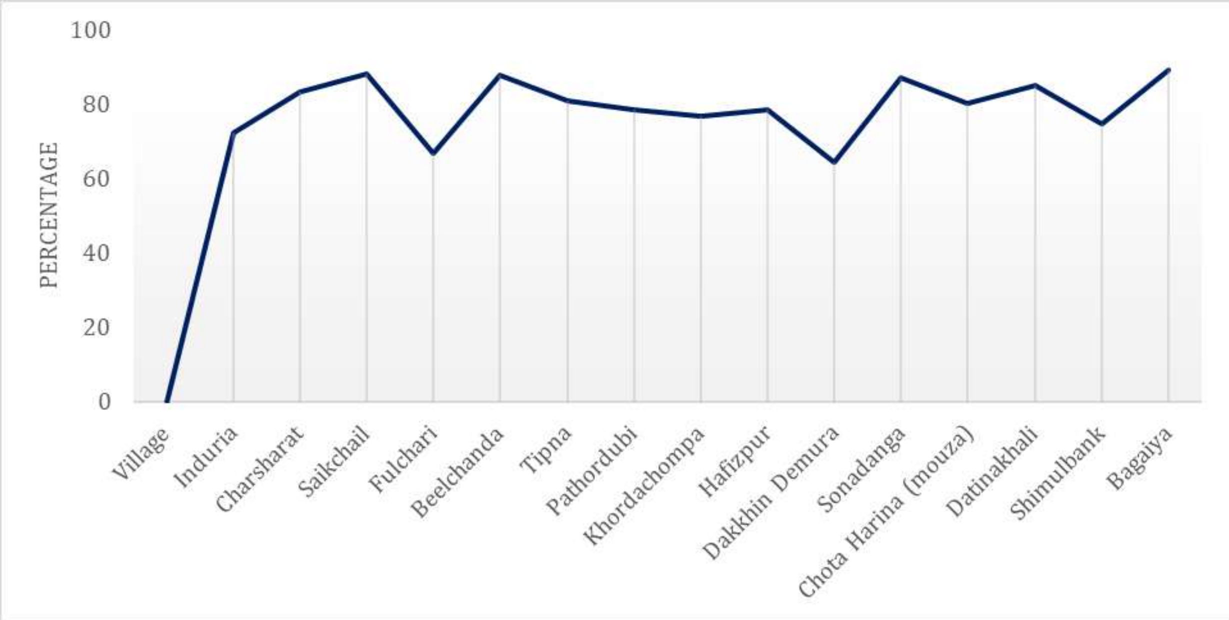


Figure 4.71: Percentage graph of households practicing cleaning of both hands with soap (pilot villages)

This table presents the different types of water storage systems for hand washing. However, the table does not show whether those water storage systems are hygienic or not. Around 62.1% of the households in Chota Harina village use only a bucket or open container to store water. 76.8% of the households in Pathordubi village do not store any water, 18.28% of the households in Datinakhali village use buckets covered with a lid or a container, and 16.61% of the people in Hafizpur use water tanks to store water.

Table 4.69: Storage of water for hand washing (pilot villages)

District	Village	In a container/bucket covered with lid		In an open container/bucket		No storing of water		Water tank with tap	
		n	%	n	%	n	%	n	%
Barishal	Induria	13	1.76	297	40.3	401	54.41	26	3.53
Chattogram	Charsharat	87	9.2	512	54.12	276	29.18	71	7.51
Cumilla	Saikchail	127	7.62	720	43.19	549	32.93	271	16.26
Gaibandha	Fulchari	12	3.12	112	29.09	256	66.49	5	1.3
Gopalganj	Beelchanda	65	14.54	210	46.98	154	34.45	18	4.03
Khulna	Tipna	28	3.56	373	47.46	343	43.64	42	5.34
Kurigram	Pathordubi	21	0.84	469	18.66	1930	76.8	93	3.7
Naogaon	Khordachompa	76	14.79	229	44.55	143	27.82	66	12.84
Narsingdi	Hafizpur	45	2.58	192	11	1219	69.82	290	16.61
Netrakona	Dakkhin Demura	12	2.94	78	19.12	302	74.02	16	3.92
Rajshahi	Sonadanga	48	6.3	422	55.38	205	26.9	87	11.42
Rangamati	Chota Harina (mouza)	28	12.79	136	62.1	44	20.09	11	5.02
Satkhira	Datinakhali	121	18.28	321	48.49	173	26.13	47	7.1
Sunamganj	Shimulbank	57	12.28	229	49.35	157	33.84	21	4.53
Sylhet	Bagaiya	148	13.77	582	54.14	274	25.49	71	6.6

4.4.3 *Hygiene Awareness Programs*

Hygiene awareness programs play a vital role in developing a hygienic environment in villages. The table below indicates whether or not public awareness activities are carried out in rural areas. The public awareness activities refer to vaccination, coronavirus prevention, cyclone preparedness, and observance of world water day, world handwashing day, world environment day, sanitation month, world toilet day, etc. The table also shows that Induria of Barishal has the highest percentage of household awareness activities (99.18%). The lowest number of awareness programs were carried out in Charsharat of Chattogram, with only 67.24 % of households saying that such programs were carried out in their areas.

Table 4.70: Public awareness activities (pilot villages)

District	Village	Yes		No	
		n	%	n	%
Barishal	Induria	722	99.18	6	0.82
Chattogram	Charsharat	628	67.24	306	32.76
Cumilla	Saikchail	1423	86.61	220	13.39
Gaibandha	Fulchari	318	85.25	55	14.75
Gopalganj	Beelchanda	341	86.99	51	13.01
Khulna	Tipna	664	86.23	106	13.77
Kurigram	Pathordubi	1143	46.29	1326	53.71
Naogaon	Khordachompa	273	60.26	180	39.74
Narsingdi	Hafizpur	1534	93.31	110	6.69
Netrakona	Dakkhin Demura	228	61.13	145	38.87
Rajshahi	Sonadanga	332	46.83	377	53.17
Rangamati	Chota Harina (mouza)	199	92.99	15	7.01
Satkhira	Datinakhali	522	91.9	46	8.1
Sunamganj	Shimulbank	434	94.14	27	5.86
Sylhet	Bagaiya	780	84.69	141	15.31

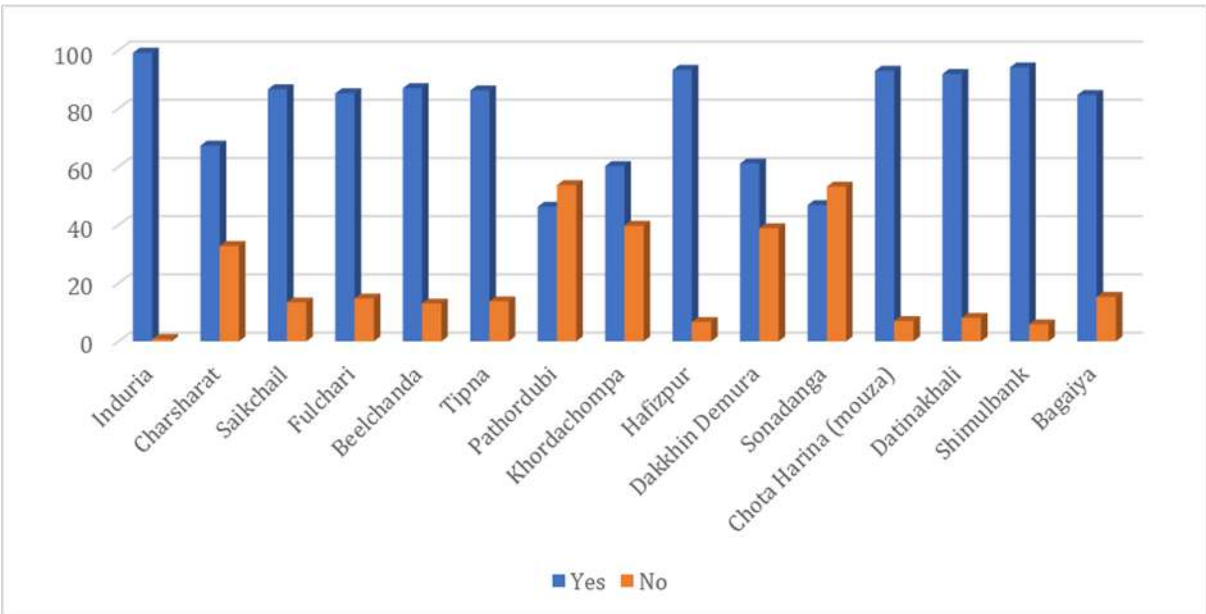


Figure 4.72: Awareness activities carried out or not (pilot Villages)

Table 4.71: Types of awareness program carried out in pilot villages

District	Village	Meeting/procession		Miking		NGO programs		Others (specify)		Poster		TV/Radio	
		n	%	n	%	n	%	n	%	n	%	n	%
Barishal	Induria	129	14.68	720	81.91	28	3.19	1	0.11	1	0.11	-	-
Chattogram	Charsharat	1	0.14	625	85.73	4	0.55	2	0.27	47	6.45	50	6.86
Cumilla	Saikchail	41	2.3	1423	79.85	23	1.29	2	0.11	162	9.09	131	7.35
Gaibandha	Fulchari	33	7.88	298	71.12	39	9.31	2	0.48	43	10.26	4	0.95
Gopalganj	Beelchanda	79	11.88	334	50.23	123	18.5	14	2.11	53	7.97	62	9.32
Khulna	Tipna	118	12.67	615	66.06	70	7.52	103	11.06	5	0.54	20	2.15
Kurigram	Pathordubi	160	11.41	1143	81.53	11	0.78	-	-	86	6.13	2	0.14
Naogaon	Khordachompa	6	1.81	273	82.23	10	3.01	-	-	43	12.95	-	-
Narsingdi	Hafizpur	631	20.2	1526	48.86	676	21.65	228	7.3	19	0.61	43	1.38
Netrakona	Dakkhin Demura	37	11.18	222	67.07	64	19.34	6	1.81	0	0	2	0.6
Rajshahi	Sonadanga	10	2.78	332	92.22	-	-	-	-	17	4.72	1	0.28
Rangamati	Chota Harina (mouza)	-	-	199	77.73	12	4.69	-	-	39	15.23	6	2.34
Satkhira	Datinakhali	106	12.3	514	59.63	135	15.66	11	1.28	80	9.28	16	1.86
Sunamganj	Shimulbank	1	0.19	433	82.63	-	-	1	0.19	75	14.31	14	2.67
Sylhet	Bagaiya	132	10.2	779	60.2	241	18.62	4	0.31	125	9.66	13	1

Table 4.72 shows the awareness programs carried out by different organizations/committees in the pilot villages. The program activities included meetings/rallies, miking, NGO initiatives, posters, TV/radio programs, etc. The table shows that the highest number of miking activity was carried out in Sonadanga village of Rajshahi (92.22 %). Meetings or rallies were held the most in Induriya village (14.68%). NGO programs were held in Hafizpur of Narsingdi (21.65%) and posters were used mainly in Chota Harina (15.23 %).

The following table shows the organizations or authorities that carried out these awareness programs.

Mosque Committees played a vital role in Shimulbank (50.06%). Even though many NGOs worked in many areas, they were the most active in Beelchanda (32.07%). In terms of awareness programs, Union Parishad played a pivotal role in every area. The most affected and benefitted area was found to be Sonadanga village (89.67%).

Table 4.72: Awareness program carried out by organization or committee (pilot villages)

District	Village	Community club		Mosque Committee		NGO		Others (specify)		Union Parishad	
		n	%	n	%	n	%	n	%	n	%
Barishal	Induria	50	4.46	356	31.79	29	2.59	12	1.07	673	60.09
Chattogram	Charsharat	30	2.91	383	37.18	33	3.2	3	0.29	581	56.41
Cumilla	Saikchail	14	0.51	1242	45.63	47	1.73	-	-	1419	52.13
Gaibandha	Fulchari	-	-	5	1.23	100	24.69	3	0.74	297	73.33
Gopalganj	Beelchanda	20	3.8	4	0.76	169	32.07	6	1.14	328	62.24
Khulna	Tipna	23	2.61	95	10.78	108	12.26	34	3.86	621	70.49
Kurigram	Pathordubi	1	0.07	198	12.94	189	12.35	-	-	1142	74.64
Naogaon	Khordachompa	6	1.73	36	10.4	33	9.54	-	-	271	78.32
Narsingdi	Hafizpur	14	0.54	245	9.47	802	31	4	0.15	1522	58.83
Netrakona	Dakkhin Demura	2	0.62	30	9.32	66	20.5	-	-	224	69.57
Rajshahi	Sonadanga	-	-	37	10.05	1	0.27	-	-	330	89.67
Rangamati	Chota Harina (mouza)	1	0.29	150	44.12	13	3.82	-	-	176	51.76
Satkhira	Datinakhali	21	2.58	131	16.09	184	22.6	5	0.61	473	58.11
Sunamganj	Shimulbank	-	-	424	50.06	-	-	-	-	423	49.94
Sylhet	Bagaiya	7	0.54	499	38.24	252	19.31	3	0.23	544	41.69

The table above and the following table and chart present the contributions of NGOs in these villages. Most of the NGO activities were found in Khordachampa village of Naogaon (86.81%), but the NGOs in Shimulbank of Sunamganj (3.23%) were the least active.

Table 4.73: NGO role in public awareness activities (pilot villages)

District	Village	Yes		No	
		n	%	n	%
Barishal	Induria	134	18.56	588	81.44
Chattogram	Charsharat	109	17.36	519	82.64
Cumilla	Saikchail	191	13.42	1232	86.58
Gaibandha	Fulchari	153	48.11	165	51.89
Gopalganj	Beelchanda	273	80.06	68	19.94

District	Village	Yes		No	
		n	%	n	%
Khulna	Tipna	222	33.43	442	66.57
Kurigram	Pathordubi	411	35.96	732	64.04
Naogaon	Khordachompa	237	86.81	36	13.19
Narsingdi	Hafizpur	1104	71.97	430	28.03
Netrakona	Dakkhin Demura	133	58.33	95	41.67
Rajshahi	Sonadanga	225	67.77	107	32.23
Rangamati	Chota Harina (mouza)	16	8.04	183	91.96
Satkhira	Datinakhali	376	72.03	146	27.97
Sunamganj	Shimulbank	14	3.23	420	96.77
Sylhet	Bagaiya	639	81.92	141	18.08

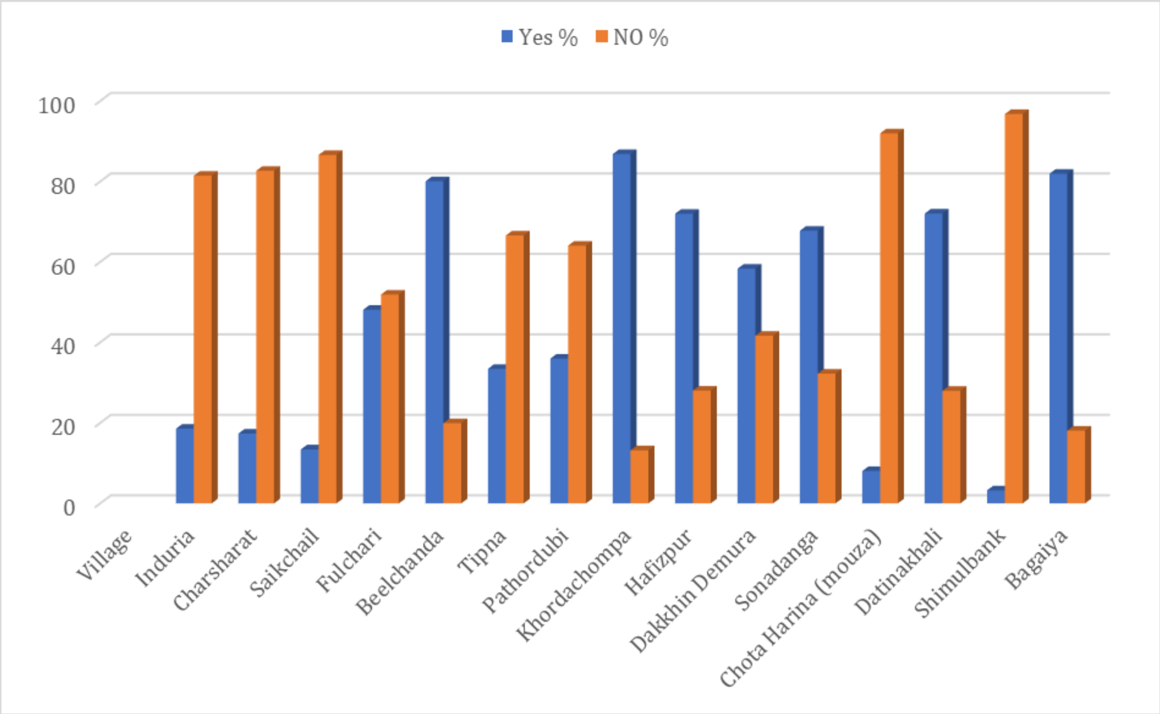


Figure 4.73: NGO role in public awareness (pilot villages)

Television is an important means of raising public awareness in villages. Access to television allows hygiene campaign messages and information to reach the people. The following Table shows the availability of Television (TV) in the pilot villages. 58.93% of households in Beelchanda village of Gopalganj have television sets. The lowest percentage of households with TV sets was found in Shimulbank of Sunamganj (1.95%).

Table 4.74: TV availability (pilot villages)

District	Village	Yes		No	
		n	%	N	%
Barishal	Induria	18	2.47	710	97.53
Chattogram	Charsharat	156	16.67	780	83.33
Cumilla	Saikchail	226	13.76	1416	86.24
Gaibandha	Fulchari	10	2.68	363	97.32
Gopalganj	Beelchanda	231	58.93	161	41.07

District	Village	Yes		No	
		n	%	N	%
Khulna	Tipna	72	9.35	698	90.65
Kurigram	Pathordubi	223	9.04	2245	90.96
Naogaon	Khordachompa	187	41.1	268	58.9
Narsingdi	Hafizpur	421	25.64	1221	74.36
Netrakona	Dakkhin Demura	24	6.43	349	93.57
Rajshahi	Sonadanga	307	43.3	402	56.7
Rangamati	Chota Harina (mouza)	22	10.28	192	89.72
Satkhira	Datinakhali	58	10.21	510	89.79
Sunamganj	Shimulbank	9	1.95	452	98.05
Sylhet	Bagaiya	134	14.55	787	85.45

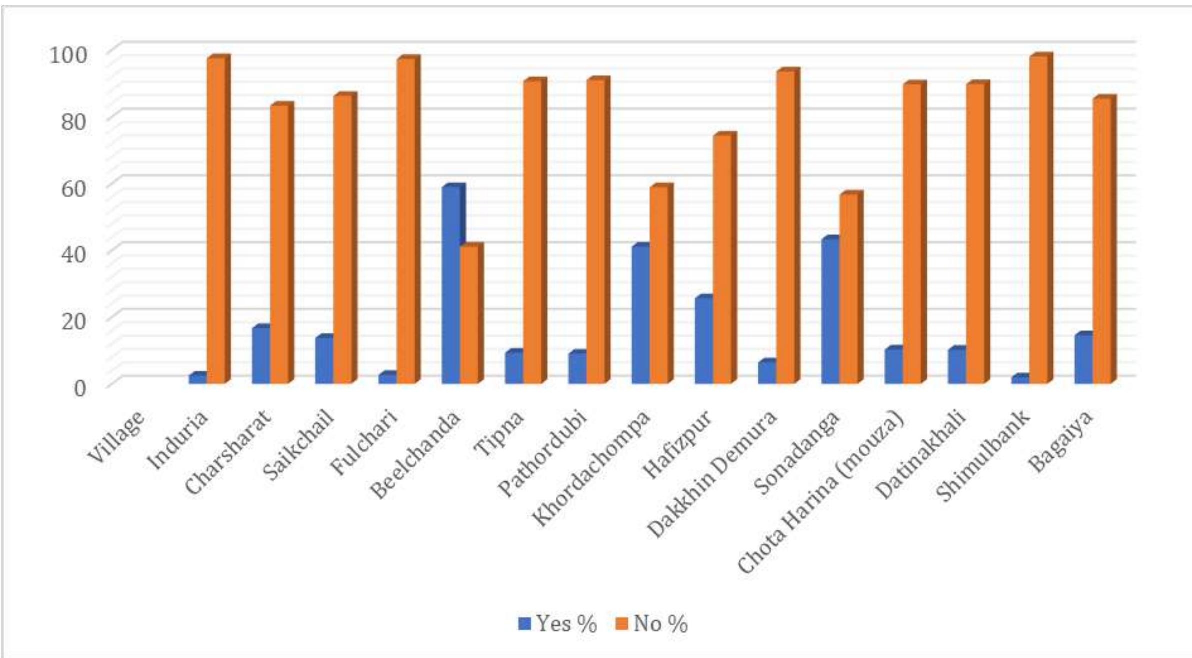


Figure 4.74: TV availability (pilot villages)

5. Potentiality of Groundwater Development in Selected Villages for Potable Water Supply

5.1 Introduction

Sustainable potable water supply is an essential issue for the rural areas of Bangladesh. As development progresses in Bangladesh, people's aspirations of living standards are getting higher. Freshwater availability and access are fundamental indices of socioeconomic development.

Bangladesh's climatic, geologic, and hydrogeologic conditions favor groundwater occurrence, movement, and storage. The Quaternary alluvium of Bangladesh constitutes a huge aquifer, the prime source of safe potable water in different parts of the country.

Groundwater is one of the major natural resources of Bangladesh. It has used advantageously as a domestic, industrial, and irrigation source. It was felt that an assessment was necessary to ensure potable water supply to the selected fifteen villages in the study area using groundwater resources. The study looked into the current water supply and sanitation conditions in the study areas.

The feasibility of constructing tube wells, the depths of tube wells, and the design of tube wells depend on the hydro-geological setting of an area, which includes i) depth of the aquifer, ii) thickness of the aquifer, iii) quality of water in the aquifer iv) groundwater level in the aquifer, and v) sustainability of the development of groundwater resource of that area.

5.2 Hydro-geological Classification of Bangladesh

Bangladesh's water policy states the importance of groundwater resources for different uses. Following the Krug Mission Report of 1957, the Bangladesh National Water Policy had evolved. The World Bank facilitated the current water policy formation process, which came into effect in 2002.

Given its importance, government and non-government organizations and local authorities have surveyed groundwater regularly since the 1960s. Based on the physiography, geology, and suitability of the region for groundwater development, Bangladesh was hydro-geologically classified as i) Younger Alluvium, Complex Geology area, Older Alluvium area, and Coastal Area (**Figure 5.1**) (BGS, 1979).

The United Nations Development Programme (UNDP, 1982) studied the groundwater development potentiality of Bangladesh with the following objectives:

(i) To increase the development of groundwater in Bangladesh;

(ii) To make a general appraisal of the groundwater resources of Bangladesh, including collection, compilation, processing, and analysis of existing data;

(iii) To evaluate the groundwater potential of an area by conducting detailed reconnaissance investigations, including aquifer tests by pumping wells and monitoring water levels for aquifer characteristics;

(iv) To monitor the effects of large-scale development on groundwater regions; and

(v) To determine whether groundwater quality is suitable for domestic, municipal, industrial and irrigational purposes.

The groundwater survey identified 15 zones for groundwater development (UNDP, 1982). Each zone was classified and rated on its development potential (**Figure 5.2**). The basis of the classification involved:

I. Approximate land area for development;
II. Physical characteristics of the aquifer;
III. Hydraulic characteristics such as transmissivity and maximum depths to the water level;
IV. Water quality including iron content, chloride content, and total hardness;
V. Estimated recharge potential of an area; and
VI. Development potential such as recommended deep tube well discharge, well-spacing, and projected deep tube well pumping level.

