The Government of the People's Republic of Bangladesh
Local Government Division
Ministry of local Government and Rural Development and Cooperatives

DATA COLLECTION SURVEY ON WATER SUPPLY SECTOR IN LOCAL MUNICIPALITIES IN BANGLADESH

September 2012

JAPAN INTERNATIONAL COOPERATION AGENCY

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Abbreviation

AAN	Asia Arsenic Network
ACE	Additional Cehif Engineer
ADB	Asian Development Bank
AE	Assistant Engineer
AIRP	Arsenic Iron Removal Plant
BBS	Bangladesh Bureau of Statistics
BWDB	Bangladesh Water Development Board
BWSPP	Bangladesh Water Supply Program Project
CBO	Community Based Organization
CE	Chief Engineer
CEO	Chief Executive Officer
CWASA	Chittagong Water and Sanitation Authority
DANIDA	Danish International Development Agency
DFID	Department of International Development
DI	Ductile Iron
DPHE	Department of Public Health Engineering
DT	District Town
DTW	Deep Tube Well
DSP	Deep Set Pump
DWASA	Dhaka Water and Sanitation Authority
DWSSDP	Dhaka Water Supply Sector Development Program
EC	Electric Conductivity
EE	Executive Engineer
FS	Feasibility Study
GDP	Gross Domestic Product
GI	Galvanized Iron
GNI	Gross National Income
GOB	Government of Bangladesh
GWD	Groundwater database
HC	Hydraulic Conductivity
HYSAWA	The Hygiene Sanitation and Water Supply (Fund)
IDA	International Development Association
IDB	Inter-American Development Bank
IG	Infiltration gallery
IRP	Iron Removal Plant
JBIC	Japan Bank for International Cooperation
JDCF	Japan Debt Cancellation Fund
JICA	Japan International Cooperation Agency
LGD	Local Government Division
LGED	Local Government Engineering Department
LGI	Local Government Institution
MAB	Municipal Association of Bangladesh
MDGs	Millennium Development Goals
MLGRD&C	Ministry of Local Government, Rural Development and Cooperatives
MoWR	Ministry of Water Resources
MP	Master Plan
NPAM	National Policy for Arsenic Mitigation
NGO	Non-government Organization
NSAPR	National Strategy for Accelerated Poverty Reduction
NWP	National Water Policy
ODA	Official Development Assistance

OFID	OPEC Fund for International Development
O&M	Operation and Maintenance
OPEC	Organization of the Petroleum Export Countries
PMU	Project Management Unit
PIU	Project Implementation Unit
PPP	Public-Private Partnership
PPRC	Pourashava Performance Review Committee
PRSP	Poverty Reduction Strategic Paper
PSF	Pond Sand Filter
PSU	Policy Support Unit
PVC	Polyvinyl Chloride
PWSS	Pourashava Water Supply and Sewerage
RAP	Reform Action Plan
RO	Reverse Osmosis
RW	Ring well
RWHS	Rain water harvesting system
SAE	Sub Assitane Engineer
SDC	The Swiss Agency for Development and Cooperation
SDP	Sector Development Plan/ Programme
SE	Service Engineer
SIE	Superintendent Engineer
TLCC	Town Level Coordination Committee
STW	Shallow Tube Well
ST	Secondary Town
STWSSP	Secondary Town Water Supply and Sanitation Sector Project
S/V	Supervision
SST	Shallow Shoureded Tubewell
T	Transmissivity
TDS	Total Dissolved Solid
Tk	Taka
TOR	Terms of Reference
ToT	Training of Trainers
UNICEF	United Nations Children’s Fund
USGS	United States Geological Survey
USNASA	United States National Aeronautics and Space Administration
VSST	Very shallow shrouded tube well
WARPO	Water Resources Planning Organization
WASA	Water Supply and Sewerage Authority
WB	World Bank
WHO	World Health Organization
WLCC	Ward Level Coordination Committee
WSF	Water Safety Framework
WSSPS	Water Supply and Sanitation Sector Program Project

1. Introduction

1.1 Background of the Survey

Piped water supply system has already been developed or has been developed in 138, out of the total 314 pourashavas in the country. The remaining nearly half pourashavas, however, do not have piped water supply system at all. Moreover, even in case of pourashavas with piped water supply system (hereafter “piped pourashava”), many pourashavas have not appropriately implemented replacement and rehabilitation of pipeline network, countermeasures for Non-Revenue Water (NRW) management through the installation of water meter, sufficient revenue collection and water quality management, thus they encounter significant challenges on their waterworks management.

Under this background, the Government of Bangladesh (GOB) has developed the master plan for development of water supply facilities for 148 pourashavas by dividing into 4 phases (12 pourashavas in Phase 1, 37 in Phase 2, 50 in Phase 3, and 49 pourashavas in Phase 4) with the financial source of the Japan Debt Cancellation Fund (JDCF). The master plan for 12 pourashavas in the scope of Phase 1 was already developed. GOB demonstrated the strong needs for the assistance of water supply facilities to the Government of Japan (GOJ) after developing the master plan. Because Japan hardly has the experience on the assistance to this sector, the validity to support this sector and challenges, basic information considering the succeeding medium and long-term assistance, and cross-sectional analysis were not sufficiently accumulated. Therefore, this Survey was necessary for further assistance.

1.2 Objectives of the Survey

This Survey was aimed: 1) to arrange the information on the current situation of overall water supply status in local municipalities in Bangladesh and to identify the challenges, which have been summarized only on a piecemeal basis, 2) to make recommendations on the necessary medium and long-term countermeasure and high priority regions, activity areas after identifying the regions with high assistance needs and with the difficulty to provide safe water in order to achieve the national target for 2015 which enables all the people to have access to safe water. The following outputs were shown by the results of this Survey.

(1) Current situation and main challenges of local municipalities in water supply sector in Bangladesh have been identified through the collection of basic necessary information for considering the succeeding Japanese assistance on overall goal, policy, budgetary allocation, future assistance direction etc.
(2) Information on current situation of waterworks management in 160 pourashavas and future development plan were arranged from the viewpoint of sustainable provision of safe water

to local residents, while identifying precise challenges, high priority regions and activity areas with high needs, concrete countermeasures not limited to JICA's assistance, have been suggested.

(3) Information on current situation of water supply in 176 pourashavas without water facilities (hereafter "non-piped pourashava"), which were targeted for development of master plans in Phase 1 of DPHE project, was arranged through the confirmation of the planning contents. While identifying precise challenges for water facility development and waterworks management, high priority regions and activity areas with high needs, concrete countermeasures not limited to JICA's assistance, have been suggested.

(4) After the analysis of the above (2), (3) and current assistance projects by other donor agencies, the scenario for succeeding assistance, the priority region and the activity area have been suggested.

1.3 Survey Area, Organization and Schedule

1.3.1 Survey Area

The Survey targets all 314 pourashavas in Bangladesh (Figure 1.1). The number of pourashavas has been increasing and the updated information indicated the total number as 316 pourashavas at the end of the Survey.

- 138 pourashavas, out of the all, have piped water supply system; 176 pourashavas do not have piped water supply system.
- 29 pourashavas are surveyed in the field by the Survey Team, the remaining pourashavas are surveyed by the local contractors mainly focusing on the basic data collection.

The Team increased the number of pourashavas to be visited during the Survey.

- 4 pourashavas were additionally visited
- In addition, 2 pourashavas indicating good performance based on the questionnaire survey on basic data collection were additionally surveyed. They were interviewed on water service management.

The following table shows the pourashavas surveyed by JICA survey team.

Table 1.1 Pourashavas Surveyed by JICA Survey Team

13 Piped Pourashavas (Under ADB project)		12 Non-piped Pourashavas (Under DPHE Phase 1 Project)	
Pourashava	District	Pourashava	District
Brahmanbaria	Brahmanbaria	Godagari	Rajshahi
Jessore	Jessore	Shibganj	Nawabganj
Pirojpur	Pirojpur	Madhabdi	Narsingdi
Sirajganj	Sirajganj	Dohar	Dhaka
Natore	Natore	Kanaighat	Sylhet
Jhinaidha	Jhinaidha	Saistaganj	Habiganj
Moulvi Bazar	Moulvi Bazar	Nabinagar	Brahmanbaria
Mymensing	Mymensing	Chatkhili	Noakhali
Netrokona	Netrokona	Muladi	Barisal
Madaripur	Madaripur	Mathbaria	Pirojpur
Narsingdi	Narsingdi	Manirampur	Jessore
Joypurhat	Joypurhat	Alamadanga	Chuadanga
Lakshmipur	Lakshmipur		
Additional survey pourashavas (4) for questionnaire improvement			
Savar (Piped)	Dhaka	Dhamrai (Non-piped)	Dhaka
Manikganj (Piped)	Manikganj	Shingair (non-Piped)	Manikganj
Additional surveyed pourashavas (2) related to good water works management			
Amtali (Piped)	Dhaka	Pataukhali (Piped)	Dhaka

1.3.2 Relevant Organizations Surveyed

Main counterparts of this survey were Local Government Division (LGD) in the Ministry of Local Government, Rural Development and Cooperatives (MoLGRD & Cooperatives), Department of Public Health Engineering (DPHE), pourashavas, international organizations and other aid agencies, research institutions, water and sanitation agencies, and NGOs.

1.3.3 Survey Schedule

The field Survey was started from February 2012, and completed in July 2012.

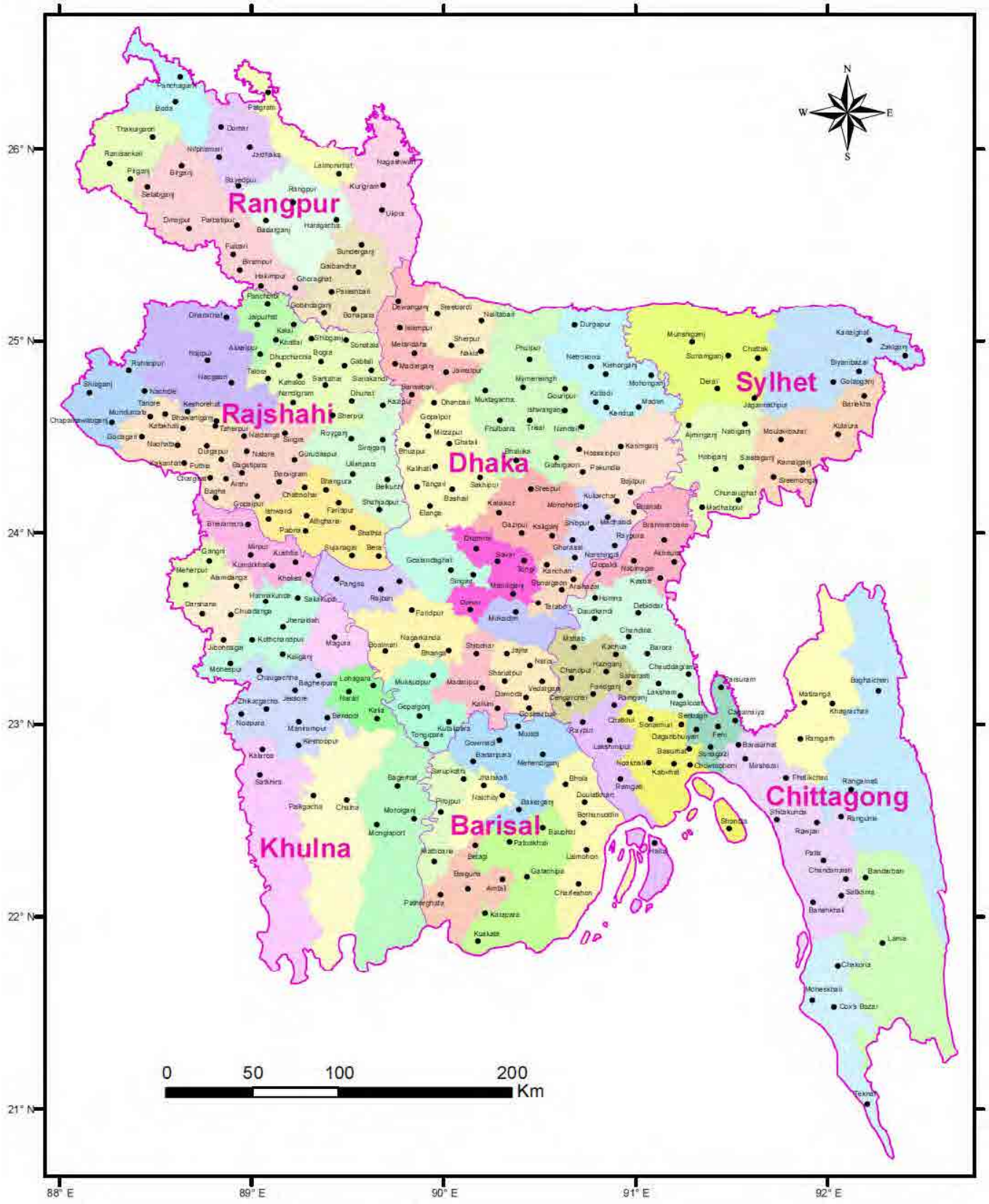

Figure 1.1 Administrative Boundaries and Location of 314 Pourashavas

2. Water Resources Potential as Drinking Water Source

2.1 Groundwater Resource Potential[1]

2.1.1 Data and Method for Evaluation

The useful data for groundwater potential evaluation are well log data, which DPHE has been using in many previous analyses for aquifer classification. As for the number of available well log, no exact figure is available showing how many wells exist in Bangladesh but the total number of wells is estimated to be up to several tens of millions. To summarize this log data, JICA and DPHE has established an Aquifer Database Inventory Program for data collection and analysis.

Based on this program, Groundwater Circle of DPHE has established a groundwater database (GWDB). This contains data on nearly 40,000 wells. The GWDB is considered as the best groundwater database in Bangladesh at the present moment.

Of the data on 40,000 wells in the GWDB, nearly 10% have bore log information. Groundwater development potential from a well depends on three factors (permeability, thickness, and hydraulic gradient); two of them are constant, deposit type (lithology) and thickness. Both of these factors can be obtained directly or indirectly from the bore log data. The factor that can be directly obtained is the thickness of different layers. Permeability however cannot be directly obtained from log data, because it basically depends on the lithology and this is the main description in the well log data. Therefore, permeability can be indirectly obtained from the well log data.

Most wells in Bangladesh were drilled by hand, using wash boring method. This kind of hand drilling method can only be used for fine grain deposits like clay, silt and sand, but not for gravels and base rocks.

Not all log data in the GWDB can be used for evaluation. The proper well log data were selected from among the available well logs in GWDB and a total of 1,335 well logs were obtained for evaluation.

The basic idea is to get the two constant factors of permeability and thickness that control the well's withdrawal capability or groundwater development potential, and then summarize them to calculate the total potential for a well log. Three main procedures are taken for the evaluation:

[1] It could be appropriate to consider not only groundwater resource volume but also water quality if we evaluate groundwater resource potential. Our evaluation in this report, however, is limited to consider only groundwater resource volume, since less availability of water quality data may cause low accuracy and low credibility of the evaluation results.

1) Calculating permeability (hydraulic conductivity: HC) for each layer by using lithology information
2) Calculating transmissivity (T) for each layer by multiplying HC with the layer's thickness.
3) Summarizing the transmissivity for the whole well by the equation below

$$T\_Transmissivity = \Sigma HCi \times Di$$

Here:

HCi is the Hydraulic Conductivity for the i^{th} layer calculated following the lithology description in the well log, and

Di is the thickness of the i^{th} layer

2.1.2 Evaluation Results of Groundwater Resources Development

Based on the above method, the groundwater development potential from ground surface to the well's bottom for the whole of Bangladesh has been summarized and shown in Figure 2.1.

The groundwater development potential is classified into 5 ranks, from the lowest to the highest and shown in different colors. The map makes it clear for all persons concerned with groundwater in Bangladesh to know where the groundwater development potential is relatively high or relatively low. For the whole of Bangladesh, the relatively high groundwater development potential can be identified in northern part of Khulna and Chittagong divisions. In contrast, most areas in Rajshahi and Sylhet division have a relatively low potential.

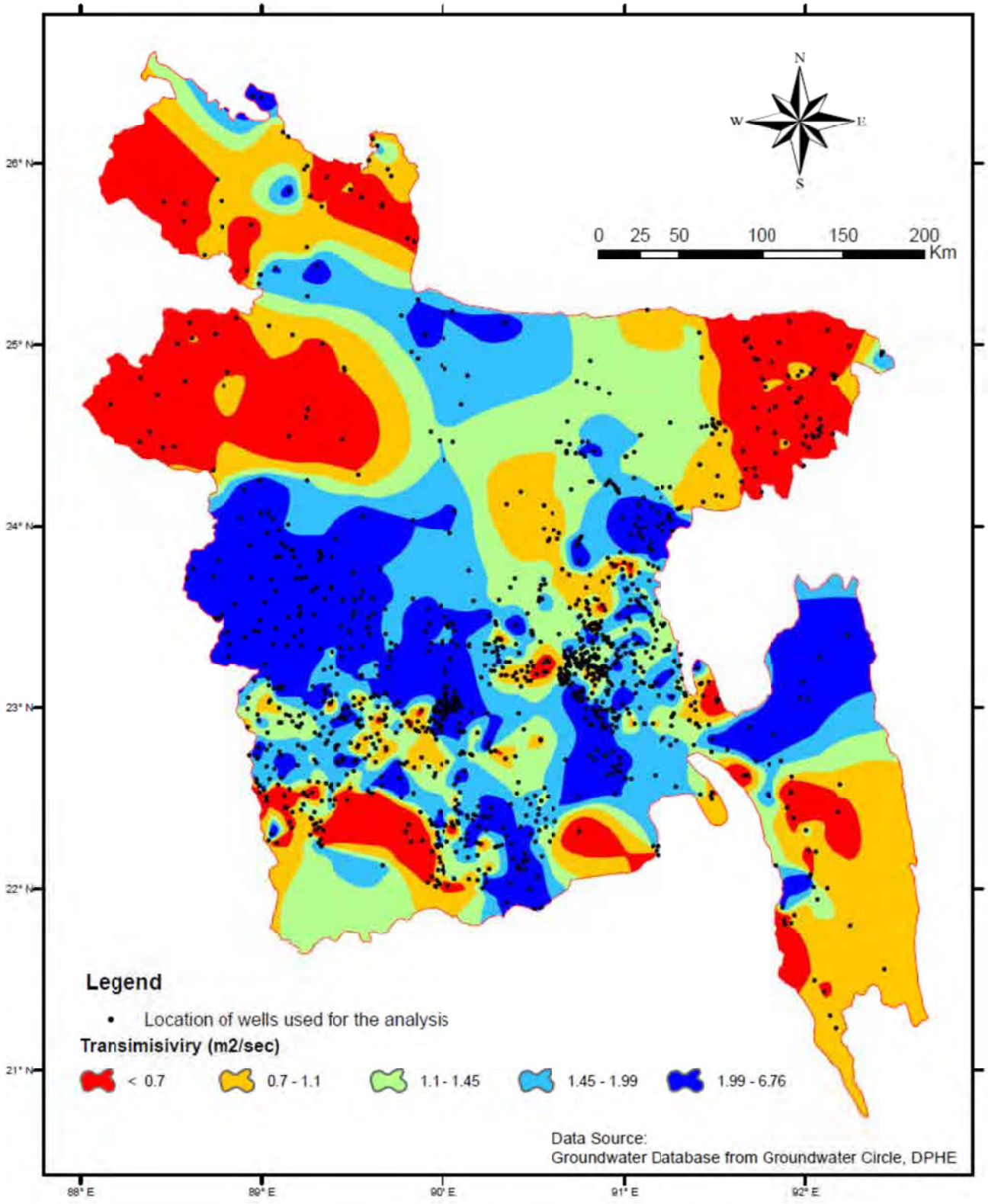

Figure 2.1 Groundwater Development Potential Evaluation in Bangladesh

Even though the general groundwater development potential can be obtained from Figure 2.1, it is still

not enough to understand the groundwater development potential, because the information of well's depth cannot be obtained from the map. And the information of existing well's depth is necessary to withdraw enough groundwater following the map. Hence, Figure 2.2 gives the depths of all wells used for the evaluation.

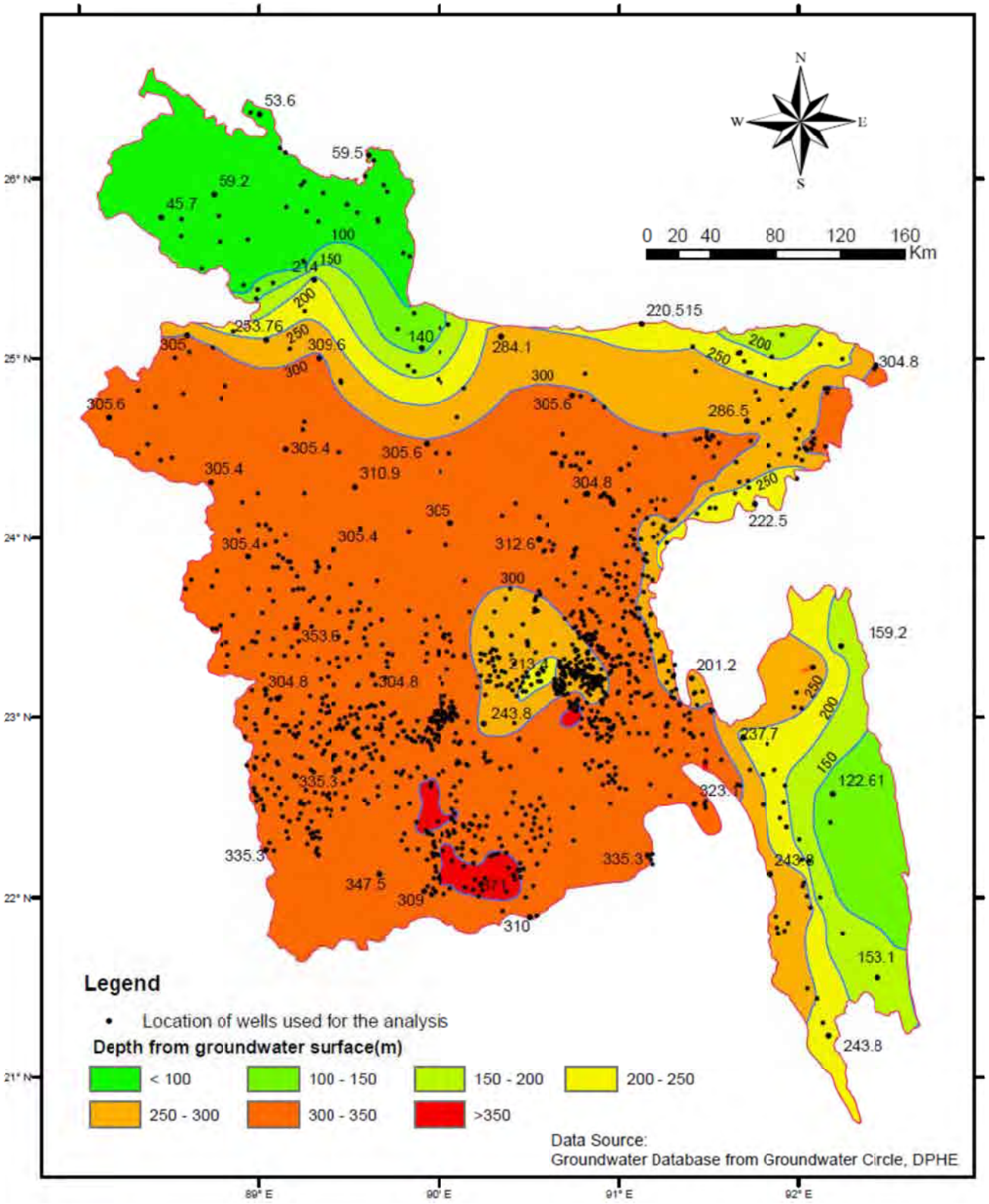

Figure 2.2 Groundwater Development Potential Evaluation Depth

The depths of well logs used for the evaluation are different. Even though following the well's selection criteria the deepest wells were considered as the target of well selection from each pourashava, no deep well can be selected in the northern part of Bangladesh, because the Quaternary deposits in this area is shallow, meaning wash boring well drilling is not possible. As the selection result, the depth of whole wells changes from 45.7 m to 380 m as shown in Figure 2.2.

In the shallow well area, it is easy to estimate the available withdrawal amount if the well being drilled is only to a depth of several tens of meters. Conversely, for deep well sites in southern parts like Khulna division, it's impossible to get groundwater from all stratums in the well.

It is certainly important to know the potential in different depths for planning well drilling. Therefore, the groundwater development potential were summarized in different depth ranges and shown in Figure 2.3 to Figure 2.5.

(a) Groundwater Resource Potential (at depths from 0 m to 100 m)
It can be found from Figure 2.3 that at depths from 0 to 100 m below the ground, there are rare areas in Chittagong with relative low potential even though the total potential is higher as shown in the total potential evaluation result. That is, the main aquifer in Chittagong area is relatively deeper. On the other hand, the potential within 100 m in between the division of Rajshahi and Dhaka are relatively higher than other divisions, even though the total potential for these two divisions are middle to lower.

Moreover, the central area of Rangpur division is also shown to have relatively high potential. When these areas are compared with geology map and river map, it can be found that this relatively high potential area with shallow depth distributes alone the major river, Brahmaputra and the stratum is mainly formed by young gravelly sand, old gravelly sand and alluvial sand.

(b) Groundwater Resource Potential (at depths from 100 m to 200 m)
In depth from 100 to 200 m as shown in Figure 2.4, most areas in Rangpur division can be found to be relatively difficult for groundwater development, because the Quaternary deposits are shallow. In Rajshahi division, potential is nearly the lowest when compared with other areas in Bangladesh, even though there is some potential in the low part from groundwater surface to 100 m. This result makes it clear that, in this area, even if a well being drilled until 200 m, there would not be such a large difference of the available amount of withdrawal when compared to a well with depth limited to 100 m. A typical example might be a test well drilled in ADB project, which were drilled to a depth of 140m, but no adequate aquifer can be found more than 100m and then the proposed strainer location was set from 33.5 to 36.6 m In northern part of Khulna division, the potential is relatively higher coinciding to the total potential evaluation result.

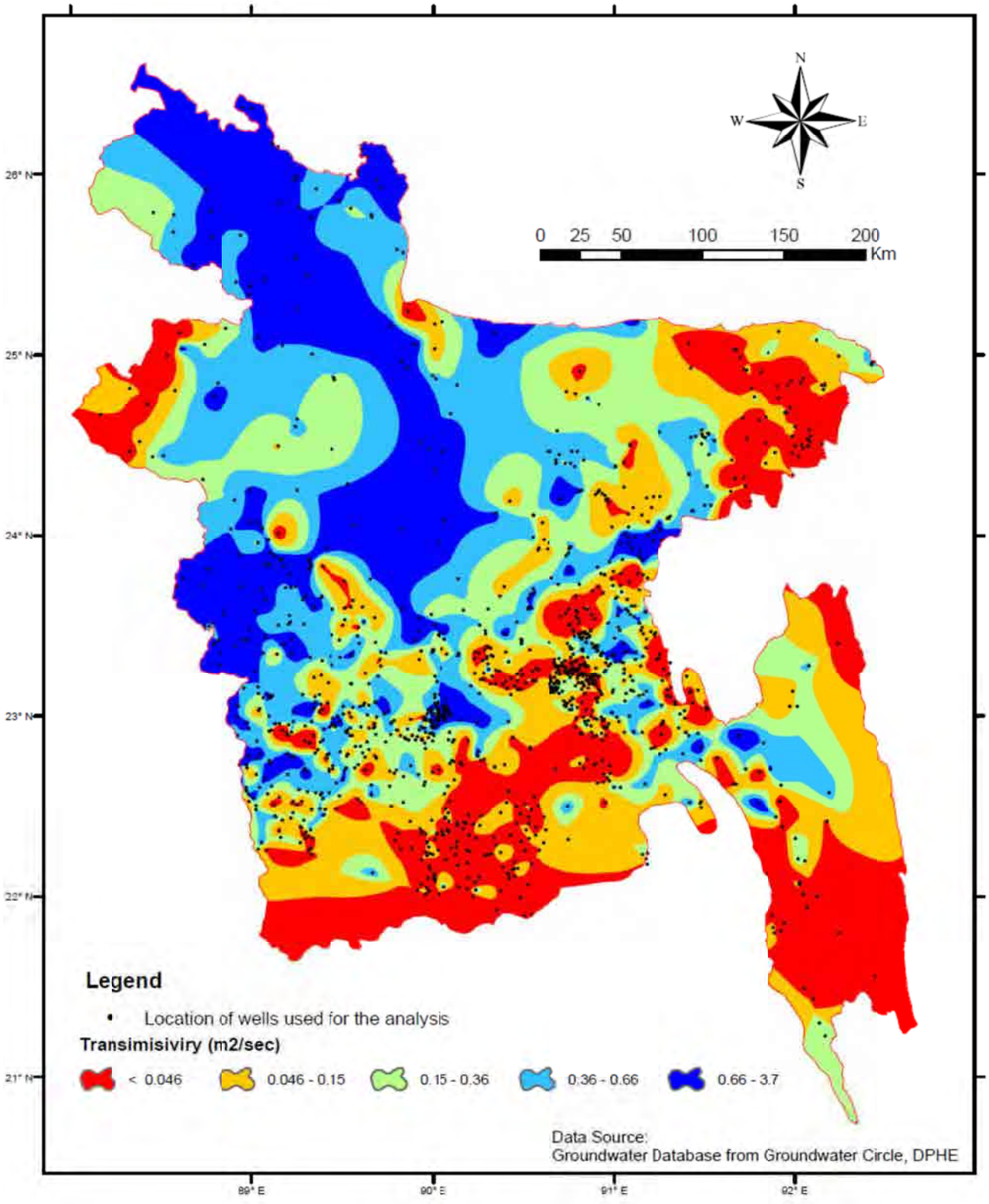

Figure 2.3 Ground Water Development Potential with Depth less than 100m

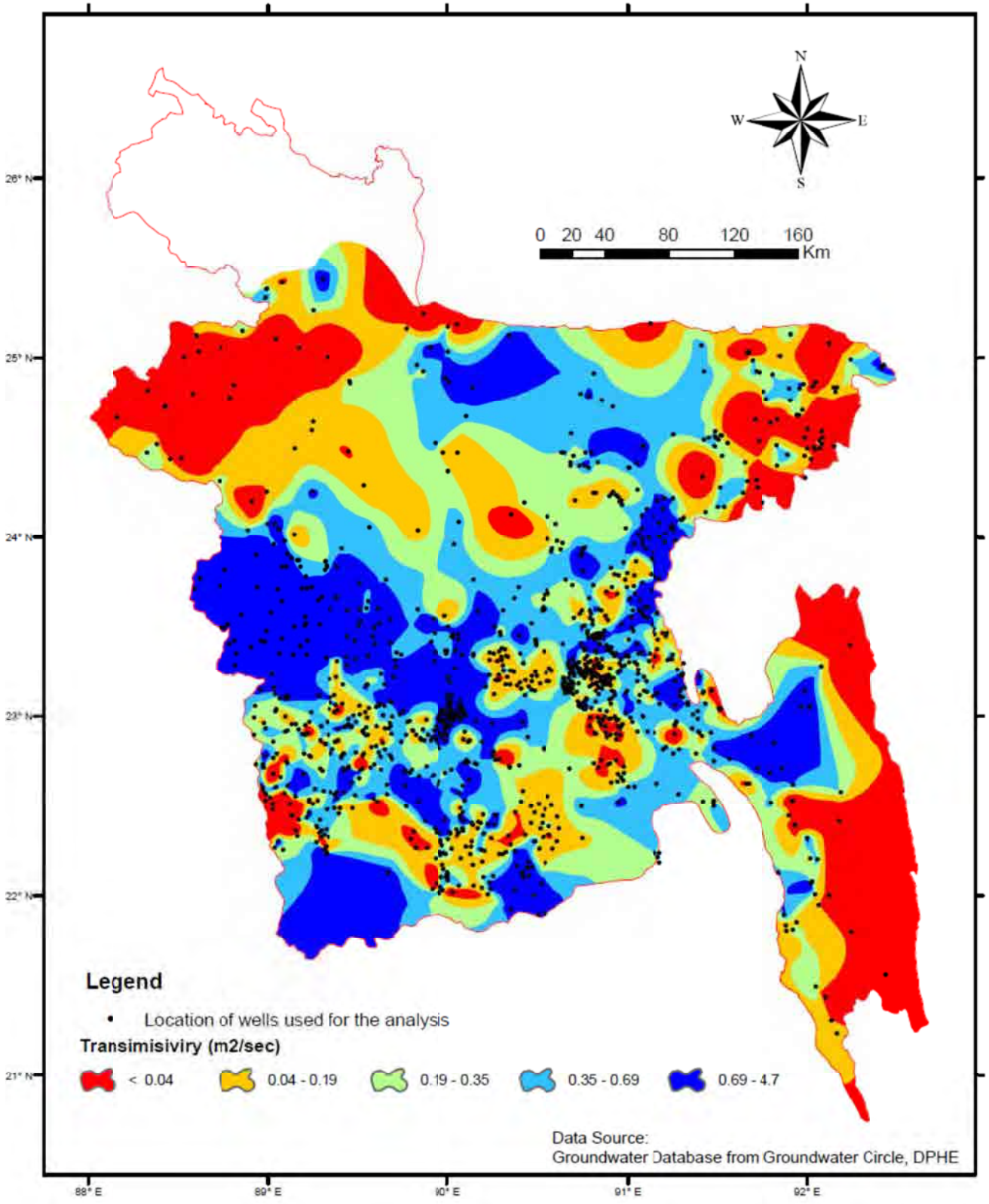

Figure 2.4 Ground Water Development Potential with Depth between 100m - 200m

(c) Groundwater Resource Potential (at depths more than 200 m)

As shown in Figure 2.5, with well depth over 200 m, it is clear that almost the whole area in Rangpur division is unsuitable for groundwater development. For other divisions the potential is more or less the same as the result of total evaluation result, especially for the area of northern part in Chittagong area, where the groundwater development potential is lower until a depth of 200 m. That is, this area has relatively high potential, but to get enough groundwater a well has to be drilled to a depth of more than 200 m.

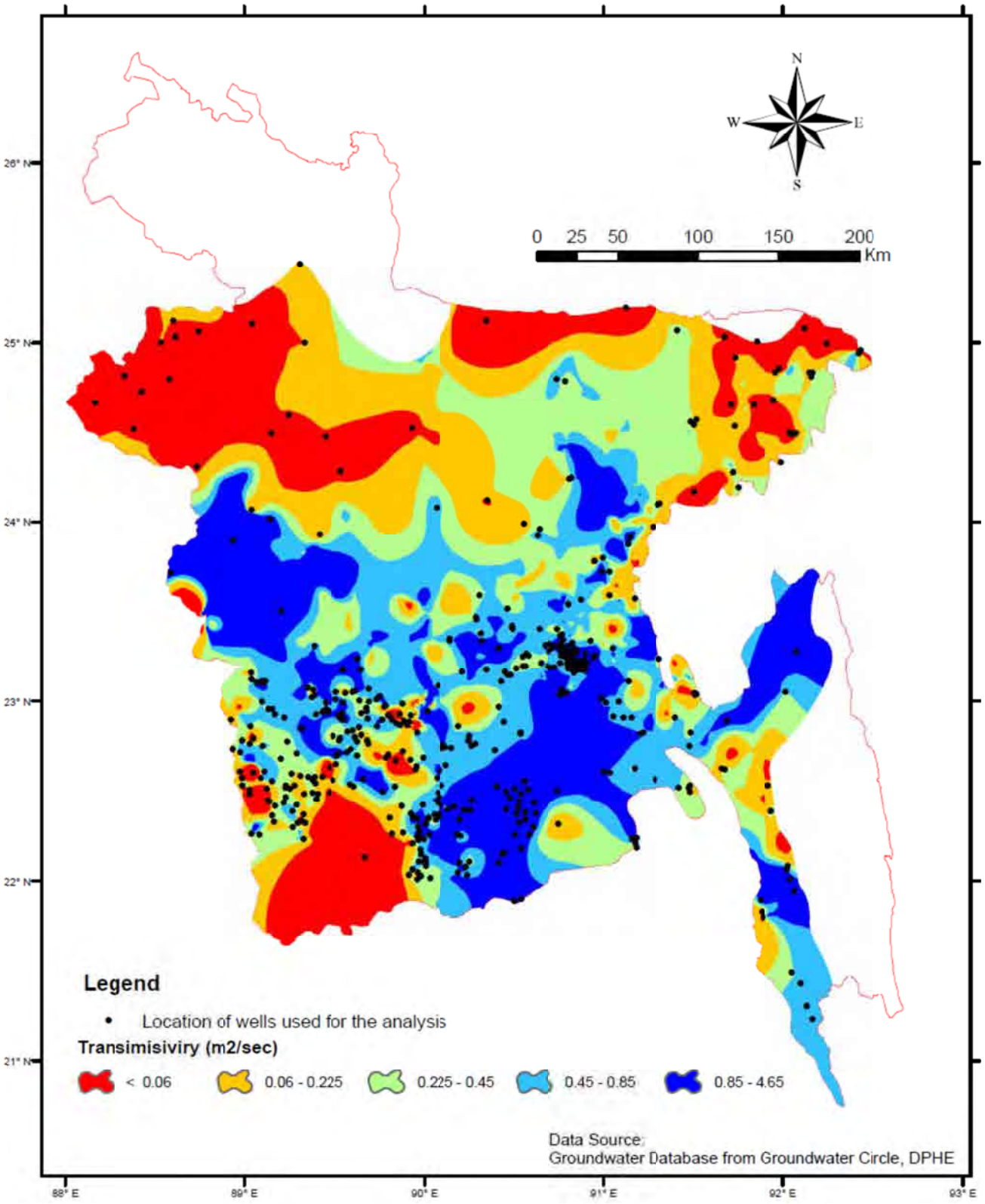

Figure 2.5 Ground Water Development Potential with Depth more than 200m

2.2 Surface Water Resources Development

2.2.1 Availability of Surface Water

In all the 314 pourashavas the availability of surface water use was confirmed by the following main items:

1) Whether there is a perennial river in or near the pourashava
2) The distance of the pourashava centre from the perennial river
3) Whether the river is affected by tides

From the questionnaire survey it was found that 192 of 314 pourashavas have a perennial river in or near the pourashava centre. But 19 of these 192 pourashavas are located in the southern coastal zone and the river water is affected by tides and has a high salinity. The distribution of the pourashava together with perennial rivers is shown in the following figure.

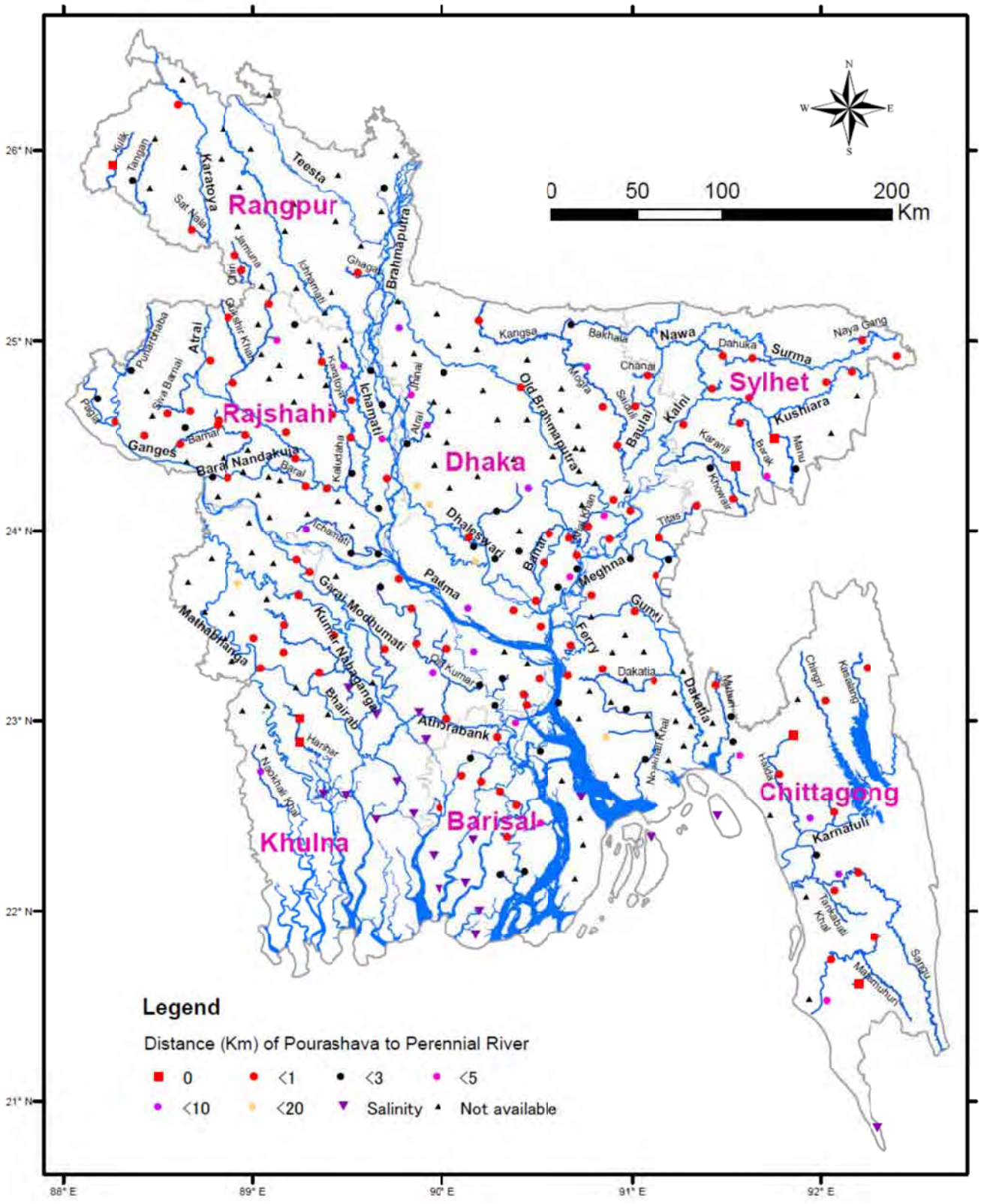

Figure 2.6 Surface Water Availability of Pourashavas

2.2.2 Policy for Preference of Surface Water

After the arsenic problem being found in groundwater in the 1980's, higher priority are given to the surface water for drinking water source. For safe drinking water supply a new guideline has been determined by the "National Policy for Arsenic Mitigation, 2004" as follows:

- Give preference to surface water over groundwater as source for water supply -

Even though surface water is determined as water source with a higher priority than groundwater, and there are thousands of rivers in Bangladesh, surface water is not available in all locations throughout the year when examined by the following four criteria prepared in DPHE Master Plan.

1. It must be a perennial river
2. The river flow amount must be sufficient
3. River water quality
4. The distance of the river to the target pourashava

2.2.3 Examination of Surface Water Availability

The result of the questionnaire survey is used for evaluation of surface water availability. The result comes from the official staff in each pourashava concerning with the issue of water resources. The answer for some items in the questionnaire can be based on the individual perception of the pourashava's staff.

As the first criterion in the DPHE M/P criteria, the perennial river is prescribed as the available surface water source. The perennial rivers in Bangladesh can be divided into 3 main types:

1) The branches of the 3 main rivers from neighbouring country of India.
2) Rivers with abundant recharge by rainfall and base flow in the northern and eastern hilly area.
3) Low elevation rivers near the Bay of Bengal.

Most of other rivers are mainly formed by direct rainfall recharge, and then large amount of water flows in the river like a flood in the rainy season. In dry season, those rivers would become dry or have same water stored in the river bed but no water flow to become a lake or pond.

A typical example can be Tangan river which is located northern west of Bangladesh. This river is not a branch of the 3 main rivers and also does not fit into the other two criteria for perennial rivers formation as mentioned above. Therefore, the river cannot get sustainable recharge to have water flow in the dry season. However, even though there is no water flow, in some part in the river water can be get accumulated to become like a lake or pond.

In rainy season or flood season, river water level is higher than sea water level in most area except sea shore area near Bengal Bay. And then the effect of tide for sea water going upstream is limited to very few areas. However, in dry season, because the river water level gets down, the tidal influence penetrates into several tens of km. Therefore, the effect of salinity in Bangladesh occurs mainly in dry season except sea shore area. Moreover, the effect of salinity is based on several factors like the flow amount of the 3 main rivers, the tide level of sea water, and others. And these factors changes every year, month, day or even hours. Therefore, it's not easy to decide the observation result and the time that should be used for salinity area's judgment.

The following figure shows the salinity observation result from Soil Resource Development Institute and Ganges Barrage Study Project together with the result of questionnaire survey.

1) The salinity boundary of 1967 (green line) and 1997 (red line) based on the result of Soil Resource Development Institute and Ganges Barrage Study Project
2) The result of Ganges Barrage Study Project (black circle marks: 2011)
3) The result of the Questionnaire Survey on the Salinity problem (2012)

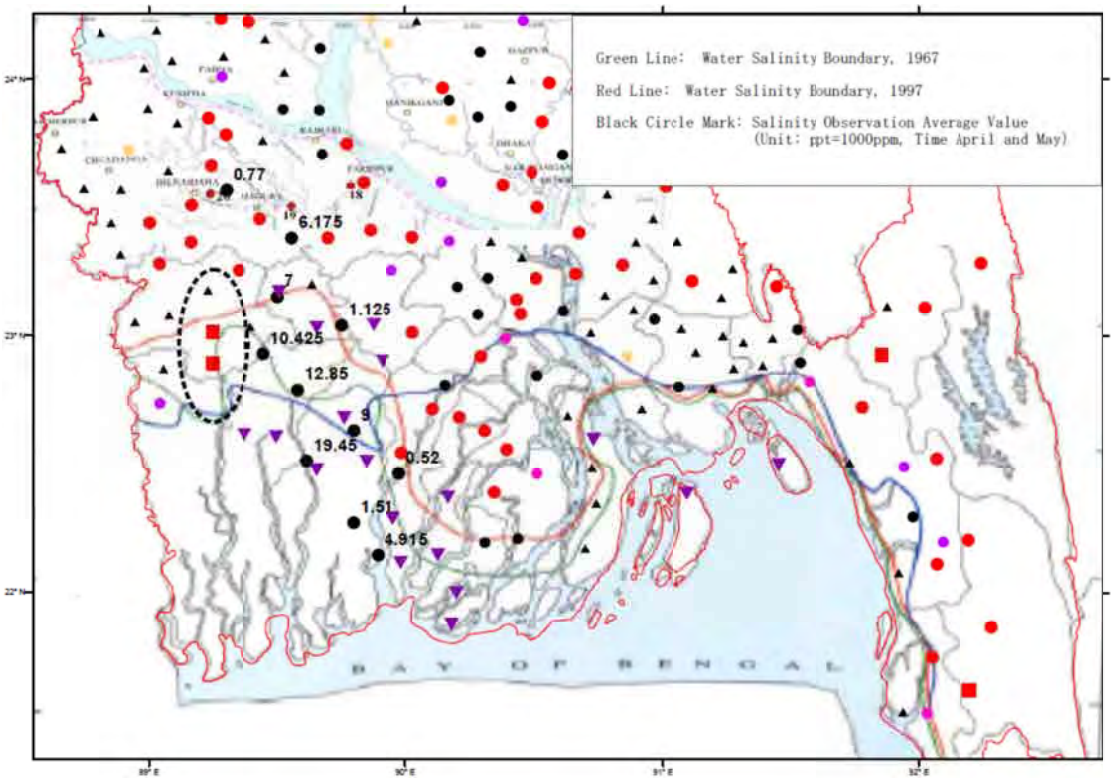

Figure 2.7 Comparison of Previous Salinity Observation Result and Questionnaire Survey Result

As shown above, answers about the salinity from most pourashava's staff coincide with the observation result shown by green line, red line and black circle marks in the figure. However, answers from some pourashavas such as Manirampur and Keshobpur indicate there is no salinity.

Location of the two pourashavas is shown in the figure by black dotted line. When comparing to the previous observation results, it can be found that the two pourashavas are near the salinity boundary of 1967 and within salinity boundary of 1997. The estimation from the observation result of 2011 by Ganges Barrage Study Project also gives high possibility of salinity for the two pourashavas. Therefore, it's not easy to judge if there is effect of salinity for the two pourashavas at the present moment. But, when water supply facility's construction or expansion projects is to be decided, it would be necessary of carefully examine whether the river water is really without salinity and if it can be used as water source.

As mentioned above, the answers of questionnaire about the surface water availability has been checked by the two main criteria of perennial rivers and salinity. The results are summarized in the table in Appendix A showing the pourashavas with certainly perennial rivers without salinity problem.

The table in Appendix A also shows those pourashavas where the answer of the questionnaire is with perennial rivers, but it is unsure if there is a really perennial river or not, and also the salinity problem can be confirmed or unsure. The criteria for summarizing in this table are:

1) The questionnaire items of perennial river and high salinity are given by "Yes"
2) The questionnaire items of salinity is given by "Yes", however it is necessary to confirm on whether there is a perennial river within or near the pourashava
3) The questionnaire items of salinity is given by "No", however it is necessary to confirm on whether there is not really any salinity problem.

3. Water Quality for Drinking Water Supply

3.1 Water Quality Monitoring

3.1.1 Water Quality Guidelines

In 1997, the guideline values of 55 parameters were established for drinking water quality monitoring parameters in the Environmental Protection Law. These parameters shall be checked for drinking water. In the same table, the WHO guideline values are also given for reference.

Table 3.1 Guideline Values for Drinking Water Quality in Bangladesh along with WHO Guidelines

No.	Parameter	Unit	Bangladesh	WHO Guideline	No.	Parameter	Unit	Bangladesh	WHO Guideline
1	Aluminium	mg/L	0.2	0.2(C)	**26**	Hardness	mg/L	200-500	---(C)
2	Ammonia	mg/L	0.5	1.5(C)	**27**	Iron	mg/L	0.3-1.0	0.3(C)
3	Arsenic	mg/L	0.05	0.01(P)	**28**	Kjeldhl Nitrogen(total)	mg/L	1	---
4	Barium	mg/L	0.01	0.7	**29**	Lead	mg/L	0.05	0.01
5	Benzene	mg/L	0.01	0.01	**30**	Magnesium	mg/L	30-35	---
6	BOD	mg/L	0.2	---	**31**	Manganese	mg/L	0.1	0.5(P), 0.1(C)
7	Boron	mg/L	1.0	0.5(P)	**32**	Mercury	mg/L	0.001	0.001
8	Cadmium	mg/L	0.005	0.003	**33**	Nickel	mg/L	0.1	0.02(P)
9	Calcium	mg/L	75	---	**34**	Nitrate	mg/L	10	50
10	Chloride	mg/L	150-600	250(C)	**35**	Nitrite	mg/L	<1	3 0.2(P)
11	Chlorinated alkanes				**36**	Odour	-	Odourless	acceptable
	Carbon tetrachloride	mg/L	0.01	0.002	**37**	Oil and grease	mg/L	0.01	---
	1,1-dichloroethylene	mg/L	0.001	0.03	**38**	pH	-	6.5-8.5	---(C)
	1,2-dichloroethylene	mg/L	0.03	0.05	**39**	Phenolic compounds	mg/L	0.002	---
	Tetrachloroethylene	mg/L	0.03	0.04	**40**	Phosphate	mg/L	6	---
	Trichloroethylene	mg/L	0.09	0.07(P)	**41**	Phosphorus	mg/L	0	---
12	Chlorinated phenols				**42**	Potassium	mg/L	12	---
	Pentachlorophenol	mg/L	0.03	---	**43**	Radioactive materials (gross alpha activity)	Bq/L	0.01	0.1
	2,4,6-trichlorophenol	mg/L	0.03	0.2, 0.002-0.3(C)					
13	Chlorine(residual)	mg/L	0.2	0.5(C)	**44**	Radioactive materials (gross beta activity)	Bq/L	0.1	1
14	Chloroform	mg/L	0.09	0.2					
15	Chromium(hexavalent)	mg/L	0.05	---	**45**	Selenium	mg/L	0.01	0.01
16	Chromium(total)	mg/L	0.05	0.05(P)	**46**	Silver	mg/L	0.02	U
17	COD	mg/L	4	---	**47**	Sodium	mg/L	200	200(C)
18	Coliform(faecal)	n/100mL	0	0	**48**	Suspended particulate matters	mg/L	10	---
19	Coliform(total)	n/100mL	0	0	**49**	Sulphide	mg/L	0	---
20	Colour	Hazen unit	15	15	**50**	Sulphate	mg/L	400	250(C)
21	Copper	mg/L	1	2(P), 1(C)	**51**	Total dissolved solids	mg/L	1000	1000(C)
22	Cyanide	mg/L	0.1	0.07	**52**	Temperature	℃	20-30	acceptable
23	Detergents	mg/L	0.2	---(C)	**53**	Tin	mg/L	2	---
24	DO	mg/L	6	---(C)	**54**	Turbidity	JTU	10	5
25	Fluoride	mg/L	1	1.5	**55**	Zinc	mg/L	5	3(C)

WHO Guideline value:（Source） Ministry of Health, Labor and Welfare, Comparison to international water quality standard
C = concentrations of the substance at or below the health based guideline value may affect the appearance, taste or odour of the water, leading to consumer complaints.
P = provisional guideline value, as there is evidence of a hazard, but the available information on health effects is limited.
U = usual concentrations of the substance in drinking water may not affect on human health.

In 2010, a workshop about water quality monitoring was held among LGD, MoLGRD&C and other academics and the water quality parameters to be monitored and their monitoring targets with priority and health and non-health base were decided as shown in table below considering the existing conditions and capability of water quality monitoring in Bangladesh.

Table 3.2 Water Quality Monitoring Targets

Sl. No.	Parameters	Unit	Targets Value	Bangladesh Guidelines
First priority parameters and targets				
Health Based				
1	Thermo-Tolerant Coliform (TTC)	N/100	0	0
2	Arsenic	mg/L	0.05	0.05
3	Chlorine (residual)	mg/L	0.5	0.2
4	Nitrate	mg/L	50	10
Non-Health Based Target (acceptability)				
1	Turbidity (urban treated)	NTU	5	10
	(rural)		10	
Second priority parameters and targets				
Health Based				
1	Cadmium	mg/L	0.003	0.005
2	Cyanide	mg/L	0.07	0.1
3	Fluoride	mg/L	1	1
4	Lead	mg/L	0.03	0.05
5	Manganese	mg/L	0.4	0.1
6	Mercury	mg/L	0.001	0.001
7	Total alpha radiation	Bq/L	0.5	0.01
8	Total beta radiation	Bq/L	1.0	0.1
9	Benzene	mg/L	0.01	0.01
10	Carbon Tetra Chloride	mg/L	0.004	0.01
11	1,1-dichloro ethane	mg/L	0.03	---
12	1,2-dichloro ethane	mg/L	0.03	---
13	Tetra-chloro ethane	mg/L	0.04	---
14	Tri-chloro ethylene	mg/L	0.07	0.09
15	Chloroform	mg/L	0.2	0.09
16	Barium	mg/L	0.7	0.01
17	Boron	mg/L	1.0	1.0
18	Copper	mg/L	2	1
19	Nickel	mg/L	0.05	0.1
20	Selenium	mg/L	0.01	0.01
21	Sulphate	mg/L	250	400
22	Phenolic compound	mg/L	0.002	0.002
23	Penta-chloro-phenol (PCP)	mg/L	0.009	0.03
24	2,4,6-trichlorophenol	mg/L	0.2	0.03
25	Aldine and dieldrin	ug/L	0	---
26	Chromium (Total)	mg/L	0.05	0.05
Non-Health Based Target (acceptability)				
1	Colour	TCU	15	15
2	Odour	-	Odourless	Odourless
3	pH	-	6.5 - 8.5	6.5 - 8.5
4	Hardness as CaCO3	mg/L	200 - 500	200 - 500
5	Total Dissolved Solids	mg/L	1000	1000
6	Aluminium	mg/L	0.2	0.2
7	Ammonia	mg/L	1.5	0.5
8	Chloride	mg/L	< 600	150 - 600
9	Iron (urban)	mg/L	0.3 - 1	0.3 - 1.0
	(rural)		0.3 - 3.0	

Local governments with piped water supply system should follow the monitoring guidelines above as much as possible. However, local governments without piped water supply should follow the monitoring guidelines below, which have been prepared considering the local conditions of equipment and expertize of water quality. The guidelines are classified into 4 types.