Table 5.1: Different zones of Bangladesh with different groundwater development potentiality (UNDP, 1982)

Zones	Development Potentiality
Zone A, Zone B, Zone D	Excellent
Zone C, Zone E, Zone G, Zone J, Zone H	Good
Zone F	Good to Fair
Zone I, Zone K	Fair
Zone L, Zone M	Poor
Zone N, Zone O	Domestic Supply

Zone-A

- The zone covers almost all the districts of Rangpur and parts of Bogra and Jamalpur districts contiguous to the Brahmaputra River. Zone A appears to offer the best potential for further groundwater development.
- The area consists mainly of coarse sediments of the Teesta River fan and alluvial deposits of the Brahmaputra River, which have the highest Transmissivities in the country. Transmissivities range from 1000 m2/day in the northwestern part to 7000 m2/day near the Brahmaputra River.
- High iron content (maximum recorded value 30 mg/l) occurs in some areas; otherwise, the water quality is good.
- Zone-A is highly favorable to large-scale groundwater development. Development of both shallow and deep tube wells is possible. Deep tube wells can yield more than 84.9 lit/sec (3 cusecs). Other shallow tube wells in the same area can operate at design discharge capacity.

Zone B

- Zone B occupies a large area in the southwest-central part of the country. It consists of floodplains of the Ganges River in the Jessore and Faridpur districts and alluvial deposits of the Brahmaputra-Jamuna River in the Tangail and Dhaka districts.

- This zone is characterized by a widely variable thickness of the upper clay and silt unit; consequently, the depth to the main aquifer also varies considerably. Transmissivities average about 3500 m2/day.
- The zone has the potential for deep tube well development with optimal discharges between 56.6 and 84.9 lit/sec (2 and 3 cusecs), but shallow tube well development does not appear promising.
- Developing deep tube wells in the southern zone may cause saline water intrusion from the coastal area.

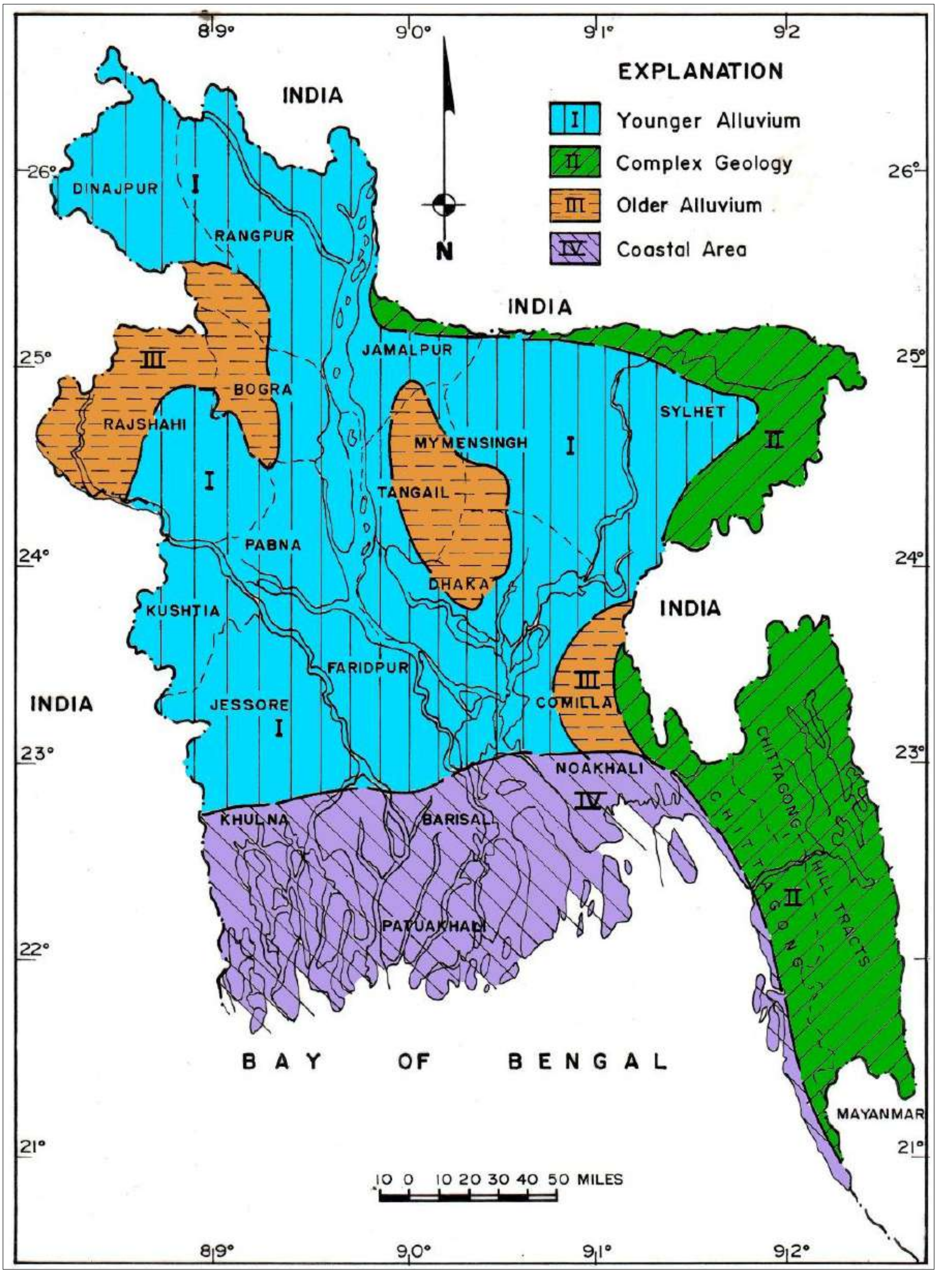


Figure 5.1: Hydro-geological classification of Bangladesh (BGS 1979).

Zone C

- Zone C covers all of Kushtia district and most of Pabna district. Sediments consist of the floodplain deposits of the Ganges River. The hydraulic properties of zone C are favorable for development. However, the development faces constraints by the potential recharge estimated to range between 130 and 290 mm (5.1 and 11.4 inches.).
- Deep tube well discharges between 56.6 and 84.9 lit/sec (2 and 3 cusecs) are considered optimum for the area. In conjunction with deep tube wells, the projected discharge of shallow tube wells is less than the design discharges.

Zone-D

- Zone D is the north-westernmost region of the country in the Dinajpur district. Sediments consist mostly of coarse detrital piedmont deposits washed down from the highlands of India.
- The absence, or very thin section, of clay and silt overlying the permeable surface sediments, allows maximum infiltration of rainfall (UNDP, 1982).
- Aquifers characterize groundwater conditions of the area with high transmissivity, shallow depth to water, potential recharge of more than 370 mm per year, and good groundwater quality. These factors make the zone highly suitable for groundwater development.
- A discharge of approximately 56.6 lit/sec (2 cusecs) is considered optimum for deep tube well development. With a deep tube well spacing of 1,000 meters or more, shallow tube wells will also function at the design discharge capacity.

Zone-E

- Zone E consists primarily of older alluvial deposits of the Pleistocene age in the Bogra and Rajshahi districts.
- The thickness of the surficial clay and silt deposits generally ranges from 5 to 15 meters, but in areas south of the town of Dinajpur, about 60 meters of clay and silt have been encountered.
- In general, a zone is suitable for deep tube well development with recommended optimal discharges between 28.3 and 56.6 lit/sec (1 and 2 cusecs)

Zone F

- Zone F covers the southern and western parts of Rajshahi district.
- In the west, the area consists of floodplains of the Mahananda River and the Ganges River Floodplains, east of Rajshahi town. Two regions are separated by a tract of older alluvium designated as zone O.
- Aquifers beneath the area are suitable for groundwater development.
- However, the low recharge seriously constrained groundwater development. Analysis shows that the lowest recharge potential in the country, estimated to range between 80 and 190 mm per year, occurs in this zone. Recommended discharges are 28.3 to 56.6 lit/sec (1 to 2 cusecs) for deep tube wells in the area

Zone G

- Zone G includes the southwestern Comilla district and the northern part of the Noakhali district. The sediments consist primarily of floodplain deposits of the Meghna River.
- The main aquifer is at depths ranging from 16 to 100 meters below the ground surface, with an average depth for the zone of 60 meters.
- This zone should consider only deep tube well development with discharges of up to 56.6 lit/sec (2 cusecs). Increased saline water intrusion to the coastal zone and the lower Meghna River and adjacent areas demands priority attention.

Zone H

- Zone H covers most of the Mymensingh district, the eastern Jamalpur district, and a small part of northeastern Dhaka.
- The aquifer is composed of floodplain deposits of the Old Brahmaputra River. Groundwater conditions are suitable for deep tube well development.
- High rainfall and relatively permeable surface soils promise excellent recharge potential. Maximum discharges of 56.6 lit/sec (2 cusecs) are considered optimum. However, where the potential is better, allowable extraction rates may be greater in the western area.

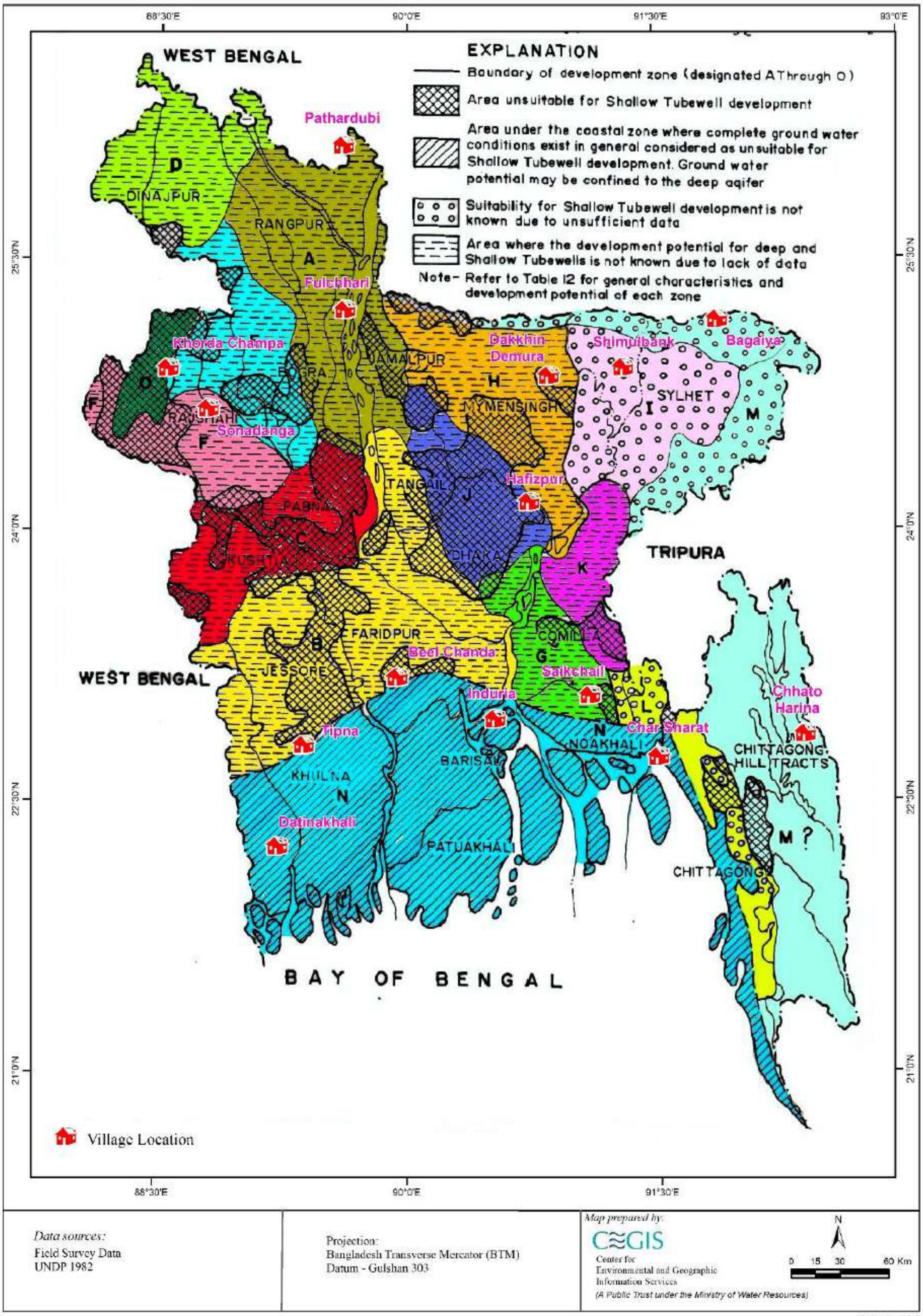


Figure 5.2: Major groundwater development zone of Bangladesh (UNDP 1982)

Zone I

- Little information is available for assessing the groundwater potential of zone I, which covers the plains of Sylhet district, known as the Sylhet Basin.
- However, the area may be able to sustain groundwater development; rainfall in the zone is nearly the highest in the country, and recharge potentials are probably high.
- The surficial layer of the basin is predominantly silt and clay. Aquifers in the area may be able to sustain deep tube well discharges of 28.3 lit/sec (1 cusec) on an intensive basis of development.

Zone J

- Zone J covers parts of Dhaka, Tangail, and Mymensingh districts. Surficial deposits consist of older alluvium, known as the Madhupur clay.
- The existing development in the area indicates the zone's potential. Present extractions in the area exceed 100 mm. In most areas, the presence of a thick sequence of surficial clay inhibits recharge. Nevertheless, the potential recharge is greater than 200 mm per year.
- Deep tube well development is feasible with optimal discharges of 28.3 to 56.6 lit/sec (1 to 2 cusecs). Shallow tube well development in the area is not feasible owing to the thick sequence of upper clay and still and deep-water levels.

Zone K

- Zone K covers the southern Meghna Basin's eastern part of Comilla district. Estuarine silts cover the area with a maximum thickness of about 60 meters.
- The depth of the main aquifer ranges from 20 to 80 mbgs.
- The area may be able to sustain the development of deep tube wells with discharges of up to 56.6 lit/sec (2 cusecs). However, the optimum discharge is about 28.3 lit/sec (1 cusec) (UNDP, 1982).
- Zone L: Zone L covers the piedmont deposits of Chattogram district and the Meghna estuarine floodplains of Noakhali district.
- The area is not considered favorable for extensive groundwater development. Aquifers in the area are generally confined. In places, semi-confined conditions exist, but leakage from the overlying water-bearing formations is negligible.
- Transmissivities average about 400 m2/day.
- Hydro-geological analyses indicate that well discharge of 28.3 lit/sec (1 cusec) is considered maximum, with optimum values ranging from 14.2 to 21.2 lit/sec (0.5 to 0.75 cusecs).

Zone M

- Zone M includes the hilly areas of Sylhet and Mymensingh districts and the Chittagong Hill Tracts in southeastern Bangladesh.
- The area's geology is complex and characterized by folded Tertiary formations. The site is considered unfavorable for extensive groundwater development.
- The aquifers have low transmissivities, and intensive development would incur a large drawdown.

- However, individuals or private sectors can develop wells successfully. Successful irrigation wells in tea plantations would have substantiated this.
- Owing to the complex hydrogeology of the area, detailed investigations, including test drilling, will be required to evaluate each potential development site.

Zone N

- Zone N covers the coastal areas of Barishal and Patuakhali, and most of Khulna district, and the coastal areas of Noakhali and Chittagong districts.
- The zone comprises floodplains of the Ganges-Padma and Meghna rivers and the Chittagong coastal plain.
- Groundwater conditions are highly variable; however, its development remains weakened by the low-quality water affected by brackish and saline water intrusion.
- The development of the main and composite aquifers is limited to isolated freshwater areas. The coastal zone's groundwater potential depends upon the development of the deep aquifer.
- The potential of the deep aquifer is relatively unknown; however, freshwater indications exist.

Zone O

- Zone O lies in the western Rajshahi district and consists of older alluvial deposits known as the Barind Tract.
- Thick clay deposits have been proven by test drilling, indicating that the main aquifer does not occur in the upper 300m.
- Therefore, groundwater potential is limited to development from relatively thin, fine-grained sand zones within the clay sequence. The aquifer is capable of supporting only small domestic water needs.

5.3 Groundwater Risk Mapping of Bangladesh

Some groundwater quality monitoring studies (BWDB, 2006, DPHE, 1999) and the hydro-geological investigations by the British Geological Survey (1999) revealed that groundwater is generally fresh in Bangladesh, excluding the coastal zone. However, contamination exposed 25% of the population, exceeding Bangladesh standards in 2001 (NWMP, 2004). Coastal salinity and localized high dissolved iron in the alluvial aquifer were considered to be the major problem before the detection of arsenic in groundwater.

The occurrence of arsenic is related to younger alluvial aquifers (Holocene age) containing finer sediments. The arsenic distribution is highly variable both at a local and regional scale. Most contaminated aquifers are within 20 – 60 m depth (NWMP, 2004). The arsenic contamination trend is above the permissible limit of 50 ppb in 61 out of 64 districts.

Figure 5.3 The shallow aquifer of the Recent Floodplain area is contaminated with elevated concentrations of arsenic in different parts (**Figure 5.3**). However, the Dupi Tila Sandstone Plio-Pleistocene age aquifer under the Madhupur Tract is free from arsenic contamination (Figure 6.4). The arsenic concentrations are in very shallow (<50m bgl) groundwater in Bangladesh as sampled under the National Hydro-chemical Survey (DPHE, 1999; BGS and DPHE, 2001).

Shamsudduha et al. (2019) constructed two multi-hazard groundwater risk maps based on the following selection criteria applying to groundwater arsenic (As), salinity (i.e., electrical conductivity, EC), and dry-season depth to shallow groundwater levels (GWD) at the national scale in Bangladesh.

Figure 5.5 presents groundwater risk maps at the national scale in Bangladesh, featuring risks imposed by groundwater arsenic alone. Similarly, groundwater risk maps at the national scale in Bangladesh feature risks imposed by groundwater salinity (EC: electrical conductivity) marked in Figure 5.6.

The potable water quality in the 15 villages must comply with Bangladesh's drinking water standard (ECR, 1997). If groundwater could be used as potable water source for any village, these maps will help to understand the quality risk and to undertake risk-minimizing measures accordingly.

Figure 5.3 shows concentrations in very shallow (50 m bgl) groundwater in Bangladesh sampled under the National Hydrochemical Survey (DPHE, 1999; BGS and DPHE, 2001). The background image is a digital elevation model showing the hilly terrains surrounding the Bengal Basin. The Pre-Holocene deposits (e.g., Madhupur Clay) are shown in green; the rest of Bangladesh is composed of Holocene alluvium deposits. Arsenic concentrations are at hydro-geological cross-sections along the transect (A-B-C). (Source: Shamsudduha et al., 2015)

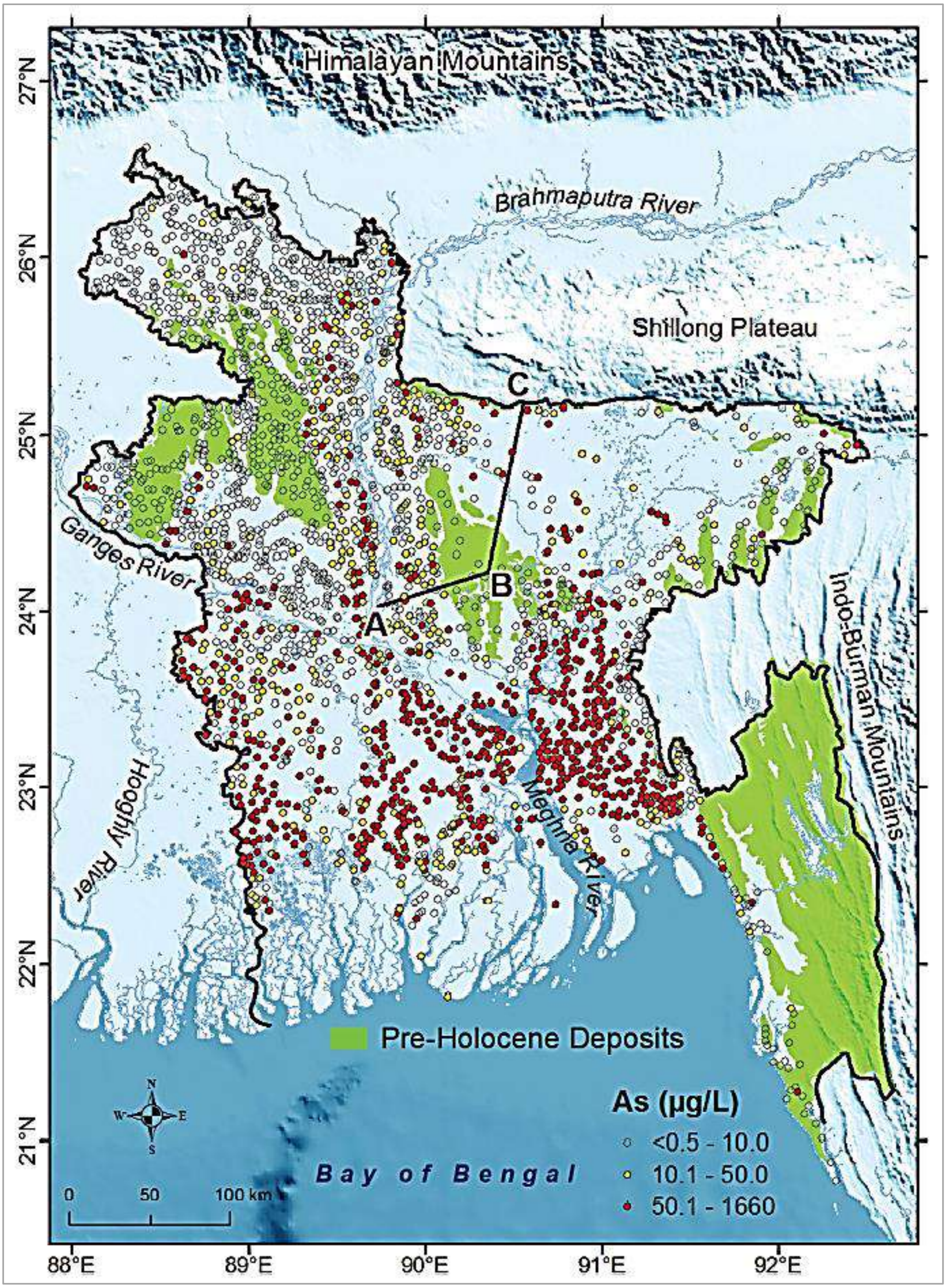


Figure 5.3: Arsenic contamination (2015)

Figure 5.4 shows the hydro-geological cross-section from the north-central part of Bangladesh (Ravenscroft, 2003) and the Plio-Pleistocene and Holocene aquifers in the Bengal Basin. Shallow groundwater concentrations schemed in the National Hydro-chemical Survey (DPHE, 1999; BGS and DPHE, 2001) were plotted along the hydro-geological transect (Shamsudduha et al., 2015).

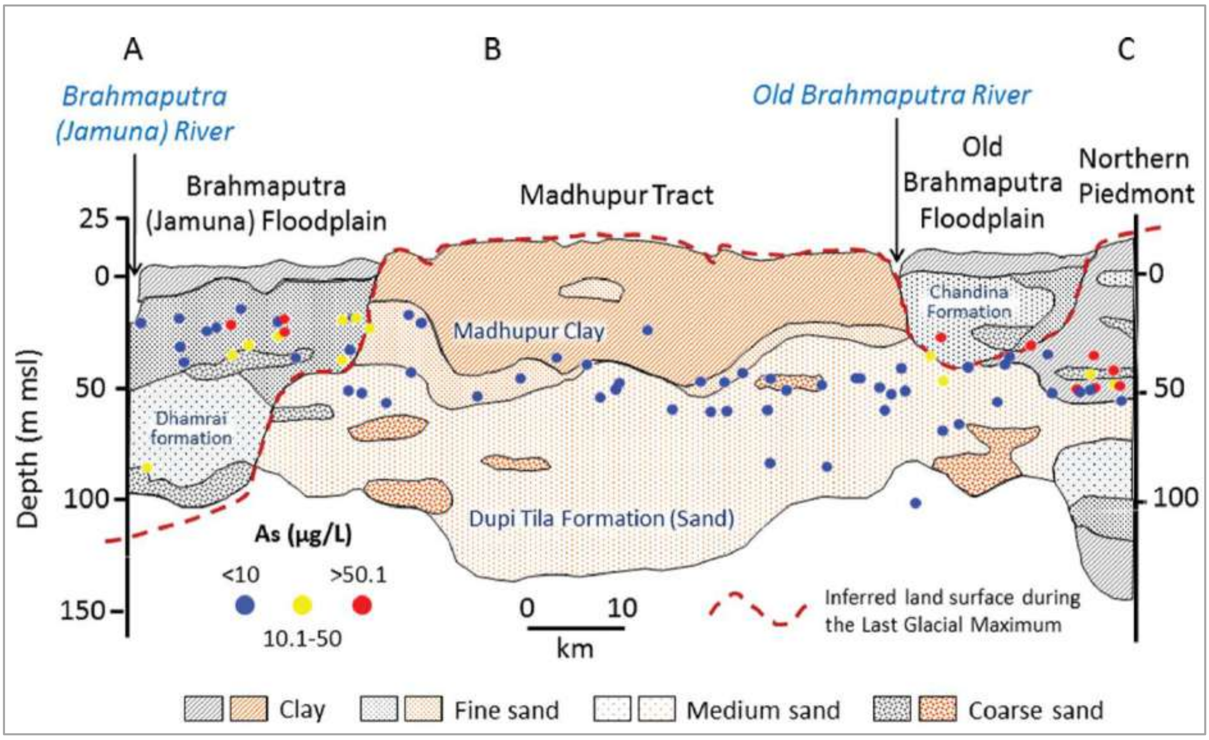


Figure 5.4: Hydro-geological cross-section from the north-central part of Bangladesh

Figure 5.5 shows groundwater risk maps at the national scale in Bangladesh featuring risks imposed by groundwater arsenic alone. The map shows four zones: extremely high, high, medium, and low risks to shallow groundwater based on concentrations of arsenic (>200, >100, >50, and >10 µg/L, respectively) in shallow groundwater (Source: Shamsudduha et al., 2019).

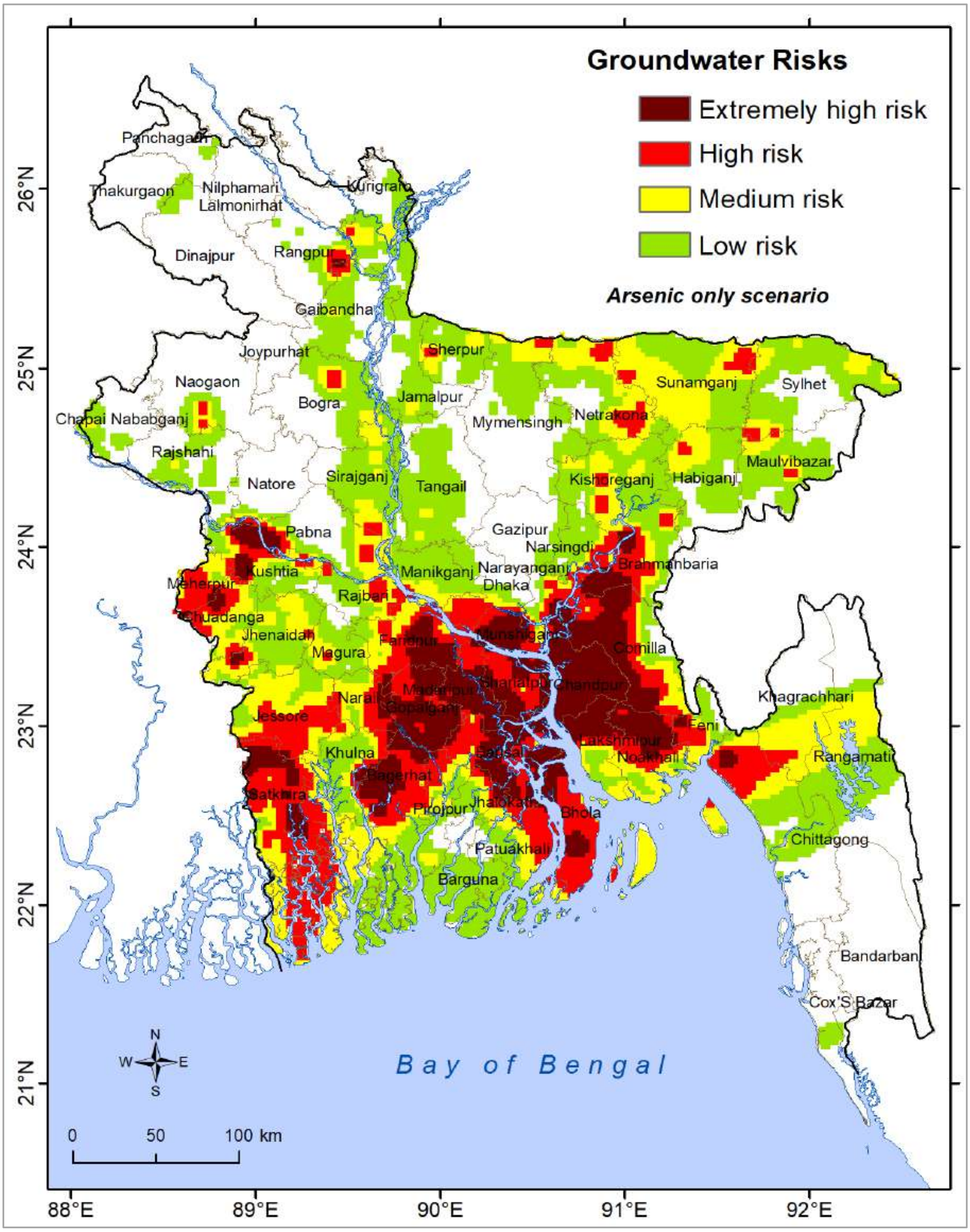


Figure 5.5: Groundwater risk maps based on arsenic at national scale in Bangladesh 2019

Figure 5.6 shows groundwater risk maps at the national scale in Bangladesh featuring risks imposed by groundwater salinity (EC: electrical conductivity) alone. The map shows four zones: extremely high, high, medium, and low risk based on values of EC (>2000, >1500, >750, and >500 µS/cm, respectively) in shallow groundwater. (Source: Shamsudduha et al., 2019).

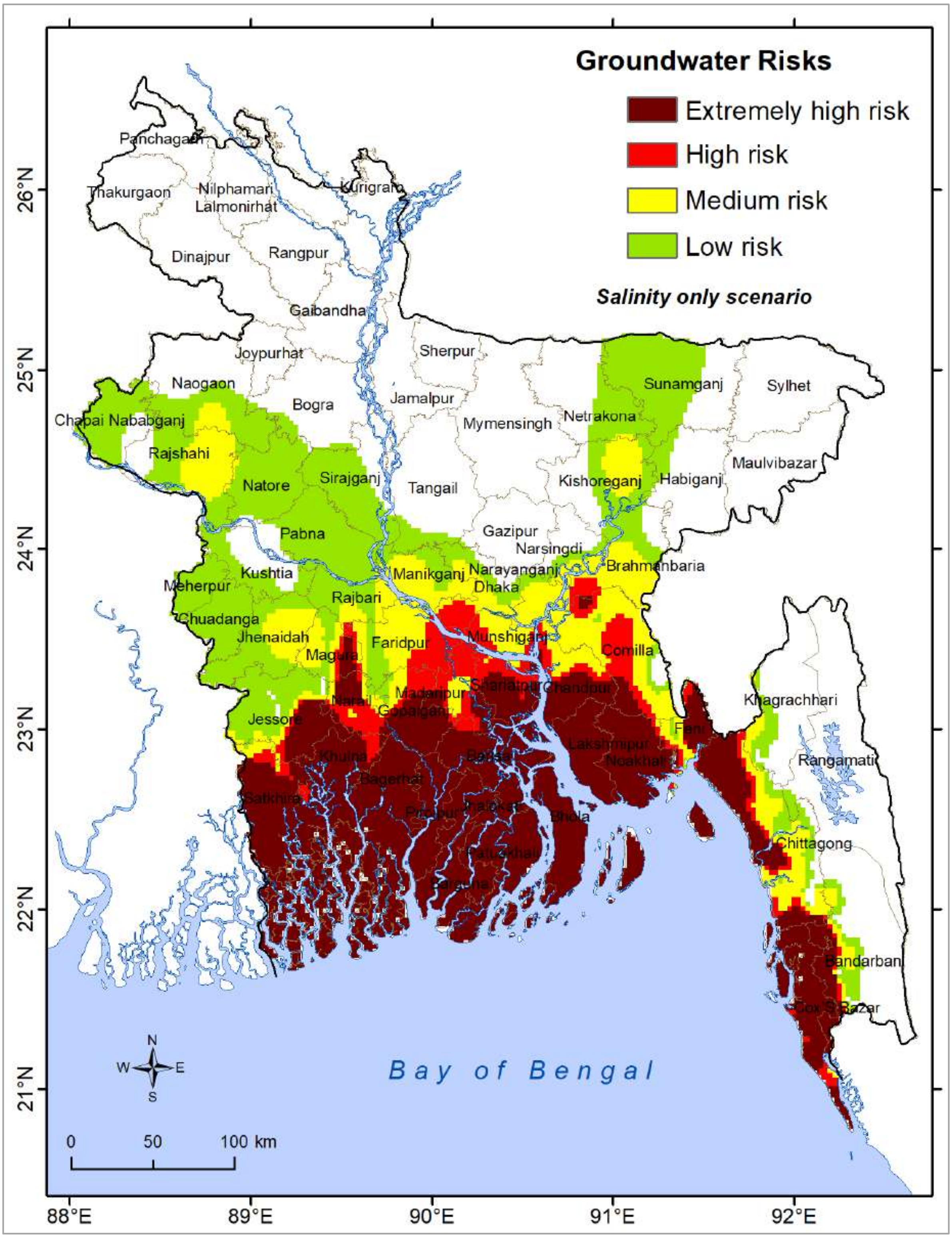


Figure 5.6: Groundwater risk maps based on salinity at national scale in Bangladesh 2019

5.4 The Trend of Variation and Depth of Groundwater Level

The Bangladesh Water Development Board (BWDB) maintains an extensive groundwater monitoring database that contains time series and water table depth recordings of more than 1,250 wells across the country. Water table depth represents the depth from the ground surface to the water table at the well site, as opposed to a groundwater elevation relative to mean sea level or some other datum. Monitoring data vary in terms of the length of time and frequency of sampling; however, many wells have data from the mid-1960s onwards measured weekly. Most wells have weekly data from at least the mid-1980s.

Hodgson et al. (2014) identified four main trend types based on the water table's annual maximum and minimum depth over time and the rate of decline in both (**Figure 5.7**). Trend types range from Type 1, which strongly display declining levels, to Type 4, which is relatively stable over time. Where groundwater levels fall rapidly, well trend types tend towards Type 1, and where groundwater levels are stable over time, well trend types tend towards Type 4. Increased groundwater abstraction induces recharge during the monsoon season at many sites because prior irrigation withdrawals would create storage. However, the annual monsoon recharge in trends 1 and 2 cannot offset dry season abstraction. In trend Type 3, total abstraction and discharge are less than the annual recharge. In Type 4 wells, both minimum and maximum water table depths are relatively stable, indicating abstraction is not impacting the long-term water table trends. Hodgson et al. (2014) analyzed the groundwater level trend in different parts of Bangladesh.

Furthermore, the pattern of trends reflects the hydrogeology, with areas having the thickest clay layers exhibiting mostly declining trends. Dhaka and Gazipur form the majority of the Madhupur Tract, and all three districts predominantly have Type 1 and 2 trends. The representative hydrographs for this region show that outside the Madhupur Tract, water tables are mostly stable, but the trends are evidently declining around Dhaka City.

The hydrograph of Dhaka district demonstrates extreme drawdown occurring due to urban water production wells identified by BWDB (1991) and Hoque et al. (2007). The depression in Dhaka goes as low as 80 meters below surface level with a radius of up to 40 km, according to the improved model developed by Hermann (2016).

Qureshi et al. (2014) prepared the groundwater table depth map of Bangladesh using groundwater level data from BWDB. They noted a substantial decline in groundwater level in the Barind area and the Madhupur area (Dhaka, Gazipur area) due to over-exploitation of groundwater for dry season irrigation and urban and industrial uses (**Figure 5.8**).

Figure 5.9 presents a map showing the depth of groundwater level in different parts of Bangladesh. Depth to groundwater level is critical in planning groundwater development.

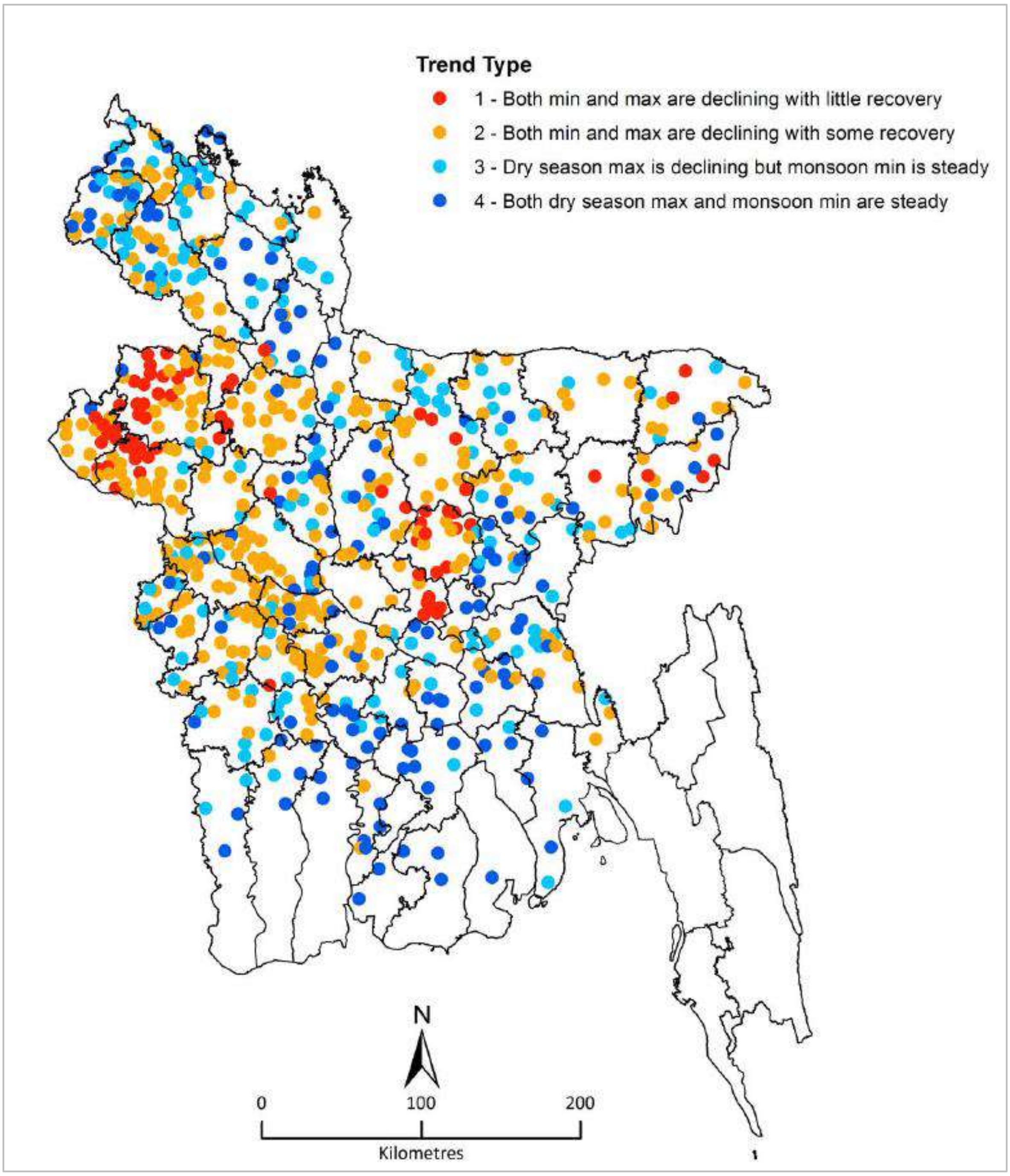
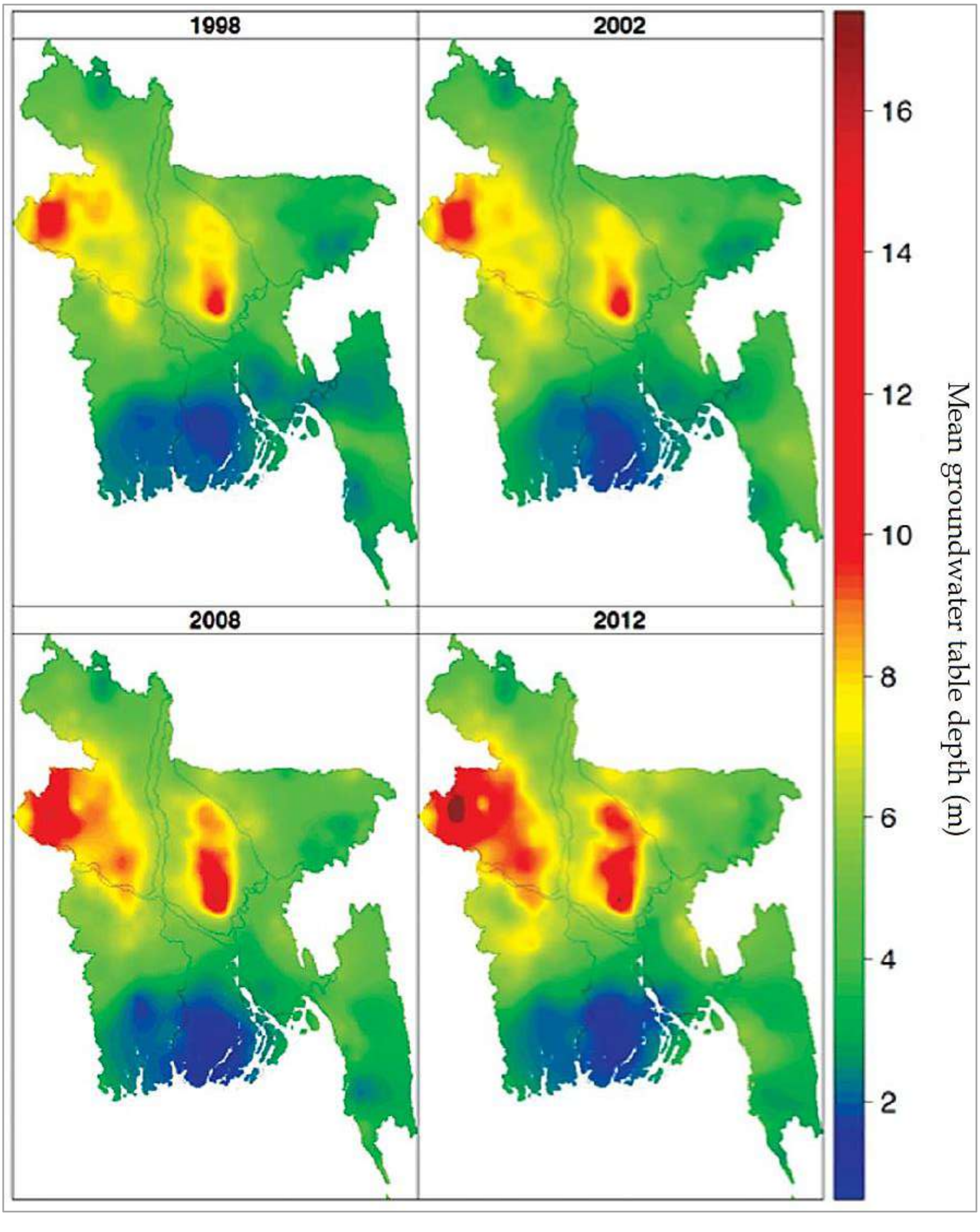


Figure 5.7: Trend types and selected hydrographs for the Central Hydrographic Region, including Dhaka and Narayanganj (Source: Hodgson et al. 2014)

Figure 5.8 shows the mean groundwater table depth (m) in the height of the dry season (March, April, and May). Surface maps were developed using multi–Gaussian Kriging from time series data of observed groundwater levels from the Bangladesh Water Development Board (BWDB).



(Source: Qureshi et al. 2014).

Figure 5.8: Mean groundwater table depth (m) in dry season (March, April and May)

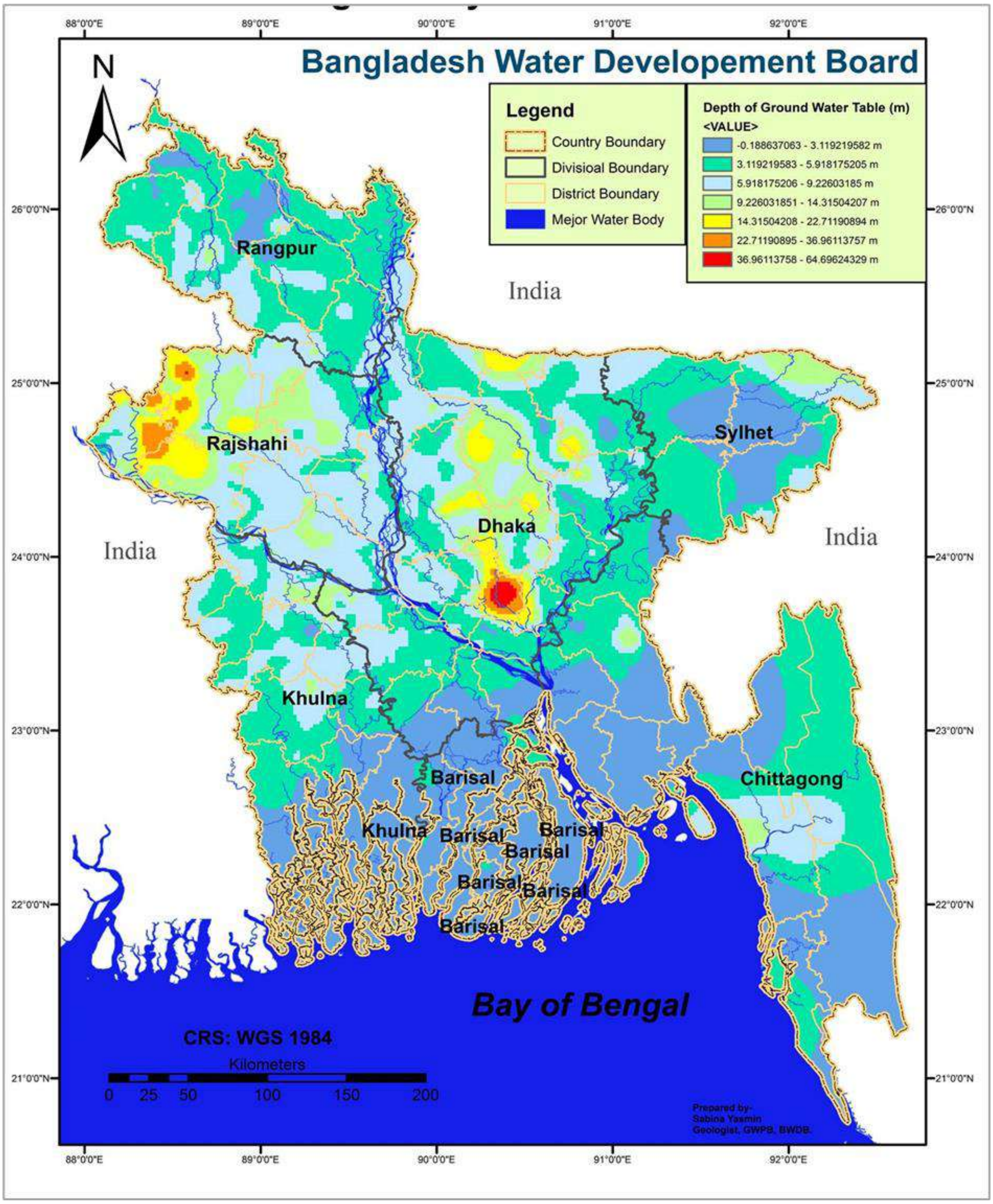


Figure 5.9: Depth to groundwater table in dry season (2016)

5.5 Selection of Water Source and Water Supply Technology

Figure 5.10 shows the location of the selected villages. Detailed data were collected regarding water supply and demand in the chosen areas to support rural people in obtaining affordable, safe, and sustainable access to potable water in the future.

Table 5.2 presents the survey results of current water supply conditions, water points, water demand, and sanitation, including the proposed measures needed to supply sufficient potable water to the inhabitants of the selected villages.