Table 3.3 Type of Water Supply in the Rural Area

	Type	Technology
1	Hand Tube Well (HTW)	a. Shallow Tube Wells (STW) b. Tara Tube Wells (TTW) c. Very Shallow Shrouded Tube Wells (VSST) d. Deep Tube Wells (DTW)
2	Arsenic Removal Technologies (ART) Note: These are all filters to remove As.	a. SIDKO b. ALCAN c. SONO d. READ-F and others e. Shawdesh f. Nelima
3	Alternate Water Supply Systems	a. Pond Sand Filter (PSF) b. Dug Well (DW) c. Infiltration Gallery (IFG) d. Gravity Flow System (GFS)
4	Rain Water Harvesting (RWH)	

Table 3.4 Monitoring Frequency, Parameters and Responsibility

Person in charge	Frequency	1	2	3	4
		HTW	ART	Alternate System	RWH
Caretakers/ Owners/ Management Committees	Daily/ Weekly	Colour, Turbidity (by visual inspection)			
Union Parishad	Quarterly/ Half Yearly/ When it is necessary	Faecal Coliform, Arsenic (by test kit)			
DPHE Lab.	Half yearly/	TTC, As, Cd, Cr, CN, F	For All	TTC, pH, Cd	TTC, pH
	Yearly	CN, F, Pb, Mn Hg, NO3 Turbidity, pH 1,1-Dichloroethene	As, Fe Phosphate pH, TTC	Cr, CN, Mn, Hg, NO3, Benzene As, Ba, Se Aldrine & Dieldrin	Colour Turbidity NO3, Pb
		1.2-Dichloroethene	For Treated water	Hardness, TDS	
		Tetrachloroethene Ba, Se, Hardness Cl Cl, Fe, B, Cu, Ni	As, Se, Al Fe, TTC	NH3, Cl, Fe Microcystin L-R	

3.1.2 Challenges to Water Quality Monitoring

The followings are challenges to water quality monitoring prepared based on observations mainly in Manikganj Pourashava in which JICA is currently implementing a pilot project for water quality monitoring.

(1) Support by DPHE Laboratory Staff

Manikganj Pourashava falls in the jurisdiction of the DPHE Tong Zonal Laboratory. From the start of the project, the staffs of the Zonal Laboratory have given technical support to the Pourashava. This technical support is essential to the pourashavas that have no expertise in water quality monitoring. This support from Zonal Laboratories of DPHE shall be extended to other pourashavas in Bangladesh through which the Pourashava staff understand the objectives and significance of water quality monitoring.

(2) Awareness of Staff

Less attention has been paid to water quality monitoring except arsenic in Bangladesh but more attention seems to have been given to water supply quantity. The significance of water quality monitoring should be educated to pourashava staff.

(3) Budget Preparation and Staff Assignment

For continuous monitoring of water quality, budget for water quality monitoring should be prepared and water quality staff should be assigned in the water section. .

3.2 Pourashava Water Quality Database

Water quality data collected in DPHE and water quality data analysed by the JICA survey team were combined for water quality database for pourashavas. The following is the summary of database of pourashava water quality in terms of main water quality parameters.

Table 3.5 Summary of Water Quality Database prepared by JICA survey team

Parameter	Number of Pourashavas having data: out of 314 pourashavas
Arsenic	238
Iron	234
Manganese	200
Electric Conductivity (EC)	117
TDS	71

The data were sorted by 3 depth of ground water (less than 100m, more than 100 m and less than 200 m, and more than 200 m) because water quality differs by depth in in a same well. Therefore, water quality data with similar depth data have been used for evaluation.

Basically, shallow ground water is polluted by arsenic in Bangladesh. This survey focuses on the water source for piped water supply; shallow groundwater is excluded from the evaluation of water quality due to arsenic problem, and deep ground water of more than 100 m depth is considered in evaluation. However, only arsenic parameter was evaluated for shallow ground water due to the significance of the arsenic pollution in Bangladesh.

3.3 Summary of Water Quality Problems of Pourashavas

3.3.1 Arsenic

(1) General Trend

Arsenic contamination in shallow wells was first reported in 1993 and arsenic pollution in shallow wells was found in 61 districts out of total 64 districts until now. According to a survey by DPHE, UNICEF and British Geological Survey (BGS), arsenic pollution was found in 284 Upazilas out of 463 Upazilas. The districts that the percentage of arsenic polluted shallow wells is higher are as follows. In particular, arsenic pollution percentage is high in Dhaka, Chittagong and Khulna Divisions.

Table 3.6 Districts with Higher Arsenic Pollution in Shallow Wells

District	Division	%	District	Division	%
Chandpur	Chittagong	90	Comilla	Chittagong	65
Munsiganj	Dhaka	83	Faridpur	Dhaka	65
Goparganj	Dhaka	79	Shriatpur	Dhaka	65
Madaripur	Dhaka	69	Meherpur	Khulna	60
Noakhali	Chittagong	69	Bagerhat	Khulna	60
Satkhira	Khulna	67	Laxmipur	Chittagong	56

The highest concentration of arsenic was found in the aquifer between 20 m to 50 m in depth from the

ground (BGS/DPHE 2001). On the contrary, arsenic concentration exceeding the guideline value (50 ppb) is rarely found in the aquifer between 100 m to 150 m in depth from the ground. Therefore, deep ground water is one of the most effective drinking water source alternatives (LGD/DPHE/JICA 2010). The following table shows the number of alternative water supply sources constructed. The deep well shows the highest number of wells constructed in alternatives.

Table 3.7 Number of Alternative Water Sources except Shallow Wells

Source	Type of facilities	Nos of Alternatives	Percentage of shallow wells	Operative	Operative Ratio
Deep GW	Deep tube well	175,363	84.23%	164,652	93.89%
Shallow GW	Arsenic Removal equipment	341	0.16%	182	53.37%
Very shallow wells	Dug wells	11,330	5.44%	9,163	80.87%
	Shourded shallow wells (SST)	9,853	4.73%	8,195	83.17%
River Water	Pond sand filter (SF)	5,823	2.80%	3,431	58.92%
Rain Harvesting	Ditto	5,493	2.64%	3,045	55.43%
Total		208,203	100.00%	188,668	90.62%

Source: LGD/DPHE/JICA (2010): Situation Analysis of Arsenic Mitigation 2009. June 2010.

If water in available wells is significantly polluted by Arsenic, alternative sources shall be considered. If not so high, it is recommended that the iron of sources should be treated by AIRP. If this technology is adopted, adequate O&M should be exercised and water quality should be checked periodically.

(2) Deep Groundwater

The geographical distributions of average concentrations of arsenic data in pourashavas deep wells are shown in Figure 3.1, respectively. There are a few spots in Sylhet and Khulna division where arsenic concentration is higher but overall arsenic concentration in Pourashavas is less than the guideline value (0.05 mg/l). From this result, deep groundwater is more preferable than shallow groundwater as drinking water source.

In Sylhet division, the arsenic data for deep groundwater is only one, which is higher than the guideline value. This data should be rechecked by generating more water quality data. In Khulna division, the average concentration is not so high but the maximum is higher than the guideline value. This indicates that there are some singular spots where higher arsenic concentration exists even in deep groundwater. Therefore, continuous water quality monitoring is required for drinking water source to ensure its safeness.

3.3.2 Iron

The geographic distribution of average concentration of iron in pourashava is shown in Figure 3.2. The deep groundwater is generally safe in arsenic but it is found that it has higher iron concentration. As shown in these figures, average and maximum iron concentrations of almost all deep wells are higher than the guideline values (0.3 – 1.0 mg/l) although the concentration in Barisal is comparatively low. The iron in deep groundwater in all Bangladesh except Barisal division areas should be treated to meet the guidelines.

When groundwater is utilized for drinking water source, iron should be removed to the level of less than 1.0 mg/l. However, it may be difficult for all pourashavas to install iron removal plant at this moment. Therefore, DPHE recommends that if water containing iron more than 3.0 mg/l is used for drinking water source, iron removal plant should be installed, considering the people's acceptance level of iron concentration and treatment cost. Furthermore, DPHE recommends that water containing iron more than 5.0 mg/l is not preferable for drinking water source considering treatment operation cost.

The highest 10 pourashavas of iron contamination in deep well more than 150 m and the number of data by concentration in pourashavas that contain higher iron concentration are shown in the following figures.

Table 3.8 The highest 10 pourashavas of iron contamination in deep well more than 150 m and water quality data

Division	District	Pourashaava	Average (mg/L)	Maximum (mg/L)	Number of data
Chittagong	Noakhali	Sonaimuri	10.9	16.0	2
Dhaka	Narayanganj	Gopaldi	9.6	17.2	2
Sylhet	Moulavibazar	Barlekha	9.3	9.3	1
Sylhet	Sylhet	Kanaighat	9.3	16.3	4
Sylhet	Sylhet	Biyanibazar	8.4	12.7	3
Rajshahi	Bogra	Sherpur	7.1	12.2	4
Chittagong	Noakhali	Noakhali	6.6	9.0	3
Chittagong	Chittagong	Banshkhali	6.6	6.6	1
Sylhet	Sylhet	Golapganj	5.7	12.9	3
Chittagong	Cox's Bazar	Cox's Bazar	5.7	14.4	5

Table 3.9 Number of samples of the highest 10 pourashavas of iron contamination in deep well more than 150m

Division	District	Pourashava	Total number of data	Less than 1.0 mg/L	1.0 mg/L - less than 3.0 mg/L	3.0 mg/L - less than 5.0 mg/L	More than 5.0 mg/L
Chittagong	Chandpur	Chandpur	84	2	17	37	28
Chittagong	Chandpur	Haziganj	76	6	29	28	13
Khulna	Satkhira	Satkhira	45	22	10	4	9
Sylhet	Sylhet	Kanaighat	4	0	0	0	4
Chittagong	Chandpur	Kachua	15	0	4	8	3
Dhaka	Narshingdi	Monohordi	8	0	1	4	3
Sylhet	Sylhet	Biyanibazar	3	0	0	0	3
Chittagong	Chandpur	Saharasti	14	2	4	6	2
Chittagong	Noakhali	Noakhali	3	0	0	1	2
Rajshahi	Bogra	Sherpur	4	0	1	1	2

3.3.3 Manganese

The geographical distribution of average concentration of manganese in pourashava water quality data are shown in Figure 3.3. It is found from these distribution that similar geographical trend to iron concentration is indicated. The highest manganese concentration is found in Dhaka division and the manganese concentration in almost all areas is more than the guidelines.

Iron can be removed by Iron Removal Plant but manganese cannot be removed by aeration in IRP. To removal manganese, oxidation by chlorine (pre-chlorination), and coagulation and sedimentation process is required.

The highest 10 pourashavas of manganese contamination in deep well more than 150 m and the number of data by concentration in pourashavas that contain higher iron concentration are shown in the following figures.

Table 3.10 The Highest 10 Pourashavas of Manganese Contamination in Deep Well more than 150m and Water Quality Data

Division	District	Pourashaava	Average (mg/L)	Maximum (mg/L)	Number of data
Dhaka	Rajbari	Pangsa	1.85	1.85	1
Dhaka	Narayanganj	Sonargaon	1.16	2.50	3
Dhaka	Narayanganj	Gopaldi	0.94	0.94	2
Dhaka	Mymensingh	Trisal	0.70	2.00	3
Dhaka	Munshiganj	Mirkadim	0.70	0.93	2
Dhaka	Narshingdi	Narshingdi	0.65	1.41	5
Dhaka	Narshingdi	Madhabdi	0.64	0.95	3
Chittagong	Noakhali	Kabirhat	0.64	0.68	2
Dhaka	Sherpur	Sherpur	0.61	0.88	4
Rangpur	Nilphamari	Nilphamari	0.60	0.68	2

Table 3.11 Number of samples of the highest 10 pourashavas of Manganese contamination in deep well more than 150 m

Division	District	Pourashava	Total number of data	Less than 0.1 mg/L	0.1 mg/L - less than 0.3 mg/L	0.3 mg/L - less than 0.5 mg/L	More than 0.5 mg/L
Dhaka	Gopalganj	Gopalgonj	141	34	65	16	26
Dhaka	Gopalganj	Muksudpur	70	9	36	16	9
Chittagong	Comilla	Nagalcoat	12	7	0	0	5
Dhaka	Dhaka	Dohar	7	0	3	1	3
Dhaka	Narshingdi	Narshingdi	5	2	0	0	3
Chittagong	Cox's Bazar	Cox's Bazar	5	0	2	0	3
Khulna	Jessore	Jessore	19	0	6	11	2
Khulna	Satkhira	Kalaroa	80	0	71	7	2
Dhaka	Gopalganj	Kutalipara	72	24	43	3	2
Dhaka	Sherpur	Sherpur	4	0	0	2	2

3.3.4 Salinity

In the southern coastal zone, deep groundwater contains high salinity that requires desalinisation facility to produce drinking water, without which this water source is not suitable for drinking water source. This is a very expensive and advanced technology option for treatment in terms of both capita and O&M costs, which is not affordable by pourashavas with low financial capability and low expertise of this technology.

In this Survey, salinity of deep well in pourashavas is evaluated using electric-conductivity (EC) as substitute indicators of salinity. Although the collected data on salinity are not many comparing arsenic and iron data, it is confirmed that salinity in deep groundwater in the southern coastal zone is quite high as shown in the table below.

Table 3.12 The highest 10 Pourashavas of Salinity (EC) Contents Contamination in Deep Well more than 150m and Water Quality Data

Division	District	Pourashava	Average (uS/cm)	Maximum (uS/cm)	Number of Data
Dhaka	Shariatpur	Damoda	3850	4100	2
		Naria	2100	2400	2
	Madaripur	Madaripur	2300	2600	4
Barisal	Barisal	Muladi	1433	1500	3
	Pirojpur	Pirojpur	3100	3100	1
	Patuakhali	Kuakata	1975	2000	2
	Jhalakati	Jhalakati	1280	1550	2
Khulna	Jessore	Benapol	1945	3180	2
		Manirampur	1634	4070	139
		Bagherpara	1293	2890	5

In Barisal division, iron and manganese concentration in deep groundwater is low compared with the guidelines but salinity is much higher for drinking water source. Therefore it is very difficult to obtain safe groundwater source for drinking water in some areas of this division.

From the observations above, to avoid higher concentration of arsenic in shallow groundwater, deep ground water is used or being used in pourashavas. However, deep groundwater is higher in iron, manganese and salinity. Some sort of treatment is required to remove these contents in deep groundwater to meet the guidelines and supply safe drinking water to the people in pourashavas.

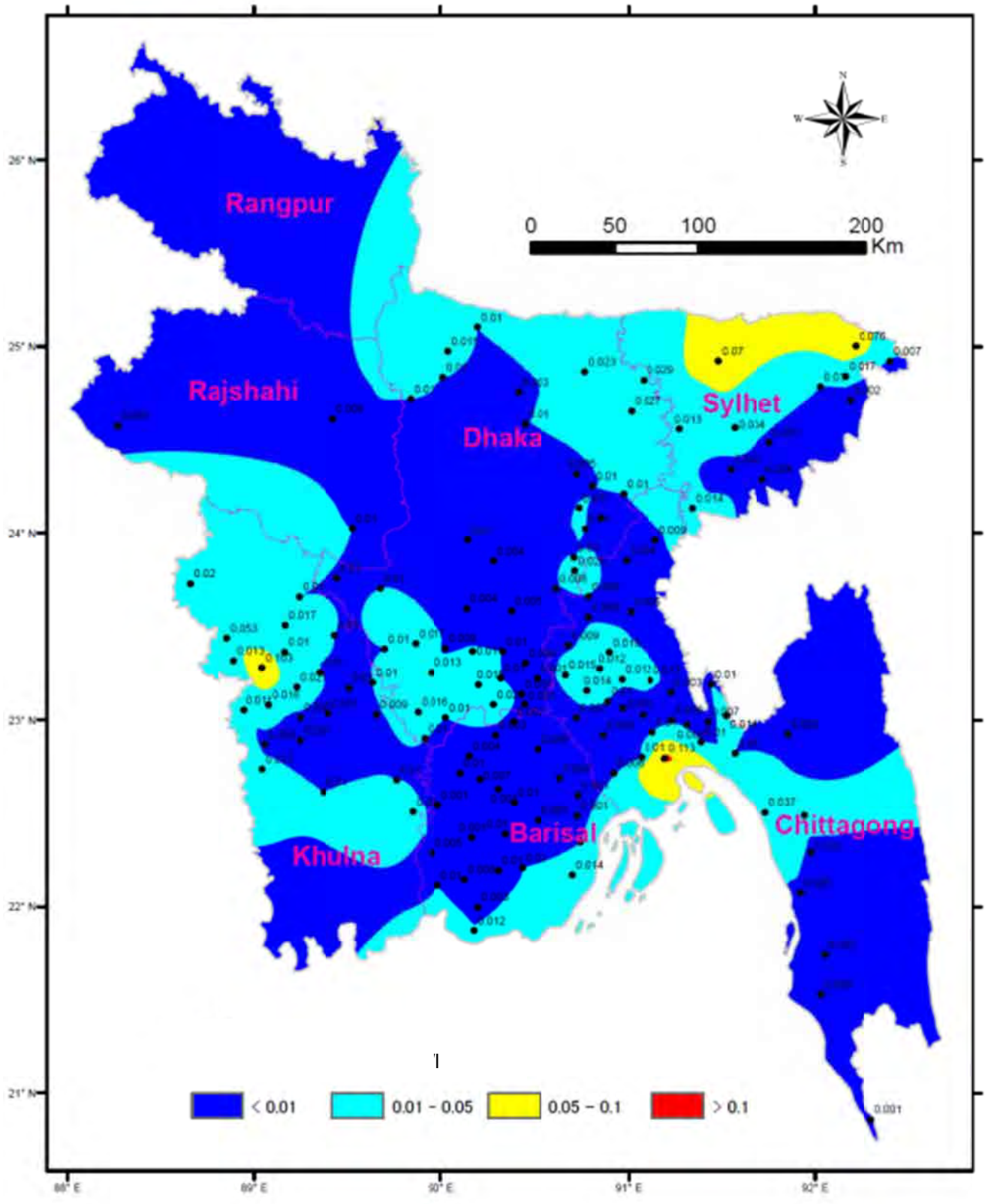

Figure 3.1 Average Arsenic Concentration in Deep Groundwater (more than 150m) in Pourashava

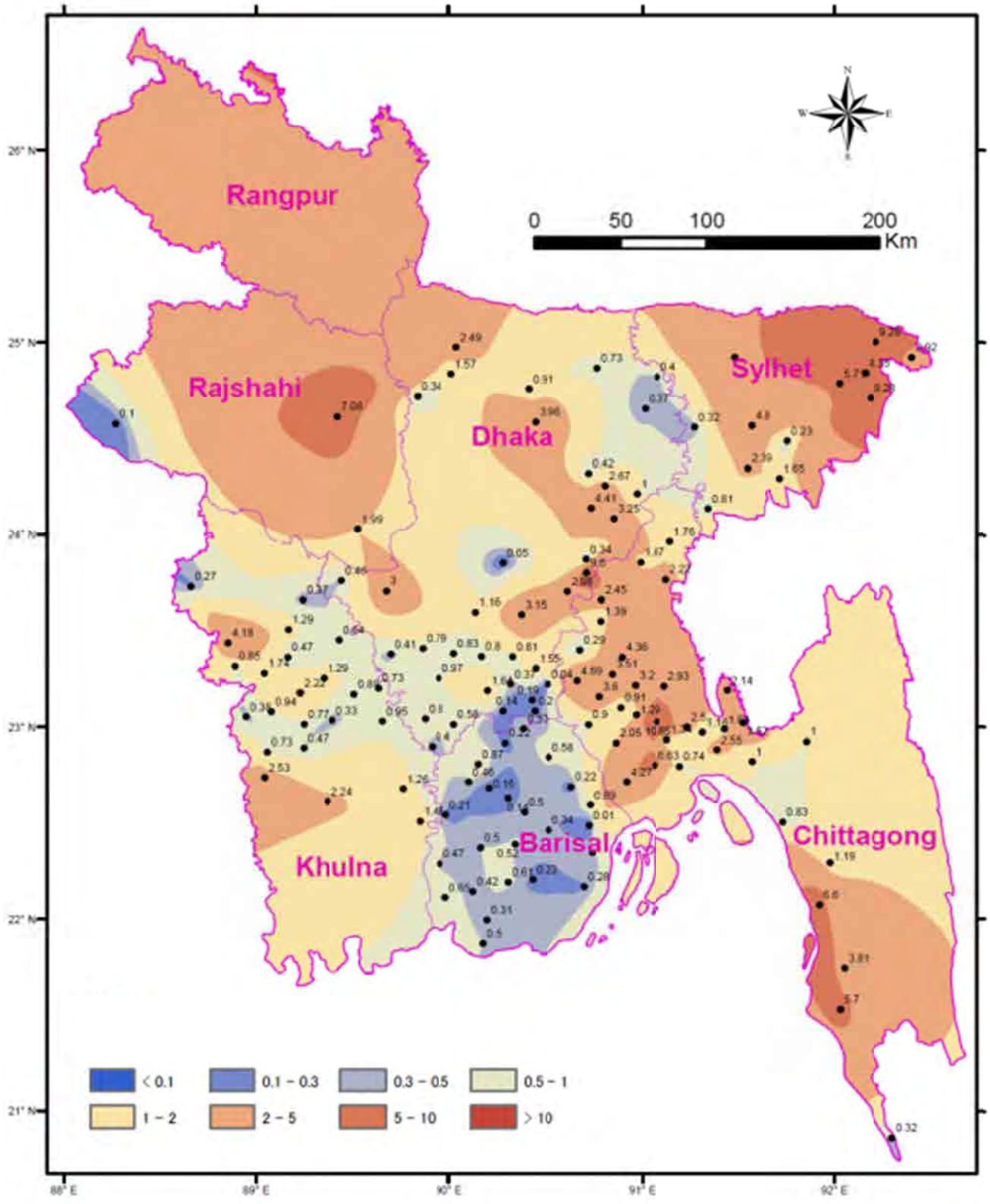

Figure 3.2 Average Iron Concentration of Deep Wells (more than 150m) in Pourashavas

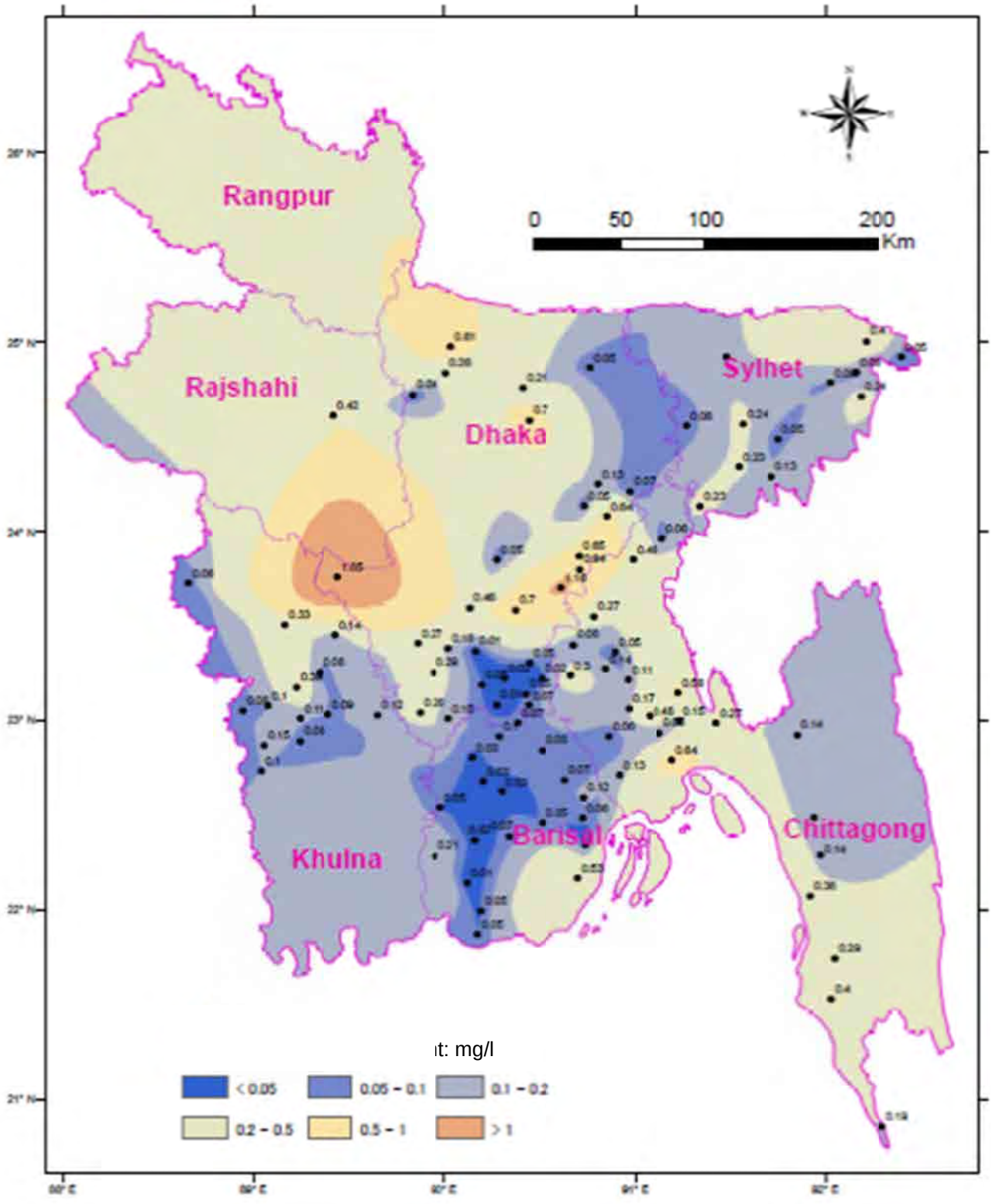

Figure 3.3 Average Manganese Concentration of Deep Groundwater (more than 150m) in Pourashava

3.3.5 Water Quality of Groundwater exceeding Bangladesh Guideline Values

The evaluation of water quality data aforementioned targets deep groundwater more than 150 m, however the actual raw water sources for water supply by pourashava are taken from the tube wells less than 150 m in many cases. The arsenic contamination of raw water in deep tube well is assumed at low level, thus it could be preferable to develop borehole wells more than 150 m afterward.

The percentage of water quality data exceeding Bangladesh guideline value by the depth is indicated as below.

Table 3.13 Percentage of Water Quality Data Exceeding Bangladesh Guideline Value

Depth	Item	Arsenic	Iron	Manganese
Less than 50m	Total number of data	1083	1471	699
	Number of data exceeding guideline value	26	887	448
	Excess（%）	2	60	64
50m – less than 100m	Total number of data	319	322	229
	Number of data exceeding guideline value	25	151	177
	Excess（%）	8	47	77
100m - less than 150m	Total number of data	315	336	165
	Number of data exceeding guideline value	30	145	117
	Excess（%）	10	43	71
More than 150m	Total number of data	1974	2024	1176
	Number of data exceeding guideline value	40	757	434
	Excess（%）	2	37	37

It could be said that there is a fact that some of groundwater sources exceeding the guideline value of iron and manganese are currently utilized. Preference tends to be given to arsenic due to a large impact on human health, however the contamination of iron and manganese also should not exceed the guideline value of Bangladesh. Therefore, the countermeasure to reduce the contamination, for instance construction of treatment plant, is necessary if the contamination of iron and manganese in groundwater sources of existing piped water supply pourashavas.is above the guideline value.

3.4 Surface Water Quality in Pourashavas

If water quality of deep groundwater has problem or deep groundwater is not available and a perennial river without salinity problem is available within reasonable distance from the pourashava, the river water is preferable to use for drinking water source. The list of river that water quality test was implemented and the availability for drinking water source is shown as follow.

Table 3.14 The list of River that Water Quality Test was Implemented and the Availability for Drinking Water Source

River name	Pourashava	District	Division	For drinking water	Remark
Manu River	Moulvi Bazar	Moulvi Bazar	Sylhet	Available	SWTP under planning
Meghna River	Narsingdi	Narsingdi	Dhaka	Available	SWTP under construction
Arial Khan River	Madaripur	Madaripur	Dhaka	Available	SWTP under construction
Boleshwar River	Pirojpur	Pirojpur	Barisal	Available	SWTP under operation
Pagla River	Shibganj	Noakhali	Rajshahi	Not appropriate	Not enough amount
Ganges River	Godagari	Rajshahi	Rajshahi	Available	-
Surma River	Kanaighat	Sylhet	Sylhet	Available	-
Khowai River	Saistaganj	Hobiganj	Sylhet	Available	-
Upper Titas River	Nabinagar	Brahmanbaria	Chittagong	Available	-
Old Brahmaputra River	Madhabdi	Narsingdi	Dhaka	Not appropriate	Not enough amount
Shahebi River	Dohar	Dhaka	Dhaka	Not appropriate	Not enough amount
Kumar (Ganges M/Canal)	Alamdanga	Chuadanga	Khulna	Not appropriate	Not enough amount
Harihar River	Manirampur	Jessore	Khulna	Not appropriate	Not enough amount
Arial Khan River	Muladi	Barisal	Barisal	Available	-
Masua Khal River	Mathbaria	Pirojpur	Barisal	Not appropriate	High salinity
Mohendra khal River	Chatkhil	Noakhali	Chittagong	Not appropriate	Not enough amount

If river water is used for drinking water source, conventional treatment process or rapid sand filtration process consisting of coagulation, sedimentation and rapid filtration can be adopted. In principle, conventional treatment process is suitable to treat insoluble, inorganic substances represented by turbidity. Therefore, this process can be adapted for water source with less organic pollution and no heavy metal pollution although some degree of organic substances can be removed by this process along with reduction of turbidity.

There is no guideline for surface water quality as drinking water source in Bangladesh. Therefore, it is not possible to judge whether river water is suitable or not for drinking water source after treatment.