Moreover, a hydro-geological study was conducted in each area that focused on aquifer depth, thickness, water quality, and groundwater resource sustainability.

Village- Hafizpur, Union- Chalakchar, Upazila- Monohardi, District- Narshingdi

Current prime water supply technology includes STW: Shallow Tube well, No 6/T. Dev, DTW: Deep Tube well, No 6, (Nationwide Public Water Point Mapping. DPHE 2014). Good quality water generally occurs at a depth of 80 feet below ground surface. Hydro-geologically, the area has a good aquifer system at the subsurface to supply potable water to the villages. The aquifer is composed of floodplain deposits of the Old Brahmaputra River. Groundwater conditions are suitable for deep tube well development.

Drilling test boreholes and constructing a piezometer of a maximum of 200m are suggested. Deep tube wells of about 200m depth can be constructed to abstract water for inhabitants of the villages. The groundwater level is not very deep, and the current trend of the groundwater level is almost steady (Figures **5.7, 5.8, and 5.9**). The area is practically free from the risk of high salinity in groundwater (**Figure 5.6**), but there is a moderate risk of the occurrence of arsenic in shallow groundwater (**Figure 5.5**).

Village- Shimulbank, Union- Shimulbank, Upazila- Dakkhin Sunamganj, District- Sunamganj

Current prime water supply technology includes DTW: Deep Tube well, No 6/ T. Dev (Nationwide Public Water Point Mapping. DPHE 2014). Good quality water generally occurs at a depth of 650 feet below ground surface. Hydro-geological considerations indicate that the area is complex and characterized by a series of folded Tertiary formations. The area is unfavorable for extensive groundwater development. The aquifers have low transmissivities, and intensive development would incur a large drawdown. However, wells can be dug on an individual basis. The existence of successful irrigation wells in tea plantations substantiates this proposition.

The area's complex hydrogeology will require detailed investigations to evaluate each potential development site, including test drilling. Drilling test boreholes and constructing 300m piezometers would be effective. Deep tube wells of about 300m depth can abstract water for inhabitants of the villages. The groundwater level is not very deep, and the current trend of the groundwater level is almost steady (Figures **5.7, 5.8, and 5.9**). The area is practically free from the risk of high salinity in groundwater (**Figure 5.6**), but there is a moderate risk of the occurrence of arsenic in shallow groundwater (**Figure 5.5**)

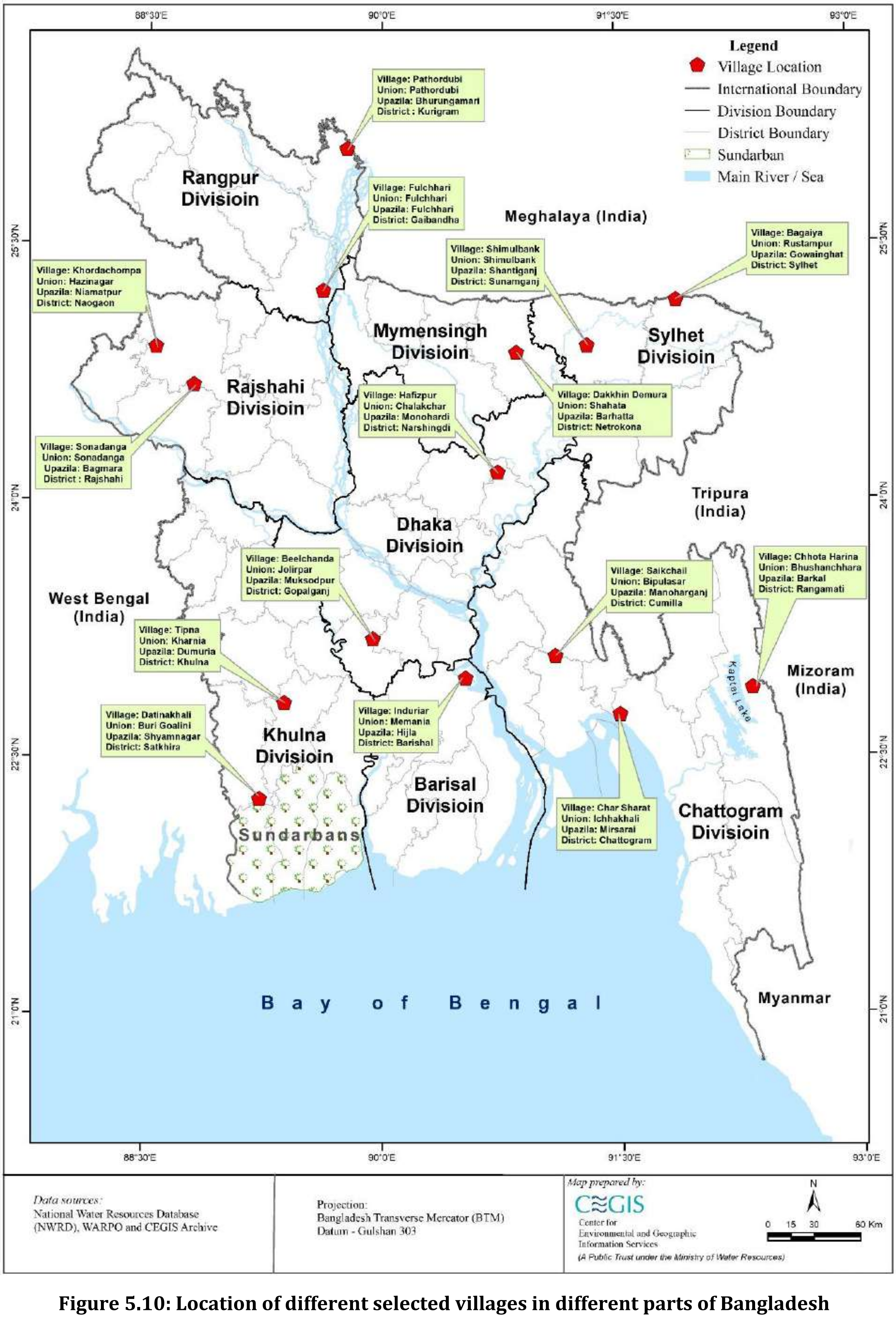


Figure 5.10: Location of different selected villages in different parts of Bangladesh

Village- Datinakhali, Union- Buri-goalini, Upazila- Shyamnagar, District- Satkhira

Current prime water supply technology includes PSF, RWHS, SST/ VSST, and STW, No 6 (Nationwide Public Water Point Mapping. DPHE 2014). Good quality water generally does not occur at the subsurface aquifer. The area is at risk of high salinity in groundwater (**Figure 5.6**) and also at risk of occurrence of high arsenic in shallow groundwater (**Figure 5.5**).

Groundwater conditions are highly variable. Brackish and saline affected low-quality water has hampered its development. The development of the main and composite aquifers is limited to isolated freshwater areas. The coastal zone's groundwater potential depends upon the development of the deep aquifer. Groundwater supply from tube wells is not reliable and sustainable for this area; therefore, test well drilling is required. The suggested water supply technology for this area is i) PSF, ii) RWHS, iii) SST/ VSST, and iv) STW, No 6. Treated surface water supply may meet the required standard of potable water.

Village- Shekchail, Union- Bipulshar, Upazila- Monoharganj, District- Cumilla

Current prime water supply technology includes DTW: Deep Tube well, No 6/T. Dev (Nationwide Public Water Point Mapping. DPHE 2014). Good quality water generally occurs at a depth of 150 feet below ground surface. Hydro-geological status indicates that the area has a sound aquifer system at the subsurface to supply potable water to the villages. The aquifer is composed of floodplain deposits of the Meghna-Gumti River. Groundwater conditions are suitable for deep tube well development. Estuarine silts cover the area with a maximum thickness of about 60 meters. The depth of the main aquifer ranges from 20 to 80 mbgs. The area may be able to sustain the development of deep tube wells with discharges of up to 56.6 lit/sec (2 cusecs).

Drilling a test borehole and constructing a 200 to 300m piezometer would be effective. Deep tube wells of about 200 to 300m depth can abstract water for inhabitants of the villages. The groundwater level depth is not very high, and the current trend of the groundwater level is almost steady (Figures **5.7, 5.8, and 5.9**). The area is at risk of high salinity in groundwater (**Figure 5.6**) and also at risk of occurrence of high arsenic in shallow groundwater (**Figure 5.5**).

Village- Sonadanga, Union- Sonadanga, Upazila- Bagmara, District- Rajshahi

Current prime water supply technology includes STW: Shallow Tube well, No 6/T. Dev (Nationwide Public Water Point Mapping. DPHE 2014). Good quality water generally occurs at a depth of 110 feet below the ground surface. Hydro-geological status indicates the area has a good aquifer system at the subsurface to supply potable water to the villages. The ground surface consists primarily of older alluvial deposits of Pleistocene age in this part of the Rajshahi district. The thickness of the surficial clay and silt deposits generally ranges from 5 to 20 meters.

Drilling a test borehole and constructing a 100 to 150m piezometer would be effective. Deep tube wells of about 100 to 150m depth can abstract water for inhabitants of the villages. The depth of the groundwater level is high, and the current trend of the groundwater level is declining (Figures **5.7, 5.8, and 5.9**). The area is free from the risk of high salinity in groundwater (**Figure 5.6**) and the risk of the occurrence of arsenic in shallow groundwater (**Figure 5.5**).

Village- Tipna, Union- Khurnia, Upazila- Dumuria, District- Khulna

Current prime water supply technology includes STW: Shallow Tube well, No 6/T. Dev and DTW: Deep Tube well, No 6/T. Dev (Nationwide Public Water Point Mapping. DPHE 2014). Good quality water generally occurs at 700 feet below ground surface. The area is at risk of high salinity in groundwater (**Figure 5.6**) and also at risk of occurrence of high arsenic in shallow groundwater (**Figure 5.5**).

Groundwater conditions are highly variable. Brackish and saline affected low-quality water has hampered its development. The development of the main and composite aquifers is limited to isolated freshwater areas. The coastal zone's groundwater potential depends upon the development of the deep aquifer. Drilling a test borehole and constructing a 250 to 300m piezometer would be effective. Deep tube wells of about 250 to 300m depth can abstract water for inhabitants of the villages. The groundwater level depth is not very high, and the current trend of the groundwater level is almost steady (Figures **5.7, 5.8, and 5.9**).

Village- Pathordubi, Union- Pathordubi, Upazila- Bhurungamari, District- Kurigram

Hydro-geological considerations indicate that the area offers the best potential for groundwater development. Current prime water supply technology includes STW: Shallow Tube well, No 6 (Nationwide Public Water Point Mapping. DPHE 2014). Good quality water generally occurs at 75 feet below ground surface. The area consists mainly of coarse sediments of the Teesta River fan, which have the highest transmissivities in the country. Transmissivities range from 1000 m^2/day in the northwestern part to 7000 m^2/day near the Brahmaputra River.

High iron content (maximum recorded value 30 mg/l) occurs in some areas; otherwise, the water quality is good. Drilling test boreholes and constructing 100 m piezometers would be effective. Deep tube wells of about 100m depth can abstract water for inhabitants of the villages. The groundwater level depth is not high, and the current trend of the groundwater level is almost steady (**Figures 5.7, 5.8, and 5.9**). The area is free from the risk of high salinity in groundwater (**Figure 5.6**) and risk of occurrence of arsenic in shallow groundwater (**Figure 5.5**).

Village- Induria, Union- Memania, Upazila- Hijla, District- Barisal

Current prime water supply technology includes DTW: Deep Tube well, No 6/T. Dev (Nationwide Public Water Point Mapping. DPHE 2014). Good quality water generally occurs at a depth of 900 feet below ground surface. The area is at risk of high salinity in groundwater (**Figure 5.6**) and also at risk of occurrence of high arsenic in shallow groundwater (**Figure 5.5**).

Groundwater conditions are highly variable. Brackish and saline affected low-quality water has hampered its development. The development of the main and composite aquifers is limited to isolated freshwater areas. The coastal zone's groundwater potential depends upon the development of the deep aquifer. Drilling a test borehole and constructing 300m piezometers would be effective. Deep tube wells of about 300m depth can abstract water for inhabitants of the villages. The groundwater level depth is not very high, and the current trend of the groundwater level is almost steady (Figures **5.7, 5.8, and 5.9**).

Village- Bagaiya, Union- Rustimpur, Upazila- Gowainghat, District- Sylhet

Current prime water supply technology includes DTW: Deep Tube well, No 6, STW: Shallow Tube well, No 6 (Nationwide Public Water Point Mapping. DPHE 2014). Good quality water generally occurs at a depth of 450 feet below ground surface. Hydro-geologically, the area is complex and is characterized by a series of folded Tertiary formations. The area is considered unfavorable for extensive groundwater development. The aquifers have low transmissivities, and intensive development would incur a large drawdown. However, wells can be developed successfully on an individual basis. This is substantiated by the existence of successful irrigation wells in tea plantations.

Due to the area's complex hydrogeology, detailed investigations, including test drilling, will be required to evaluate each potential development site. Drilling test borehole and construction of piezometer of a maximum of 200m have been suggested. Deep tube wells of about 200m depth can be constructed to abstract water for inhabitants of the villages. The groundwater level depth is not very high, and the current trend of groundwater level is almost steady to slight decline (**Figure 5.7, 5.8 and 5.9**). The area is almost free from the risk of high salinity in groundwater (**Figure 5.6**), but there is a moderate risk of the occurrence of arsenic in shallow groundwater (**Figure 5.5**).

Village- Dakkhin Demura, Union- Shahata, Upazila- Barhatta, District- Netrokona

Current prime water supply technology includes STW: Shallow Tube well, No 6/T. Dev, DTW: Deep Tube well, No 6, (Nationwide Public Water Point Mapping. DPHE 2014). Good quality water generally occurs at a depth of 200 to 300 feet below ground surface. Hydro-geologically, the area has a good aquifer system at the subsurface to supply potable water to the villages. The aquifer is composed of floodplain deposits of the Old Brahmaputra River. Groundwater conditions are suitable for deep tube well development.

Drilling test borehole and construction of piezometer of a maximum of 200m is suggested. Deep tube wells of about 200m depth can be constructed to abstract water for inhabitants of the villages. The depth of groundwater level is not very high, and the current trend of groundwater level is almost steady to slight decline (**Figures 5.7, 5.8, and 5.9**). The area has a moderate risk of high salinity in groundwater (**Figure 5.6**) and a moderate risk of arsenic in shallow groundwater (**Figure 5.5**).

Village- Fulchari, Union- Fulchari, Upazila- Fulchari, District- Gaibandha

Hydro-geologically, the area appears to offer the best potential for groundwater development. Current prime water supply technology includes STW: Shallow Tube well, No 6 (Nationwide Public Water Point Mapping. DPHE 2014). Good quality water generally occurs at a depth of 50 feet below the ground surface. The area consists mostly of coarse sediments of the Teesta River fan, which have the highest transmissivities in the country. Transmissivities range from 1000 m^2/day in the northwestern part to 7000 m^2/day near the Brahmaputra River.

High iron content (maximum recorded value 30 mg/l) occurs in some areas; otherwise, the water quality is good. Drilling test borehole and construction of piezometer of maximum 100m are suggested. Deep tube wells of about 100m depth can be constructed to abstract water for inhabitants of the villages. The groundwater level depth is not high, and the current trend of groundwater level is almost steady (**Figures 5.7, 5.8, and 5.9**). The area is almost free from the risk of high salinity in groundwater (**Figure 5.6**), but there is a moderate risk of occurrence of arsenic in shallow groundwater (**Figure 5.5**).

Village- Khordachompa, Union- Hazinagar, Upazila- Niamatpur, District- Naogaon

Current prime water supply technology includes STW: Shallow Tube well, No 6/T. Dev (Nationwide Public Water Point Mapping. DPHE 2014). Good quality water generally occurs at a depth of 130 feet below the ground surface. Hydro-geologically, the area has a good aquifer system at the subsurface to supply potable water to the villages. The ground surface consists primarily of older alluvial deposits of Pleistocene age in this part of Rajshahi and Naogaon districts. The thickness of the surficial clay and silt deposits generally ranges from 5 to 20 meters.

Drilling test borehole and construction of piezometer of a maximum of 100 to 120m is suggested. Deep tube wells of about 100 to 120m depth can be constructed to abstract water for inhabitants of the villages. The depth of groundwater level is high, but the current trend of groundwater level is declining (Figures **5.7, 5.8, and 5.9**). The area is free from the risk of high salinity in groundwater (**Figure 5.6**) and risk of the occurrence of arsenic in shallow groundwater (**Figure 5.5**).

Village- Chota Harina, Union- Bhushonchora, Upazila- Borkol, District- Rangamati

Current prime water supply technology includes Ring Well (RW), which is used predominantly, DTW: Deep Tube well, No 6/T. Dev, STW: Shallow Tube well, No 6 and surface water collected from a small stream (Chara), (Nationwide Public Water Point Mapping. DPHE 2014). Hydro-geologically, the area is complex and is characterized by a series of folded Tertiary formations. The area is considered unfavorable for extensive groundwater development. The aquifers have low transmissivities, and intensive development would therefore incur a large drawdown. However, wells can be developed successfully on an individual basis.

Due to the area's complex hydrogeology, detailed investigations, including test drilling, will be required to evaluate each potential development site. Drilling test bore hole and construction of piezometer of a maximum of 50m is suggested. Tube wells of about 50m depth can be constructed to abstract water for inhabitants of the villages. The depth of groundwater level is not monitored in this part of hilly areas (**Figure 5.7, 5.8 and 5.9**). The suggested water supply technology for this area is i) Ring Well (RW), ii) RWHS, iii) DTW: Deep Tube well, No 6/T. Dev, and iv) STW: Shallow Tube well, No 6. Treated surface water may also be supplied as potable water. The area is almost free from the risk of high salinity in groundwater (**Figure 5.6**) and risk of occurrence of arsenic in shallow groundwater (**Figure 5.5**).

Village- Beelchanda, Union- Jolirpar, Upazila- Muksodpur, District- Gopalganj

Current prime water supply technology includes DTW: Deep Tube well, No 6/T. Dev (Nationwide Public Water Point Mapping. DPHE 2014). Good quality water generally occurs at a depth of 250 feet below the ground surface. The area is at risk of high salinity in groundwater (**Figure 5.6**) and also at risk of occurrence of high arsenic in shallow groundwater (**Figure 5.5**).

Groundwater conditions are highly variable, and development is highly impaired by the low quality of water affected by brackish and saline water intrusion. Development of the main and composite aquifers is limited to isolated freshwater areas. The coastal zone's groundwater potential depends upon the deep aquifer's development. Drilling test borehole and construction of piezometer of a maximum of 250 to 300m is suggested. Deep tube wells of about 300m 250 to depth can be constructed to abstract water for inhabitants of the villages. The groundwater level depth is not very high and the current trend of groundwater level is almost steady (**Figures 5.7, 5.8, and 5.9**).

Village- Charsharat, Union- Ichakhali, Upazila- Mirsarai, District- Chattogram

The area is at risk of high salinity in groundwater (**Figure 5.6**) and also at moderate risk of occurrence of high arsenic in shallow groundwater (**Figure 5.5**). Good quality water generally occurs at a depth of 600 feet below the ground surface. Current prime water supply technology includes DTW: Deep Tube well, No 6/T. Dev, STW: Shallow Tube well, No 6 (Nationwide Public Water Point Mapping. DPHE 2014).

Groundwater conditions are highly variable, and development is highly impaired by the low quality of water affected by brackish and saline water intrusion. Development of the main and composite aquifers is limited to isolated freshwater areas. Groundwater potential of the coastal zone depends upon the development of the deep aquifer. Drilling test bore hole and construction of piezometer of a maximum of 200 to 300m is suggested. Deep tube wells of about 200 to 300m depth can be constructed to abstract water for inhabitants of the villages. The depth of groundwater level is not very high and the current trend of groundwater level is almost steady (**Figure 5.7, 5.8 and 5.9**).

6. Analysis of Water Availability in Pilot Villages

6.1 Introduction

Water availability analysis calculates surface run-off, evapotranspiration percolation, or base flow in response to rainfall events for a particular catchment. The feasibility study assessed a hydrologic model (SWAT) water availability and detailed time series data for the selected 15 villages.

A water balance assessment analyzed the water availability. This computation includes all water-receiving components (rainfall, snowfall, etc.) within the system and water losses (evaporation, percolation, runoff, etc.) from the system. The main principle of water balance is that the difference between total incoming water and total losses should equal the system's storage change. For the water balance analysis of the study area, the calibrated SWAT models were simulated from 1981 to 2022, and the hydrological components were analyzed to compute the average annual and monthly water balance. The following section discusses the average yearly water balance of the selected 15 villages for the feasibility study.

6.2 Methodology

The process identified different response measures. There were three steps to achieving the objectives: (1) scenario development, (2) hydrological model (SWAT) set up with data input from climate data, and (3) hydrological data and water availability assessment. The detailed methodology of each step is described in the following section.

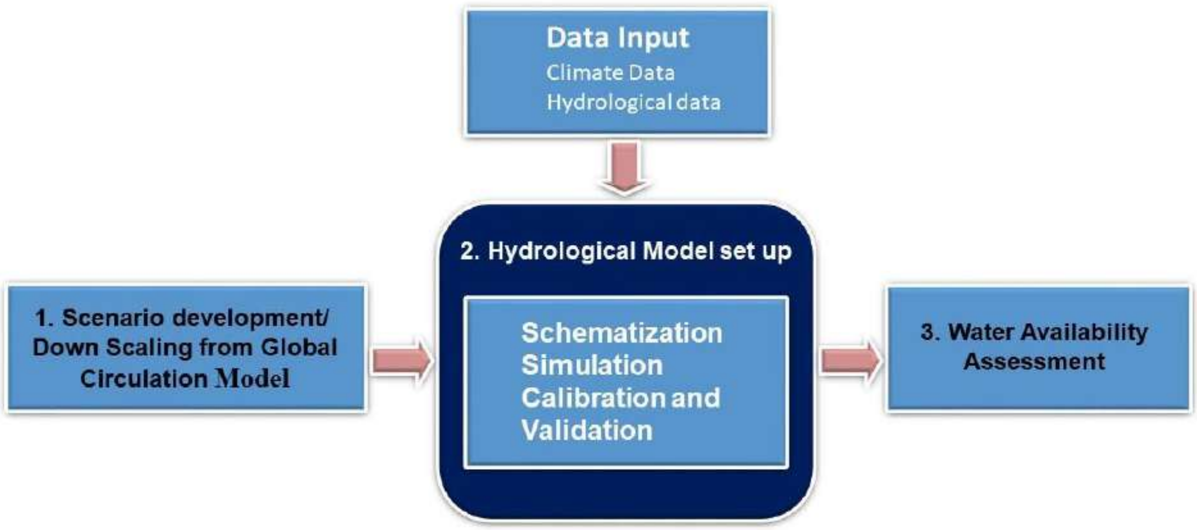


Figure 6.1: Overall study approach

Step 1: Scenario Development

The study assessed possible future change in the water balance model's inputs (weather data), which may impact the spatial and temporal distribution of water availability in the study area. There are different types of downscaling, and here, dynamic downscaling was used by applying PRECIS (Providing Regional Climate for Impact Studies).

Step 2: Hydrological model setup

An extensive review of available hydrological modeling tools was performed to select a water balance modeling software. SWAT is a widely used catchment-scale model. It is a physically based semi-distributed model. It can predict the impact of land management practices (human activities) & climate change over time on water, sediment & agriculture. This model is open source and easy to use globally, as assistance is readily available. The SWAT model is very flexible, can assess surface water availability, is easy to modify, and takes less simulation time than other models. SWAT can quantify point & non-point pollution, drought types, magnitude, risk, and water resources. It can be coupled with other models like MODFLOW to assess groundwater availability. Therefore, the SWAT model was chosen for the present study. (Arnold, 2005). In this model, the hydrological complexity mainly depends on topography to assess flow direction, drainage network to carry water, soil properties, land use to estimate loss and storage, and water source as rainfall or outflow as the variability of the hydrological system.

The following set of consecutive activities was required and followed to set up an operational water balance model for the study area.

Schematization

The schematization of the model included defining boundary conditions, watersheds, and input variables in both time and space.