It seems that there is not much problem in river water quality comparing existing surface water quality data with drinking water quality guidelines. However, raw river water source should be checked several times through a year to design treatment process since river water quality is fluctuated seasonally.

In this Survey, river water samples were taken from few locations and water quality analysis was made. It is found that the water sample in Masua Khal river near Mathabaria in the southern coastal zone has very high salinity contents (3,300～4,000μS/cm). Soluble content of salinity cannot be removed in the conventional treatment process. River water that may contain salinity should be checked thoroughly to decide water source and treatment process.

3.5 Chlorination and Bacterial Pollution

In piped water supply, disinfection or chlorination is indispensable because supplied water has risk of bacteria pollution while water is passing through pipeline to customers, even if the source water does not contain bacteria. Chlorination has two objectives; to disinfect raw water at source point and to keep residual effect of chlorine in pipeline to avoid additional bacterial pollution.

In this Survey, it was found that almost all pourashavas visited by JICA survey team do not consider chlorination important or they do not have enough budgets for chlorine. As a result, almost no pourashavas use chlorine treatment. A few pourashavas apply chlorination but it was found that there is no pourashava which put enough chlorine to keep residual chlorine after chlorination. It may be concluded that the idea that adequate residual chlorine concentration must be kept in piped water has not been established in Bangladesh. It should be educated that chlorination should be adopted and residual chlorine should be kept in piped water.

4. Results of Questionnaire Survey

4.1 General Information of All 314 pourashavas

4.1.1 Summary

Average features of pourashavas on general information can be summarized by piped and non-piped pourashava as follows.

(1) Piped pourashava
Average population of pourashava is approximately 114,000 people and average area is 21.1 km^2. The main water-borne diseases with the prevalence rate are diarrhea as 36.4%, dysentery as 33.6%, Typhoid as 17.1%. The number of technical staff members are 11.3 people (ClassA:14.0, ClassB: 6.1,Class C: 6.2), and 4.2 staffs have high educational background as more than bachelor in average. Average pourashava budget accounts for 118 million TK, actual revenue and expenditure in FY2010/2011 are 50 million TK and 48 million TK respectively. Thereby the balance is slightly positive. The progress of computerization on pourashava works can be seen in “rate schedule and estimate preparation” and “engineering” in general. TLCC and WATSAN are institutionalized in 86% and 51% of pourashava respectively.

(2) Non-piped pourashava
Average population of pourashava is approximately 43,000 people and average area is 14.0 km^2. The main water-borne diseases with the prevalence rate are diarrhea with 35.1%, dysentery with 29.1%, Typhoid with 16.0%. The number of technical staff members are 4.8 people (ClassA:7.0, ClassB: 5.7,Class C: 3.5), and 2.2 staffs have high educational background as more than bachelor in average. Average pourashava budget accounts for 72 million TK, actual revenue and expenditure in FY2010/2011 are 16 million TK and 21 million TK respectively. Thereby the balance is negative. The progress of computerization on pourashava works can be seen in “rate schedule and estimate preparation” and “engineering” in general. TLCC and WATSAN are institutionalized in 69% and 37% of pourashava respectively.

4.1.2 Organization, Finance and Management

(1) Number of engineer/technical staff, educational background

The number of engineer/technical staff and educational background by pourashava class are shown as follows[2].

Table 4.1 Number of Engineer/Technical Staff

Piped Pourashavas

	Average	A	B	C	Special	Max	Min
Total no. of Technical staff	11.3	14.0	6.1	6.2	44.0	44	1
Executive engineer	0.6	1.0	0.1	0.0	1.0	1	0
Assistant engineer	0.9	0.9	1.0	0.8	2.0	2	0
Sub-assistant engineer	2.0	2.6	1.1	0.7	5.0	6	0
Technician/mechanic	3.2	3.9	1.4	1.8	32.0	32	0
Other technical staff	4.5	5.6	2.6	2.9	4.0	32	0
No. of technical staff/ 10,000 persons	1.0	0.9	1.6	1.9	0.4	-	-
Educational Background							
Master	0.3	0.4	0.0	0.2	1.0	5	0
Bachelor	1.0	1.2	0.7	0.8	4.0	5	0
Diploma	2.9	3.7	1.5	1.2	8.0	7	0
Vocational school	0.6	0.8	0.4	0.5	2.0	6	0
Secondary school	3.5	4.4	1.4	2.2	26.0	29	0
Primary school	2.3	2.8	1.7	0.8	4.0	32	0
Other	0.6	0.7	0.5	0.5	0.0	22	0

Non-piped Pourashavas

	Average	A	B	C	Special	Max	Min
Total no. of Technical staff	4.8	7.0	5.7	3.5	-	20	1
Executive engineer	0.1	0.7	0.0	0.0	-	1	0
Assistant engineer	0.9	0.8	0.9	0.9	-	2	0
Sub-assistant engineer	0.9	1.3	1.1	0.7	-	3	0
Technician/mechanic	0.9	1.5	1.0	0.6	-	8	0
Other technical staff	2.0	2.7	2.7	1.4	-	19	0
No. of technical staff/ 10,000 persons	1.1	1.4	1.0	1.1		-	-
Educational Background	5.1	7.0	5.7	3.6	-	20	1
Master	0.1	0.2	0.1	0.0	-	2	0
Bachelor	0.7	1.1	0.7	0.6	-	4	0
Diploma	1.4	2.1	1.7	1.2	-	5	1
Vocational school	0.3	0.3	0.3	0.2	-	3	0
Secondary school	1.4	1.9	1.8	0.8	-	7	0
Primary school	0.8	0.3	0.9	0.6	-	5	0
Other	0.4	1.1	0.3	0.3	-	19	0

Pourashava organogram sanctioned by the MoLGRD&Co determines the number of staff, for instance, 1 Executive Engineer, 1 Assistant Engineer, 3 Sub-Assistant Engineers for class A, 1 Assistant Engineer, 3 Sub-Assistant Engineers for class B. These numbers seem, however, not necessarily be allocated. The number of staff in non-piped pourashavas is relatively less than that in piped pourashavas.

(2) Annual budget, revenue and expenditure

Information on annual budget, revenue and expenditure by pourashava class are summarized in the following table.

[2] The number of staff in water supply and sewerage section is not included in these numbers.

Table 4.2 Pourashava Annual Budget, Revenue and Expenditure

Piped pourashava

	Average	Maximum	Minimum	A	B	C
2009/2010 Budget	118,333,195	808,251,791	2,644,613	155,621,751	52,528,118	54,495,747
2009/2010 Revenue	38,805,950	510,270,436	3,033,283	54,905,555	9,043,593	9,917,759
2009/2010 Expenditure	38,091,313	483,930,192	2,529,340	53,176,562	11,053,779	7,881,997
2010/2011 Budget	170,657,604	1,185,442,014	2,872,386	227,503,185	76,195,918	61,111,458
2010/2011 Revenue	49,731,613	403,378,971	3,033,283	68,653,272	16,250,437	12,900,615
2010/2011 Expenditure	48,083,575	365,400,000	2,558,750	65,567,498	19,148,979	11,840,713

Non-piped pourashava

	Average	Maximum	Minimum	A	B	C
2009/2010 Budget	41,883,950	924,100,000	1,190,804	54,044,347	41,224,307	33,184,458
2009/2010 Revenue	11,521,537	192,598,910	1,224,482	14,742,031	12,908,206	7,769,133
2009/2010 Expenditure	11,325,426	342,100,000	1,343,329	13,332,113	11,809,989	8,765,792
2010/2011 Budget	71,829,857	1,078,500,000	1,825,310	99,762,248	73,219,110	54,541,752
2010/2011 Revenue	16,093,718	173,013,400	947,010	22,343,141	18,699,462	10,381,769
2010/2011 Expenditure	21,307,562	1,075,376,000	1,544,700	21,305,570	18,338,290	20,723,438

Pourashava budget accounts for relatively high number value rather than revenue and expenditure, because the budget includes both of development budget, and capital budget in addition to revenue budget.

(3) Town level coordination committee (TLCC) and Water and sanitation committee (WATSAN)

TLCC is established in 86% of piped pourashavas and 69% of non-piped pourashavas. More than 60% of answered pourashavas (142) have meetings every three months, followed by quarterly as 16% (37) monthly as 12% (29). They have discussions on all issues related to Pourashava including water supply and sanitation and water tariff.

Table 4.3 Establishment of TLCC and WATSAN

Committee	Piped		Non-piped	
	Established	Not yet	Established	Not yet
TLCC	118	20	120	56
WATSAN	70	68	64	112

WATSAN is established in 51% of piped pourashavas and 37% of non-piped pourashavas. The frequency of meetings is every 3 months as 30%, followed by every month as 19% and every 6 monthes as 18%. They have discussions on the issues related to water, sanitation, solid waste, public health and so on.

4.2 General Information on Water Supply in 138 Piped Pourashavas

4.2.1 Summary

The construction of piped water supply system and the establishment of water supply section have been started in earnest since 1970s, the new construction and the new establishment was made in about 50 pourashavas during 2001 – 2010. Average number of staff members are 22.1 persons, the

largest number by job type is pump operators as 6.0 persons. Piped water supply system in 118 out of 138 pourashavas are operational, however not operational in 20 pourashavas.

95% of pourashavas predominantly utilizes groundwater resources for piped water supply system. Average depth of production wells is 168 m, the current average capacity is 69 m^3/h. Average production volume per day of production wells is 3,608 m^3/h in dry season with 8.6 average operational hours. 19% of the total production wells are not in use. There are 68 water treatment plants owned by pourashavas, 6 plants out of that has been not in operational. The largest number of plants are IRP as 47, followed by SWTP as 15. Average production capacity of plant per day accounts for 4,116 m^3/day with 13 average operational hours in dry season. Average production capacity per pourashava is 3,651 m^3/h, however there is a big disparity between pourashavas. Average length of distribution network is 35,553m having 120 average leakage points annually.
Main challenges of O&M (No. of respondents) are: leakage in distribution network(79), leakage in house connection service pipeline (61), decrease of production capacity (52), motor damage (52), joint problem in distribution network (24). Some pourashavas have received technical assistance, provision of materials and assistances in case of troubles on project-base from DPHE, the percentage remain at 21%.

Average number of customer connections per pourashava accounts for 1,887, 93% of the connections is for domestic customers. 17% of total connections is metered. Average water supply hours is 6.4 hours, 60% of total pourashavas replied that water pressure at end-user point was low or almost zero. The number of average customer complaints are 323, the top three issues are: low water pressure (50%), leakage (44%), short supply hours (42%). 56% of pourashava answered existence of water quality problems as: high iron contamination (66%), contamination caused by leakage (13%), bacteria pollution (12%), salinity (10%).
Dominant tariff structure is fixed tariff rates by piped size shared by 80% of pourashavas, metered rates are applied to only 11% of pourashavas. Average water tariff of fixed rates and metered rates are 127 TK/ month and 9 TK/month respectively, however the disparity between pourashavas is large[3]. Average revenue and expenditure of waterworks accounts for 5.35 million TK and 5.17 million TK respectively, the result shows a bit positive balance. Average O&M cots is 2.82 TK. Average annual household income and affordability to pay for water supply service is 10,515 TL/month and 201 TK/ month respectively[4].

4.2.2 General Information on Water Supply

(1) Staffing of water supply and sewerage section

Average number of staffs in water supply and sewerage section are 22 people including water superintendent. The largest number is 71 staff memebers including contract-based staff.

Table 4.4 Staffing in Water Supply and Sewerage Section

	Average per Pourashava	Maximum	Minimum	Remark
Water superintendent	1.0	1	1	
Treatment plant operator	3.6	16	0	Only having treatment plant pourashavas
Mechanic (tube well)	1.6	5	1	
Mechanic (pipeline)	2.3	10	1	

[3] This average of fixed tariff rates is refer from that of diameter 13mm for domestic use, which is most popular size.
[4] This data may not necessarily reflect the reality because the answer is collected from pourashava staff members.

	Average per Pourashava	Maximum	Minimum	Remark
Pump driver (operator)	6.0	35	1	
Bill clerk	1.5	7	1	
MLSS	1.2	4	1	
Guard	3.3	21	1	
Others	1.8	26	0	
Total number of staff	22.1	71	0	

(2) Operational status of water supply facilities in piped pourashavas

Operational status of water supply facilities in piped pourashavas is shown below. Water supply facilities in 20 pourashavas are not operational.

Table 4.5 Operational Status of Water Supply Facilities

Items	Number of pourashavas
All pourashavas surveyed	312
Piped pourashavas	138
Operational	118
Not operational	20
Non-piped pourashavas	176
Not started（New pourashavas）	2

4.2.3 Water Supply Facilities (Production and Distribution)

(1) Water resources for piped water supply system

The largest number of water resources for piped water supply system is groundwater used by 131 pourashavas. Meanwhile, surface water and both surface water and groundwater are used as water sources in 11 pourashavas and 4 pourashavas, respectively.

(2) Production

(a) Number of production wells

Total number of production tube wells (PTW) owned by pourashavas accounts for 682 wells, and the average per pourashava is 4.9 wells. The largest and smallest number of wells is 33 and 0 respectively. 19% of the total production wells are not in operation for some reasons.

Table 4.6 Production Wells

	Number of wells	Average per pourashava	Maximum	Minimum
All PTW (Nos.)	682	4.9	33	0
PTW not in operation (Nos.)	127 (18.6%)			

(b) Features of production wells

Average depth of production wells is 168m, the deepest and the shallowest wells are 479m and 30m respectively. Average production capacity and current average capacity are 85 m3/h and 69 m^3/h respectively. Average production volume per day is 3,608 m^3 in dry season; the largest volume is 33,995 m^3/day; average operation hours are 8.6 hours.

Table 4.7 Features of Production Wells

	Average per pourashava	Maximum	Minimum
Ave. depth (m)	168	479	30
Capacity at commission (m3/hrs)	85	263	10
Ave. current capacity per unit (m3/hrs)	69	210	6
Ave. production hours, Summer (hrs/day)	8.6	21	2
Total production, Summer (m3/day)	3,608	33,995	84

(c) Water treatment plant

There are 68 water treatment plants owned by pourashavas, 6 AIRPs, 47 IRPs, and 15 STWP. Out of these, 6 treatment plants are not in operation.

Table 4.8 Number of Water Treatment Plant

	Total number of WTP	Number of pourashavas having WTP	Average per pourashava	Maximum	Minimum
AIRP	6	4	1.5	2	1
IRP	47	31	1.5	3	1
Surface water treatment plant	15	11	1.4	3	1
Plants not in operation	6	5	1.2	2	1

(d) Production capacity of water treatment plant

Plants' production capacities of maximum and minimum are 900m^3/h and 40m^3/h respectively. Production capacity of plants per day is 4,116m^3/day on average and 11,600 m^3/day in the largest capacity. Average operational hour is 13 hours in dry season.

Table 4.9 Production Capacity of Water Treatment Plant

	Total production	Average per pourashava	Maximum	Minimum
Total capacity (m3/hrs)	14,181	364	900	40
Production hours, Summer (hrs/day)	455.5	13	22	0
Total production (m3/day)	152,290	4,116	11600	0

(e) Chlorination points

Number of chlorination points are 0.7 points in production wells as the smallest, 1.0 points in AIRP/ IRP, and 1.4 points in SWTP.

Table 4.10 Chlorination Point

	Total chlorination point	Pourashava average	Maximum	Minimum
PTW	76	0.7	14	0
IRP/AIRP	26	1.0	3	0
Surface WTP	13	1.4	3	1

(f) Water production volume per pourashava

Average production volume per pourashava is 3,651 m^3/day in dry season. There is a disparity between pourashavas from 33,995 m^3/day in maximum and 84 m^3/day in minimum.

Table 4.11 Production Volume

	Total	Pourashava average	Maximum	Minimum
Total production in summer (m^3/day)	423,553	3,651	33,995	84

(3) Distribution

(a) Overhead tank

Average number of overhead tank per pourashava is 0.9, and the largest number accounts for seven. Average capacity and the largest capacity of OHT are 504 m3 and 6,000 m3 respectively.

Table 4.12 Overhead Tank (OHT) Capacity

	Total	Pourashava average	Maximum	Minimum
Overhead tanks (Nos.)	123	0.9	7	0
Total capacity (m3)	69,073	504	6,000	0

(b) Distribution network

Average length of distribution network per pourashava is 35,773 m. The longest and shortest length of distribution network are 180,000 m and 1,071 m respectively. Average number of leakage points, the largest number and the smallest number are 119, 1,100 and 4 points respectively.

Table 4.13 Distribution Network Length and Leakage Points

	Total	Pourashava average	Maximum	Minimum
Distribution network (m)	4,936,714	35,773	180,000	1,071
Leakages in distribution (Nos.)	13,546	119	1,100	4

4.2.4 O&M of Water Supply Facilities

(1) Main challenges

Most frequently answered issue is related to pipeline. The major issues are: leakage (79), joint problem

(24), old pipe (12), and iron blockage (11). The next challenge area is pump, followed by production well, and house connection. The representative issues are motor damage for pump, decrease of production capacity, iron blockage and so on.

Table 4.14 Main Challenges for O&M

Production well		Pump		Distribution network		Meter (Total 24 pourashavas)		House connection	
Challenges	Nos	Challenges	Nos.	Challenges	Nos.	Challenges	Nos	Challenges	Nos.
Decrease of production capacity	52	Motor damage	52	Leakage	79	Iron blockage	6	Leakage	61
Groundwater table down	9	Pump damage	19	Joint problem	24	Damage by water vapour	3	Iron blockage	14
Strainer damage	9	Bearing problem	12	Old pipe	12	No reserved meter	2	Wastage	3
Iron problem	7	Leakage	6	Iron blockage	11			Unauthorized house connection	2
Shaft problem	7	Sound problem	5						
Colum pipe damage	5	Circuit breaker damage	4						
Total	89		98		126		11		80

(2) Number of water leakage reported

Average number of water leakage is 119 points. However there is a large disparity among pourashavas from 1,100 to 0 points. The accuracy may not be reliable because it is estimated by pourashava staffs without precise recording

Table 4.15 Number of Annual Leakage Points

	Pourashava average	Maximum	Minimum
Annual leakages (Nos.)	119	1,100	0

4.2.5 Customer Service

(1) Basic information on customer service.

Average water supply coverage (region) is 36%. The large difference can be seen between pourashavas, from 87% in maximum and 6% in minimum. Total average of water supply coverage is 31% of population.

Table 4.16 Basic Information on Customer Service

	Pourashava average	Maximum	Minimum
Piped water supply service area (sq.km)	8.6	67.7	0.5
Piped water supply service area (% of total area)	36	87	6
Total population currently served (Nos. of people)	36,136	295,680	500
Service population (%)	31	75	2

(2) Customer connection

(a) Customer connection

The number of pourashava where water supply facilities are operational is 118. Out of that, 24 pourashavas have metering system. Average number of connection per pourashava is 1,887

connections. The largest number is more than 10,000 connections. With regard to the composition of customer connection, the largest number is for domestic customers with 93% followed by commercial and industry with 4% and public tap stand with 2%.

Table 4.17 Number of Customer Connection

	Pourashava average	Maximum	Minimum	Number of pourashavas
All pourashavas				118
Service connections (Nos.)	1,887	11,745	0	
Domestic	1,755	11,283	0	
Public tap/ stand pipe	36	653	0	
Public institutions	16	300	0	
Commercial & industrial	67	887	0	
Others	13	788	0	
Total	1,887	11,745	0	
Metered pourashava				24
Metered connections (Nos.)	2,091	6,552	0	

(b) New connection

Average number of annual new connection is 204, and average necessary days for installation are 7 days. Average number of application outstanding are 209, the largest number of outstanding is 2,500 applications.

Table 4.18 New Connection

	Pourashava average	Maximum	Minimum
Applications outstanding (Nos.)	209	2,500	0
New connections in 2010/2011 (Nos.)	204	860	0
Average waiting time (days)	7	30	2

(3) Water availability to customers

(a) Water supply hours

Average supply hours are 6.4 hours. The longest and shortest supply hours are 24 hours and 1 hour respectively. The percentage of customer receiving 24 hours supply is 4.3%.

Table 4.19 Water Availability

	Pourashava average	Maximum	Minimum
Continuity of service (hrs/day)	6.4	24	1
Customer with 24 hrs supply (%)	4.3	100	0

(b) Water supply pressure at the end of pipeline

14% (17) of pourashavas answered that water supply pressure at the end of pipeline is “good”, however 60% (72) responded “low” or “almost no” pressure.

Table 4.20 Water Supply Pressure at the End of Pipeline

Water pressure	Number of answers
Good	17
Fair	30
Low	65
Almost Nil	7

(4) Customer dissatisfaction

(a) Main customer complaints

Major complaints are “low pressure”(28%), “leakage”(44%), “”Short supply hours (42%), “water quality problems”(37%), and “insufficient water supply volume”(28%).

Table 4.21 Main Customer Complaints

	Low pressure	Leakage	Short supply hours	Water quality problem					Insufficient water supply	Low coverage	Pipeline blockage	Meter problem	Water cost complaint	Other
				Overall	Fe	Dirty	Odour	Salinity						
Top 3 complaints	50.0%	44.2%	42.0%	37.0%	23.2%	4.3%	3.6%	1.4%	27.5%	12.3%	8.0%	2.9%	2.2%	7.2%
1st complaint	29.7%	8.0%	13.8%	9.4%	8.0%	0.7%	0.7%	0.0%	19.6%	2.9%	0.7%	0.7%	0.0%	0.0%

(b) Water quality monitoring

56% (77) pourashava answered that water quality in piped water supply system is problem. The detail answers are “iron contamination”(66%), “contamination due to leakage”(13%)”, “Bacteria contamination”(12%), and “Salinity contamination”(10%)”. 20 pourashava replied that they have a water quality monitoring plan, although partially.

Table 4.22 Water Quality Monitoring Situation

Pourashava having water quality problem	Fe	Contamination due to leakage	Bacteria	Salinity	As	Mn	Odour
55.8%	66.2%	13.0%	11.7%	10.4%	6.5%	5.2%	5.2%

4.2.6 Water Tariff and Billing and Collection

(1) Water tariff structure

Most frequent answered tariff system is tariff based on diameter of connection pipe with 80%. Other options are “metered rates”(11%), “family size rate”(2%), “both pipe size and metered rates”(6%). Family size rates are tariff system to charge different tariff rates depending upon the number of families. The detail water tariff structure of all surveyed pourashavas are given in Appendix B.

Table 4.23 Water Tariff Structure

	Nus of pourashavas	(%)
Based on pipe size	110	80
Metered rate	15	11
Family	3	2
Both pipe size and metered	8	6

(2) Water tariff rates

Average water tariff of most popular size is 127 Tk for domestic 13 mm (1/2") and 334 Tk for non-domestic. The difference between maximum and minimum is more than 8 times larger for domestic rates and more than 57 times larger for non-domestic customers. Average tariff rates for metered rate is 9 Tk/m3, the difference is more than three times.

Table 4.24 Water Tariff Rates

	Pourashava average	Maximum	Minimum
Domestic 13 mm (1/2") (Tk/month)	127	320	40
Non domestic lowest (Tk/month)	334	4,000	70
Lowest volumetric charge (Tk/m3)	9	15	5
House connection fee (1/2") (Tk)	739	4,000	0

4.2.7 Organogram and Financial Situation of Water Supply Section

(1) Financial situation

Average budget amount of water section accounts for 34.85 Tk. Average revenue in revenue account is 5.35 million Tk, average expenditure is 5.17 million Tk, which slightly exceeds revenue amount. Meanwhile, average O&M costs accounts for 4.1 million Tk. The breakdown is personnel cost (43%), electricity and fuel cost (25%), chemical costs (7%), repair and material costs (12%), and other costs (13%).

Average billing amount per pourashava is 4.23 million Tk, out of which 2.98 million Tk is actual collected amount. The collection efficiency is approximately 70%.

Table 4.25 Financial Situation of Water Service

	Pourashava average	Maximum	Minimum
● Annual budget of the Pourashava 2010/2011 (Tk)			
Budget (total)	34,855,603	476,446,708	51,000
Development	13,518,519	160,000,000	0
O&M	5,210,368	31,500,250	15,000
Revenue	5,354,004	68,233,381	0
Expenditure	5,174,996	62,015,073	53,410
● Annual O&M costs of water service 2010/2011 (Tk)			
Personnel	2,075,680	17,659,752	16,800
Power/Fuel	1,196,638	14,928,651	0
Chemicals	324,303	3,000,000	0
Repair	582,143	8,020,000	1,300
Other	615,751	14,520,348	25
Total O&M cost	4,794,515	39,703,318	77,199
● Billing and Collections			
Annual billings (Tk)	4,238,028	45,903,000	0
Annual collections (Tk)	2,981,239	33,167,000	0

(2) Outstanding arrears

Average outstanding arrears for water tariff accounts for 1.66 million Tk, while accumulated electricity arrears are 2.82 million Tk. The largest number of electricity arrears accounts for 150 million Tk.

Table 4.26 Outstanding Arrears

	Pourashava average	Maximum	Minimum	Number of answered pourashavas
Water arrears (Tk)	1,665,441	14,099,860	0	108
Electricity arrears (Tk)	2,820,787	150,000,000	0	60

4.2.8 Challenges and Needs for Water Supply

(1) Priority needs

The Pourashavas have identified 8 major challenges from total 21 items. They also put their priorities on top 3 challenges. Top 3 priorities are “increase of production capacity” (64), “expansion and replacement of network” (39), and “O&M of production wells and pump” (37).

Table 4.27 Priority Needs

	Number of answered pourashavas	%
Increase of production capacity	64	46.4%
Expansion and replacement of network	39	28.3%
Production well and pump	37	26.8%

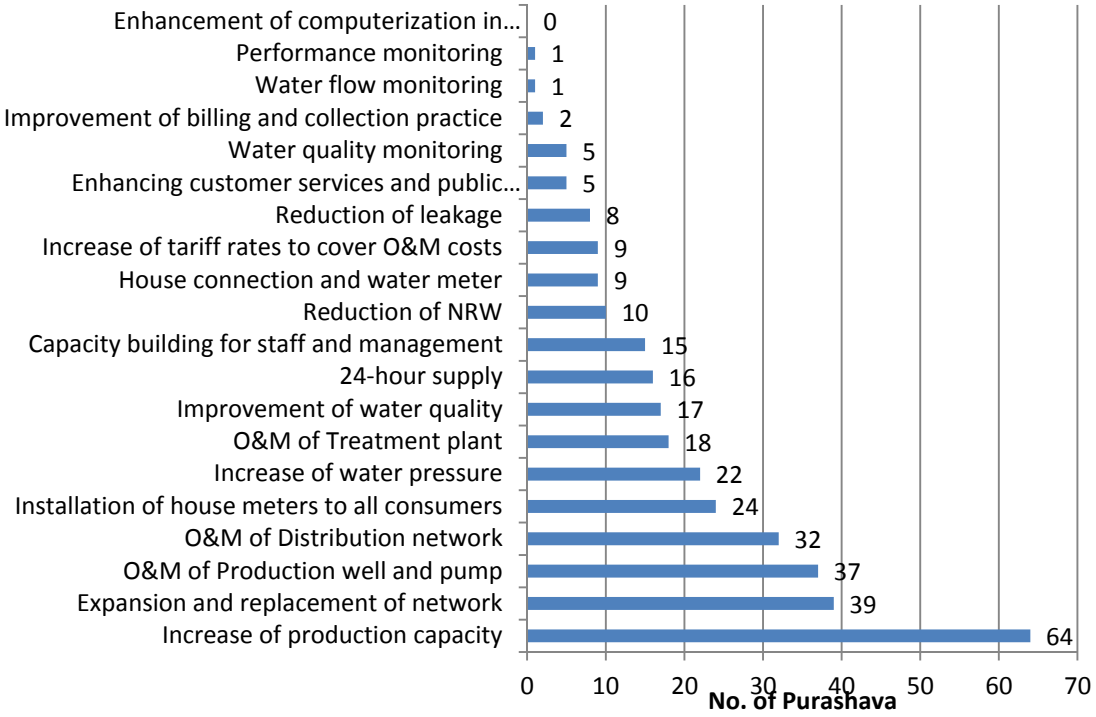

Figure 4.1 Priority Needs

(2) Necessity of piped water supply and metering in non-piped supply system areas

Most of pourashavas answered that they need piped water supply service to non-piped areas. In addition, 87% of the pourashavas replied that water meter installation and application of metering rates is necessary.