Watershed delineation was done with the automatic SWAT 2012 delineation tool using the DEM and river network. The Bangladesh Transverse Mercator (BTM) projection was used for the DEM and all other GIS layers. All the watershed delineation steps, such as filling the sink and defining flow direction and accumulation, were done automatically through the SWAT user interface. Additional outlets were incorporated manually. The overlay of land use, soil layer, and slope class defined the Hydrological Response Units (HRU)s. HRU is the smallest hydrological simulation unit with a unique soil, land use, and slope combination. The discretization of the basin into HRUs allows a detailed simulation of the hydrological processes.

Simulation

The simulation methods used different calculation units for the model, i.e., rainfall distribution, channel water routing, surface runoff, potential evapotranspiration, and defined hydrological characteristics and data availability. In this simulation, the skewed normal probability distribution function was used to describe the distribution of rainfall amounts. The skewed distribution was used to generate representative stream flow, whereas the exponential distribution is an alternative to the skewed distribution. SWAT uses Manning's equation to define the rate and velocity of flow. Water is routed through the channel network using the variable storage or the Muskingum River routing method. In this simulation, the Muskingum method was used. The SCS curve number (CN) method was used for estimating runoff, and the variable CN: Moisture condition II curve number was specified. The Hargreaves method was used for calculating Potential Evapotranspiration (PET) since it requires less data (air temperature only). The details of these methods are described in the SWAT theory manual (SWAT, 2009a).

Calibration and Validation

Before calibration, sensitivity analysis was done to rank the simulation parameters of the model for each sub-basin. In this step, the calibration and validation periods were defined based on observed data, such as discharge data. The calibration and validation results were evaluated against four performance measures – Nash-Sutcliffe efficiency, mean relative bias, root mean square error ratio to the standard deviation of measured data, and coefficient of determination.

Step 3: Water Availability Assessment

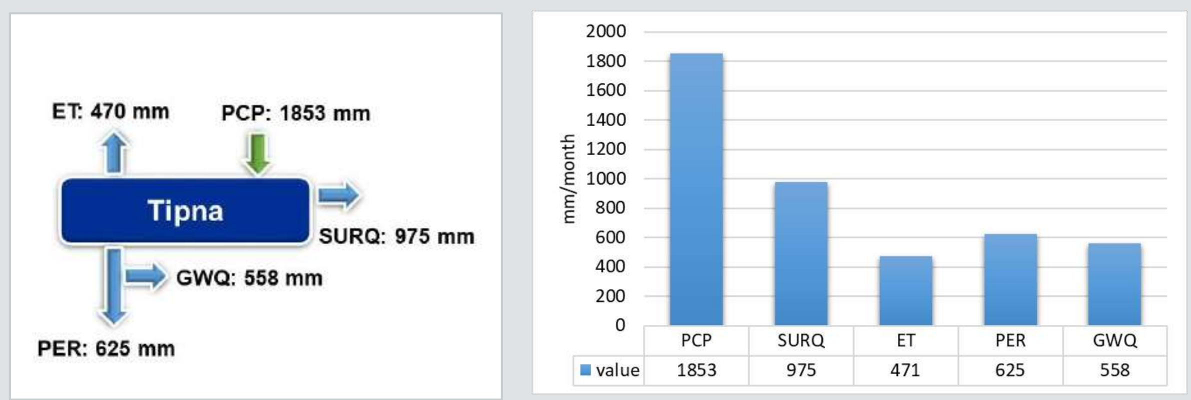
In this step, a SWAT model was set up for baseline conditions to simulate the water's temporal and spatial distribution in the study area.

6.2.1 *Water Balance for the Village Tipna*

The simulation results of the annual water for Tipna village, located in the south-central areas of Bangladesh, are shown in **Figure 6.2** (for the simulation period of 1981 to 2022). The average annual rainfall of the village is 1853, while the national average is about 2100. The monsoon starts in May and reaches its peak at about 338 mm in June. There is a decreasing trend of rainfall during August, a slight increase in September, and then a rapid decrease again. **Figure 6.3.** illustrates the monthly variation of water availability.

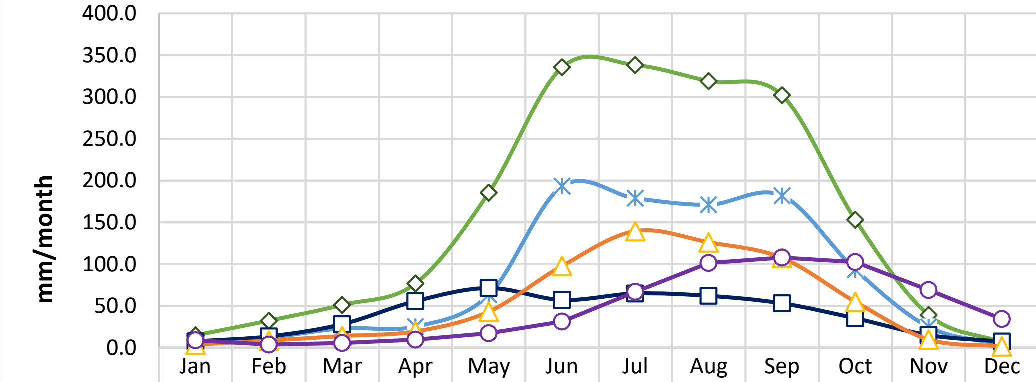
In the water balance concept, rainfall is the main water source that goes into the system. Water is lost through evapotranspiration and percolation. Considering the loss, the rest of the water is surface runoff, which contributes to the stream flow. The yearly evapotranspiration loss is 470 mm, 26% of annual rainfall, whereas yearly percolation is 625 mm.

After water loss through evapotranspiration and percolation, the remaining water contributes to stream flow as overland and lateral (subsurface) flow. The annual surface runoff for Tipna is 975 mm, whereas the lateral flow is 558 mm.



PCP: Precipitation ET: Evapotranspiration PER: Percolation SURQ: Surface Runoff
GWQ: Groundwater contribution to stream flow

Figure 6.2: Average annual water balance (Tipna village)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCP	14.8	32.3	51.1	76.8	185.3	335.5	338.1	318.9	301.9	152.9	39.1	6.3
SURQ	5.0	12.0	23.1	25.2	63.2	193.2	178.8	171.1	182.0	93.3	24.8	3.7
ET	7.6	13.4	28.1	55.6	71.4	57.1	64.8	62.0	53.0	35.2	15.0	7.3
PER	3.6	8.5	13.9	19.4	43.1	97.8	139.5	126.0	107.4	54.8	9.8	1.5
GWQ	8.9	3.6	5.6	9.5	17.4	31.3	66.9	101.4	107.8	102.4	69.0	34.4

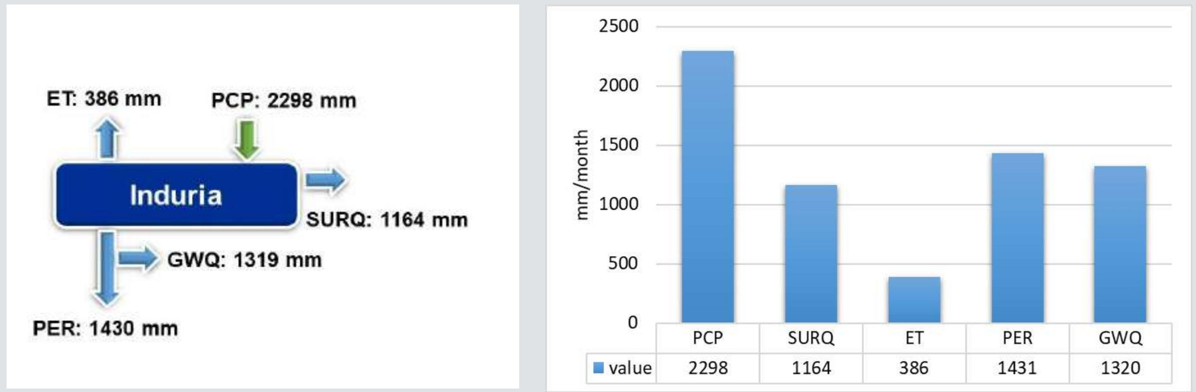
Figure 6.3: Average monthly water balance (Tipna village)

6.2.2 *Water Balance for the Village Induria*

The simulation results of the annual water for Induria village, located in the southwest areas of Bangladesh, are shown in **Figure 6.4** (for the simulation period of 1981 to 2022). The yearly rainfall of the village is 2298, while the national average is about 2100. The monsoon starts in May and reaches its peak at about 464.5 mm in June. **Figure 6.5.** illustrates the monthly variation of water availability.

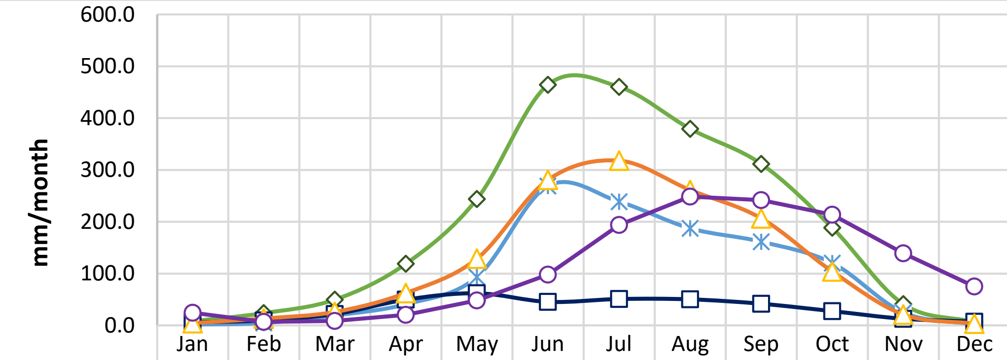
In the concept of water balance, rainfall is considered to be the main water source that goes into the system. Water is lost through evapotranspiration and percolation. After the loss, the rest of the water is surface runoff, which contributes to the stream flow. The yearly evapotranspiration loss is 386 mm, 17% of annual rainfall, whereas yearly percolation is 1430 mm.

After water loss through evapotranspiration and percolation, the remaining water contributes to stream flow as overland and lateral (subsurface) flow. The annual surface runoff for Induria is 1164 mm, whereas the base flow is 1319 mm. Base flow exceeds precipitation in October. The water from shallow aquifers also contributes to stream flow as base flow.



PCP: Precipitation   ET: Evapotranspiration   PER: Percolation   SURQ: Surface Runoff
GWQ: Groundwater contribution to stream flow

Figure 6.4: Average annual water balance (Induria village)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCP	8.3	23.9	49.9	119.1	244.0	464.5	460.3	379.4	311.7	188.6	41.2	6.7
SURQ	1.5	4.8	19.2	40.9	93.4	269.1	238.8	187.3	161.5	120.3	24.8	2.1
ET	5.9	9.7	22.0	49.8	62.1	45.5	51.0	50.4	41.9	27.6	12.8	7.3
PER	4.4	13.4	26.0	62.6	128.9	281.0	318.0	261.2	206.7	104.1	21.0	3.4
GWQ	24.6	7.0	8.9	20.6	48.2	98.1	193.8	248.7	241.9	213.7	139.2	75.3

Figure 6.5: Average monthly water balance (Induria village)

6.2.3 *Water Balance for the Village Beel Chanda*

The simulation results of the annual water for Beel Chanda village, located in the south-central areas of Bangladesh, are shown in **Figure 6.6** (for the simulation period of 1981 to 2022). The average annual rainfall of the village is 2025, while the national yearly average is about 2100. The monsoon starts in May and reaches its peak at about 395.4 mm in July. **Figure 6.7.** illustrates the monthly variation of water availability.

In the water balance concept, rainfall is the primary water source that goes into the system. Water is lost through evapotranspiration and percolation. After the loss, the rest of the water is surface runoff, contributing to the stream flow. The yearly evapotranspiration loss is 625 mm, 30% of annual rainfall, whereas yearly percolation is 463 mm.

After water loss through evapotranspiration and percolation, the remaining water contributes to stream flow as overland and lateral (subsurface) flow. The average surface runoff for Beel Chanda is 915 mm, whereas the base flow is 410 mm. Base flow exceeds precipitation in November. The water from shallow aquifers also contributes to stream flow as base flow.

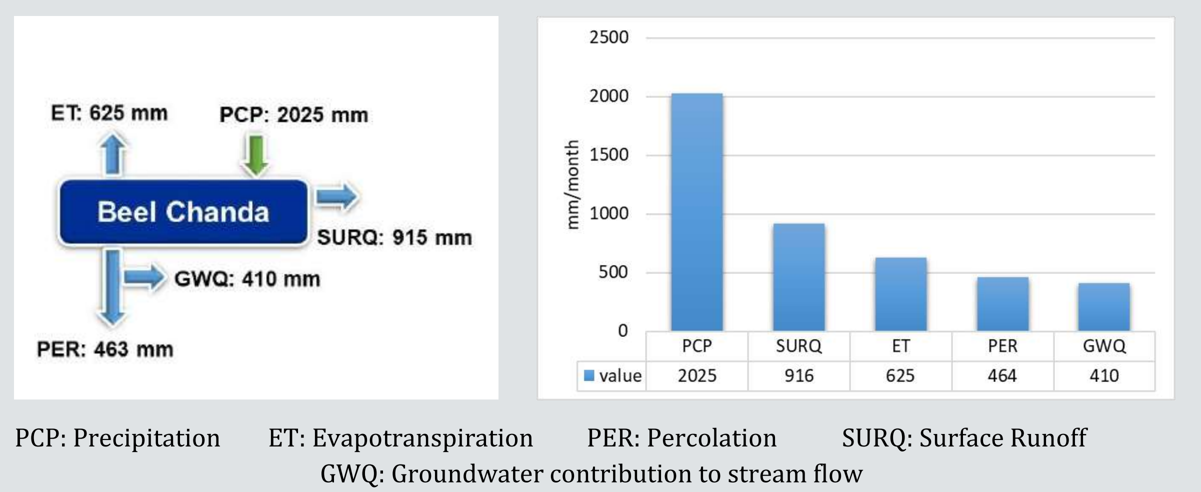
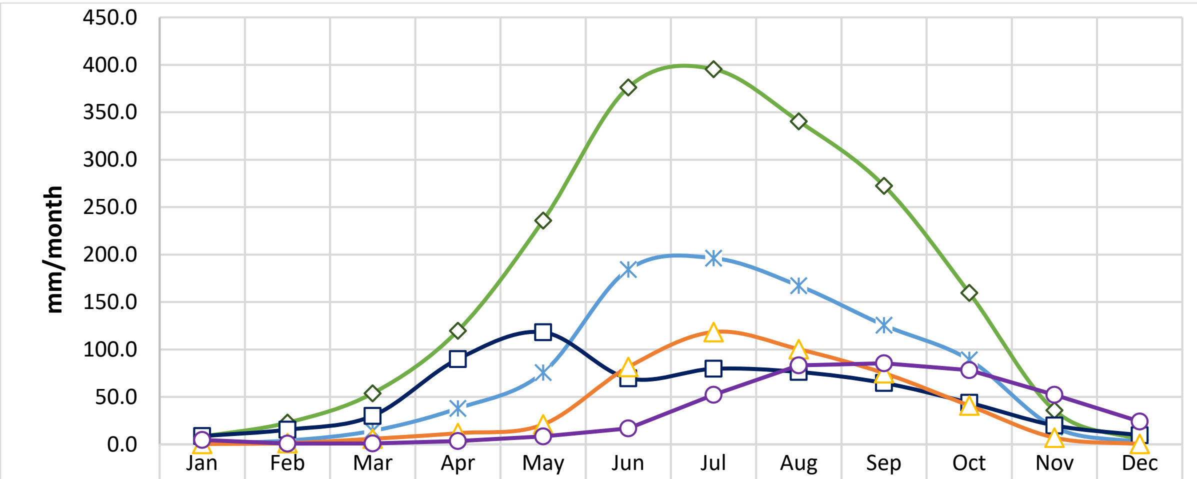


Figure 6.6: Average annual water balance (Beel Chanda village)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCP	8.1	22.8	53.8	119.7	235.8	376.1	395.4	340.5	272.5	159.6	35.8	4.5
SURQ	1.2	4.0	14.3	38.0	75.7	184.3	196.3	167.2	125.6	89.1	18.1	2.0
ET	8.6	15.4	30.0	89.8	118.2	69.6	79.6	76.3	64.6	43.7	19.9	9.6
PER	0.4	1.3	6.0	11.8	21.0	81.5	118.3	100.2	75.0	40.8	7.1	0.4
GWQ	4.6	0.8	0.9	3.5	8.4	16.8	52.2	83.3	85.4	78.2	52.1	24.1

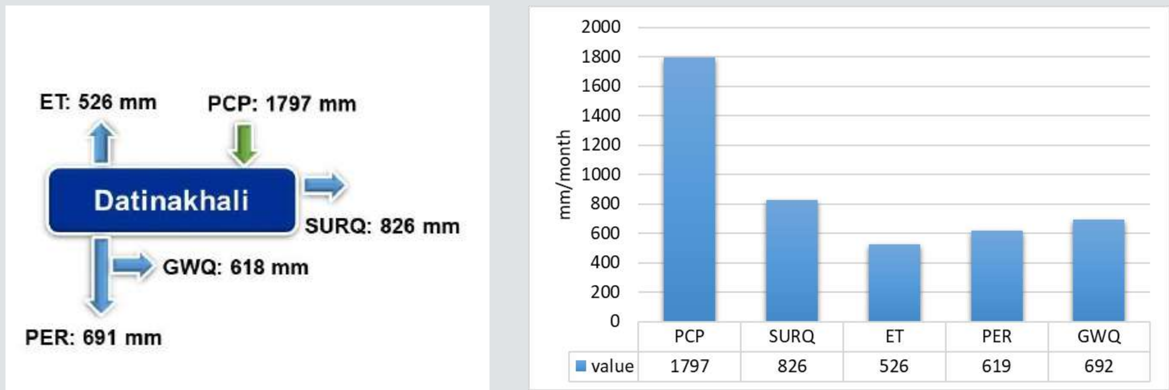
Figure 6.7: Average monthly water balance (Beel Chanda village)

6.2.4 *Water Balance for the Village Datinakhali*

The simulation results of the annual water for Datinakhali village, located in the south-central areas of Bangladesh, are shown in **Figure 6.8** (for the simulation period of 1981 to 2022). The yearly average rainfall of the village is 1797, while the national average is about 2100. The monsoon starts in May and reaches its peak at about 352.6 mm in July. **Figure 6.9.** illustrates the monthly variation of water availability.

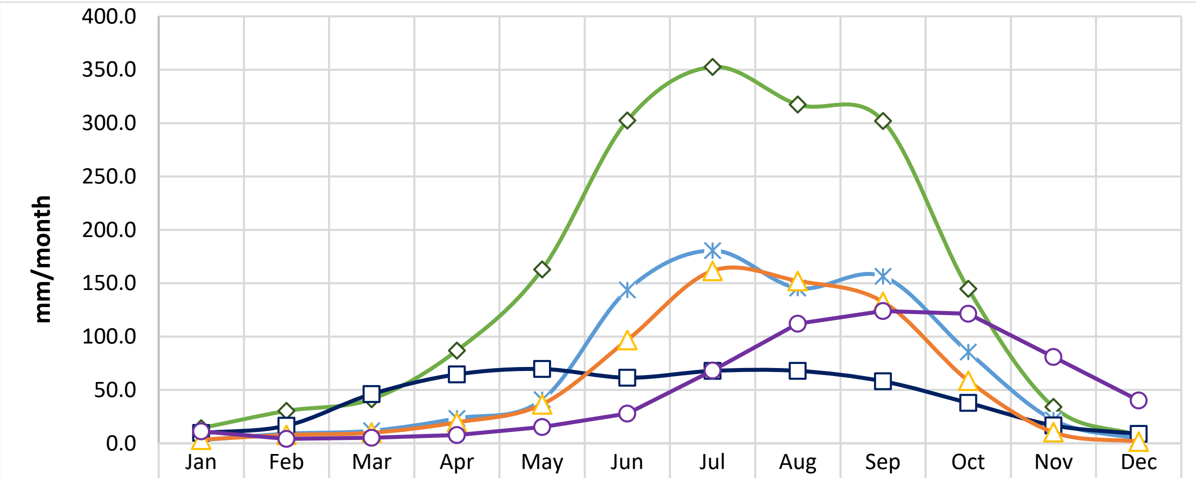
In the water balance concept, rainfall is the primary water source that goes into the system. Water is lost through evapotranspiration and percolation. After the loss, the rest of the water is surface runoff, contributing to the stream flow. The yearly evapotranspiration loss is 526 mm, 29% of annual rainfall, whereas yearly percolation is 691 mm.

After water loss through evapotranspiration and percolation, the remaining water contributes to stream flow as overland and lateral (subsurface) flow. The annual surface runoff for Datinakhali is 826 mm, whereas the base flow is 618 mm. Base flow exceeds precipitation in October. The water from shallow aquifers also contributes to stream flow as base flow.



PCP: Precipitation ET: Evapotranspiration PER: Percolation SURQ: Surface Runoff
GWQ: Groundwater contribution to stream flow

Figure 6.8: Average annual water balance (Datinakhali village)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCP	14.3	30.4	41.4	86.9	163.0	302.4	352.6	317.4	302.1	144.8	34.2	7.2
SURQ	3.1	9.0	11.9	23.4	40.9	143.7	180.7	145.5	156.4	85.5	21.9	4.1
ET	9.7	16.5	46.2	64.6	69.6	61.5	67.9	67.9	58.1	37.9	16.8	8.9
PER	3.5	7.9	10.0	19.7	36.6	96.8	161.6	152.1	132.6	58.8	10.4	1.7
GWQ	11.2	4.3	5.3	7.8	15.3	27.8	68.3	112.2	124.0	121.5	80.9	40.2

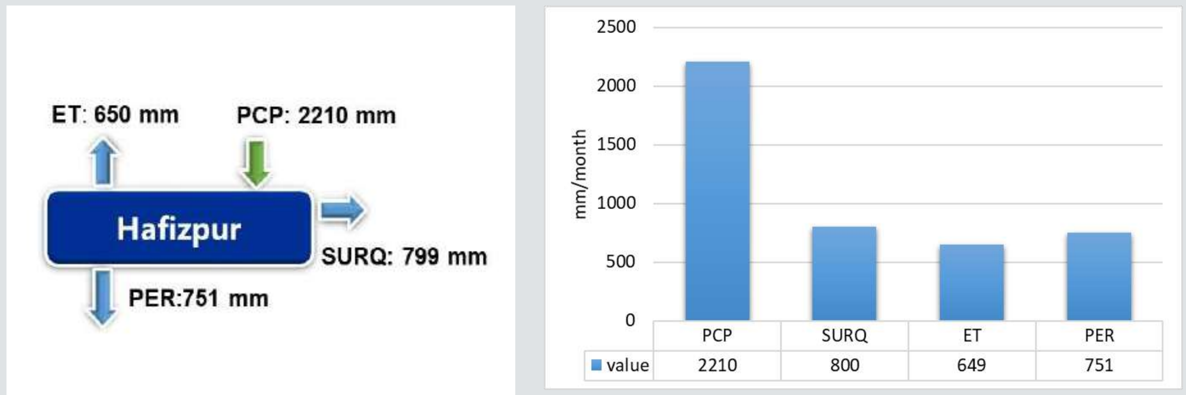
Figure 6.9: Average monthly water balance (Datinakhali village)

6.2.5 *Water Balance for the Village Hafizpur*

The simulation results of the annual water for Hafizpur village, located in the northeast areas of Bangladesh, are shown in **Figure 6.10** (for the simulation period of 1981 to 2022). The average annual rainfall of the village is 2,210mm, while the yearly national average is about 2,100. The monsoon starts in May and reaches its peak at about 426.7 mm in July. **Figure 6.11.** illustrates the monthly variation of water availability.