Table 4.28 Necessity of Piped Water Supply and Metering

Need piped water supply system outside of piped water supply area	134
Need water meter to all customers and payment based on water volume consumed	120

4.3 Water Sources and Development Potential in Non-piped Water Supply System Areas

4.3.1 Summary

Priority needs of pourashavas for water supply are (No. of pourashavas): increase of production capacity (64), expansion and replacement of network (39), O&M of production well and pump (37). With regard to potential water supply sources in non-piped supply system area, there are 8 pourashavas not having deep wells with sufficient water volume in dry season. Water quality problem in deep wells are identified as: high iron contamination (77%), salinity (15%), high arsenic contamination (5%). In case of deep well, 82 pourashavas having piped system and 83 pourashavas having non-piped system evaluate that water supply sources has a high potential for piped water system. About 4% of pourashaavas answered no potential of deep wells for water supply. In terms of potential river sources, 61% of pourashavas replied that there is available river sources near by pourashava.

4.3.2 Water Usage in Non-piped Water Supply System Areas

(1) Number of existing water resources

The largest number of water sources is shallow wells with 2,500-3,500 sources per pourashavas. Piped pourashavas have 314 water sources of deep wells on average, more than two times of non-piped pourashavas.

Table 4.29 Existing Water Sources

	Piped Pourashava		Non-Piped Pourashava	
	Ave. of poura	Max.	Ave. of poura	Max.
(1) River water	0.6	5	0.5	3
(2) Ring/dug well	145	420	18	71
(3) Shallow tube well	3,643	32,200	2,673	11,700
(4) Deep tube well	314	7,800	139	1,500
(5) Ponds	146	1,013	135	1,138
(6) Pond sand filter	16	20	27	100

(2) Percentage of people using unsafe drinking water sources

In total, 7-10% of population in the Pourashavas is drinking arsenic contaminated water, 9-10% unsafe water and 25% using neighbours' well for drinking. The disparity among pourashavas in each categories are 0-90% for arsenic contaminated water, 0-85% for unhygienic water.

Table 4.30 Percentage of People using Unsafe Drinking Water Sources

	Piped Pourashava			Non-Piped Pourashava		
	Ave.	Max.	Min.	Ave.	Max.	Min.
Arsenic contaminated water (% of total population)	7.3	90.0	0.0	10.0	90.0	0.0
Unhygienic drinking water (% of total population)	11.4	85.0	0.0	9.3	80.0	0.0

4.3.3 Potential Water Supply Sources

(1) Groundwater sources

(a) Groundwater quantity

Results from Pourashava which answered insufficient water volume for drinking water are summarized as follows. In case of shallow wells, almost half of pourashavas responded that sufficient quantity is not ensured. Meanwhile, in case of deep wells, 6 pourashavas replied that they do not get enough water quantity in dry season.

Table 4.31 Insufficient Groundwater Quantity

	Piped Pourashava		Non-Piped Pourashava	
	In summer	In winter	In summer	In winter
Shallow well	69	11	85	19
Deep well	6	0	2	5

(b) Groundwater quality

Pourashavas recognize that water quality problems in shallow wells resources are Iron (65%), Arsenic (34%), and Salinity (9%). While as, in deep wells, main problems are Iron (77%), Salinity (15%), and Arsenic (5%). In overall, iron contamination problem is widely raised by pourashavas.

Table 4.32 Water Quality in Groundwater Resources

	Piped pourashava		Non-piped pourashava		All pourashavas	
	Nos.	%	Nos.	%	Nos.	%
Shallow well						
High As	45	33	62	35	107	34
High Fe	87	63	117	66	204	65
High Salinity	16	12	13	7	29	9
Deep well						
High As	5	4	2	1	7	5
high Fe	58	42	48	35	106	77
High Salinity	8	6	13	9	21	15
Combination of water quality in deep well						
Both As and Fe are high	4	3	2	1	6	2
Both Fe and Salinity are high	5	4	9	5	14	4
Both As and Salinity are high	1	1	2	1	3	1
All As, Fe and Salinity are high.	1	1	2	1	3	1

(c) Decrease of groundwater resources

The percentage of pourashavas which acknowledge that groundwater level is declining is 73% in case of shallow well and 48% in case of deep well.

Table 4.33 Decrease of Groundwater Level

	Piped Pourashava	Non-Piped Pourashava
Shallow well	96	136
Deep well	78	73

(d) Evaluation of potential resources for piped water supply system

In case of shallow well, 13% of pourashavas evaluate that the water resource has a high potential for piped water supply system. Meanwhile, in case of deep well, almost half of the pourashavas evaluate that the water resources has a high potential for piped water system.

Table 4.34 Evaluation of Water Resources for Piped Water System (Groundwater)

	Piped Pourashava			Non-Piped Pourashava		
	High	Moderate	None	High	Moderate	None
Shallow well	9	58	58	33	84	57
Deep well	82	37	4	83	27	4

(2) Surface water resources

192 pourashavas answered that they have surface river water resources nearby pourashavas. Among them, 128 pourashavas mentioned that the river has enough water quantity even in dry season. Evaluation results of river water resources are high (61), medium (79), and no potential (50).

Table 4.35 Surface Water Resource Potential for Drinking Water

Item	Piped pourashava		Non-piped pourashava		All pourashavas	
	Nos.	%	Nos.	%	Nos.	%
No river nearby Pourashava	48	35	74	42	122	39
River nearby pourashava	90	65	102	58	192	61
Not enough water in summer in the nearby pourashava	26	19	38	22	64	20
High salinity river water	9	7	20	11	29	9

Table 4.36 Evaluation Results of Water Resources for Piped Water System (Surface Water)

	Piped Pourashava			Non-Piped Pourashava		
	High	Moderate	None	High	Moderate	None
Evaluation	33	39	29	28	40	31

(3) Pourashavas with water quality problems

Pourashavas with water quality problems on groundwater and surface water are summarized as follows.

Table 4.37 Pourashavas with Water Quality Problems (Groundwater)

Pourashava	Division	District	Piped supply	As in DTW	Fe in DTW	Salinity in DTW	Salinity in river
Nagarkanda	Faridpur	Dhaka	None		O	O	
Kutalipara	Gopalgonj	Dhaka	Piped		O	O	
Goshairhat	Shariatpur	Dhaka	None		O	O	
Shibchar	Madaripur	Dhaka	None		O	O	
Barguna	Barguna	Barisal	Piped		O	O	O
Gouranadi	Gouranadi	Barisal	Piped		O	O	
Kuakata	Patuakhali	Barisal	None		O	O	O
Kalapara	Patuakhali	Barisal	Piped		O	O	O
Meherpur	Meherpur	Khulna	Piped	O	O	O	
Manirampur	Jessore	Khulna	None		O	O	
Kalaroa	Satkhira	Khulna	None	O	O	O	
Satkhira	Satkhira	Khulna	Piped	O	O		
Chuadanga	Chuadanga	Khulna	Piped	O	O		
Moheshkhali	Cox's Bazar	Chittagong	None		O	O	
Hatia	Noakhali	Chittagong	None	O	O	O	O
Senbagh	Noakhali	Chittagong	None		O	O	

Note: ”O” indicates water quality problem parameter.

Table 4.38 Porashavas with Water Quality Problems (Surface Water)

Pourashava	Division	District	Salinity problem
Gopalgonj	Gopalgonj	Dhaka	O
Tongipara	Gopalgonj	Dhaka	O
Patharghata	Barguna	Barisal	O
Kalapara	Patuakhali	Barisal	O
Betagi	Barguna	Barisal	O
Barguna	Barguna	Barisal	O
Daulatkhan	Bhola	Barisal	O
Kuakata	Patuakhali	Barisal	O
Mathbaria	Pirojpur	Barisal	O
Chalna	Khulna	Khulna	O
Paikgacha	Khulna	Khulna	O
Narail	Narail	Khulna	O
Kalia	Narail	Khulna	O
Bagerhat	Bagerhat	Khulna	O
Morolganj	Bagerhat	Khulna	O
Monglaport	Bagerhat	Khulna	O
Teknaf	Cox'sBazar	Chittagong	O
Hatia	Noakhali	Chittagong	O
Shandia	Chittagong	Chittagong	O

Note: ”O” indicates water quality problem parameter.

5. Survey Findings for Pourashavas Surveyed by JICA Survey Team

5.1 Summary of Survey Findings of ADB Project for 13 Piped Pourashavas

Overall average features on the targeted pourashava and the waterworks based on questionnaire surveys can be summarized as followings;

- Pourashava population 176,000 persons, % of total population currently served by piped system 39%, Water supply hours 6 hours, Customer connection 3,800, Production capacity per population served 86 m^3/day
- TLCC and WATSAN has been institutionalized in general
- O&M costs are generally recovered according to the operating ratio
- Collection efficiency 75%, debt service ratio 10.4 months, water charge outstanding arrears 3.8 million TK are remained as financial challenges to be improved
- Average unit production cost 5.94 TK/ m^3 is still at high level, however there is disparity between pourashavas.

The priority challenges in pourashava are “low coverage”, “insufficient technical and managerial capacity”,and “less financial resource”. The priority needs are “increase of production capacity”, “improvement of O&M (production well and pump)”, and “expansion and replacement of distribution network”. The needs on improvement in water supply services by new development and rehabilitation, and O&M of facilities are mostly equivalent.

Main data and performance indicators of 13 pourashavas targeted by ADB STWSSP are summarized as the following tables.

Table 5.1 Main Data and Performance Indicators of 13 Pourashavas Targeted by ADB STWSSP
(Summary – 1)

	Items	Joypurhat	Natore	Sirajganj	Mymen singh	Netrokona	Moulavi bazar	Brahman baria
Main Data	Population (2011)	106,729	85,001	297,630	475,000	102,000	150,000	155,392
	Household	21,085	10,377	20,229	24,168	11,400	30,000	18,305
	Area (km^2)	27	15	28	22	21	10	18
	Area covered (%)	35	40	51	43	30	40	35
	Population covered (%)	31	40	30	26	15	40	25
	No. of connections	2,500	3,514	1,898	4,735	1,348	2,729	2,416
	No. of metered connections	1,650	2,600	886	4,000	930	1,587	0
	Daily production (m^3)	3,200	5,609	7,200	16,556	1,450	3,800	1,960
	Supply hours per day	9	9	3	4	5	6	8
	Per capita consumption (LPCD)	140	120	160	100	79	130	120
	Billing 2010-11	4,447,087	6,346,844	13,375,645	8,284,000	7,385,411	2,450,378	1,925,750
	Collection 2010-11	3,790,733	4,109,940	9,655,107	4,522,000	2,489,516	2,384,515	1,471,530
	Arrears 2010-11	354,500	2,236,904	2,100,000	6,879,120	4,935,895	2,800,000	2,280,000
	O&M Cost 2010-11	4,234,813	3,723,188	7,700,000	5,830,000	4,084,251	3,191,855	2,930,000
	Staff in WS Section	16	18	18	16	14	17	15
	NRW estimated by Pourashava (%)	5	No estimation	No estimation	20–22	15	15–20	10
	Annual No. of leaks	5	150	250	100	128	120	165
	Annual No. of complaints	76	675	280	127	260	120	200
	Annual No. of new connections	130	450	124	790	60	130	474
	Water tariff (1/2" Dom)	150	100	100	120	130	200	60
	Connection fee (1/2" Dom)	825	1,500	300	1,200	750	500	60
	Leakage control team	Y	Y	Y	Y	N	Y	N
	TLCC	Y	Y	Y	Y	Y	Y	Y
	WATSAN	Y	Y	Y	Y	Y	Y	Y
	Computerization of Psv works (Nos.)	4	7	1	7	8	8	5
Performance Indicators (PIs)	Av. per capita production (LPCD)	96	165	81	134	95	63	50
	Staff/1000 connections	6.4	5.1	9.5	3.4	10.4	6.2	6.2
	Collection efficiency (%)	85	65	72	55	34	97	76
	Metering ratio (%)	66	74	47	84	69	58	0
	Population served per connection	13	10	47	26	11	22	16
	Accounts receivable (months)	1.1	6.5	2.6	18.3	23.8	14.1	18.6
	O&M Cost per connection (Tk)	1,694	1,060	4,057	1,231	3,030	1,170	1,213
	Operating ratio	0.63	0.62	0.59	0.82	0.57	0.75	0.97
	Unit production cost (Tk/m^3)	3.63	1.82	2.93	0.96	7.72	2.3	4.1

(Summary – 2)

	Items	Narshingdi	Jhenaidah	Jessore	Madaripur	Pirojpur	Laksh mipur	Average
Main Data	Population (2011)	176,800	128,292	286,163	112,500	64,170	150,218	176,146
	Household	27,630	13,303	42,793	26,118	11,250	15,312	20,921
	Area (km^2)	10	32	15	14	30	20	20
	Area covered (%)	70	65	79	40	40	25	46
	Population covered (%)	37	65	69	49	40	34	39
	No. of connections	2,484	5,654	11,745	2,534	3,861	4,510	3,841
	No. of metered connections	2,196	1,600	6,552	2,138	2,600	2,612	2,258
	Daily production (m^3)	539	5,160	24,030	2,880	2,850	3,900	6,087
	Supply hours per day	7	6	16	2	2	5	6
	Per capita consumption (LPCD)	133	120	195	80	40	150	121
	Billing 2010-11	5,211,001	7,930,500	20,502,330	3,896,760	13,375,645	10,745,565	8,144,378
	Collection 2010-11	3,879,351	6,631,868	18,182,856	2,755,720	9,855,107	10,716,927	6,188,090
	Arrears 2010-11	8,721,220	1,298,632	13,000,000	1,587,850	2,139,955	2,084,364	3,878,342
	O&M Cost 2010-11	5,273,000	5,316,537	23,007,752	1,878,463	11,925,000	11,827,488	6,994,027
	Staff in WS Section	19	42	71	15	13	42	24
	NRW estimated by Pourashava (%)	28.3	5	20	5-10	No estimation	25	15
	Annual No. of leaks	67	45	160	100	63	38	107
	Annual No. of complaints	67	250	260	775	900	42	310
	Annual No. of new connections	79	210	790	167	55	300	289
	Water tariff (1/2" Dom)	150	75	130	120	150	320	139
	Connection fee (1/2" Dom)	1,200	700	500	1,000	800	4,000	1,026
	Leakage control team	Y	Y	Y	Y	Y	Y	Y=11
	TLCC	Y	Y	Y	Y	Y	Y	Y=13
	WATSAN	Y	Y	N	Y	Y	Y	Y=12
	Computerization of Psv works (Nos.)	2	6	6	3	4	4	5
Performance Indicators (PIs)	Av. per capita production (LPCD)	8	62	122	52	111	76	86
	Staff/1000 connections	7.6	7.4	6	5.9	3.4	9.3	6.7
	Collection efficiency (%)	74	84	89	71	74	100	75
	Metering ratio (%)	88	28	56	84	67	58	60
	Population served per connection	26	15	17	22	7	11	19
	Accounts receivable (months)	27	2.3	8.6	6.9	2.6	2.3	10.4
	O&M Cost per connection (Tk)	2,123	940	1,959	741	3,089	2,623	1,918
	Operating ratio	0.73	0.86	0.95	0.68	0.69	0.84	0.75
	Unit production cost (Tk/m^3)	26.8	2.82	2.62	1.79	11.46	8.31	5.94

5.2 Observations from ADB Project for 13 Piped Pourashavas and Recommendation

Based on the field observations and analysis of questionnaire survey data a few important issues have been identified as listed below. Addressing the concerns on these issues will be helpful for further raising effectiveness and sustainability of future projects:

5.2.1 Water Source and Treatment

(1) Use of groundwater and surface water

Groundwater is used as the water source as far as possible. Surface water is considered only when there is a severe water quality problem in the groundwater; especially arsenic and salinity. Of all the 16 Pourashavas having piped water supply and covered by ADB assisted Secondary Town Water Supply and Sanitation Project (STWSSP), surface water source is being used in only one Pourashava (Pirojpur). Four new surface water treatment plants, including one more in Pirojpur, are being constructed under the project.

(2) Inadequate disinfection

Disinfection is not done for any groundwater source when the water is supplied without any purification (treatment). Where the groundwater is treated through IRP disinfection is done in some but not in all. Disinfection is not done adequately even for surface water where it is a most. Importance of disinfection and microbial safety of drinking water has not been understood at the field level.

(3) Indifference to water quality

Water quality and especially, microbial water quality have not been given enough attention. Water quality monitoring at distribution is almost non-existent.

(4) Water treatment plant and electricity cost

In two Pourashavas, Jessore and Natore, existing treatments plants are not used in the pretext of saving electricity cost. These are IRP plants where use of electrical power is required only to pump treated water from treated water reservoir to OHT. Rest, water flows by gravity from aeration to filter and filter to storage reservoir. Thus their reason of not using WTPs is not convincing. In the existing PTWs of these Pourashavas iron concentration is in the boarder range of allowable limit (~1 mg/L), thus most likely they are not bothered to treat water.

5.2.2 Coverage and Supply System

(1) Limited coverage and different supply hour

Coverage by piped water supply is limited to the range of 30~40% of the total Pourashava population. Supply duration varies from a few hours to 16 hours daily.

(2) Saving of electricity cost

Even though the deep tube wells (production tube wells – PTWs) are capable of working continuously for up to 20 hrs per day or even more, they are run for a much shorter period of time, most often 10~12 hrs a day. Main reason given for this short operation is to save electricity consumption. This has resulted in underutilization of available facilities on one hand and low coverage of population on other. By extending operation hours of PTWs total production can almost be doubled from the current value.

(3) Mixed water supply system

Water supply system is mixed type; sometimes directly from production wells, sometimes from OHT, and sometimes both combined. In some instances water from the WTP or OHT is supplied turn by turn

to different supply zones. Thus the customers get water only for a short duration, say for 3~4 hours even though the supply from WTP or OHT is for much longer period. Supplying from OHT results in a more stable supply and less problem to O&M of pump compared to direct pumping supply but as the size of the city grows the limited head available from the OHT becomes insufficient. Pumps can be changed for higher head if required in future but OHT's height cannot be increased.

5.2.3 Organization of Water Supply Section

Organograms of Pourashavas have been standardized by the Ministry of LGRD & C based on Pourashava class. But not all posts are filled or sometimes some additional posts are created temporarily and positions filled. The necessary staff which is not included in the organogram are: accountant, meter reader, operator of treatment plant and store room keeper. In STWSSP, the proposal and request to allocate the additional staff is sent to Ministry of LGRD & C, however, in most cases the request is not accepted. Most of the additional staff is temporally employee.

5.2.4 Computerization and Automation

Computerization has been introduced and practiced for many functions of the Pourashavas, including accounting, taxation, engineering calculations, and citizen services.
In water supply billing and accounting are almost always computerized but other functions are not computerized or automated.

5.2.5 Metering

(1) Malfunction bulk meter

Metering of PTWs has started under the STWSSP but a significant number of these bulk meters (about 30%~40%) are already out of order. Almost all the PTWs along with the bulk meters are housed in permanent structures, thus vandalism is not the cause of meter damage. Most likely these meters are jammed or damaged by intrusion of pebbles or dirt passed from worn-out well screens. Detached pipe lining materials also sometimes jam the meters. The meters also malfunction sometimes due to exceeding their maximum operational flow range. But during field survey it was observed that the installed meters are often 150 mm in size with rated flow of 150 m^3/h. Actual production of wells is lower than this, usually in the range of 100-120 m^3/h. Thus this is most likely not the cause of meter problem. If the meter has only jammed it can be opened and cleaned by the Pourashava staff but if it has malfunctioned due to wear and tear it needs to have a major repair/replacement which can only be done at meter workshops.

(2) Lack of regular recording

Even in places where the meters were in working condition, regular recording of the readings was not practiced except in a few locations. And even if the flows were recorded in these few places, the information was not used for any purpose. The main reasons for this seem to be lack of awareness of the Pourashava staff responsible for water supply. More trainings highlighting the importance of properly measuring water production and using this data for water balance and other planning functions are necessary.

(3) Improvement in customer meter

Customer metering was absent in these Pourashavas before the STWSSP but due to the project's mandatory provision they have installed customer meters in the project's first phase. The meters are also being installed to the remaining or new customers in the currently ongoing phase of the project. Several issues relating to customer meters were observed during the field survey:

- Quality of meters - It was only about a year since the meters were installed but in some Pourashavas the meters were already seen in rusted condition. The meters had international standard marks (ISO 4064) and as per this, the meter body should have been adequately

protected against rusting by way of material or by external coating. But it did not appear so.

- Meter boxes – Design and location of meter boxes are not appropriate in many Pourashavas. There are three main issues; the cover of the boxes are too heavy for one person to open during meter reading, the top of the boxes do not rise above ground level making them susceptible to flooding, enough space to construct boxes are not available for many customers.

These issues need to be carefully considered in future projects for making metering operation sustainable. There are lessons to be learned in these regards from DANIDA assisted Coastal belt project where meters are satisfactorily working for last six years. In this project, the customers were made fully responsible for protection of meters, meters were installed by the side of building wall without a meter box but at a raised height. This allowed easy access to meter readers, did not require much space for installation, and protected the meters from flooding.

(4) Different stages of introducing meter reading

Pourashavas are found to be in different stages of introducing meter reading based (volumetric) billing and tariff collection system. Some of them do not have any plan to switch from connection size-based tariff to volumetric system any time soon, some are going to start soon, while a few of them (like Netrakona) have already started.

(5) Issues about water meter and meter reading

Several issues were found to be affecting the full introduction of volumetric tariff system. They include:

- Current organogram of the Pourashavas do not have any provision of staff for meter reading,
- It requires two persons to read a meter because of the heavy meter box cover,
- Many meters give erratic readings due to intermittent supply and use of pump by the customers to suck water from pipe line,
- Low quality of meters in some instances,
- Clogging of internal screens of the meters due to excessive iron in water, and
- Additional head loss caused by the meters where the supply pressure is already low resulting into customer complaints.

(6) Challenges in O&M and repair of water meter

In the absence of meter readers' post in the current organogram and in view of difficulty of changing organogram, the STWSSP has been trying to promote outsourcing for meter reading and billing procedure. One of the Pourashavas visited (Natore) has informed us that outsourcing contract for meter reading and bill distribution has been finalized with a local NGO. The NGO will be paid TK 35,000 monthly against a guarantee by the NGO of at least 80% bill collection efficiency. It has agreed not to take any money if the collection efficiency goes below 80%. Other Pourashavas are trying to manage meter reading with whatever available manpower they have, for example, the guards, pum operators etc are mobilized to take meter readings. It is not known how sustainable this system will be.

5.2.6 Water Tariff

In brief, due to requirement of STWSSP for compulsory metering and volumetric billing Pourashavas are gradually changing their pipe diameter based billing to the volumetric billing. But gaining confidence in metering and volumetric billing system is going to take some time. Some of the visited Pourashavas were reluctant to adopt this system because of increased work load and likely complications.

5.3 Evaluation of 1st Phase of DPHE Master Plan for 12 Non-Piped Pourashavas

Main findings in evaluation of the DPHE master plan by JICA survey team in the technical, financial, economic, social and environmental aspects is summarized as follows.

5.3.1 Water Source, Water Supply Demand, Capacity/ Facility Scale

(1) Development plan and water supply demand

(i) Target Year
Planning frame for the long-term (2040) is too long. Population growth and city expansion pattern for such a long term may not be correctly predicted now since most of the Pourashavas are young and growing rapidly. There are also uncertainties with the water availability due to global climate change. Because of these reasons, the long-term plan may require a major change and will have to be revisited at the end of mid-term period.

(ii) Phasing strategy
The implementation of the activities is planned to be done in two or three phases based on the Pourashava. For Pourashavas to be completed in two phases the first phase will be implemented by 2015 and the second or last phase will be completed by 2025. For Pourashavas to be taken up in three phases Phase-I to be implemented by the year 2015, Phase-II to be implemented by the year 2025 and Phase-III to be implemented by the year 2040. Phase-I is concentrated in providing the facilities mostly in and around "core area" of the Pourashava since concentration of population is in and around the core area. Gradually and in stages, the system (pipe network and other facilities) would be provided depending on the population growth and expansion of the Pourashava.

(iii) Non-Revenue Water (NRW)
The range given for NRW is 20-40%, which is reasonable. But what is not reasonable is that the NRW has been projected to increase from 14% in 2015 to 26% in 2040. This is in contrary to common understanding that NRW has to be reduced in future as far as possible and not to let worsen. At least the percentage of NRW can be kept constant although even with this the actual volume of NRW will increase in future as the production volume increases.

(iv) Backwash water volume
There is no logic why the backwash water percentage increases in future as projected in the design criteria. It can also be kept constant or even slightly reduced in future. It is because recycling of backwash water can be possible in future.

(v) Supply hour
As per the design criteria, the ultimate supply hour (in 2040) is to be 23 hours. The situation has arisen because there is no provision of storage in the plan and the supply is to be directly from the wells or treatment plants. It is neither recommended nor practical to supply for 23 hours. Instead the aim should be 24 hours to get many benefits of a continuous system.

(vi) Water demand used in modeling and facility sizing
The water demand calculated for the modeling and reported in the summary (S.N. B 5, and B 4 respectively in above table) are different. They do not have any definite ratio and we could not find any explanation for this discrepancy in any report. The demand values shown in the summary are much smaller compared to the values used in the modeling, ranging from a low of 20% to a high of 50%.

(vii) Water source selection policy
The first priority given to surface water irrespective of the size of the Pourashava and other

factors is not logical because of the following reasons:

- If the Pourashava is small or medium in size, there is no significant groundwater table decline, and no serious water quality problem, groundwater should be given the first priority. This is because compared to surface water, treatment of groundwater is easier, less expensive, and consequences of inadvertent problems in treatment are not as severe as that of surface water.
- Surface water source should be considered when the groundwater use is unsustainable (i.e., when the annual lowering of GW table is significant).
- If the groundwater has enough quantity for sustainable use but serious quality problems (very high salinity, arsenic and iron) and surface water is available, a comparative study between the two sources should be made based on life cycle cost.
- Conjunctive use of surface and groundwater is practically difficult because the nature of impurities and treatment philosophies are entirely different for ground and surface waters.

(viii) No provision for water storage
No overhead tank (OHT) or ground reservoir has been proposed for storage of water although the design criteria list 15% of TDD (total daily demand) as the storage requirement for both OHT and ground reservoir. In the absence of storage water is to be supplied directly from the PTWs or WTPs.

(ix) No provision for water meter
The system has no provision of water metering, be it production or consumption. The lessons learnt from successfully run water supply systems indicate that for a sustainable operation metering of water supply system plays a crucial role. In the absence of metering the system will be affected by wastage and misuse of water.

(x) Allocation of water treatment plant (WTP)
The Master Plan for Pourashavas having WTP shows 0.5 WTP in the first and remaining 0.5 WTP in the later phase and has divided the funding equally into two. From this it may be inferred that the WTPs are to be constructed in two phases. But each phase should be capable enough to operate independently.

(2) Water supply facility plan

(i) No provision for water storage
No OHT or ground reservoir has been proposed for storage of water although the design criteria list 15% of TDD (total daily demand) as the storage requirement for both OHT and ground reservoir. In the absence of storage water is to be supplied directly from the PTWs or WTPs.

(ii) No provision for water meter
The system has no provision of water metering, be it production or consumption. The lessons learnt from successfully run water supply systems indicate that for a sustainable operation metering of water supply system plays a crucial role. In the absence of metering the system will be affected by wastage and misuse of water.

(iii) Allocation of WTP
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(iv) Insufficient chlorination treatment
The Master Plan is silent on the significance and the necessity of chlorination. Chlorination should be conducted even in case of direct water supply from deep tube wells without any

treatment of raw water.

5.3.2 Evaluation of Project Implementation Plan

The available reports do not clearly say anything on the implementation approach. Performance based implementation approach as applied by STWSSP or other forms can be considered. In the project implementation, the Master Plan overlooked the way how the plan is translated into practice considering institutional arrangement, implementation schedule, contract packaging and budding system and so on. In addition, phasing of the projects should also be modified accordingly so that even if the project does not advance to the next stage the works completed that far are not wasted.

5.3.3 Management, Operation and Maintenance Capability

(1) Lack of O&M plan

The DPHE Master Plan does not include the O&M plan of water facilities, thus it is not clear on how pourashava operate and manage the constructed facilities after the construction. This is one of a weakness of the Master Plan; the appropriate plan should be considered and added in the Master Plan to secure the sustainable O&M of the facilities.

(2) Overlooked Capacity Building of Pourashava Staffs

The Master Plan is silent on capacity building of pourashava personnel. The project suggested by the Master Plan designed water facilities for non-piped pourashavas which do not have any experience of water service management in general. Most of non-piped pourashavas does not have water supply and sewerage section, the personnel who will be assigned may not have any experience of the O&M of water facilities. On the other words, the Master Plan does not indicate any O&M plan and capacity building plan and the contents. Thus, the Master Plans should pay sufficient attention on the orientation and the ways for sustainable O&M of water facilities.

5.3.4 Financial, Environmental and Social Aspects

(1) Lack of economic and financial analysis

The economic and financial analysis is not implemented in the M/P. Thus, feasibility is not analyzed. The cost for project is estimated for three phases till year 2040, but O&M cost estimation is done for only first phase.