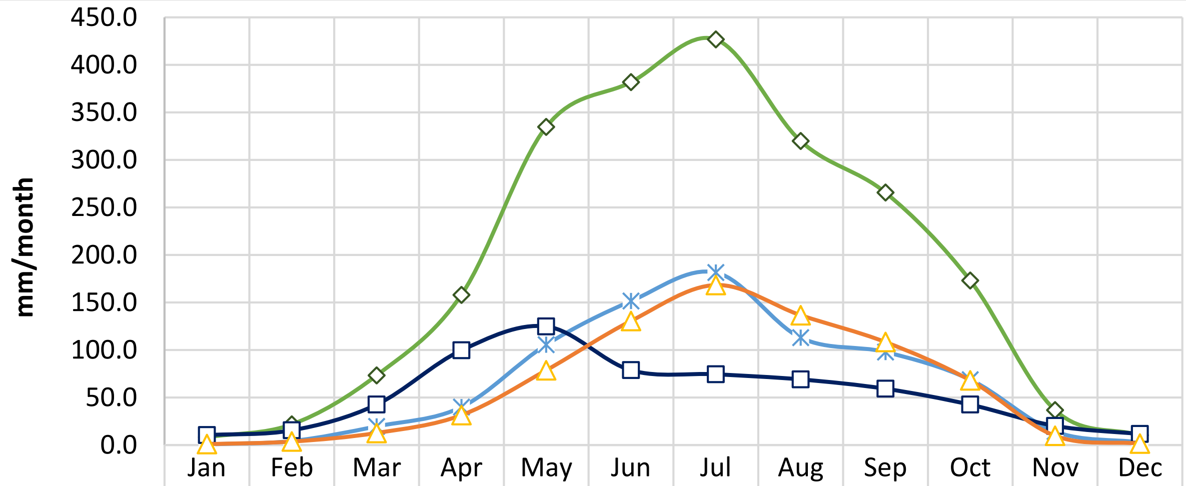
In the water balance concept, rainfall is the primary water source that goes into the system. Water is lost through evapotranspiration and percolation. After the loss, the rest of the water is surface runoff, contributing to the stream flow. The yearly evapotranspiration loss is 650 mm, 29% of annual rainfall, while yearly percolation is 751 mm.

After water loss through evapotranspiration and percolation, the remaining water contributes to stream flow as overland and lateral (subsurface) flow. The annual average surface runoff for Hafizpur is 799 mm. The water from shallow aquifers also contributes to stream flow as base flow.



PCP: Precipitation   ET: Evapotranspiration   PER: Percolation   SURQ: Surface Runoff
GWQ: Groundwater contribution to stream flow

Figure 6.10: Average annual water balance (Hafizpur village)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCP	8.3	21.7	73.3	158.0	334.8	381.9	426.7	319.8	265.6	173.1	36.8	10.3
SURQ	0.7	4.2	19.6	39.9	105.6	151.5	181.6	113.0	97.9	68.8	14.2	2.8
ET	10.5	15.5	42.6	99.7	124.9	78.8	74.5	69.1	59.3	42.6	20.2	11.7
PER	1.0	3.7	12.7	31.5	78.7	130.6	168.4	136.7	108.4	68.0	9.8	1.6

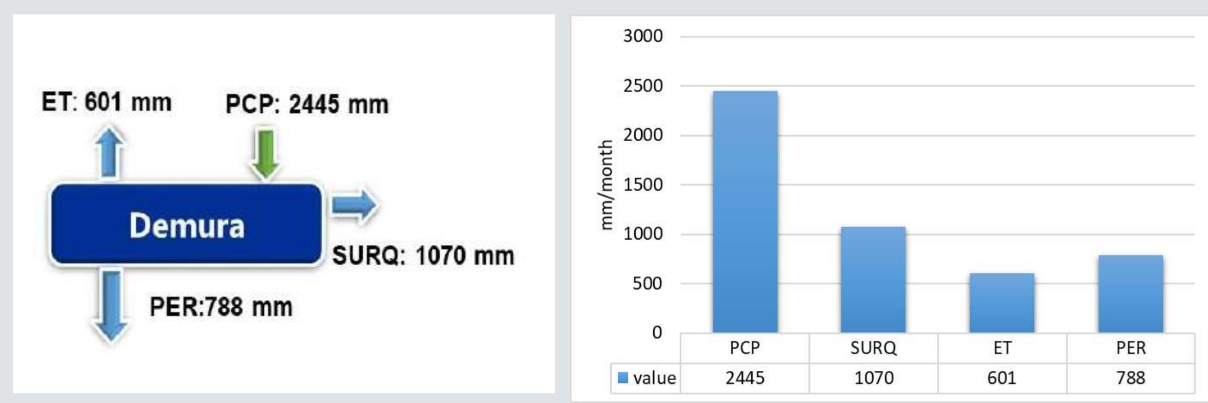
Figure 6.11: Average monthly water balance (Hafizpur village)

6.2.6 *Water Balance for the Village Demura*

The simulation results of the annual water for Demura, located in the northeast areas of Bangladesh, are shown in **Figure 6.12** (for the simulation period of 1981 to 2022). The average annual rainfall of the village is 2,445mm, while the yearly national average is about 2100. The monsoon starts in May and reaches its peak at about 489 mm in July. **Figure 6.13.** illustrates the monthly variation of water availability.

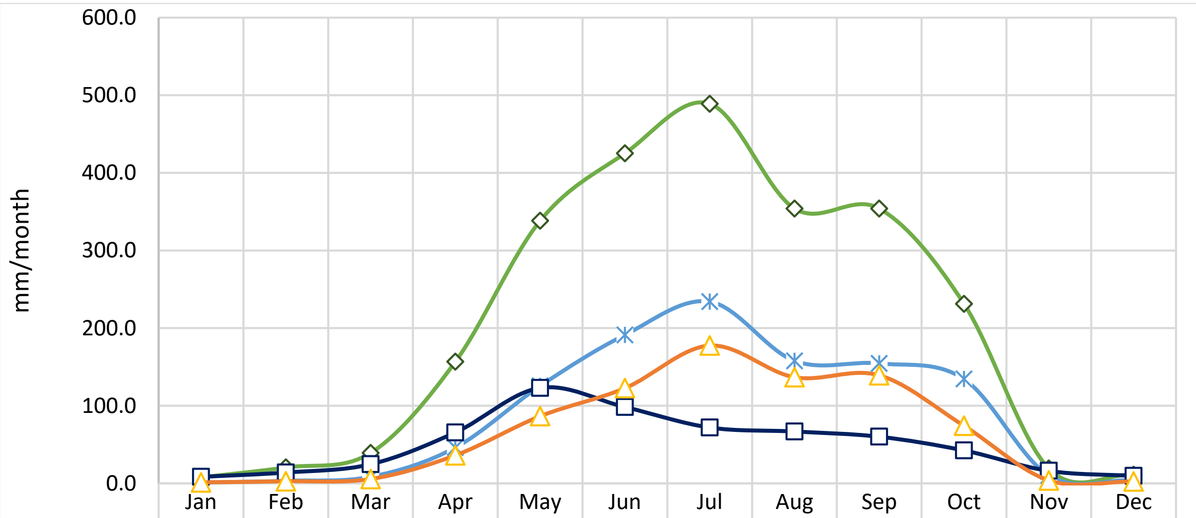
In the water balance concept, rainfall is the primary water source that goes into the system. Water is lost through evapotranspiration and percolation. After the loss, the rest of the water is surface runoff, which contributes to the stream flow. The yearly actual evapotranspiration loss is 601 mm, 24% of annual rainfall, whereas yearly percolation is 788 mm.

After the loss of water through evapotranspiration and percolation, the remaining water contributes to stream flow as overland flow and lateral (subsurface) flow. The annual average surface runoff for Demuria is 1070 mm. The water from shallow aquifers also contributes to stream flow as base flow.



PCP: Precipitation ET: Evapotranspiration PER: Percolation SURQ: Surface Runoff
GWQ: Groundwater contribution to stream flow

Figure 6.12: Average annual water balance (Demuria village)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCP	7.7	20.5	39.1	156.7	338.2	425.1	489.0	354.0	353.9	231.1	19.0	11.0
SURQ	1.0	3.2	8.4	46.1	125.5	191.3	234.2	157.8	154.5	134.4	10.0	4.0
ET	8.4	14.0	24.6	65.6	123.0	98.3	71.9	66.8	60.1	42.4	16.1	9.7
PER	1.2	2.6	5.5	36.1	86.5	122.6	177.6	136.7	139.3	74.1	3.7	2.4

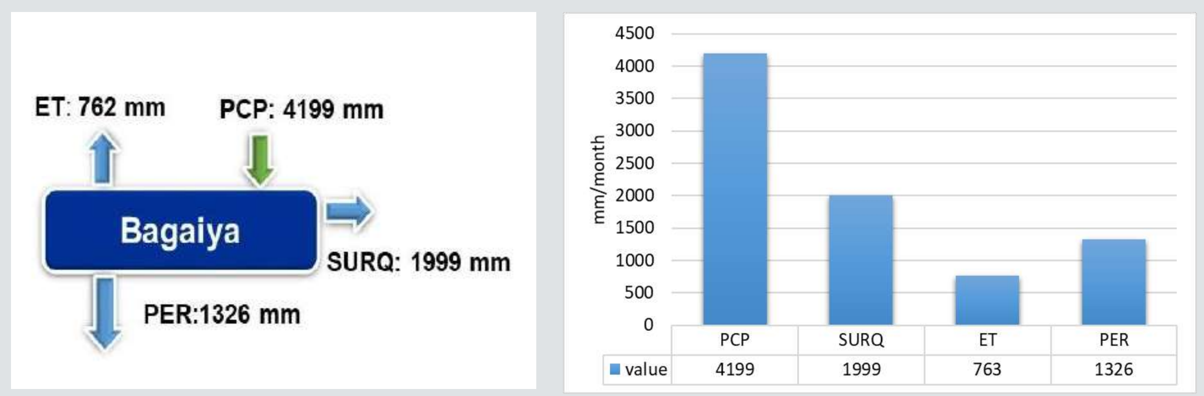
Figure 6.13: Average monthly water balance (Demuria village)

6.2.7 *Water Balance for the Village Bagaiya*

The simulation results of the annual water for Bagaiya village, located in the northeast areas of Bangladesh, are shown in **Figure 6.14** (for the simulation period of 1981 to 2022). The average annual rainfall of the village is 4,199mm, while the yearly national average is about 2100. The monsoon starts in May and reaches its peak at about 426.7 mm in July. **Figure 6.15.** illustrates the monthly variation of water availability.

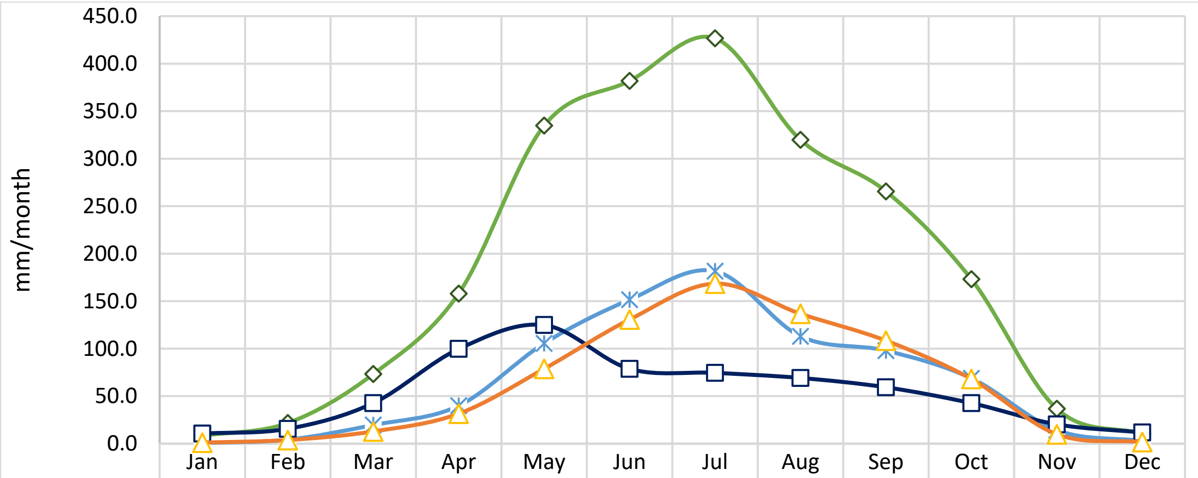
In the concept of water balance, rainfall is considered to be the main water source that goes into the system. Water is lost through evapotranspiration and percolation. After the loss, the rest of the water is surface runoff, contributing to the stream flow. The yearly evapotranspiration loss is 762 mm, 18% of annual rainfall, whereas yearly percolation is 1326 mm.

After water loss through evapotranspiration and percolation, the remaining water contributes to stream flow as overland and lateral (subsurface) flow. The annual average surface runoff for Bagaiya is 1999 mm. The water from shallow aquifers also contributes to stream flow as base flow.



PCP: Precipitation ET: Evapotranspiration PER: Percolation SURQ: Surface Runoff
GWQ: Groundwater contribution to stream flow

Figure 6.14: Average annual water balance (Bagayia village)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCP	8.3	21.7	73.3	158.0	334.8	381.9	426.7	319.8	265.6	173.1	36.8	10.3
SURQ	0.7	4.2	19.6	39.9	105.6	151.5	181.6	113.0	97.9	68.8	14.2	2.8
ET	10.5	15.5	42.6	99.7	124.9	78.8	74.5	69.1	59.3	42.6	20.2	11.7
PER	1.0	3.7	12.7	31.5	78.7	130.6	168.4	136.7	108.4	68.0	9.8	1.6

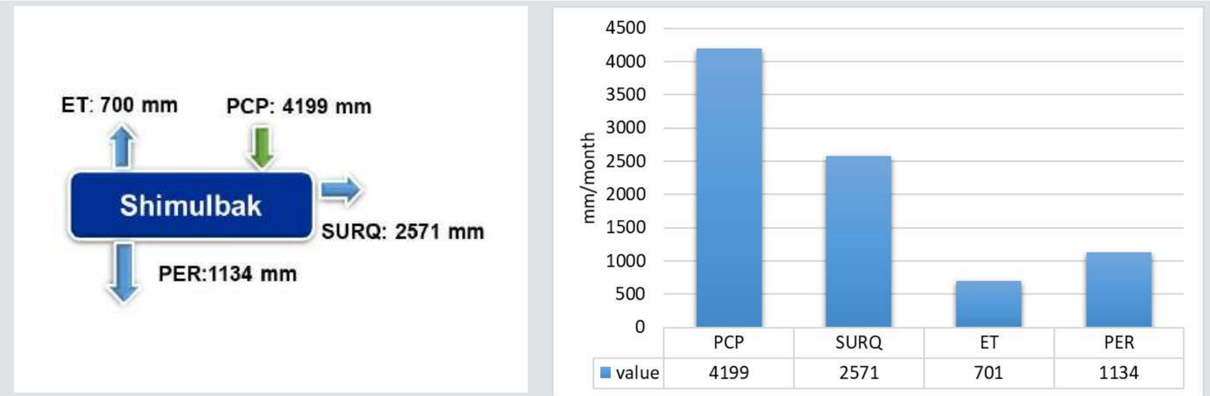
Figure 6.15: Average monthly water balance (Bagayia village)

6.2.8 *Water Balance for the Village Shimulbak*

The simulation results of the annual water for Shimulbak village, located in the northeast areas of Bangladesh, are shown in **Figure 6.16** (for the simulation period of 1981 to 2022). The average annual rainfall of the village is 4199, while the national average is about 2100. The monsoon starts in May and reaches its peak at about 822.7 mm in July. **Figure 6.17.** illustrates the monthly variation of water availability.

In the water balance concept, rainfall is the main water source that goes into the system. Water is lost through evapotranspiration and percolation. After the loss, the rest of the water is surface runoff, which contributes to the stream flow. The yearly evapotranspiration loss is 700 mm, 18% of annual rainfall, whereas yearly percolation is 1134 mm.

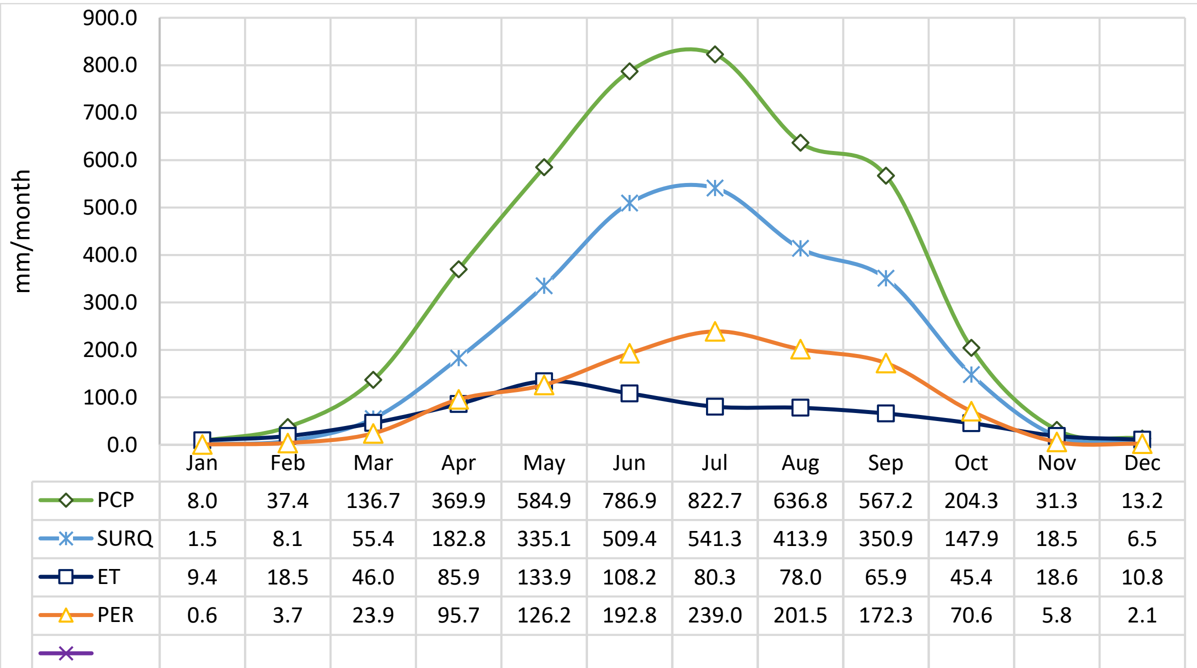
After water loss through evapotranspiration and percolation, the remaining water contributes to stream flow as overland and lateral (subsurface) flow. The annual average surface runoff for Shimulbak is 2,551 mm. The water from shallow aquifers also contributes to stream flow as base flow.



	PCP	SURQ	ET	PER
value	4199	2571	701	1134

PCP: Precipitation ET: Evapotranspiration PER: Percolation SURQ: Surface Runoff
GWQ: Groundwater contribution to stream flow

Figure 6.16: Average annual water balance (Shimulbak village)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCP	8.0	37.4	136.7	369.9	584.9	786.9	822.7	636.8	567.2	204.3	31.3	13.2
SURQ	1.5	8.1	55.4	182.8	335.1	509.4	541.3	413.9	350.9	147.9	18.5	6.5
ET	9.4	18.5	46.0	85.9	133.9	108.2	80.3	78.0	65.9	45.4	18.6	10.8
PER	0.6	3.7	23.9	95.7	126.2	192.8	239.0	201.5	172.3	70.6	5.8	2.1

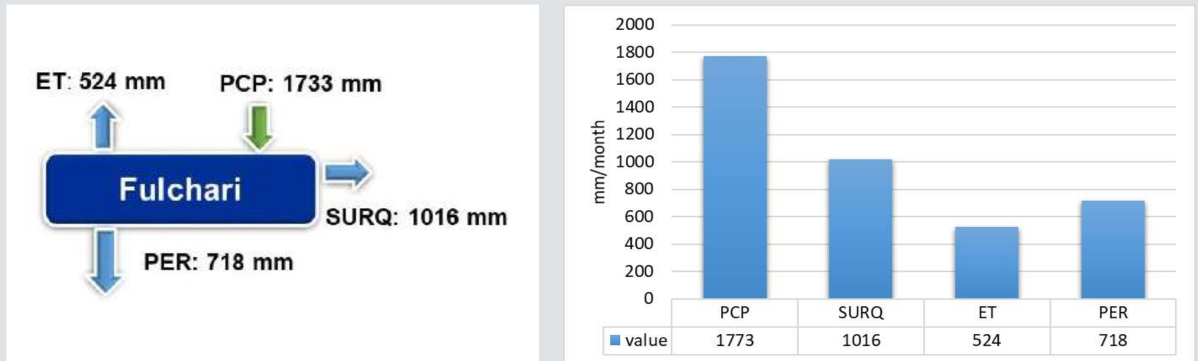
Figure 6.17: Average monthly water balance (Shimulbak village)

6.2.9 *Water Balance for the Village Fulchari*

The simulation results of the annual water for Fulchari village, located in the northwest areas of Bangladesh, are shown in **Figure 6.18** (for the simulation period of 1981 to 2022). The average annual rainfall of the village is 1,753mm, while the yearly average in the driest part of the country is about 1500. **Figure 6.19** illustrates the monthly variation of water availability. The monsoon starts in May and reaches its peak at about 355.9 mm in July**.**

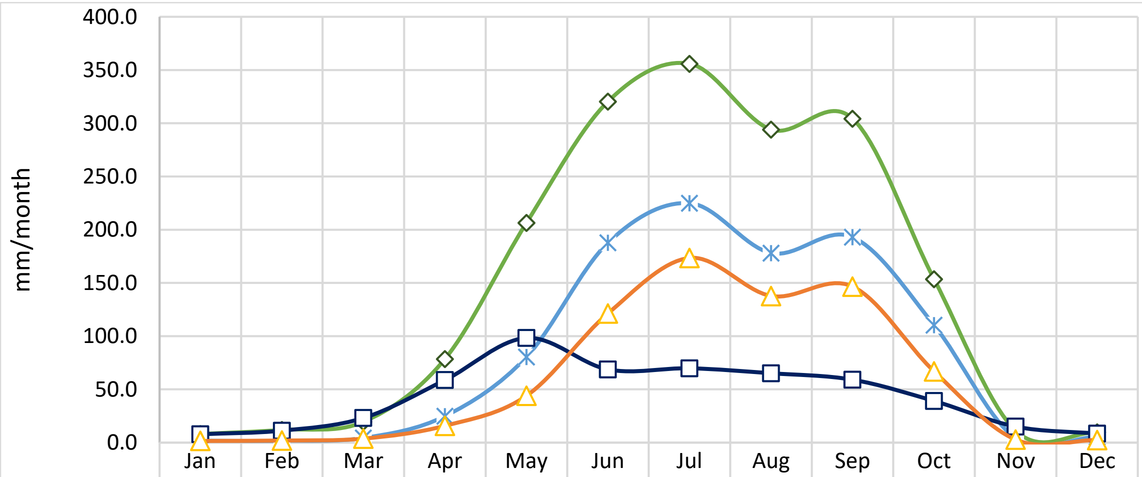
In the concept of water balance, rainfall is considered to be the main water source that goes into the system. Water is lost through evapotranspiration and percolation. After the loss, the rest of the water is surface runoff, which contributes to the stream flow. The yearly evapotranspiration loss is 524 mm, 30% of annual rainfall, whereas yearly percolation is 718 mm.

After water loss through evapotranspiration and percolation, the remaining water contributes to stream flow as overland and lateral (subsurface) flow. The annual average surface runoff for Fulchari is 1016 mm. The water from shallow aquifers also contributes to stream flow as base flow.