(2) Water tariff setting and difference with willingness to pay

Although baseline surveys have been conducted to assess willingness to pay and affordability, it is not clear on what basis the water tariff rates have been decided. It is presumed that the water tariff is decided to cover all O&M cost.

Table 5.2 Proposed Water Tariff and Willingness to Pay

DK-N-2 Dohar		DK-N-23 Madhabdi		SL-N-2 Saistaganj		SL-N-7Kanaighat				CG-N-2 Nabinagar		CG-N-25 Chatkhil	
						for Grond water system with IRP		for Surface water system					
Dia.	Tariff (TK/month)	Dia.	Tariff (TK/month)	Dia.	Tariff (TK/month)	Dia.	Tariff (TK/month)	Dia.	Tariff (TK/month)	Dia.	Tariff (TK/month)	Dia.	Tariff (TK/month)
1/2"	200	1/2"	300	1/2"	450	1/2"	500	1/2"	600	1/2"	350	1/2"	350
3/4"	300	3/4"	500	3/4"	800	3/4"	850	3/4"	900	3/4"	600	3/4"	450
1" (commercial)	500	1" (commercial)	800	1" (commercial)	1,500	1" (commercial)	1,500	1" (commercial)	1,500	1" (commercial)	1,000	1" (commercial)	1,000
Willingness to pay: 182.83 TK/month (98 % prefer flat rate) No metered rate specified. Average income: 21,119 TK/month		Willingness to pay 137.74 TK/Month (97 % prefer flat rate) 12.50 TK/m3 (3 %: metered rate) Average income: 17,315 TK/month		Willingness to pay: 153.17 TK/month (93 % prefer flat rate) 5 TK/m3 (7 % metered rate) Average income: 16,056 TK/month		Willigness to pay: 152.07 TK/month (88 % prefer flat rate) 5 TK/m3 (metered rate) Average income: 16,056 TK/month				Willigness to pay: 112.73 TK/month (90 % prefer flat rate) No metered rate specified. Average income: 15,316.73 TK/month		The amount of willingness to pay is not mentioned. 100 % prefer flat rate Average income: 19,049 TK/month	

BS-N-2 Muladi				BS-N-6 Mathbaria		KN-N-1 Alamdanga		KN-N-4 Manirampur		RJ-N-19 Shibganj		RJ-N-24 Godagari	
for Ground water system		for Surface water system											
Dia.	Tariff (TK/month)	Dia.	Tariff (TK/month)	Dia.	Tariff (TK/month)	Dia.	Tariff (TK/month)	Dia.	Tariff (TK/month)	Dia.	Tariff (TK/month)	Dia.	Tariff (TK/month)
1/2"	300	1/2"	400	1/2"	400	1/2"	150	1/2"	200	1/2"	200	1/2"	400
3/4"	500	3/4"	700	3/4"	700	3/4"	300	3/4"	300	3/4"	300	3/4"	600
1" (commercial)	800	1" (commercial)	1,500	1" (commercial)	1,000	1" (commercial)	500	1" (commercial)	500	1" (commercial)	800	1" (commercial)	1,500
Willigness to pay: 152.5 TK/month (100 % prefer flat rate) Average income: 13,817.88 TK/month				Willigness to pay: 209.62 TK/month (95 % prefer flat rate) No metered rate specified. Average income: 14,403 TK/month		Willigness to pay: 71.26 TK/Month (92 % prefer flat rate) 5.5 TK/m3 (metered rate) Average income: 11,648.15 TK/month		Willigness to pay: 79.31 TK/Month (99 % prefer flat rate) 6 TK/m3 (metered rate) Average income: 12,000 TK/month		Willigness to pay: 156.92 TK/month (for 3/4") (97 % prefer flat rate) 5.5 TK/m3 (metered rate) Average income: 10,291.27 TK/month		Willigness to pay: 84.92 TK/month (96 % prefer flat rate) 6 TK/m3 (metered rate) Average income: 11,922.72 TK/month	

* The amount of willingness to pay is for 1/2 " connection if not otherwise specified.

The willingness to pay is evaluated in the baseline survey; however it is not clear that the results are reflected to water tariff setting. The average water tariff is more than 2.5 times of the willingness to pay in the diameter 1/2" and four times in the diameter 3/4". Thus, more detail analysis and proposal for water tariff considering the sustainable O&M should be implemented in the M/P.

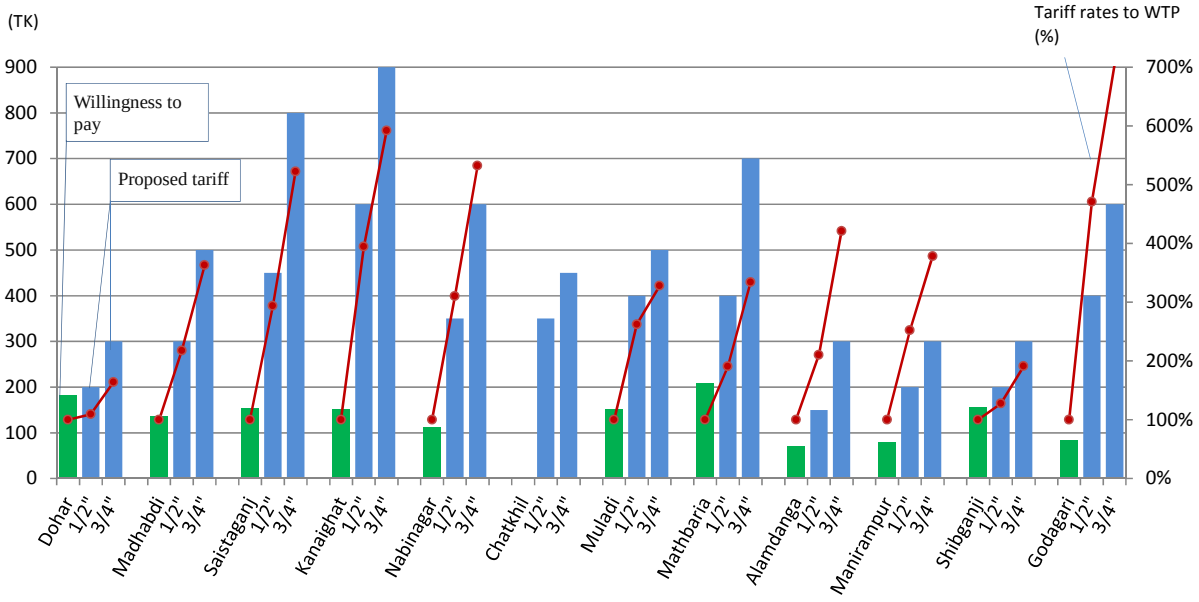

Figure 5.1 Comparison of Willingness to Pay and Proposed Water Tariff

According to the national policy, it is mentioned that "the transition from the current level of subscription to new rate of payment should be gradual and there should be a safety net for hard-core poor communities". In the M/P, no considerations is paid to gradual increase of water tariff and vulnerable people.

(3) No cost allocation for soft component

The total cost shown at this stage does not include any cost for training or other institutional support activities.

(4) Improvement regarding environmental and social considerations

The environmental and social considerations in the M/P should be improved in:

- Regarding to land acquisition, it is only mentioned that "the necessary land is limited and the procedures should be followed by laws of Bangladesh". The proposed location, land use and land owner are not described in the report.
- In Mathbaria, the SWTP is proposed outside of Mathbaria Pourashava boundary, but no description is found about it.
- By the field survey, the location of SWTP of Saistaganj will be the middle of the rice field and the impacts by land acquisition may occur. However no description is found.

- Alternative studies including with/without project analysis is not analyzed.
- The alternative of water source (groundwater or surface water) is studied but the environmental and social aspects are not considered.

5.3.5 Results of Review

In the review mentioned above, these mater plans have been prepared based on the insufficient data and analysis in planning, and the information required for implementation is not sufficient. In addition, several items to be reviewed in the contents of planning and designing are found. Therefore, if these master plans are materialized, more detailed studies shall be made including the necessity of piped water supply. The contents of detailed studies are listed below.

- Weighting in selection criteria
- Review of water demand
- Review of selection of water supply sources (including cost comparison)
- Study on alternatives for optimum water supply facility plan including optimum reservoir location
- Study on meter and unmetered tariff system (The master plan selected fixed tariff)
- Details of operation and maintenance
- Preparation of capacity development plan
- Study on willingness to pay and tariff design
- Calculation of financial and economic internal rate of return (FIRR, EIRR)
- Socio-economic environmental considerations on proposed facility sites.

Until now, master plans for 12 pourashavas have been formulated and continuously, 37 pourashava master plans will be prepared in this year. The master plan shall be prepared including the results of review mentioned above, if possible.

6. Assistance to Pourashavas by Donors and NGOs

A large number of assistances to the water supply sector in Bangladesh have been done by donors and NGOs organizations for several decades. The assistances have included diverse fields such as physical infrastructure project, organizational capacity building and policy aspects. The assistances by donors and NGOs are summarized and located in the Appendix C and the figure below.

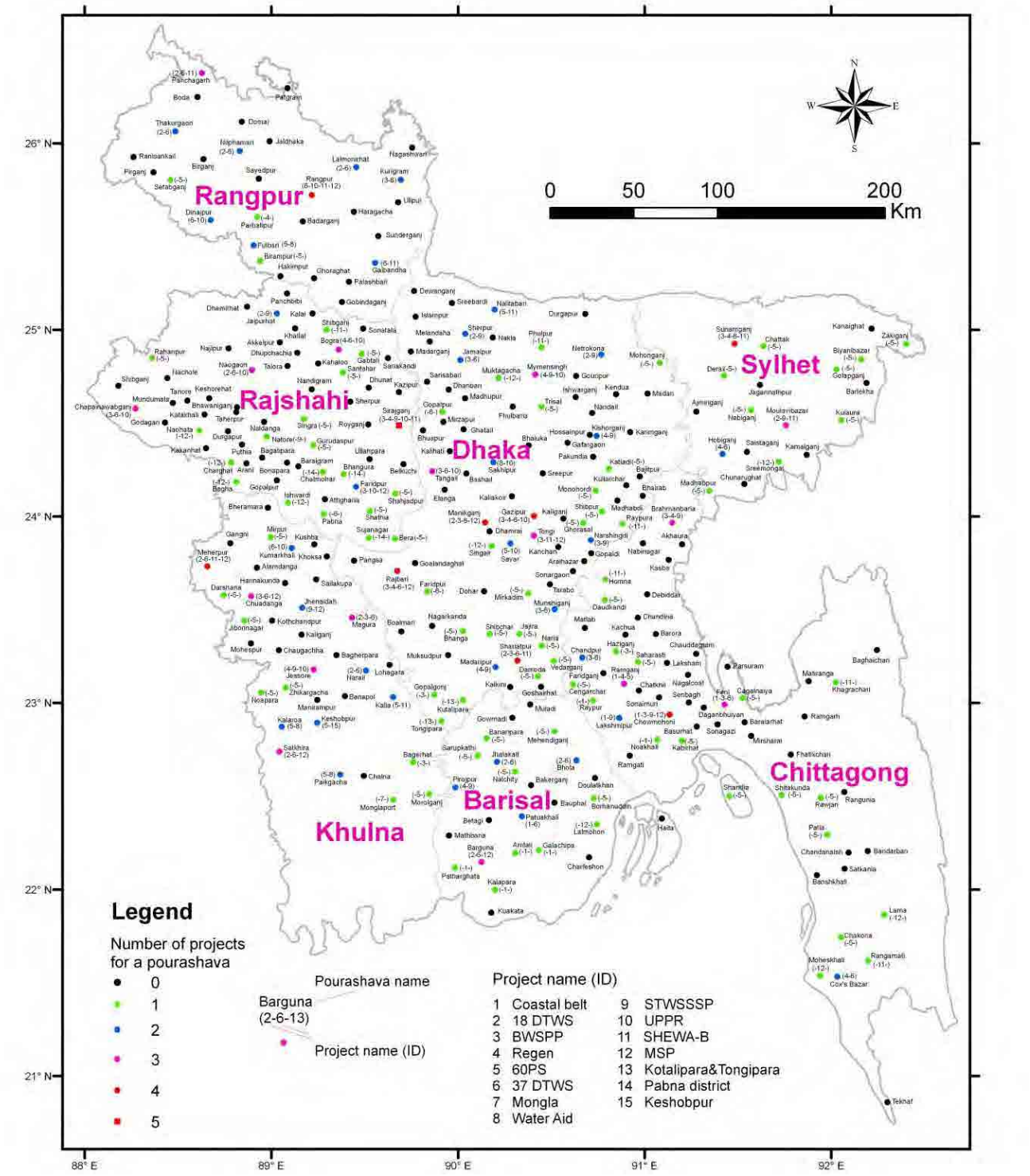

Figure 6.1 Pourashava Location of Donors and NGO Projects

7. Focus Areas for Works for Donor and Japanese Assistance

7.1 Challenges on Water Supply of Pourashavas

As a result of the Survey, main challenges can be summarized as follows so as to manage water supply services of pourashavas.

7.1.1 Water Resource Potential as Drinking Water Source

(1) Groundwater

- Development potential of groundwater more than 100 m depth in Rangpur division is none
- Development potential of groundwater more than 100 m depth in Rajshahi division is very low
- People in the west side of Rajshahi division have to depend mainly on shallow wells as drinking water sources due to geological reasons of hard rock layers and insufficient capacity of boring rig equipment which make impossible to dig deep wells successfully.

(2) Surface water

- It is difficult to utilize surface water sources in the southern coastal zone of Khulna, Barisal, and Chittagong divisions due to influence of water salinity.
- Potential for utilization of surface water is low due to no perennial river except for three major rivers such as Ganges river, the Brahmaputra river, and Meghna river flowing from India.

7.1.2 Water Quality

- Groundwater sources in the southern coastal zone areas contains high salinity concentration, therefore it is not suitable for drinking water source due to the difficulty of treatment by conventional treatment methods.
- High arsenic contamination in shallow aquifer tends to be found in the Dhaka, Chittagong and Khulna divisions.
- Drinking water source in deep well tends to contain less arsenic, but high iron and manganese.
- Water quality monitoring of supplied water to residents is rarely implemented in most pourashavas.

7.1.3 Water Treatment

- Pourashava staffs do not have sufficient basic knowledge on “water treatment”, thereby O&M is not appropriately done in most of pourashavas. Coagulant is rarely put in the treatment facilities and filter backwash method has not been established. .
- In general, iron concentration after AIRP/IRP is less than the allowable standard level of water quality, however manganese concentration is still higher than the allowable level due to low percentage of manganese removal. Even if the concentration does not exceed the standard level, appropriate O&M of AIRP/ IRP is hardly done by pourashavas.
- In overall, very limited pourashava implement disinfection with chlorination in water treatment of both groundwater and surface water. Even pourashava put chlorine in the water supply system, residual chlorine in pipe is rarely found. Also, pourashava people do not fully understand the importance of chlorination.
- There is no water quality guideline for raw water to judge the appropriateness in Bangladesh.

7.1.4 O&M of Water Supply Facilities

- Overall salient feature of O&M of water supply facilities is insufficient technical capacity of pourashava staff which leads to poor O&M.
- Technical knowledge and expertise on piped water supply facilities of civil, electrical and

mechanical engineers is very limited in non-piped pourashava, even these engineers generally exist in non-piped pourashava.
- Piped pourashavas face difficulties of O&M of well, pump, water treatment plant, pipeline, water meter without finding effective solutions and taking countermeasures in many cases.

7.1.5 Finance and Water Tariff

- In general, pourashavas do not have sufficient internal financial resources due to insufficient revenue from tariff collection.
- Sufficient budget allocation to water supply sector largely depends upon the understanding of the importance of the mayor and pourashava staffs even if water supply and sewerage section is institutionalized.
- Water revenue is utilized for development sources for other sectors because water supply service is not financially autonomous in some pourashavas.
- Water tariff tends to become a political and sensitive issue in piped pourashavas, the tariff rates level are kept artificially low in some pourashavas.
- The accountants specialized in water accounting works do not exist. Thus, the specialized expertise and knowledge seem not to be accumulated and the application of double-accounting system is limited.

7.1.6 Organization

- There is no specialized staff in water supply service in most of non-piped pourashavas; therefore the specialized knowledge on water service is not accumulated and institutional capacity is not fully established. The first step for these pourashavas is to institutionalize water and sewerage section and assign necessary staff.
- Recruitment system of staff for water supply section and assignment of positions are inflexible. For efficient works for water service, it would be necessary for pourashava to employ additional contract-based staff responding to actual workload.
- The sustainability of water service management largely rely upon leadership capability of the mayor and his/her understanding on the importance of piped water supply system.

7.1.7 Consideration of Poor People and Socially Vulnerable People, and Social Responsibility

- In overall pourashavas have no strong sense of responsibility and roles for water service regardless of piped water supply system. To foster the sense of responsibility and awareness that pourashava has a responsibility for provision of basic human needs which directly influence local people's lives is an essential element.
- Some piped pourashavas tend to put their priorities on "profitability" rather than "publicness". Public water supply service should benefit not only a limited part of rich people but also poor people and socially vulnerable people. It is crucial challenge for piped pourashavas to take a balance between "profitability" and "publicness".

7.1.8 Assistance from DPHE and Capability for Technical Support

- DPHE hardly provides any particular follow up assistance to pourashavas after handing over water facilities. If problems occur, pourashava may ask for advice and consultation to DPHE in some cases, their opportunities to receive technical supports and training for capacity building are few.
- DPHE has some resource persons at management level who can provide technical training, it can be said that the support capability is limited in the frequency, the training fields and the level of speciality.

7.2 Identification of Pourashavas Hard to Access to Safe Water

7.2.1 Evaluation Criteria

Shallow groundwater is exposed to severe arsenic contamination and the yield of the wells is too small to cater the large water demand for urban cities in Bangladesh. On the other hand, deep groundwater is advantageous in terms of the following points:

- Deep groundwater is available throughout Bangladesh expect in some small areas
- Decrease of groundwater level due to excessive intake is not seen except for in the areas of Dhaka and Tongi.
- Deep groundwater has much less arsenic contamination than shallow groundwater.
- Deep groundwater has high iron and manganese contents but these can be treated at conventional treatment technology.
- If there is no problem in water quality such as arsenic and salinity, deep groundwater can be used for drinking purpose at low treatment cost and by adequate technology

Therefore, deep wells are recommendable for water supply source if available.

In evaluating deep groundwater as water supply source, the seriousness in terms of water quality is greater at following order:

1. High salinity (To remove this content, the cost of technology is quite high and it may not be feasible to utilize this treatment option for most of the pourashavas considering the Bangladesh's economic conditions).
2. High concentration of arsenic (This is problematic contents but it can be treated along with iron by AIRP).
3. High concentration of iron and manganese (IRP is required for removal).

If the deep groundwater is not feasible in terms of water quality in some pourashavas, surface water must be used for water supply source. However, the seriousness of problems is greater at the following order when river water is used for drinking water source:

1. There is no perennial river nearby pourashava.
2. There is a perennial river within reasonable distance from pourashava but the river water contains high salinity.
3. The river water is polluted by human waste such as sewerage and industrial wastewater.

A flowchart for selection of water resources and level of hard to access to safe water by pourashavas are shown as follow.

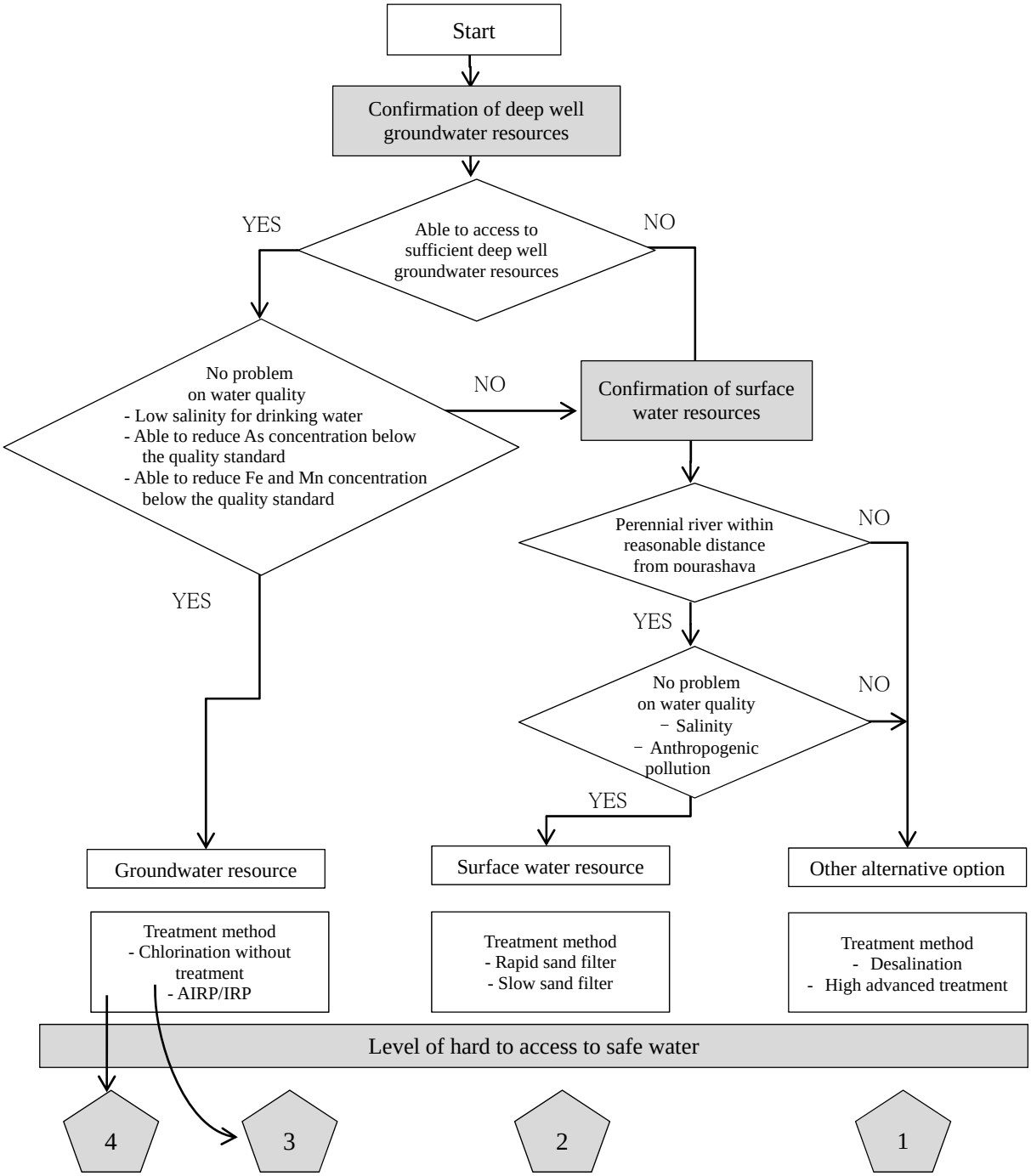

Figure 7.1 Flowchart for Selection of Water Resources and Level of Hard to Access to Safe Water

Considering the problems of surface and groundwater mentioned above comprehensively, the evaluation criteria for seriousness of pourashavas hard to access to safe water are established as follow:

Table 7.1 Evaluation Criteria for Seriousness of Pourashavas Hard to Access to Safe Water

Seriousness		Criteria
1	Case 1 (1-1)	Drinkable water can't be produced by conventional treatment due to high salinity groundwater in deep well and no perennial river nearby pourashava.
	Case 2 (1-2)	Drinkable water can't be produced by conventional treatment due to high salinity groundwater in deep well and in perennial river.
2	-	Drinkable water can be produced by conventional surface water treatment due to available perennial river nearby pourashava, even if high salinity can be seen in groundwater of deep well.
3	Case 1 (3-1)	AIRP treatment is necessary due to high arsenic, high iron and high manganese contamination in groundwater of deep well.
	Case 2 (3-2)	AIRP treatment is necessary due to high arsenic contamination in groundwater of deep well.
	Case 3 (3-3)	IRP treatment is necessary due to high iron and high manganese contamination in groundwater of deep well.
4	-	Drinkable water can be produced only by chlorination treatment of groundwater in deep well..

7.2.2 Identification of Pourashavas Hard to Access to Safe Water

Based on the criteria established above, the seriousness of access to safe water is evaluated. The used data for evaluation are as follows:

- Results of pourashava questionnaire survey in terms of development potential of water resources
- Pourashava water quality database prepared in this Survey

(1) Hard to access to safe water

The results of evaluation are summarized in the table below showing pourashavas hard to access to safe water with seriousness. Information of past and/or on-going project and the simplified financial indicators[5] are also included as reference in the table.

*[2, 3] 2 indicators regarding revenue account of pourashava are selected because revenue account may reflect fund-raising capacity of pourashava. "Ratio of revenue to expenditure" indicates a balance between revenue and expenditure of revenue account. "Average revenue amount per capita" gives us information on the appropriateness of revenue scale. It will be considered the higher the 1st indicator, the larger the 2nd indicator, the better the performance is.

Ratio of revenue to expenditure	= Revenue / Expenditure	1.11 (average of available data)
Average revenue amount per capita	= Revenue / Pourashava population	492 (average of available data)

Table 7.2 Pourashavas Hard to Access to Safe Water

Division	District	Pourashava	Water quality problem in DTW[*1]			River		Past or/ and on-going project	Financial situation	
			Salinity	As	Fe	Perennial river	Salinity in perennial river		Rev./ Exp Ratio[*2]	Rev. amount per capita[*3] (TK)
Seriousness 1										
Piped										
Dhaka	Gopalgonj	Kutalipara	○		○			-	1.19	441
Barisal	Barguna	Barguna	○		○	○	○	18 DTWS MSP	0.23	715
Khulna	Meherpur	Meherpur	○	○	○			18 DTWS, 37 DTWS, SHEWA-B, MSP	0.96	392
Non-piped										
Dhaka	Faridpur	Nagarkanda	○		○			-	1.13	372
Dhaka	Madaripur	Shibchar	○		○			60PS	1.32	685
Barisal	Patuakhali	Kuakata	○		○	○	○	-	ND	ND
Barisal	Patuakhali	Kalapara	○		○	○	○	Coastal belt	0.95	586
Khulna	Jessore	Manirampur	○		○			-	1.15	297
Khulna	Satkhira	Kalaroa	○	○	○			60PS WaterAid	1.25	260
Chittagong	Cox's Bazar	Moheskhali	○		○			MSP	0.59	560
Chittagong	Noakhali	Senbagh	○		○			-	0.99	542
Chittagong	Noakhali	Hatia	○	○	○	○		-	1.05	35
Seriousness 2										
Piped										
Dhaka	Shariatpur	Damoda	○			○	○	60PS	1.11	405
Dhaka	Madaripur	Madaripur	○			○	○	Regen. STWSSSP	1.08	290
Dhaka	Shariatpur	Naria	○			○	○	60PS	1.00	220
Barisal	Gouranadi	Gouranadi	○			○	○	-	1.01	504
Barisal	Pirojpur	Pirojpur	○			○		Regen. STWSSSP	1.08	929
Barisal	Jhalakati	Jhalakati	○			○		18DTWS, 37DTWS	0.94	121
Non-piped										
Dhaka	Shariatpur	Goshairhat	○		○	○		-	ND	ND
Barisal	Barisal	Muladi	○			○		-	1.25	337
Khulna	Jessore	Benapol	○			○		-	1.08	464
Khulna	Jessore	Bagherpara	○			○		-	1.04	421
Seriousness 3 (Arsenic contamination exceeds the standard)										
Piped										
Dhaka	Kishorganj	Bhairab		○				-	1.09	443
Khulna	Satkhira	Satkhira		○	○			18DTWS, 37DTWS, MSP	1.26	350
Khulna	Chuadanga	Chuadanga		○	○			BWSPP, 37DTWS, MSP	1.16	205
Chittagong	Noakhali	Kabirhat		○				60PS	1.04	249
Sylhet	Sunamganj	Sunamganj		○				BWSPP, Regen, 37DTWS, SHEWA-B	0.20	563
Rajshahi	Sirajganj	Shahjadpur		○				60PS	1.11	197
Non-piped										
Khulna	Chuadanga	Jibonnagar		○				60PS	1.00	207
Khulna	Jessore	Chaugachha		○				-	0.90	410
Sylhet	Sunamganj	Chattak		○				60PS	0.95	246
Sylhet	Sylhet	Kanaighat		○				-	0.55	46
Seriousness 3 (Especially high iron contamination)										
Piped										
Chittagong	Noakhali	Noakhali			○			Coastal belt	1.01	484
Chittagong	Cox's Bazar	Cox's Bazar			○			Regen, 37DTWS	1.70	480
Non-piped										
Dhaka	Narayanganj	Gopaldi			○			-	ND	ND
Chittagong	Noakhali	Sonaimuri			○			-	1.08	807
Chittagong	Chittagong	Banshkhali			○			-		
Sylhet	Sylhet	Kanaighat			○			-	0.55	46
Sylhet	Moulavibazar	Barlekha			○			-	1.11	1059

Division	District	Pourashava	Water quality problem in DTW[*1]			River		Past or/ and on-going project	Financial situation	
			Salinity	As	Fe	Perennial river	Salinity in perennial river		Rev./ Exp Ratio[*2]	Rev. amount per capita[*3] (TK)
Sylhet	Sunamganj	Jagannathpur			○			-	1.00	283
Sylhet	Sylhet	Biyanibazar			○			60PS	0.89	293
Sylhet	Sylhet	Golapganj			○			60PS	1.00	575
Rajshahi	Bogra	Sherpur			○			-	0.95	456
Rangpur	Gaibandha	Palashbari			○			-	ND	ND

*1 DTW --- Deep Tube Well, *2 Rev./ Exp Ratio --- Ratio of revenue to expenditure
*3 Rev. amount per capita --- Average revenue amount per capita (TK)
<Project>

Coastal belt:	Water Supply and Sanitation in Coastal Belt Project, 1997-2008
18 DTWS:	18 District Town Water supply by Dutch Embassy, 1996-1999
BWSPP:	Bangladesh Water Supply Program Project, 2005-2010
Regen :	Repair, Rehabilitation and Development of Water Supply system in Pourashavas including regeneration of Production Tube Wells, 1997-2008
60PS:	Environmental sanitation and Water Supply with Piped Network in Thana Sadar and Growth Center Pourashavas, 1st Phase, 2000-2008
37 DTWS:	37 District Towns Water Supply Project, 2010-2014
STWSSP:	Secondary Towns Water Supply and Sanitation Sector Project, 2007-2013
SHEWA-B:	Sanitation Hygiene, Education & Water, 2007-
MSP :	Municipal Services Project, Phase I: 1999-2011, Additional: 2011-2012

(2) Hard to access to safe deep groundwater

In addition, pourashavas hard to access to deep groundwater is evaluated and identified as shown in table below based on development potential of deep groundwater discussed in the chapter 2.

Table 7.3 Pourashavas Hard to Access to Safe Deep Groundwater

Criteria	Region	Pourashava in the Region
Deep water development more than 100 m is not possible due to rock formation	Most of Rangpur division	Panchagarh, Palashbari, Badarganj, Birganj, Pirganj, Ranisankail, Jaldhaka, Domar, Nagashwari, Ulipur, Boda, Patgram, Setabganj, Fulbari, Thakurgaon, Sayedpur, Nilphamari, Kurigram, Lalmonirhat
Low development potential of deep groundwater more than 100 m	Western part of Rajshahi	Bogra, Dhupchachia, Shibganj, Jaipurhat, Panchbibi, Akkelpur, Kalai, Khatlal, Dhamirhat, Naogaon, Najipur, Chapainawabganj, Rahanpur, Shibganj, Nachole, Taherpur, NaohataTanore, Bhawaniganj, Kakanhat, Katakhali, Arani
	Dhaka	Kaliakoir, Gazipur
	Sylhet	Kanaighat, Nabiganj , Barlekha, Kulaura, Jagannathpur, Habiganj
	Chittagong	Bandarban, Haziganj, Lama, Rangunia, Rawjan, Teknaf, Cagalnaiya, Lakshmipur, Chowmohoni, Baghaichari
	Barisal	Patharghata
	Khulna	Monglaport, Benapol, Satkhira
	Rangpur	Gaibandha

7.3 Focus Areas for Works for Donor Assistance and Assistance Needs

7.3.1 Focus Areas for Assistance and Assistance Needs based on Questionnaire Survey Results

Priority needs, challenges for O&M, and training needs were interviewed to pourashavas. Based on their answers, evaluation of focus areas for donor assistance was done by the JICA survey team.

Focus areas for donor assistance are categorized into: (A). improvement of water service, (B). improvement of O&M, (C). improvement of financial management, and (D). capacity development. In the evaluation, the answer results of priority needs mainly reflect to the focus areas for donor assistance. Evaluation results of focus areas for donor assistance are shown as follow.

Table 7.4 Focus Areas for Works for Donor

Large category/ Small category	Priority needs for improvement[*1]	For reference[*]		Evaluation of focus areas for donor assistance[*2]
		Challenge of O&M	Training needs	
(A). Improvement in water supply service				
- 24-hours supply	16	―	―	△
- Increase of water pressure	22	―	―	△
- Increase of production capacity	64	52	―	◎
- Expansion and replacement of distribution network	39	―	―	◎
- Improvement of water quality	17	38	―	○
- Water quality monitoring	5	―	―	
(B). Improvement of Operation and Maintenance				
1.O&M（production well and pump）	37	119	―	◎
Mechanical and electrical works	―	―	107	
2.O&M（water treatment plant）	18	―	89	○
3.O&M（distribution network）	32	115	―	◎
Flow monitoring（bulk meter and recording）	1	―	―	
4.Leakage control	8	―	111	◎
Plumbing works	―	―	117	
5.O&M（house connection and water meter）	24	71	81	◎
(C). Improvement of Financial Management				
1.Non-Revenue Water reduction	10	―	92	○
2. Installation of customer meter	9	―	―	△
3.Cost recovery and increase of water tariff	9	―	―	△
4.Improvement of billing and collection practice	2	―	98	○
(D). Capacity building				
1.Capacity building of staffs	15			◎
2.Top management			71	○

[*1] The number value indicated in table are the number of answers from pourashavas.
[*2] Level of importance ◎ --- High, ○--- Middle, △ --- Relatively low

A-3: Increase of production capacity
The highest priority was given to this area within the priority needs. Water supply coverage of pourashava still remains low at 30.5%. Strong needs of pourashavas on safe water supply by developing piped system can be seen. The importance of increase of production capacity is high in order to meet local people's needs paticularly in non-piped pourashavas.

A-4: Expansion and replacement of distribution network
Second priority was given to this area within the priority needs. Same as above, water supply demand is high in the non-piped areas of pourashava, expansion and replacement of distribution network is highly important from donor assistance.

B-1: O&M（production well and pump） and Mechanical and electrical works
Third priority was given to this area within the priority needs. This is the most frequent answered issue in the main challenges of O&M. Particularly “decrease of production capacity” and “motor damage of pump” etc. are raised as urgent problems. Also second priority was given to this area within the training needs.

B-3: O&M （distribution network） and Water flow monitoring (bulk metering and recording)
Fourth priority was given to this area within the priority needs. This is the second most frequent answered issue in the main challenges of O&M. Particularly “decrease of production capacity” and “motor damage of pump” etc. are raised as an urgent problem. Also second priority was given to this area within the training needs.

B-4: Leakage control and plumbing works of distribution network
First priority was given to this area within the training needs. Current average number of annual leakage points in distribution network accounted for 4.9 points per km, thus further improvements in this area is necessary.

B-5: O&M（house connection and water meter）
Fifth priority was given to this area within the priority needs. In addition, this is the third most frequently answered issue in the main challenges of O&M and the training need can be seen. The O&M of house connection and water meter will increase the importance along with expansion of distribution network for raising water supply coverage in near future.

D-1: Capacity development of pourashva staff members (overall capacity building including A,B, C)
The importance and the contents seems to be not fully understood by pourashava side, however the importance can be evaluated at high according to site surveys by the Survey Team and exchange of opinion with donor agencies. Since accumulation of specialized knowledge and expertise on O&M of water facilities and public waterworks are particularly very limited in non-piped pourashava, the basis is very weak.

7.3.2 Assistance Needs and Focus Areas for Water Supply Facility Development

The pourashavas that are hard to access to safe water are identified in 6.2. The assistance needs for supply of safe water to these pourashava are apparently very high. Out of these pourashavas, the non-piped pourashavas have the highest needs.

The treatment technologies of iron and manganese contents have not yet been established in Bangladesh and treatment needs of higher concentration of iron and manganese seem not currently so high. However, as piped water supply using deep groundwater increases and the importance of water quality is more acknowledged, these technological needs in terms of design and O&M will increase in near future. Therefore, the needs of improvement of current technologies would be high when these technologies are adapted to the pourashavas that will develop water supply system using groundwater source.

According to the water policy in Bangladesh, higher priority for drinking water source is given to surface water. Therefore, surface water treatment facilities would increase more in future and the needs of assistance to surface water treatment will increase.

From the view point of development potential of deep groundwater, there are rocky areas hard to assess to deep groundwater and the areas that development potential of deep groundwater is low. The former area is mainly Rangpur and the latter area is Rajshahi, Chittagong, and so on. The needs of assistance to these areas are also high.

Considering above, options for assistant needs related to development of water supply facilities are summarized as follows:

Option 1: Assistance to pourashavas hard to access to safe water (the areas requiring desalination)

- Feasibility study including detailed study on alternative water sources and treatment method

Option 2: Improvement of iron and manganese treatment technologies, the needs of which will be expected to be higher in future although the current seriousness is not higher

- Improvement of O&M of existing IRP
- Construction of iron and manganese removal facilities using adequate design and assistance to O&M of constructed facilities

Option 3: Assistance to development of water supply system using surface water treatment technologies consistent with priority water source of the water policy in Bangladesh

- Improvement of O&M of existing surface water treatment plants
- Construction of surface water treatment facilities using adequate design and assistance to O&M of constructed facilities

Option 4: Assistance to pourashavas hard to dig deep well due to rocky formation or less development potential of deep groundwater

- Technology transfer on survey methodology for deep well
- Technology transfer on drilling technologies and procurement of advanced drilling machine

7.4 Focus Areas for Works for Japanese Assistance

In addition to evaluation of focus areas for donor assistance mentioned in previous section, focus areas for Japanese assistance was evaluated considering areas of Japan's ODA experience, Japanese support experiences in Bangladesh, and focus areas of foreign assistance. Evaluation results are shown below:

Table 7.5 Focus Areas for Japanese Assistance

Large category/ Small category	Evaluation of focus areas for donor assistance *	Assistance areas by other donors	Japan's ODA Experience	Japanese experience of assistance in Bangladesh	Evaluation of focus areas for Japanese assistance *
A. Improvement in water supply service					
1. 24-hours supply	△				△
2. Increase of water pressure	△		△		△
3. Increase of production capacity	◎	○	○	○	◎
4. Expansion and replacement of distribution network	◎	○	○	○	○
5. Improvement of water quality Water quality monitoring	○		○	○	◎
6. Provision of boring equipment for deep well			○	○	◎
B. Improvement of Operation and Maintenance					

Large category/ Small category	Evaluation of focus areas for donor assistance *	Assistance areas by other donors	Japan's ODA Experience	Japanese experience of assistance in Bangladesh	Evaluation of focus areas for Japanese assistance *
1. O&M（production well and pump） Mechanical and electrical works	◎	○	△		△
2. O&M（water treatment）	○	○	○		◎
3. O&M（distribution network） Water flow monitoring（bulk meter and recoding）	◎	○	○		◎
4.Leakage control Plumbing works	◎		○	○	◎
5.O&M（house connection and water meter）	◎	○			△
C. Improvement of Financial Management					
1.Non-Revenue Water reduction	○		◎	○	◎
2. Installation of customer meter	△	○			△
3.Cost recovery and increase of water tariff	○	○	○		○
4.Improvement of billing and collection practice	○	○	○		○
D. Capacity building					
1.Capacity building of staffs	◎	○	○	○	◎
2.Top management	○				△

* Level of importance ◎ --- High, ○ --- Middle, △ --- Relatively low

Main options for Japanese assistance for development of piped water supply can be summarized as follows.

Table 7.6 Main Options for Japanese Assistance

Category	Assistance Needs	Assistance areas with comparative advantage of Japan	Japanese experience of assistance in Bangladesh	Evaluation of focus areas for Japanese assistance*
E	Assistance to pourashavas hard to access to safe water with the highest seriousness - Feasibility study including detailed study on alternative water sources and treatment method	◎	△	◎
F	Improvement and optimization of iron and manganese treatment technologies, the needs of which will be expected to be higher in future although the current seriousness is not higher - Assistance to improvement of O&M of existing facilities - Assistance to new facility construction with appropriate design and appropriate O&M methods	△	○	○
G	Assistance to development of water supply system using surface water treatment technologies consistent with priority water source of the water policy in Bangladesh - Improvement of O&M of existing surface water treatment plants - Construction of surface water treatment facilities using adequate design and assistance to O&M of constructed facilities	○	△	○
H	Assistance to pourashavas hard to dig deep well due to rock for - Technology transfer on survey methodology for deep well - Technology transfer on drilling technologies and procurement of advanced drilling machine mation or less development potential of deep groundwater	◎	○	◎

* Level of importance ◎ --- High、○ --- Middle、△ --- Relatively low

A-3: Increase of production capacity
Japanese assistance has implemented much new construction of water treatment plant and expansion project in many developing countries through ODA for long years. If these experiences are continuously utilized, it will be expected to make assistance more effective.

A-4: Expansion and replacement of distribution network
Comparative advantage cannot be particularly seen in this area; however this area will need to be implemented together with the above increase of production capacity.

A-5: Improvement of water quality and water quality monitoring
Japan has experienced knowledge and expertise in this area, and has provided much assistance through ODA. While, other other's activities are relatively limited to water safety plan, promoted by WHO. Therefore it could be said that high importance will be given to this area for Japanese assistance. In past JICA technical cooperation project on water quality monitoring, it has supported for Manikganj pourashava, and some key good element to be possibly disseminated to other pourashava has been identified. It will be an effective way to continuously assist this capacity building and enhance their capability, eventually can disseminate the good practice to other pourshavas like from a point to an area.

A-6: Provision of boring equipment for deep well
DPHE has boring equipment for development of deep wells, however the sufficient capacity is not ensured due to the aged equipment. Japan has planned assistance to this area considering the above circumstance in Bangladesh. Also this Survey reveals that some pourashavas in the north-western region face a difficulty to access to safe drinking water source from deep wells due to lack of boring equipment with sufficient capacity to drill gravel and rock layers. It could be significant for Japanese government to assist this area with high importance because groundwater resources are recognized as a main source in Bangladesh However, if effective technical transfer of drilling technology and O&M is conducted to DPHE, similar assistance may not be immediately necessary. It is crucial to observe the progress of the project planned carefully and evaluate the further necessity.

B-2: O&M (water treatment plant)
Japan has highly advanced and experienced knowledge and expertise in water treatment such as iron and manganese. Japan has provided assistance on O&M of water treatment plant through technical cooperation project and ODA loan project. Thus it could be said that high importance will be given to this area for Japanese assistance.

B-3: O&M (distribution network) and water flow monitoring (bulk meter and recording)
Japan has experienced knowledge and advanced expertise in the area of O&M of distribution network including water flow monitoring, thus it could be fair to say that an importance will be given to this area for Japanese assistance.

B-4: Leakage control and plumbing works of distribution network
This area is relevant to B-3, Japan has relatively large assistance experiences in this area through ODA. Japanese assistance experience of this area also can be seen in the on-going technical cooperation project aiming reduction of non-revenue water in CWASA.

C-1: Reduction of Non-Revenue Water
As mentioned before, Japan has experienced knowledge and advanced expertise not only in this technical area but also in waterworks management including improvement of financial management. Japanese assistance experience of this area in Bangladesh also can be seen in the on-going project of reduction of non-revenue water in CWASA. In the project, some countermeasures such as leakage detection, pipeline repair, replacement of malfunctioned meters, mitigation of illegal connection have been implemented for the reduction of non-revenue water. Thus it could be said that high importance

will be given to this area for Japanese assistance.

D-1: Capacity building of staff members
This assistance intends to plan capacity building of staff members in all areas of the above A –C. Recently the experience of ODA through a technical cooperation project are accumulated increasingly. It is essential to enhance specialized knowledge and expertise on O&M of facilities and waterworks targeting not only pourashava people but also DPHE employees. Japan has extended many ODA assistances to this country, thereby it is possible to build capacity and enhance institutionalization by using accumulated network and resources. The importance and the priority are high.

E: Assistance to the most difficult pourashavas to access to safe water with development of water facilities (desalination plant)
Desalination technology of Japan in water treatment has a comparative advantage in the world, it could be fully utilized in Japanese assistance. On the other hand, since the O&M cost is generally high, the application of this technology to Bangladesh as a developing country should be determined after careful and sufficient implementation of the feasibility study.

H: Assistance to difficult pourashavas to access to sa water due to a difficulty of drilling deep wells and low groundwater development potential
High need has been already presented by GoB, Japan has launched a study for provision of boring equipment. Continuous support of this assistance is expected.

7.5 Required Capacity Building for Pourashavas

7.5.1 Necessary Training Field for Capacity Building

(1) Capacity building of pourashavas for water service management

In order to manage public water supply service responsively, capacity building in the various aspects of technical, institutional, managerial, financial, public and social, and mind-set will be necessary for pourashava personnel. It will inherently take time to develop capacity, and it could be not an exaggeration to say that pourashava need to start their service from almost zero point. Therefore it will be essential to set up targets in the short term-, medium-term and long-term, and enhance their capacity in a planned and sustainable manner.

The necessary training fields in overall and the priority are shown as the following table. The priority is given as reference to be utilized for the target setting in short-term, medium-term and long-term and for the planned capacity building.

Table 7.7 Proposed Necessary Training Fields and Topics for Pourashava

Fields		Required sub-fields and topics for capacity building and training	Priority		
Technical	1.	Basics of public water supply service and responsibilities of pourashava	A		
	2.	Basics of water supply infrastructure	A		
	3.	Pipeline installation and plumbing works	A		
	4.	House connection installation	A		
	5.	Water meter installation	A		
	6.	Basics and Operation & Maintenance (O&M) - Production tube well - Pump and motor - Overhead Tank - Pipeline, Water network maintenance - Water treatment plant (SWTP, IRP, AIRP) - Water meter (bulk and house meters)	A		
	7.	Distribution system management		B	
	8.	Water leakage detection and repair		B	
	9.	Water quality management and monitoring, water safety plan	A		
	10.	Water treatment and chlorination	A		
	11.	Groundwater resource management and hydrogeology		B	
	12.	Geographical Information system (GIS)			C
	13.	Performance indicators and benchmarking			C
Institutional	14.	Local government acts/ ordinances/ regulation on water sector	A		
	15.	Institutional development, TLCC & WATSAN	A		
	16.	Good governance and anti-corruption		B	
	17.	Office and personnel management			C
	18.	Human resource development plan			C
Managerial	19.	National policies, strategies in water sector	A		
	20.	PPP and other developing trends in water supply system management			C
	21.	Planning and development, water sustainability plan	A		
	22.	Quality management		B	
	23.	Performance monitoring and evaluation			C
	24.	Public procurement management and supervision		B	
	25.	Basic computer literacy		B	
	26.	Occupational health safety			C
Financial	27.	Water balance and Non-Revenue Water		B	
	28.	Double-entry accounting system	A		
	29.	Budgeting and auditing			C
	30.	Water billing and tariff collection	A		
	31.	Water meter reading and recording	A		
	32	Water tariff setting and cost analysis	A		
	33.	Asset management		B	
Public and Social	34.	Hygiene promotion and awareness raising	A		
	35.	Customer satisfaction on water supply service and public relation		B	
	36.	Social responsibility and accountability		B	
	37.	Socio-economic situation and water tariff	A		
	38.	Participatory development, gender development		B	

(2) Training Mechanism and Collaboration

The training mechanism can be designed by dual training components; (1) cascade-type training through Training of Trainers (ToT) for DPHE personnel and (2) direct training for DPHE personnel. The subjects of general concepts and basic knowledge are assumed to develop capacity of pourashava personnel through ToT fro DPHE personnel. High technical issue, high computerized issue, specialized expertise and practical know-how will be enhanced by direct training by technical

cooperation consultants and other relevant agencies in a collaborative way.

Pourashava personnel as trainees will be grouped into nine based on their regional distribution. Training will be implemented by using the nine regional DPHE training centers which will be established. The idea of training mechanism for the capacity building is shown as the following figure.

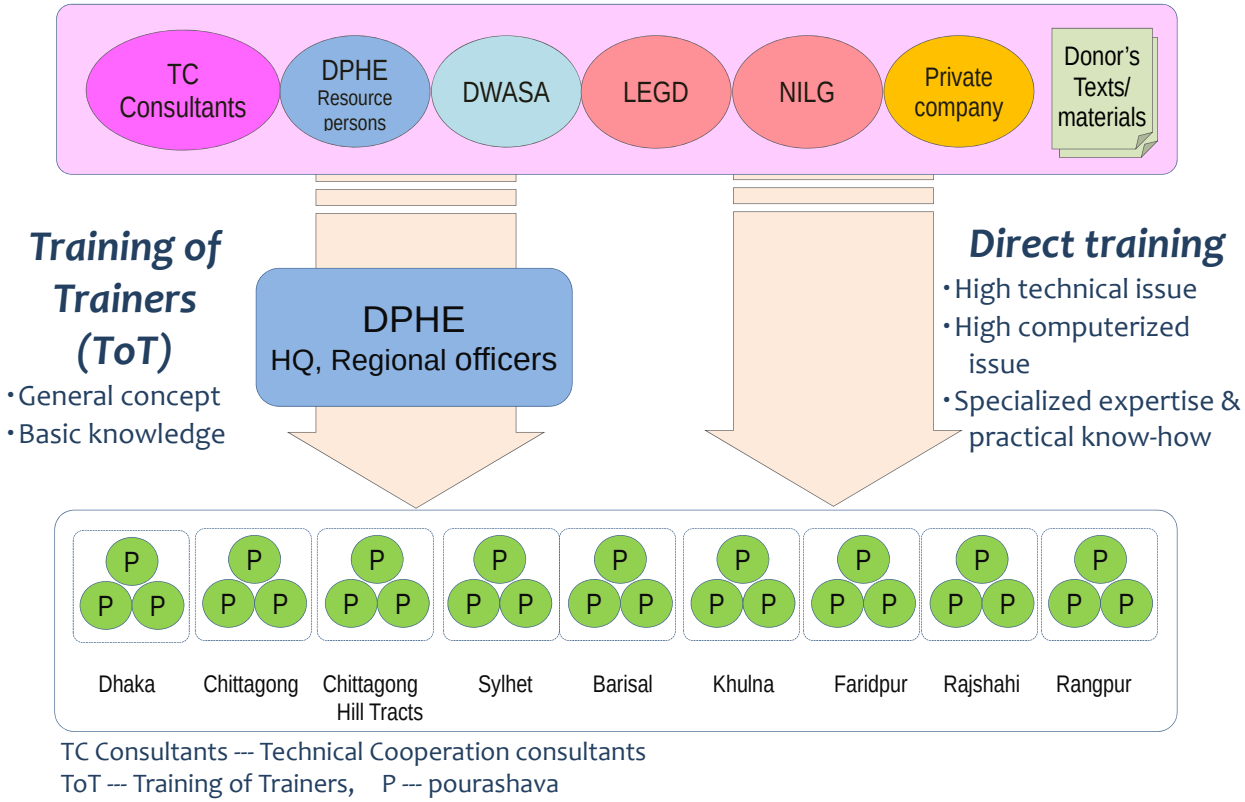

Figure 7.2 Training Mechanism for Capacity Building of Pourashava Personnel

Appendix

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Appendix A

Surface Water Available Pourashava
and
Pourashava with Surface Water not Available or Need to be Confirmed

1. Surface Water Available Pourashava

Division	District	Pourashava	Distance	Perennial river
Barisal	Barguna	Amtali	1.5	Garachipa
Barisal	Barisal	Bakerganj	0.2	Rajaganj
Barisal	Barisal	Gowrnadi	0.5	Athorabank
Barisal	Barisal	Banaripara	1.5	Katecha
Barisal	Barisal	Muladi	4	Jayanti
Barisal	Jhalakati	Nalchity	0.5	Bishkhali
Barisal	Jhalakati	Jhalakati	0.5	Bishkhali
Barisal	Patuakhali	Patuakhali	1	Garachipa
Barisal	Patuakhali	Galachipa	1.5	Garachipa
Barisal	Patuakhali	Bauphal	4	Tentulia
Barisal	Pirojpur	Pirojpur	0.5	Katecha
Barisal	Pirojpur	Sarupkathi	1	Katecha
Chittagong	Bandarban	Bandarban	0.1	Sangu
Chittagong	Brahmanbaria	Brahmanbaria	0.2	Titas
Chittagong	Brahmanbaria	Kasba	0.3	Sonia
Chittagong	Brahmanbaria	Nabinagar	1.5	Meghna
Chittagong	Brahmanbaria	Akhaura	2	Agartala
Chittagong	Chandpur	Chandpur	0.5	Low Meghana
Chittagong	Chandpur	Matlab	0.9	Low Meghana
Chittagong	Chandpur	Cengarchar	3	Low Meghana
Chittagong	Chittagong	Satkania	0.5	Tankabati
Chittagong	Chittagong	Fhatikchari	1	Halda
Chittagong	Chittagong	Patia	1.5	Karnafuli
Chittagong	Chittagong	Rawjan	10	Karnafuli
Chittagong	Chittagong	Chandanaish	10	Sangu
Chittagong	Comilla	Homna	0.1	Meghna
Chittagong	Comilla	Debiddar	0.5	Gumti
Chittagong	Cox's Bazar	Chakoria	0.5	Matamuhuri
Chittagong	Cox's Bazar	Cox's Bazar	4	Matamuhuri
Chittagong	Khagrachari	Ramgarh	0	Halda
Chittagong	Rangamati	Rangamati	0	Matamuhuri
Dhaka	Dhaka	Savar	1.3	Dhaleswari
Dhaka	Dhaka	Dhamrai	3	Dhaleswari
Dhaka	Dhaka	Dohar	7	Padma
Dhaka	Faridpur	Nagarkanda	0.2	Old Kumar
Dhaka	Faridpur	Faridpur	0.2	Old Kumar
Dhaka	Faridpur	Bhanga	0.3	Arial Khan
Dhaka	Faridpur	Boalmari	1	Garai Modhumati
Dhaka	Gazipur	Kaliganj	0.3	Banar
Dhaka	Gazipur	Kaliakoir	1.5	Turag
Dhaka	Gazipur	Sreepur	7	Turag
Dhaka	Gopalganj	Kutalipara	1	Athorabank
Dhaka	Gopalganj	Muksudpur	10	Old Kumar
Dhaka	Jamalpur	Jamalpur	2	Old Brahmaputra
Dhaka	Jamalpur	Sarisabari	4	Jhinai
Dhaka	Jamalpur	Islampur	7	Old Brahmaputra
Dhaka	Kishorganj	Kuliarchar	0.2	Meghna
Dhaka	Kishorganj	Karimganj	0.5	Mogra
Dhaka	Madaripur	Kalkini	2	Arial Khan
Dhaka	Madaripur	Madaripur	3	Arial khan
Dhaka	Madaripur	Shibchar	8	Arial Khan
Dhaka	Manikganj	Manikganj	0.3	Dhaleswari
Dhaka	Munshiganj	Mirkadim	0.5	Meghna
Dhaka	Munshiganj	Munshiganj	1	Meghna
Dhaka	Munshiganj	Singair	15	Dhaleswari
Dhaka	Mymensingh	Mymensingh	1	Old Brahmaputra
Dhaka	Narayanganj	Kanchan	0.5	Banar
Dhaka	Narayanganj	Tarabo	0.5	Meghna
Dhaka	Narayanganj	Gopaldi	1.5	Meghna
Dhaka	Narayanganj	Sonargaon	2.5	Meghna
Dhaka	Narayanganj	Araihazar	5	Meghna
Dhaka	Narshingdi	Shibpur	0.2	Arial Khan
Dhaka	Narshingdi	Raypura	1	Meghna
Dhaka	Narshingdi	Narshingdi	1	Meghna
Dhaka	Narshingdi	Madhabdi	5.5	Old Brahmaputra