PCP: Precipitation ET: Evapotranspiration PER: Percolation SURQ: Surface Runoff
GWQ: Groundwater contribution to stream flow

Figure 6.18: Average annual water balance (Fulchari village)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCP	8.0	11.8	19.5	78.5	206.4	320.4	355.9	294.1	304.3	153.5	11.1	9.7
SURQ	1.7	1.6	4.3	24.8	80.4	187.7	224.9	178.0	193.0	110.3	4.0	5.3
ET	7.8	11.2	23.1	58.7	98.3	68.7	69.8	65.1	59.1	39.1	15.0	8.4
PER	1.6	2.0	3.8	15.8	44.0	121.4	173.5	137.8	146.6	66.9	2.8	2.4

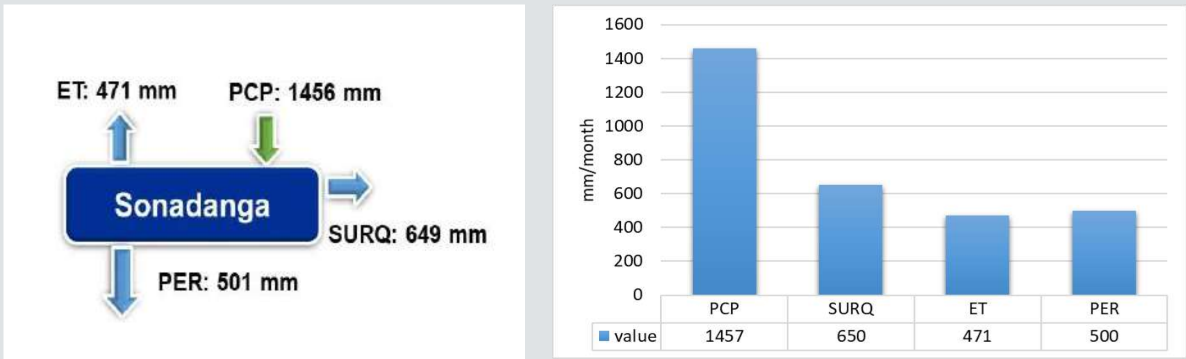
Figure 6.19: Average monthly water balance (Fulchari village)

6.2.10 *Water Balance for the Village Sonadanga*

The simulation results of the annual water for Sonadanga village, located in the northwest areas of Bangladesh, are shown in **Figure 6.20** (for the simulation period of 1981 to 2022). The average annual rainfall of the village is 1,456mm, while the yearly average in the driest part of the country is about 1,500mm. The monsoon starts in May and reaches its peak at about 316.3 mm in July. **Figure 6.21.** illustrates the monthly variation of water availability.

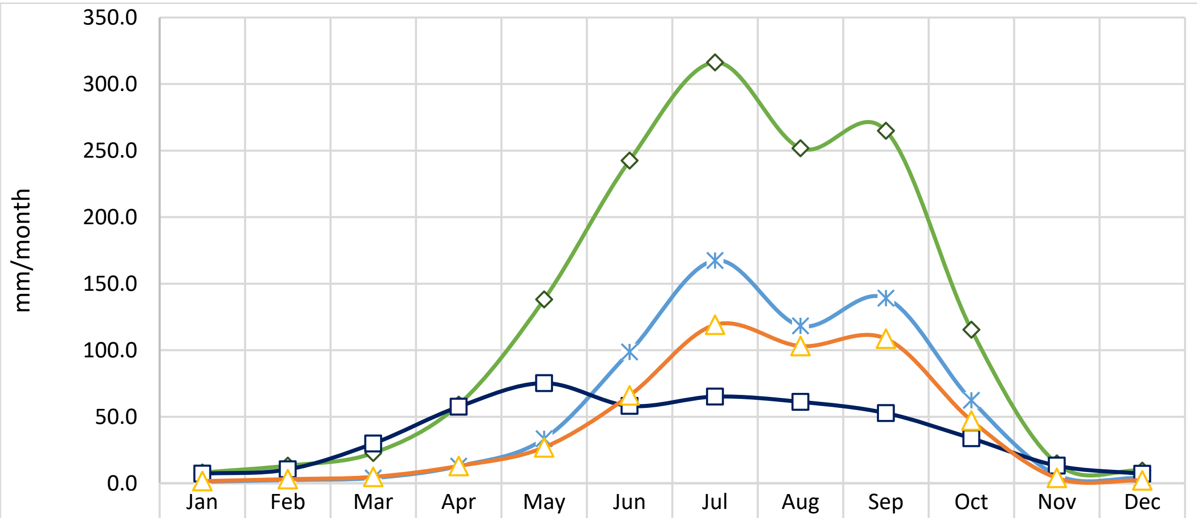
In the concept of water balance, rainfall is considered to be the main water source that goes into the system. Water is lost through evapotranspiration and percolation. After the loss, the rest of the water is surface runoff, which contributes to the stream flow. The yearly evapotranspiration loss is 471 mm, 32% of annual rainfall, whereas yearly percolation is 501 mm.

After water loss through evapotranspiration and percolation, the remaining water contributes to stream flow as overland and lateral (subsurface) flow. The annual average surface runoff for Sonadanga is 649 mm. The water from shallow aquifers also contributes to stream flow as base flow.



PCP: Precipitation ET: Evapotranspiration PER: Percolation SURQ: Surface Runoff
GWQ: Groundwater contribution to stream flow

Figure 6.20: Average annual water Balance (Sonadanga village)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCP	8.1	13.2	22.7	59.1	138.2	242.6	316.3	251.8	264.9	115.4	14.9	9.5
SURQ	1.2	2.4	3.9	12.9	33.4	98.7	167.4	118.3	139.1	62.3	6.2	4.0
ET	7.2	10.4	29.9	57.5	75.2	58.1	65.1	61.1	52.7	33.8	13.2	7.1
PER	1.6	3.1	4.8	13.0	27.0	66.0	119.1	103.1	108.7	47.2	4.0	2.2

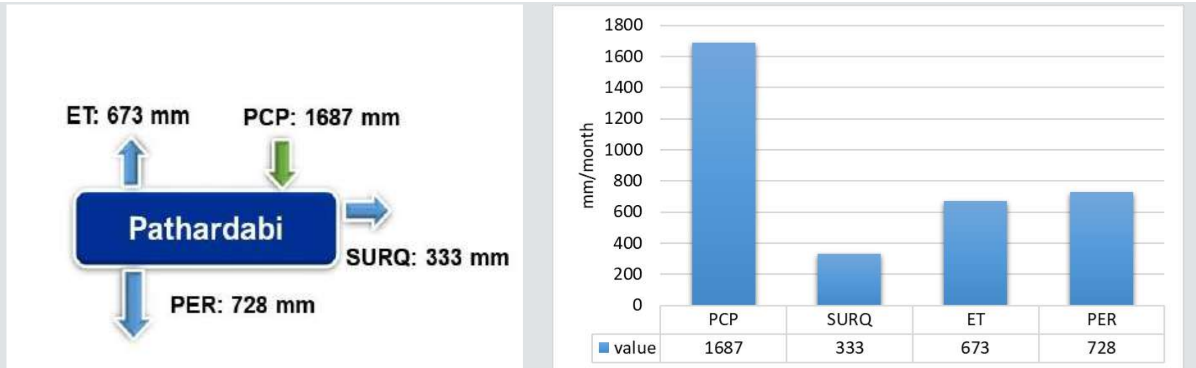
Figure 6.21: Average monthly water balance (Sonadanga village)

6.2.11 *Water Balance for the Village Pathardabi*

The simulation results of the annual water for Pathardabi village, located in the northwest areas of Bangladesh, are shown in **Figure 6.22** (for the simulation period of 1981 to 2022). The average annual rainfall of the village is 1,687mm, while the annual average in the driest part of the country is about 1,500mm. The monsoon starts in May and reaches its peak at about 411.1 mm in July. **Figure 6.23.** illustrates the monthly variation of water availability**.**

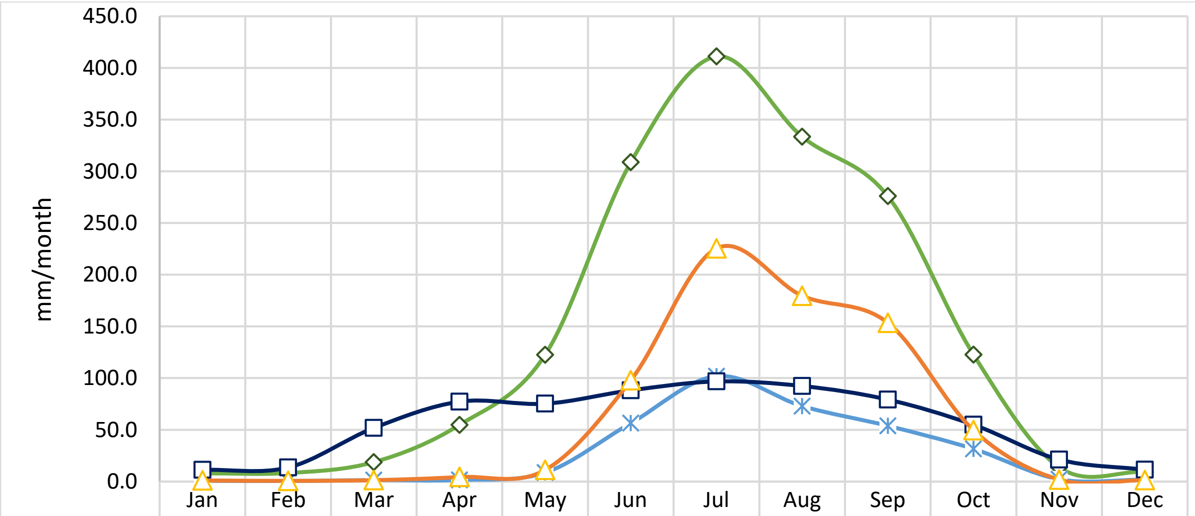
In the concept of water balance, rainfall is considered to be the main water source that goes into the system. Water is lost through evapotranspiration and percolation. After the loss, the rest of the water is surface runoff, which contributes to the stream flow. The yearly evapotranspiration loss is 673 mm, 32% of annual rainfall, whereas yearly percolation is 728 mm.

After water loss through evapotranspiration and percolation, the remaining water contributes to stream flow as overland and lateral (subsurface) flow. The annual average surface runoff for Pathardabi is 333 mm. The water from shallow aquifers also contributes to stream flow as base flow.



PCP: Precipitation ET: Evapotranspiration PER: Percolation SURQ: Surface Runoff
GWQ: Groundwater contribution to stream flow

Figure 6.22: Average annual water balance (Pathardabi village)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCP	7.9	8.1	18.7	54.7	122.5	308.8	411.1	333.5	275.9	122.6	13.7	9.2
SURQ	0.7	0.6	1.4	1.5	8.7	56.4	101.8	72.9	53.8	31.5	2.2	1.8
ET	11.3	13.5	51.8	77.2	75.2	88.2	96.8	92.4	79.2	54.9	21.2	11.4
PER	1.0	0.6	1.3	4.4	11.2	97.8	225.4	179.5	153.4	49.6	1.9	1.4

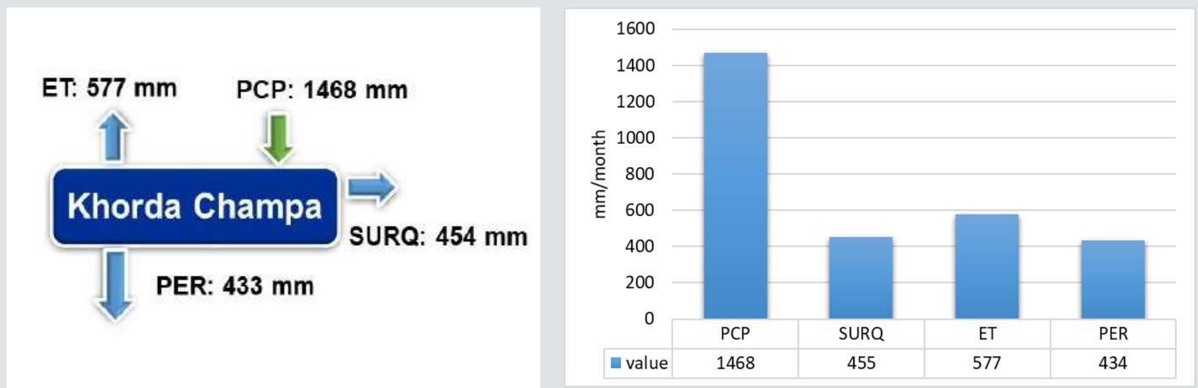
Figure 6.23: Average monthly water balance (Pathardabi village)

6.2.12 *Water Balance for the Village Khorda Champa*

The simulation results of the annual water for Khorda Champa village, located in the northwest areas of Bangladesh, are shown in **Figure 6.24** (for the simulation period of 1981 to 2022). The average annual rainfall of the village is 1,468mm, which is below the yearly average in the driest part of the country, 1500mm. The monsoon starts in May and reaches its peak at about 318.7 mm in July. **Figure 6.25.** illustrates the monthly variation of water availability.

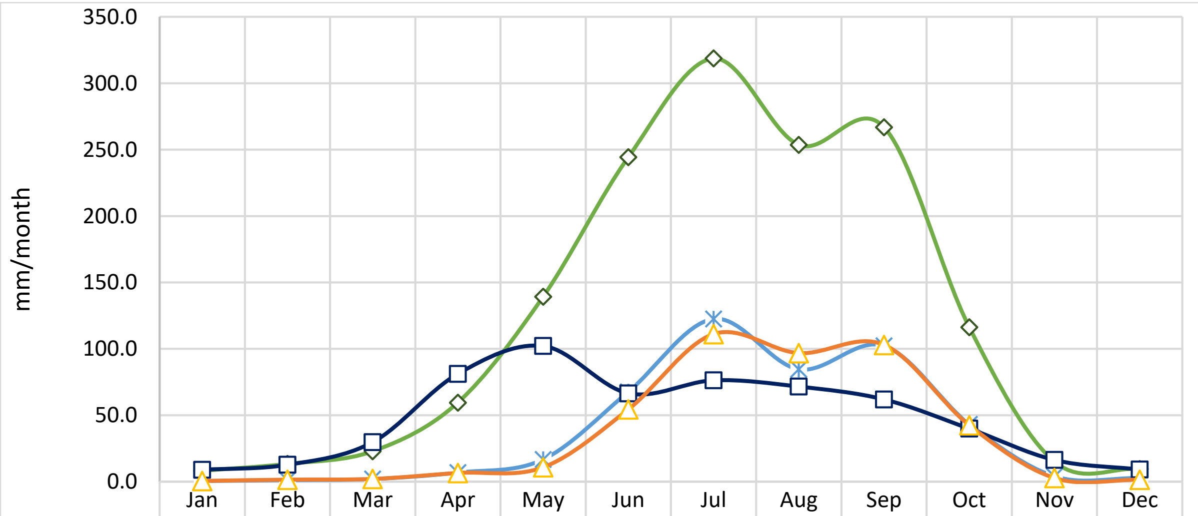
In the concept of water balance, rainfall is considered to be the main water source that goes into the system. Water is lost through evapotranspiration and percolation. After the loss, the rest of the water is surface runoff, which contributes to the stream flow. The yearly evapotranspiration loss is 577 mm, 32% of annual rainfall, whereas yearly percolation is 433 mm.

After water loss through evapotranspiration and percolation, the remaining water contributes to stream flow as overland and lateral (subsurface) flow. The annual average surface runoff for Khorda Champa is 455 mm. The water from shallow aquifers also contributes to stream flow as base flow.



PCP: Precipitation ET: Evapotranspiration PER: Percolation SURQ: Surface Runoff
GWQ: Groundwater contribution to stream flow

Figure 6.24: Average annual water balance



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
PCP	8.2	13.3	22.9	59.6	139.3	244.4	318.7	253.7	266.9	116.3	15.0	9.6
SURQ	0.5	1.2	2.1	6.9	16.8	67.7	122.5	84.7	102.3	43.2	4.0	2.8
ET	9.0	12.8	29.8	81.2	102.2	66.5	76.3	71.6	62.0	40.0	16.4	9.2
PER	0.5	1.5	2.1	6.6	10.8	54.4	111.1	96.8	103.0	42.5	2.8	1.5

Figure 6.25: Average monthly water balance (Khorda Champa village)

6.3 Identification of Suitable Aquifer:

To identify the suitable aquifer for a safe piped water supply, drilling test well data was collected from primary and secondary sources (DPHE). In the cases of Simulbank, and Chotta Harina villages, drilling test well data was not collected because tertiary rocks are encountered at shallow depths in those villages. Water samples was collected from the test well and tested. **Table 6.1-6.12** shows the suitable aquifer for a safe piped water supply and water quality of the aquifer.

District: Rajshahi; Upazila: Bagmara; Union: Sonadanga; Village: Sonadanga

In Sonadanga village of Bagmara Upazila under Rajshahi district suitable aquifer has been found in shallow depth (40m). Water quality test result from test well shows iron (Fe) concentration is 0.20-0.50 mg/I, chloride (CI-) concentration is 15-25 mg/I and arsenic (As) concentration is 0.001-0.002 mg/I. From the water quality result, it is seen that Iron, arsenic and chloride concentration is within allowable limit of ECR 1997.

Table 6.1: Water point depth and water quality of the test wells in Sonadanga Village of Bagmara Upazila under Rajshahi district

SL	Latitude	Longitude	Water Point Depth	Water Quality Parameters		
				Fe (mg/l)	As (mg/l)	CI^- (mg/l)
1.	24.67747	88.79534	40	0.4	0.001	25
2.	24.67805	88.80051	40	0.5	0.001	15
3.	24.68182	88.79627	40	0.2	0.003	15
Drinking Water Standards (ECR, 1997)				**0.3-1.0**	**0.05**	**150-600**

District: Narsingdi, Upazila: Monohardi, Union: Chalakchar, Village: Hafizpur

For Hafizpur village in Narsingdi district, suitable aquifer has been found at a depth of (175–181) m and this village is suitable for the development of Deep tubewell. Water quality test result from test well shows iron (Fe) concentration is 0.91-0.33 mg/I, chloride (CI-) concentration is 10-25 mg/I and arsenic (As) concentration is 0.001 mg/I. From the water quality result, it is seen that Iron, arsenic and chloride concentration is within allowable limit of ECR 1997.

Table 6.2: Water point depth and water quality of the test wells in Hafizpur Village of Monohardi Upazila under Narsingdi district

SL	Latitude	Longitude	Water Point Depth	Water Quality Parameters		
				Fe (mg/l)	As (mg/l)	CI^- (mg/l)
1.	24.157237	90.73481	182.92	0.91	0.001	10
2.	24.16633	90.732841	181.8	0.33	0.001	15
3.	24.166339	90.732843	175.3	0.28	0.001	25
Drinking Water Standards (ECR, 1997)				**0.3-1.0**	**0.05**	**150-600**

District: Cumilla, Upazila: Monohorganj, Union: Bipulashar, Village: Shaikchail

In case of Shaikchail village of Cumilla, suitable aquifer has been found at a depth of 210 m. Water quality test result from test well shows iron (Fe) concentration is 3.35-5.25 mg/I, chloride (CI^-) concentration is (69-119) mg/I and arsenic (As) concentration is (0.001-0.02) mg/I. From the water quality result, it is seen that arsenic and chloride concentration is within allowable limit of drinking water standards (ECR 1997). Iron concentration exceeds the allowable limit of drinking water standards (ECR 1997).

Table 6.3: Water point depth and water quality of the test wells in Shaikchail Village of Monohorganj Upazila under Cumilla district

SL	Latitude	Longitude	Water Point Depth	Water Quality Parameters		
				Fe (mg/l)	As (mg/l)	CI^- (mg/l)
1.	23.08865	91.090376	210.36	3.35	0.001	94
2.	23.093696	91.089328	207.70	5.25	0.02	69
3.	23.09632	91.089301	207.62	4.50	0.002	119
Drinking Water Standards (ECR, 1997)				**0.3-1.0**	**0.05**	**150-600**

District: Khulna, Upazila: Dumuria, Union: Khurnia, Village: Tipna

In Tipna village, suitable aquifer has been found at a depth of 223 m. Water quality test result from test well shows iron (Fe) concentration is 0.55 mg/I, chloride (CI^-) concentration is 30 mg/I and arsenic (As) concentration is 0.008 mg/I. From the water quality result, it is seen that iron, arsenic and chloride concentration is within allowable limit of drinking water standards (ECR 1997).

Table 6.4: Water point depth and water quality of the test wells in Tipna Village of Dumuria Upazila under Khulna district

SL	Latitude	Longitude	Water Point Depth	Water Quality Parameters		
				Fe (mg/l)	As (mg/l)	CI^- (mg/l)
1.	22.8181	89.37707	223	0.55	0.008	30
Drinking Water Standards (ECR, 1997)				**0.3-1.0**	**0.05**	**150-600**

District: Kurigram, Upazila: Bhurungamari, Union: Pathordubi, Village: Pathordubi

For Pathordubi village in kurigram district, suitable aquifer has been found in suitable aquifer has been found in shallow depth (60m). Water quality test result from test well shows iron (Fe) concentration is 0.20-0.90 mg/I, chloride (CI-) concentration is 25-26 mg/I and arsenic (As) concentration is 0.001-0.003 mg/I. From the water quality result, it is seen that Iron, arsenic and chloride concentration is within allowable limit of ECR 1997.

Table 6.5: Water point depth and water quality of the test wells in Pathordubi Village of Bhurungamari Upazila under Kurigram district

SL	Latitude	Longitude	Water Point Depth	Water Quality Parameters		
				Fe (mg/l)	As (mg/l)	CI^- (mg/l)
1.	26.156975	89.624091	60.97	0.5	0.001	25
2.	26.146665	89.604215	60.97	0.4	0.001	26
3.	26.141769	89.625344	61	0.9	0.003	26
Drinking Water Standards (ECR, 1997)				**0.3-1.0**	**0.05**	**150-600**

District: Barisal; Upazila: Hijla; Union: Memania; Village: Induria

In Induria village of Hijla Upazila under the Barisal district suitable aquifer has been found in Deep depth (268m). Water quality test result from test well shows iron (Fe) concentration is 0.184-0.196 mg/I, chloride (CI-) concentration is 35 mg/I and arsenic (As) concentration is 0.0001 mg/I. From the water quality result, it is seen that Iron, arsenic and chloride concentration is within allowable limit of ECR 1997.

Table 6.6: Water point depth and water quality of the test wells in Induria Village of Hijla Upazila under Barisal district

SL	Latitude	Longitude	Water Point Depth	Water Quality		
				Fe (mg/l)	As (mg/l)	CI^- (mg/l)
1.	22.96664	90.51837	268	0.196	0.0001	35
2.	22.96766	90.52307	267	0.184	0.0001	35
3.	22.96748	90.52313	268	0.196	0.0001	35
Drinking Water Standards (ECR, 1997)				**0.3-1.0**	**0.05**	**150-600**

District: Sylhet; Upazila: Gowainghat; Union: Rustimpur; Village: Bagaiya

In Bagaiya village of Gwainghat Upazila under Sylhet district suitable aquifer has been found in Shallow depth (54.50 m). Water quality test result from test well shows iron (Fe) concentration is 4.5 mg/I, chloride (CI-) concentration is 19 mg/I and arsenic (As) concentration is 0.015 mg/I. From the water quality result, it is seen that Iron, arsenic and chloride concentration is within allowable limit of ECR 1997.

Table 6.7: Water point depth and water quality of the test wells in Bagaiya Village of Gowainghat Upazila under Sylhet district

SL	Latitude	Longitude	Water Point Depth	Water Quality		
				Fe (mg/l)	As (mg/l)	CI^- (mg/l)
1.	25.15209	91.88243	54.50	4.5	0.015	19
Drinking Water Standards (ECR, 1997)				**0.3-1.0**	**0.05**	**150-600**

District: Netrokona; Upazila: Barhatta; Union: Shahata; Village: Dakhin Demura

In Dakhin Demura village of Barhatta Upazila under Netrokona district suitable aquifer has been found in Deep depth (200 m). Water quality test result from test well shows iron (Fe) concentration is 4.5 mg/I, chloride (CI-) concentration is 19 mg/I and arsenic (As) concentration is 0.015 mg/I. From the water quality result, it is seen that Iron, arsenic and chloride concentration is within allowable limit of ECR 1997.

Table 6.8: Water point depth and water quality of the test wells in Dakhin Demura Village of Barhatta Upazila under Netrokona district

SL	Latitude	Longitude	Water Point Depth	Water Quality		
				Fe (mg/l)	As (mg/l)	CI^- (mg/l)
1.	24.884043	90.811277	201	0.28	0.040	9
2.	24.865233	90.847666	195	4.9	0.025	8
Drinking Water Standards (ECR, 1997)				**0.3-1.0**	**0.05**	**150-600**

District: Gaibandha, Upazila: Fulchari, Union: Fulchari, Village: Baje Fulchari

In Baje Fulchari village of Fulchari Upazila under Gaibandha district suitable aquifer has been found in Shallow depth (38 m). Water quality test result from test well shows iron (Fe) concentration is 0.5 – 0.8 mg/I, chloride (CI-) concentration is 24-28 mg/I, and arsenic (As) concentration is 0.001 – 0.002 mg/I. From the water quality result, it is seen that Iron, arsenic, and chloride concentration is within the allowable limit of ECR 1997.

Table 6.9: Water point depth and water quality of the test wells in Baje Fulchari Village of Fulchari Upazila under Gaibandha district

SL	Latitude	Longitude	Water Point Depth	Water Quality		
				Fe (mg/l)	As (mg/l)	CI^- (mg/l)
1.	25.18664	89.64109	38.10	0.5	0.001	24
2.	25.20597	89.63057	36.58	0.8	0.002	28
Drinking Water Standards (ECR, 1997)				**0.3-1.0**	**0.05**	**150-600**

District: Naogaon, Upazila: Niamotpur, Union: Hazinagar, Village: Khordchampa.

In Khordachampa village of Niamotpur Upazila under Naogaon district suitable aquifer has been found in a Shallow depth (48 m). The water quality test result from the test well shows iron (Fe) concentration is 0.1-0.5 mg/I, chloride (CI-) concentration is 15-170 mg/I, and arsenic (As) concentration is 0.001 mg/I. From the water quality result, it is seen that Iron, arsenic, and chloride concentration is within the allowable limit of ECR 1997.

Table 6.10: Water point depth and water quality of the test wells in Khordachampa Village of Niamotpur Upazila under Naogaon district

SL	Latitude	Longitude	Water Point Depth	Water Quality		
				Fe (mg/l)	As (mg/l)	CI^- (mg/l)
1.	24.83183	88.57405	45.73	0.5	0.001	20
2.	24.91339	88.55517	48.78	0.1	0.001	170
3.	24.93976	88.55036	48.78	0.1	0.001	15
Drinking Water Standards (ECR, 1997)				**0.3-1.0**	**0.05**	**150-600**

District: Gopalganj, Upazila; Muksodpur, Union: Jolirpar, Village; Beelchanda.

In Beelchanda village of Muksodpur Upazila under Gopalganj district suitable aquifer has been found in Deep depth (259 m). Water quality test result from test well shows iron (Fe) concentration is 0.325 mg/I, chloride (CI-) concentration is 345 mg/I, and arsenic (As) concentration is 0.001 mg/I. From the water quality result, it is seen that Iron, arsenic, and chloride concentration is within the allowable limit of ECR 1997.

Table 6.11: Water point depth and water quality of the test wells in Beelchanda Village of Muksodpur Upazila under Gopalganj district

SL	Latitude	Longitude	Water Point Depth	Water Quality		
				Fe (mg/l)	As (mg/l)	CI^- (mg/l)
1.	23.21922	89.9692	259	0.325	0.001	345
Drinking Water Standards (ECR, 1997)				**0.3-1.0**	**0.05**	**150-600**

District: Chattogram, Upazila; Mirsarai, Union: Ichakhali, Village; Charsharat.

In Charsharat village of Mirsarai Upazila under Chattogram district suitable aquifer has been found in Deep depth (160 m). Water quality test result from test well shows iron (Fe) concentration is 0.09-0.12 mg/I, chloride (CI-) concentration is 30-180 mg/I, and arsenic (As) concentration is 0.001-0.005 mg/I. From the water quality result, it is seen that Iron, arsenic, and chloride concentration is within allowable limit of ECR 1997.

Table 6.12: Water point depth and water quality of the test wells in Charsharat Village of Mirsarai Upazila under Chattogram district

SL	Latitude	Longitude	Water Point Depth	Water Quality		
				Fe (mg/l)	As (mg/l)	Cl^- (mg/l)
1.	22.44225	91.29549	167.98	0.12	0.004	180
2.	22.44372	91.29392	155.48	0.15	0.005	165
3.	22.45361	91.30234	161.58	0.09	0.001	30
Drinking Water Standards (ECR, 1997)				**0.3-1.0**	**0.05**	**150-600**

7. Conclusions

7.1 Conclusions

The survey covered a total of 58043 households, where 50.9% were male and 49.07% female. Most of the households were a nuclear family setup. The average size of the households was approximately 4.6 (parents and dependent children). The average sex ratio in the study villages was 105.0 and the majority of the households were headed by men, Except for Hafizpur, Fulchori, and Beelchanda, more than 90% of the households in every village were headed by men. Around 23% of the households of Hafizpur village was found to have female heads, followed by Fulchori (14.06%) and Beelchanda (12.76%). Most importantly, a few third-gender-headed HHs were discovered in four villages: Induria, Charsharat, Pathordubi, and Hafizpur.

In the surveyed villages, more than 90% of HH heads were found unemployed. They worked in a variety of professions to support themselves, with day labour being the main occupation particularly in Datinakhali of Shatkhira, Shimulbank of Shunamganj, Bagaiya of Sylhet, and Chota Harina of Rangamati. Additionally, a striking number of HH heads listed business as their primary source of income. Secondary activities included agriculture, followed by day labour and business. In most of the villages, agriculture was most people's primary line of work, followed by day labor and private employment.

The average monthly income of the surveyed HH heads was noted as BDT 14,945, and the average monthly expenditure was BDT 11,719. Individuals with disabilities comprised 3.5% to 11.3% of the HHs. The two villages, Shimulbank (10.8%) and Sonadanga (11.3%) had the most significant percentage of HHs with disabled members. On average, however, more than 90% of the HHs had no family member with disability.

In terms of water sources, 42% of the HHs were observed to use personal tube well, and 25.39% used neighbor's tube well. The rest of the HHs used piped water supply, personal motorized tube well, government tube well, pond, and river. The survey inquired about the quality of water from the various sources. 74.08% of the respondents reported that the quality of the water was good, with the highest percentage (96.26%) reporting good quality noted in Khordachompa village. On the other hand, around 15.08% of the households reported that the quality of water sources was bad, with the highest percentage (58.98%) reporting bad quality noted in Dakkhin Demura village. 22.79% of the respondents said that the quality of water sources was acceptable.

The survey found that more than 90% of the families in nine (09) out of the 15 pilot villages obtained water from year-round sources. In four (04) experimental villages, 70 and 80 percent of the families claimed to get their water from an open source all year round. Homes in Dakkhin Demura (60.05%) and Chota Harina (mouza) (50.7%) informed that they collected water from a source that is accessible year round. In most cases, water scarcity occurs from February to May.

In most families surveyed, purifying drinking water before consumption is not an everyday habit. Except for Chota Harina (mouza) and Bagaiya, more than 94% of the households indicated that they drank water right away after collecting it from the water sources.

Most of the respondents (30.18%) proposed improving the water supply system. 23.90% wanted to improve tube wells by making them arsenic-free, 19.54% wanted to improve region-based deep tube wells, and the rest wanted to improve the government and non-government tube-well through elevated installation to continue getting clean water natural during disasters. 47.53% of the people in Beelchanda and 44.98% people in Hafizpur village proposed to improve the water supply system.

The study further looked into the availability of toilets in the study areas. It was discovered that around 75.34 % of the households had access and 24.65 % of the households had no access to toilets.

The study also revealed that the idea of community toilets is not popular in rural areas. Only 6 villages namely, Khordachompa of Naogaon, Chota harina of Rangamati, Datinakhali of Satkhira, Induriya of Barisal, Charsharat of Chittagong, and Fulchari of Gaibandha had community toilets.

Among the types of toilets, the study found that 43.40% were pit latrines, 15.30% were VIP latrines, and 9.19 % were flush latrines. The rest include septic tanks, open toilets, etc.

It can be concluded from the study that 59.4% HH agreed to improve their toilets, whereas approximately 16% of people were of the opinion that there was no need for improvement.

The study revealed the hygiene situation of the study area—more than 65% of households cleaned with a broom once or twice daily. Also, about 20-30% of the families who do the cleaning mop the floor of their house twice daily or once a week.

The study also revealed the habit of regular hand washing regularly among the surveyed households. Saikchail village had the highest percentage of people with hand washing habits (86.44%). On the other hand, Dakhin Demura village had the lowest percentage (56.03%) of people practising the habit of hand washing. 30-35% of the households washed their hands before taking a meal, 20-25% washed their hands after completion of work outside the home, 25-30% washed their hands before cooking, and 10-25% washed their hands before feeding children.

Induria of Barishal had the highest percentage of households covered by awareness activities (99.18%). Only 6 households in that area reported that they did not know of any awareness programs in their areas. The lowest percentage of awareness programs was carried out in Charsharat of Chattogram, with only 67.24 % of the households reporting to be aware of such programs in their areas.

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Appendix-I

Approach and Methodology

I.1 Needs assessment

At the beginning of the work, consultation meetings were organized with relevant professionals and officials of LGED and DPHE to understand the project's requirements, including data and information needs, expected outputs from the project, and the monitoring process. The needs assessment task followed different sub-activities such as (i) literature review and data. (ii) water quality, and arsenic contamination-related data and information, for a specific district, available in DPHE's Groundwater Circle, previous and other running projects, and other NGO reports, (iii) individual expert consultation for selection of sampling methodology, (iv) identification of data and information with their sources; (v) data collection format/questionnaire, (vi) identification of the content of the inception report including the implementation plan (vii) consultation meetings to identify the overall needs of the proposed project.

I.2 Review of literature and information

The selected literature, data, and information directly or indirectly related to village water supply technology, water quality, current hygiene and sanitation practices, hydro-geological settings, arsenic concentration, etc., were collected from DPHE, different published papers, as well as from other relevant organizations. Data sources were identified in a consultation meeting during the needs assessment. Government long-term plans and commitments for attaining the targets of Vision -2041 were also collected and reviewed.

I.3 Demographic Information of Project Area

The project area comprised plain land, hills, haor, char/beel, coast, barind and economic zone areas. following the BBS population information, the demographic profile maps were prepared. Furthermore, satellite images from CEGIS and other sources were used to prepare the study area base map. CEGIS has substantial spatial/GIS data under the National Water Resources Database (NWRD), Mouza Database, Roads and infrastructure data, historical satellite images, different types of maps (e.g., base map, road and infrastructure map, settlement map, land use maps, utilities & facilities map, etc.). For strategic planning of services and facilities of the rural people, the base map with the demographic profile is highly essential.

I.4 Development and Testing of Data Collection Tools

Developing data collection and testing of tools are among the essential activities accomplished through several tasks, some of which were:

- **a)** Development of draft questionnaires
- **b)** Development of data collection tools, and
- **c)** Field testing and finalization of questionnaires

A brief description of these sub-tasks are presented below:

Development of draft questionnaires:

After thorough research on similar previous data and inquiries, a structured questionnaire was prepared. The DPHE officials validated the questionnaire, following which it was tested at field level. In the field test, the enumerators used the prepared and validated questionnaire to conduct a test survey. The questionnaire was streamlined and implemented with the test results. The questionnaire had several parts, such as:

- General Information on households
- Water supply system
- Sanitation, and
- Awareness and cleanliness

Household Questionnaire

Comprehensive household data, including financial and expenditure information, etc. were analyzed in this survey. The questionnaire (Figure 3.2) design kept the interrelated pace of the questions along with the purpose of the study. The questionnaire helped to collect information about the respondent's identity, geographical location, household information, household head information, main occupation, number of family members, source of monthly household income, and expenditure. It also gathered data on the number of adult men, women, and children in the household—the number of children receiving education, their cost, etc.

Water Supply System Questionnaire

The water supply system questionnaire was used to gather information about the primary source of drinking water, quality of water from source, purification of water before drinking, and whether the amount of water available at home was sufficient for drinking and cooking. Moreover, the cost of water source maintenance, water scarcity, causes of water shortage, recommendations for improvement, and the cost of improving the water supply system were clearly expressed in the questionnaire.

Sanitation Questionnaire

The questionnaire on sanitation was very important for the data collection. People are still not aware of sanitation in our country. So, the questions were set in a way that helped to collect correct answers. The queries were related to the availability of toilets, types of toilets, facilities available inside the toilets depicting the hygiene situation, number of community toilets (if available), types of containment, condition of containment, etc.

Awareness and Cleanliness Questionnaire

There were many questions about cleanliness and awareness in the questionnaire. It included household and nearby environmental situations, hygiene habits, disadvantages/constraints associated with poor sanitation, public awareness activities (*vaccination, corona, cyclone, strike, World Water Day, World Handwashing Day, World Environment Day, Sanitation Month, and World Toilet Day*), etc. There were other questions on awareness, i.e., the availability of TV programs or advertisements that people watch—for example, the immunization program for children, diarrhea, awareness about sanitary napkins, etc.

Development of data collection tools:

After developing the questionnaire, “KoboToolbox” was used for its digital version. This tool has two versions.

I. Web-version and

II. Mobile version

For the convenience of collecting data in the field, a mobile version of the questionnaire was used. The app on the mobile for KoboToolbox is named “KoboCollect.”

Field testing and finalization of Questionnaires

After developing the digital questionnaire in the KoboCollect App, a reconnaissance field visit satisfied the understanding of the project activities, tested and assessed the field questionnaire/tools, and identified other relevant problems and issues that could arise during the survey. During the reconnaissance survey, the CEGIS team discussed the parameters of the questionnaire and tools and other WATSAN-related matters with DPHE officials. The reconnaissance field visit contributed to refining the existing tools and preparing additional assessments of the tools.

Figure I.1: Data collection during Reconnaissance field visit

I.5 Development of Sampling Methodology

Sample Frame

The survey universe (also called sample frame) consisted of 35 communities (also referred to as villages) spread across all 15 districts in 8 regions of the country. These selected regions were plain land, hilly area, coastal areas, cyclone prone, arsenic contaminated, haor areas, bill/char areas, and barind areas. The total population covered was approximately 58,043 (Fifty-Eight thousand and Forty-Three), and the number of households was about 12,684 (Twelve Thousand six hundred and eighty-four). The scope of analysis of the study was the "household" in targeted communities.

Sample Size Determination

Sample size estimation looked at two aspects:

The number of households in the pilot village

The number of households in the sample village

There were **15 pilot villages** in this survey. All the households of the pilot villages were surveyed, and data were processesed comprehensively. In the other **20 sample villages**, 10% of households were surveyed. This 10% of the total households was selected in such a way that it represented the whole village.

Table I.1: Sampling size determination

Number of households	12,684
Total estimated population	58,043
Average household size	5 persons/households
Margin of error	10%
Confidence level	90%
Number of villages to survey	35

Sample Distribution

The sample distribution is presented in the table below:

Table I.2: Sample distribution

<table>
<tr><th>District</th><th>Upazila</th><th>Union</th><th>Village</th><th>Household No. (appx.)</th><th>No. of Households Surveyed</th></tr>
<tr><td>Cumilla</td><td>Monoharganj</td><td>Bipulshar</td><td>Shaikchail *</td><td>1652</td><td>1652</td></tr>
<tr><td rowspan="2">Khulna</td><td rowspan="2">Dumuria</td><td rowspan="2">Khurnia</td><td>Tipna *</td><td>772</td><td>772</td></tr>
<tr><td>Gonali</td><td>600</td><td>60</td></tr>
<tr><td rowspan="5">Satkhira</td><td rowspan="5">Shyamnagar</td><td rowspan="5">Burigoalini</td><td>Jabakhali</td><td>250</td><td>25</td></tr>
<tr><td>Kalbari</td><td>420</td><td>42</td></tr>
<tr><td>Banbibitala</td><td>330</td><td>33</td></tr>
<tr><td>Chunar</td><td>450</td><td>45</td></tr>
<tr><td>Datinakhali *</td><td>568</td><td>568</td></tr>
<tr><td rowspan="2">Sunamganj</td><td rowspan="2">Dakkhin Sunamganj (Shantiganj)</td><td rowspan="2">Shimulbank</td><td>Lalukhali</td><td>260</td><td>26</td></tr>
<tr><td>Shimulbank *</td><td>462</td><td>462</td></tr>
<tr><td rowspan="2">Naogaon</td><td rowspan="2">Niamatpur</td><td rowspan="2">Hazinagar</td><td>Khordachompa *</td><td>459</td><td>459</td></tr>
<tr><td>Patail</td><td>170</td><td>17</td></tr>
<tr><td>Chattogram</td><td>Mirsarai</td><td>Ichakhali</td><td>Charsharat *</td><td>941</td><td>941</td></tr>
<tr><td>Rajshahi</td><td>Bagmara</td><td>Sonadanga</td><td>Sonadanga *</td><td>709</td><td>709</td></tr>
<tr><td rowspan="4">Gaibandha</td><td rowspan="4">Fulchari</td><td>Gazaria</td><td>Ziadanga</td><td>370</td><td>37</td></tr>
<tr><td rowspan="3">Fulchari</td><td>Fulchari *</td><td>377</td><td>377</td></tr>
<tr><td>Parul</td><td>570</td><td>57</td></tr>
<tr><td>Baje Fulchchari</td><td>550</td><td>55</td></tr>
<tr><td rowspan="2">Barisal</td><td rowspan="2">Hijla</td><td rowspan="2">Memania</td><td>Induria *</td><td>728</td><td>728</td></tr>
<tr><td>Baduri</td><td>230</td><td>23</td></tr>
</table>

District	Upazila	Union	Village	Household No. (appx.)	No. of Households Surveyed
Sylhet	Gowainghat	Rustimpur	Bagaiya *	921	921
Rangamati	Borkol	Bhushonchora	Chota Harina (mouza) *	215	215
Gopalganj	Muksodpur	Jolirpar	Beelchanda *	392	392
			Baniarchar	840	84
			Jolirpar	1860	186
Kurigram	Bhurungamari	Pathordubi	Pathordubi *	2469	2469
			Maidam	720	72
		Baladia	Sarkarpara	2080	208
			Uttar Baladia	2860	286
Narshingdi	Monohardi	Chalakchar	Hafizpur *	1646	1646
			Chengain	500	50
			Chalakchar	1750	175
Netrokona	Barhatta	Shahata	Dakkhin Demura *	373	373
			Shahata	730	73
			Kadam Deuli	460	46

The * marked village names are pilot villages all of which were surveyed. On the other hand, only 10% of the total households in the sample villages were studied.

I.6 Baseline Data Collection through Field Survey

Collection of union-wise data using the developed format/questionnaire from target communities, Union Parishad, NGOs, and other stakeholders was the main activity, carried out through several tasks, including:

a) Field team formation

b) Training of field team

c) Mobilization of field team, and

d) Collection of union-wise data using the developed questionnaires

Field Team Formation

Field team formation is crucial in ensuring the collection of primary data on which a project output depends. Quality survey teams were recruited based on their educational background and professional qualification and trained in collecting field data. Each team consisted of nine to ten members, one of whom was selection as team leader and had previous experience /skills in related work.

The field supervisor trained the staff to monitor water supply and sanitation facilities. Sessions were held separately on mapping, monitoring of sanitation, checking the water point, and water quality testing by field test kit using a digital camera and GPS, etc.

Figure I.2: GPS used for collection of the geographic locations of HHs

Training of field staff

After developing the digital questionnaire in the KoboCollect App, 60 enumerators, five among whom were supervisors, conducted the field survey in 40 villages. The questionnaire included latrine-related terms and water supply source types. The 60 enumerators were divided into 3 groups. A two-day training program from 20 - 21 June 2022 was arranged to scrutinize the questionnaire and explain the terminology and other relevant but potentially confusing subjects.

Figure I.3: Field staff training

Mobilization of the field team

Teams were mobilized to the field after the survey was set up according to the field plan. LGED and CEGIS issued a letter to the team for possible help from government/non-government organizations and individuals. The field team members extended the necessary financial and other logistic support.

Collection of village-wise data using developed questionnaires

After team mobilization, the field data collection process followed a systematic approach. Using a developed questionnaire, information on water and sanitation coverage, identifying potential freshwater sources, small and piped water supply schemes, water quality, and current hygiene practices was collected carefully from the target communities, Union Parishad, NGOs, and other stakeholders. Following the village-wise data collection plan, the team leader monitored the progress of the data collection.

I.7 Real-Time Verification of Data Collection

The field surveyor collected data in *kobocollect* (Mobile version), which were stored in *kobotoolbox* (Web version). Here the data were checked and appropriately corrected by cross-checking or calling the responder directly. The verified and approved information was then processed for further analysis.

Figure I.4: In-house verification of field data

I.8 Data Management and Analysis

As per DPHE and CEGIS officials' guidance, the consultant used the “KoboCollect App” and “KoboToolbox web version” for data management. “Kobo” is a platform for data collection. Data were collected accordingly and converted to an Excel file. Finally, the analyzed findings were visualized through synchronized use of the Excel file.

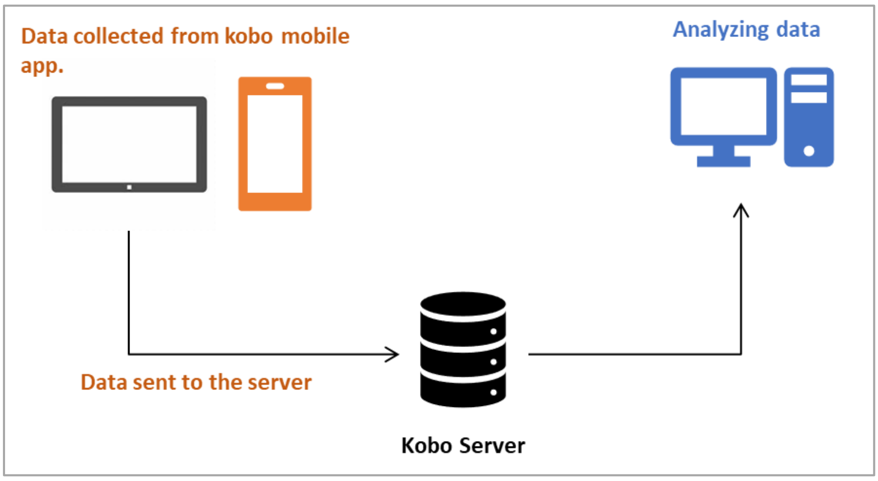

Figure I.5: Data collection and management

Upon completion of fieldwork, data were shifted to MS Excel for cleaning and analysis. The raw datasets were thoroughly checked and cleaned for aspects such as faulty response options, wrong information, and the resulting missing data, specifying ‘others’ data where required, etc. Alongside Excel, Python was also used to analyze data. The image sorting, sorting, distributing data among the consultants, etc., were efficiently conducted using Excel and Python coding.

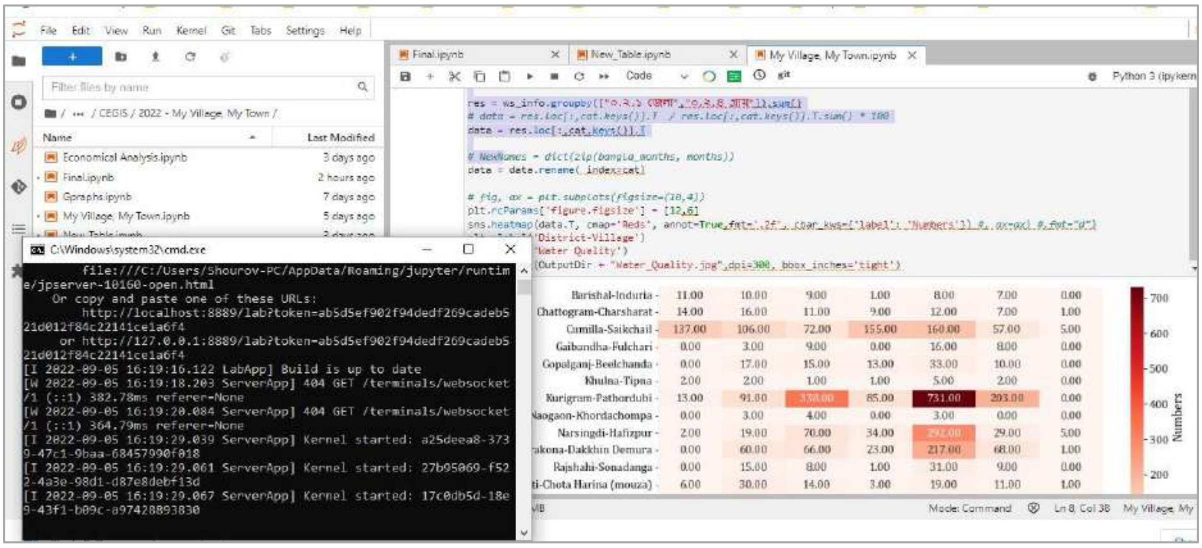

Figure I.6: Data analysis

CEGIS
Center for Environmental and
Geographic Information Services
A Public Trust under the Ministry of Water Resources
www.cegisbd.com