Division	District	Pourashava	Distance	Perennial river
Dhaka	Netrokona	Kendua	0.5	Mogra
Dhaka	Netrokona	Durgapur	1.3	Bakhaia
Dhaka	Netrokona	Netrokona	5	Old Brahmaputra
Dhaka	Rajbari	Goalandaghat	1	Pafdma
Dhaka	Rajbari	Rajbari	3	Old Kumar
Dhaka	Shariatpur	Goshairhat	1	Jayanti
Dhaka	Shariatpur	Damoda	1	Jayanti
Dhaka	Shariatpur	Vedarganj	1	Low Meghana
Dhaka	Sherpur	Nalitabari	0.5	Kangasa
Dhaka	Tangail	Bhuapur	3	Brahmaputra
Dhaka	Tangail	Tangail	15	Dhaleswari
Dhaka	Tangail	Elanga	17	Dhaleswari
Khulna	Chuadanga	Alamdanga	12	Mathabhanga
Khulna	Jessore	Chaugachha	0.1	Marhabhanga
Khulna	Jhenaidah	Sailakupa	0.2	Kumar Nabaganga
Khulna	Jhenaidah	Kothchandpur	1	Marhabhanga
Khulna	Kushtia	Kumarkhali	0.2	Garai Modhumati
Khulna	Kushtia	Khoksa	0.8	Garai Modhumati
Khulna	Magura	Magura	0.8	Kumar Nabaganga
Rajshahi	Bogra	Dhunat	1	Ichamati
Rajshahi	Bogra	Sariakandi	1.5	Brahmaputra
Rajshahi	Chapainawabganj	Chapainawabganj	0.5	Ganges
Rajshahi	Naogaon	Najipur	0.5	Atrai
Rajshahi	Natore	Singra	0.5	Atrai
Rajshahi	Natore	Gurudaspur	1	Batal Nandakuja
Rajshahi	Pabna	Bhangura	1	Atrai
Rajshahi	Pabna	Bera	2	Brahmaputra
Rajshahi	Pabna	Sujanagar	3	Ichamati
Rajshahi	Pabna	Pabna	7	Ichamati
Rajshahi	Rajshahi	Arani	0.2	Batal Nandakuja
Rajshahi	Rajshahi	Charghat	1.5	Batal Nandakuja
Rajshahi	Sirajganj	Belkuchi	0.5	Brahmaputra
Rajshahi	Sirajganj	Royganj	0.5	Ichamati
Rajshahi	Sirajganj	Shahjadpur	2	Brahmaputra
Rajshahi	Sirajganj	Kazipur	2	Brahmaputra
Rajshahi	Sirajganj	Ullahpara	2	Kaludaha
Rajshahi	Sirajganj	Sirajganj	4	Brahmaputra
Rangpur	Kurigram	Kurigram	2	Brahmaputra
Rangpur	Panchagarh	Boda	0.2	Karatoya
Sylhet	Hobiganj	Saistaganj	0	Karanji
Sylhet	Hobiganj	Nabiganj	0.2	Barak
Sylhet	Hobiganj	Madhabpur	0.2	Titas
Sylhet	Hobiganj	Ajmiriganj	0.5	Kalni
Sylhet	Hobiganj	Chunarughat	0.8	Khowair
Sylhet	Hobiganj	Hobiganj	2	Khowair
Sylhet	Moulavibazar	Moulavibazar	0	Manu Barrage
Sylhet	Moulavibazar	Kamalganj	2	Manu Barrage
Sylhet	Moulavibazar	Sreemongal	5	Barak
Sylhet	Sunamganj	Chattak	0.1	Dahuka
Sylhet	Sunamganj	Jagannathpur	0.1	Kushiara
Sylhet	Sunamganj	Derai	0.5	Dahuka
Sylhet	Sunamganj	Sunamganj	0.5	Dahuka
Sylhet	Sylhet	Golapganj	0.5	Kushiara
Sylhet	Sylhet	Kanaighat	0.5	Naya Gang
Sylhet	Sylhet	Biyanibazar	0.7	Kushiara

2. Pourashava with Surface Water not Available or Need to be Confirmed

Division	District	Pourashava	Distance	Salinity
Barisal	Barguna	Barguna	0.2	Yes
Barisal	Barguna	Patharghata	0.3	Yes
Barisal	Barguna	Betagi	1	Yes
Barisal	Barisal	Mehendiganj	1.8	
Barisal	Bhola	Doulatkhan	1	Yes
Barisal	Patuakhali	Kalapara	0.5	Yes
Barisal	Patuakhali	Kuakata	6	Yes
Barisal	Pirojpur	Mathbaria	2	Yes
Chittagong	Bandarban	Lama	1	
Chittagong	Chandpur	Haziganj	0.4	
Chittagong	Chittagong	Rangunia	1	
Chittagong	Chittagong	Baraiarhat	2	
Chittagong	Chittagong	Shandia	5	Yes
Chittagong	Chittagong	Mirsharai	5	
Chittagong	Comilla	Laksham	1	
Chittagong	Feni	Teknaf	1	Yes
Chittagong	Feni	Parsuram	1	
Chittagong	Feni	Cagalnaiya	1.5	
Chittagong	Khagrachari	Khagrachari	0.8	
Chittagong	Lakshmipur	Lakshmipur	12	
Chittagong	Noakhali	Chatkhil	2	
Chittagong	Noakhali	Noakhali	2	
Chittagong	Noakhali	Haita	6	Yes
Chittagong	Rangamati	Baghaichari	0.5	
Dhaka	Gazipur	Tongi	2	
Dhaka	Gopalganj	Tongipara	1.5	Yes
Dhaka	Gopalganj	Gopalgonj	5	Yes
Dhaka	Kishorganj	Bhairab	1	
Dhaka	Narshingdi	Ghorasal	0.2	
Dhaka	Netrokona	Madan	0.5	
Dhaka	Netrokona	Mohonganj	1	
Dhaka	Shariatpur	Shariatpur	3	
Dhaka	Tangail	Gopalpur	8	
Khulna	Bagerhat	Morolganj	0.5	Yes
Khulna	Bagerhat	Bagerhat	1.5	Yes
Khulna	Bagerhat	Monglaport		Yes
Khulna	Jessore	Manirampur	0	
Khulna	Jessore	Keshobpur	0	
Khulna	Jessore	Bagherpara	0.2	
Khulna	Jhenaidah	Kaliganj	0.5	
Khulna	Jhenaidah	Jhenaidah	0.8	
Khulna	Khulna	Paikgacha	0.5	Yes
Khulna	Khulna	Chalna	1	Yes
Khulna	Narail	Narail	0.2	Yes
Khulna	Narail	Kalia	0.5	Yes
Khulna	Satkhira	Satkhira	9	
Rajshahi	Bogra	Sherpur	0.1	
Rajshahi	Bogra	Bogra	0.3	
Rajshahi	Bogra	Gabtali	7	
Rajshahi	Chapainawabganj	Shibganj	1.5	
Rajshahi	Chapainawabganj	Rahanpur	2	
Rajshahi	Jaipurhat	Panchbibi	1	
Rajshahi	Jaipurhat	Kalai	2.5	
Rajshahi	Jaipurhat	Khatlal	4	
Rajshahi	Naogaon	Dhamirhat	0.1	
Rajshahi	Naogaon	Naogaon	0.5	
Rajshahi	Natore	Naldanga	0.3	
Rajshahi	Pabna	Chatmohar	0.2	
Rajshahi	Rajshahi	Godagari	0.1	
Rajshahi	Rajshahi	Keshorehat	0.2	
Rajshahi	Rajshahi	Bhawaniganj	0.2	
Rajshahi	Rajshahi	Taherpur	0.5	
Rajshahi	Rajshahi	Tanore	0.5	
Rajshahi	Rajshahi	Naohata	0.5	
Rajshahi	Rajshahi	Katakhali	2	

Division	District	Pourashava	Distance	Salinity
Rangpur	Dinajpur	Fulbari	0.3	
Rangpur	Dinajpur	Birampur	0.5	
Rangpur	Dinajpur	Dinajpur	1	
Rangpur	Gaibandha	Gaibandha	0.5	
Rangpur	Thakurgaon	Ranisankail	0	
Rangpur	Thakurgaon	Pirganj	2	
Sylhet	Sylhet	Zakiganj	0.4	

Appendix B

Water Tariff Table

District	Ref. No.	Pourashava	Rate based on pipe diameter													Volumetric (TK/m^3)		Remarks
			Residential (TK)						Non-residential (TK)									
			1/2" (13 mm)	3/4" (20 mm)	1" (25 mm)	1.5" (40 mm)	2" (50 mm)	3" (75 mm)	1/2" (13 mm)	3/4" (20 mm)	1" (25 mm)	1.5" (40 mm)	2" (50 mm)	3" (75 mm)	4" (100 mm)	Resi-dential	Non-residential	
1. Dhaka Division																		
Dhaka	DK-P-1	Savar	Not yet commissioned															
Faridpur	DK-P-2	Faridpur	100	150	750				250	350	1,500	3,000	5,000	15,000				Re-connection fee Tk.1,000 and transfer fee Tk.300 Effective from 1997
	DK-P-3	Bhanga	110	175					200	400								Effective from 2009
Gazipur	DK-P-4	Tongi	Family Type Tariff (Ref. Appendix)															
	DK-P-6	Gazipur	Family Type Tariff (Ref. Appendix)															
Gopalganj	DK-P-7	Gopalgonj	175	275					320	500	1,200	3,200						Effective from 2011
	DK-P-8	Tongipara	200	350	1,000	4,000	6,000	15,000	350	700	2,000	8,000	12,000	30,000				Effective from 2004
	DK-P-9	Kutalipara	150	225	500	1,500			200	350								Effective from 2012
Jamalpur	DK-P-10	Jamalpur	50	150	180	500			80	200	270	500						Effective from 1999 Industrial tariff for 1.5" Tk.2,000
	DK-P-11	Sarisabari	50	125	200	450			100	250	400	900						Effective from 1996
Kishorganj	DK-P-12	Kishorganj	200	500	800				400	700	1,200	2,500						Effective from 2005
	DK-P-13	Bhairab	125	200					250	400								Effective from 2000
	DK-P-14	Bajitpur	100	250	400				200	500	800							Effective from 2011
	DK-P-15	Katiadi	Not yet commissioned															
Madaripur	DK-P-16	Madaripur	120	180	300	700	1,500	2,500	230	280	600	1,000	2,000	4,000	5,000			TK 3,500 for 4" Residential
	DK-P-18	Kalkini	125	190	375				190	375	750							Effective from 2008
Manikganj	DK-P-19	Manikganj	150	200	350	3,000	6,000	20,000	300	400	700	3,000	6,000	20,000				Last revised 2010-2011
	Volumetric rate																	
	Usage 0-20 m^3/month															150	150	Minimum charge for up to 20 m^3
	24 to 40 m^3															6	12	
	41-100 m^3															8	12	
	More than 100 m^3															12	12	
Munshiganj	DK-P-20	Munshiganj	200	400	550	1,500	2,450	5,000	390	750	1,150	2,000	3,600	8,600				Effective from 2012
	DK-P-21	Mirkadim	150	325	500				325	375	750							Effective from 2009
Mymensingh	DK-P-22	Mymensingh	120	150	275	1,500	2,000		300	550	900	1,500	2,000					Non-residential rate is for Commercial. The Pousv has separate rates for Institutional: TK 225, 375, & 500, 1500, 2000 for 1/2", 3/4", 1", 1.5", and 2" respectively
	DK-P-23	Muktagacha	75	110	200				250	450	750							Effective from 2009 Industrial tariff for 1/2" Tk.250; for 3/4" Tk.450, for 1" Tk.650; Institution tariff for 1/2" Tk.200, for 3/4" Tk.375, for 1" Tk.650
	DK-P-24	Gouripur	Not yet commissioned															
	DK-P-25	Trisal	100	150	200	250	300		150	250	300	350	400					Effective from 2009
Narshingdi	DK-P-26	Narshingdi	150	200						500	900	2,000	4,000					
	DK-P-27	Ghorasal	Not yet commissioned															
	DK-P-28	Shibpur	Not yet commissioned															
	DK-P-29	Monohordi	Not yet commissioned															
Netrokona	DK-P-32	Netrokona	130	250	350				320	700	1,050							Non-residential rate is for Commercial. The Pousv has separate rates for Institutional: TK 330, 700, & 1220 for 1/2", 3/4", and 1" respectively
Rajbari	DK-P-34	Rajbari	75	110	350	500	400		125	250	400	800	550					Effective from 1990
	DK-P-35	Pangsa	75	120	300	450			125	250	400	800						Effective from 2007
Shariatpur	DK-P-36	Shariatpur	150	225	375	675			300	450	750	1,350						Effective from 2011 Industrial and Institution connection fee for 1/2" Tk.300, for 3/4" Tk.450, for 1" Tk.750, for 1.5" Tk.1350
	DK-P-37	Jajira	Not yet commissioned															
	DK-P-38	Damoda	100	150	200				200	300	400							Effective from 2008
	DK-P-39	Naria	100	130	200													Effective from 2009
	DK-P-40	Vedarganj	Not yet commissioned															
Sherpur	DK-P-41	Sherpur	150	300					300	600	1,500	2,400						Effective from 2005
	DK-P-42	Nalitabari	125	250					250									Effective from 2009
Tangail	DK-P-43	Tangail	100	300	300	450			200	500	800	1,800	3,500					Effective from 2007
	DK-P-44	Gopalpur	100	150					200	300								Effective from 2007
2. Sylhet Division																		
Hobiganj	SL-P-1	Hobiganj	175	350	700	1,400			350	700	1,400	2,800						Effective from 2011
	SL-P-2	Madhabpur		120	240													Effective from 2009
Moulavibazar	SL-P-4	Moulavibazar	200	375	700				350	600	1,000	1,500	2,000			6	6	
	SL-P-5	Sreemongal	120	250	400				170	360	600							Effective from 2011
Sunamganj	SL-P-9	Sunamganj	140	200	300				250	400	500	700						Effective from 2009
3. Chittagong Division																		
Bandarban	CG-P-1	Bandarban	88	221	353	794	1,411	3,175	276	662	1,103	2,481	4,410	9,923	19,845			
Brahmanbaria	CG-P-3	Brahmanbaria	60	125	250				120	250	500							till June 2012
			180	250	400				250	350	650					6	6	To be applied from July 2012
Chandpur	CG-P-4	Chandpur	150	250	350	1,200	1,500		400	800	1,200	1,700	4,000					
	CG-P-5	Haziganj	200	300	550	800	1,000		400	700	1,300	2,600	5,000					
	CG-P-6	Saharasti	150	250	450	650	800		300	600	1,100	2,200	4,000					
	CG-P-7	Kachua	200	300	650	800			400	600	1,300	1,600						
	CG-P-8	Matlab	100	150	300	450	600		200	300	500	1,000	2,000					
	CG-P-9	Cengarchar	Not yet commissioned															
Comilla	CG-P-14	Laksham	125	175	300					700	1,000							
	CG-P-15	Daudkandi	150	200	300					400	600							
	CG-P-16	Chandina	Not yet commissioned															
	CG-P-17	Barora	Not yet commissioned															
Cox's Bazar	CG-P-18	Cox's Bazar	100	200	360	600			180	400	440	900						Effective from May, 1993
Feni	CG-P-20	Feni	180	300	400				360	600	800							Effective from March, 2008
			360	600	800													Special case, If one building have four or more family member
Khagrachari	CG-P-22	Khagrachari	80	150	600	1,000			250	500	1,000	1,600	2,500	14,000				
	CG-P-23	Ramgarh	125	175	225	325					500							
Lakshmipur	CG-P-25	Lakshmipur	320	475	700				700	1,100	1,600					15	24	Sub-connection TK 280 (Res.), TK 700 (Non-Res.); Effective from July 2011
	CG-P-26	Raypur	240	300					320	450						12	16	
	CG-P-27	Ramganj														9	15	
Noakhali	CG-P-28	Chowmohoni	240	450	850				700	1,200	2,000							Re-connection fee for residential Tk.200 and Non-residential Tk.600. Name change fee Tk. 1000, Connection-disconnection fee Tk.1000 and Re-connection fee Tk.2000. Effective from 1-February-2012
	CG-P-29	Noakhali														7	20	Effective from 5-June-2012
	CG-P-30	Kabirhat	Not yet commissioned															
Rangamati	CG-P-32	Rangamati	80	150	1,500	2,000	4,000		400	800	2,000	3,000	6,000	8,000	10,000 15,000 30,000			Effective from 7-July-2009, Water tariff for 4" Residential Tk.6000, Water Tanker Tk.300 4"Non Residential: Temple 10000, general 15000, Army 30000

District	Ref. No.	Pourashava	Rate based on pipe diameter												Volumetric (TK/m³)		Remarks
			Residential (TK)						Non-residential (TK)								
			1/2" (13 mm)	3/4" (20 mm)	1" (25 mm)	1.5" (40mm)	2" (50 mm)	3" (75 mm)	1/2" (13 mm)	3/4" (20 mm)	1" (25 mm)	1.5" (40 mm)	2" (50 mm)	3" (75 mm)	4" (100 mm)	Resi-dential	Non residential	
4. Barisal Division																	
Barguna	BS-P-1	Barguna	130	350					325	700							
	BS-P-2	Amtali														10	20	
	BS-P-3	Patharghata	200	400												15		
Barisal	BS-P-4	Gowrnadi	150	200	350				200	350	650							
	BS-P-6	Bakerganj																Monthly water tariff Tk.100 for one connection
	BS-P-7	Mehendiganj	150	200	250				200	250	350							
Bhola	BS-P-8	Bhola	150	300					300	500	1,000	1,500						Effective from 1-January-2009
	BS-P-9	Lalmohon	125	200	350				250	400	550							Institutional rate from 3/4 inch to 1 inch Tk.550
	BS-P-10	Charfeshon	150	200	300				250	350	600							
	BS-P-11	Borhanuddin	Not yet commissioned															
Jhalakati	BS-P-12	Jhalakati														6	7	Effective from 1-September-2011 Minimum Bill for 1/2 " Residential (20 m3) Tk.120 Minimum Bill for 1/2 -1 " Commercial (25 m3) Tk.175 Minimum Bill for 1/2 -1 " Institutional (25 m3) Tk.175 Meter charge (1/2") Tk.1500 Waer connection form Tk.100, Re-connection fee Tk.600. Name change fee Tk.500
Patuakhali	BS-P-14	Patuakhali														7	10	till June-2012.
																10	13	Effective from 1-July-2012.
	BS-P-15	Galachipa														8	15	Public Institution (mosque, Temple, School, College etc) water Tariff Tk.1000. For Residential, 0-13 m3, min charge Tk.100 For Commercial, 0-20 m3, min charge Tk.300 For Institutional, 0-20 m3, min charge Tk.100
	BS-P-16	Kalapara														10	13	Effective form 25-January-2012 Religious Institution, water Tariff Tk.7/m3. For Residential (1/2"), min 10 m3, min charge Tk.100 For Commercial (1/2"), min 23 m3, min charge Tk.299 For Institutional (1/2"), min 15 m3, min charge Tk.105 For Residential (3/4"), min 25 m3, min charge Tk.250 For Commercial (3/4"), min 39 m3, min charge Tk.507 For Institutional (3/4"), min 29 m3, min charge Tk.203
Pirojpur	BS-P-17	Sarupkathi	Not yet commissioned															
	BS-P-18	Pirojpur	150	338	2,000	4,000	16,000		420	750	2,000	4,000	16,000			7.5	12.5	TK 40,000 for dia >2", volumetric charge proposed from July 2012
5. Khulna Division																		
Bagerhat	KN-P-1	Bagerhat	100	150	350	420	560		200	300	700	840	1,120					As bulk, for 1.25" dia Tk.2,540, 2" dia Tk.7,000
	KN-P-2	Monglaport	200	250	300						350 500							At commercial, 1" line for resturent Tk. 500 and for small shop Tk. 350
Chuadanga	KN-P-4	Chuadanga	Family Type Tariff (Ref. Appendix)															
Jessore	KN-P-7	Jessore	130	170	400	650			350	550	850	2,050						
	KN-P-8	Noapara	300	350	1,000							4,000	4,500	5,000	6,000			For commercial/industrial 6" Tk. 6,500 For Group tap/instutional, for 1/2", 3/4", 1" Tk.300 + each flat add Tk.200
	KN-P-9	Zhikargacha	110															
Jhenaidah	KN-P-11	Jhenaidah	75	100					150	200								Valid up to June 2012
	KN-P-12	Kothchandpur	80	100	200				150	200	350							
	KN-P-13	Mohespur	80	60	120				120	120	120							
	KN-P-14	Sailakupa	150	200	300				225	300								For 2" dia residential (UNO office) Tk.7,350
	KN-P-26	Kaliganj	100	130	230					230	325							
Kushtia	KN-P-16	Kushtia	70	160	360	1,300			150	330	750	1,300						
	KN-P-17	Kumarkhali	100	175	275	425			150	325	425	825						
	KN-P-19	Bheramara	75	175	300				150	350	600							
Magura	KN-P-20	Magura	120	270	480	1,080			240	540	960	2,160						Approved from July,2011
Meherpur	KN-P-21	Meherpur	100	225	400	1,800	3,200		200	450	800	1,800	3,200					
Narail	KN-P-22	Narail	150	270	390	780			300	540	780	1,560						Approved from July,2011
	KN-P-23	Kalia	80	120	200				200	300	400							For only ground floor
			40	60	150				150	200	300							From 1st floor to upward
																		For Institutional, For only ground floor 1/2" - Tk. 150, 3/4" - Tk. 200, 1" - Tk. 300 From 1st floor to upward 1/2" - Tk. 75, 3/4" - Tk. 100, 1" - Tk. 200
Satkhira	KN-P-24	Satkhira	150	210	400	1,000			300	420	800	2,000						
6. Rajshahi Division																		
Bogra	RJ-P-1	Bogra	40	75					70	180	300							
	RJ-P-2	Santahar	120	250	300				200	350	450							
	RJ-P-3	Gabtali	Not yet commissioned															
Jaipurhat	RJ-P-4	Jaipurhat	150	225	330				230	360	550	850				5	8	Effective from Jan 2012
Naogaon	RJ-P-6	Naogaon	125	225	650				250	450	1,300	2,100						
	RJ-P-7	Najipur	75	112	300				225	338								
Natore	RJ-P-8	Gurudaspur	80	100	200	300	600		120	150	300	500	1,200					
	RJ-P-9	Singra	50	80	200	300	600		100	150	300	500	1,200					
	RJ-P-10	Natore	100	120	250	350	550		150	200	350	550	1,250			7		Effective from April 2012
Chapainawabganj	RJ-P-11	Chapainawabganj	80	160	320	640	1,300		160	320	640	1,300	2,600					
	RJ-P-12	Rahanpur	80	120	180				360	180								
Pabna	RJ-P-13	Pabna	100	200	400	1,000	2,000	4,000	200	400	700	2,000	4,400	10,000				
	RJ-P-14	Bera	80	80	250	350			120	160	500	700						
	RJ-P-15	Ishwardi	100	175					150	300								
	RJ-P-16	Chatmohar	Not yet commissioned															
	RJ-P-17	Bhangura	Not yet commissioned															
	RJ-P-18	Shathia	150	150	180				300	300	300							
	RJ-P-21	Sujanagar	Not yet commissioned															
Rajshahi	RJ-P-22	Charghat	50	80	100													
	RJ-P-23	Mundumala	100	100	100				100	100	100							
	RJ-P-24	Naohata	80	100	200	500	1,000		120	200	400	800	1,500					
Sirajganj	RJ-P-19	Sirajganj	100	175	225				150	200	275	950						For 2009/10 to 2012/13
	RJ-P-20	Shahjadpur	Not yet commissioned															
7. Rangpur Division																		
Gaibandha	RP-P-1	Gaibandha	200	300	400				300	400	500	1,200	2,000					Approved from July 2011
Rangpur	RP-P-2	Rangpur	50	100	200				100	200	400	1,000	2,000					
Dinajpur	RP-P-3	Dinajpur	75	150					200	350								
	RP-P-4	Birampur	120	160	225													
	RP-P-5	Parbatipur	Not yet commissioned															
	RP-P-6	Setabganj	50	100	200													
	RP-P-7	Fulbari	Not yet commissioned															
Thakurgaon	RP-P-8	Thakurgaon	120	170	480				250	370	700							
Nilphamari	RP-P-9	Sayedpur	40	60	100													
	RP-P-10	Nilphamari	300	350	1,000							4,000	4,500	5,000	6,000			
Kurigram	RP-P-11	Kurigram	100	120	150	250	400		200	250	300	500	700					
Panchagarh	RP-P-12	Panchagarh	125	200	300				300	500	700							
Lalmonirhat	RP-P-13	Lalmonirhat	90	160	450	600			160	320	750	900	1,120					

Appendix C

Donor Project List

District	Ref. No.	Pourashava	Water Supply Sector															Infrastructure Development Project		
			Completed								On-going							On-going		
			DANIDA	Neitherland	DPHE	DPHE	DPHE	DPHE	DPHE	NGO	ADB	DPHE	UNDP	UNICEF	IDA	DPHE	Others	ADB	LGED	LGED
			Coastal belt	18 DTWS	BWSPP	Regen	60PS	37 DTWS	Individual project	Water Aid	STWSSSP	F/S	UPPR	SHEWA-B	MSP	Individual project	Others	UGIIP_II	UTIDP	DTIDP
1. Dhaka Division																				
Dhaka	DK-P-1	Savar					Y						Y							
	DK-N-1	Dhamrai										Y-2							Y	
	DK-N-2	Dohar										Y-1							Y	
Faridpur	DK-P-2	Faridpur						Y										Y		Y
	DK-P-3	Bhanga					Y											Y	Y	
	DK-N-3	Nagarkanda										Y-2							Y	
	DK-N-4	Boalmari										Y-3							Y	
Gazipur	DK-P-4	Tongi			Y								Y		Y					
	DK-P-6	Gazipur			Y	Y		Y					Y							
	DK-N-5	Sreepur										Y-3						Y	Y	
	DK-N-6	Kaliakoir										Y-3							Y	
	DK-N-48	Kaliganj										Y-4								
Gopalganj	DK-P-7	Gopalgonj			Y															Y
	DK-P-8	Tongipara														Y *2			Y	
	DK-P-9	Kutalipara														Y *2			Y	
	DK-N-7	Muksudpur										Y-2							Y	
Jamalpur	DK-P-10	Jamalpur			Y			Y										Y		
	DK-P-11	Sarisabari																	Y	
	DK-N-8	Madarganj										Y-4							Y	
	DK-N-9	Islampur										Y-4							Y	
	DK-N-10	Melandaha										Y-4							Y	
	DK-N-11	Dewanganj										Y-4							Y	
Kishorganj	DK-P-12	Kishorganj				Y					Y									
	DK-P-13	Bhairab																	Y	
	DK-P-14	Bajitpur																	Y	
	DK-P-15	Katiadi					Y												Y	
	DK-N-12	Kuliarchar										Y-2							Y	
	DK-N-13	Karimganj										Y-2							Y	
	DK-N-14	Hossainpur										Y-3								
	DK-N-15	Pakundia										Y-4								
Madaripur	DK-P-16	Madaripur				Y					Y									Y
	DK-P-18	Kalkini																	Y	
	DK-N-44	Shibchar					Y												Y	
Manikganj	DK-P-19	Manikganj		Y	Y			Y							Y					
	DK-N-16	Singair										Y-2			Y				Y	
Munshiganj	DK-P-20	Munshiganj			Y	Y		Y										Y		
	DK-P-21	Mirkadim					Y												Y	
Mymensingh	DK-P-22	Mymensingh				Y					Y		Y					Y		
	DK-P-23	Muktagacha													Y				Y	
	DK-P-24	Gouripur																	Y	
	DK-P-25	Trisal					Y												Y	
	DK-N-17	Gafargaon										Y-4							Y	
	DK-N-18	Bhaluka										Y-3							Y	
	DK-N-19	Ishwarganj										Y-4							Y	
	DK-N-20	Nandail										Y-3							Y	
	DK-N-21	Phulpur										Y-3		Y					Y	
	DK-N-22	Fhulbaria										Y-4							Y	
Narshingdi	DK-P-26	Narshingdi			Y	Y					Y									
	DK-P-27	Ghorasal					Y											Y	Y	
	DK-P-28	Shibpur					Y													
	DK-P-29	Monohordi					Y												Y	
	DK-N-23	Madhabdi										Y-1							Y	
	DK-N-24	Raypura										Y-2		Y						
Narayanganj	DK-N-25	Sonargaon										Y-2							Y	
	DK-N-26	Tarabo										Y-4							Y	
	DK-N-27	Kanchan										Y-4							Y	
	DK-N-46	Araihazar																		
	DK-N-47	Gopaldi																		
Netrokona	DK-P-32	Netrokona		Y							Y									
	DK-N-28	Kendua										Y-3							Y	
	DK-N-29	Madan										Y-3							Y	
	DK-N-30	Durgapur										Y-3							Y	
	DK-N-45	Mohonganj					Y												Y	
Rajbari	DK-P-34	Rajbari			Y	Y		Y							Y					
	DK-P-35	Pangsa																	Y	
	DK-N-31	Goalandaghat										Y-3							Y	
Shariatpur	DK-P-36	Shariatpur		Y	Y			Y						Y						
	DK-P-37	Jajira					Y												Y	
	DK-P-38	Damoda					Y												Y	
	DK-P-39	Naria					Y												Y	
	DK-P-40	Vedarganj					Y												Y	
	DK-N-32	Goshairhat																		
Sherpur	DK-P-41	Sherpur		Y							Y									
	DK-P-42	Nalitabari					Y							Y					Y	
	DK-N-33	Sreebardi										Y-3								
	DK-N-34	Nakla										Y-3							Y	
Tangail	DK-P-43	Tangail			Y			Y					Y							Y
	DK-P-44	Gopalpur						Y											Y	
	DK-N-35	Ghatail										Y-4							Y	
	DK-N-36	Mirzapur										Y-3						Y	Y	
	DK-N-37	Sakhipur								Y		Y-4							Y	
	DK-N-38	Kalihati										Y-4							Y	
	DK-N-39	Madhupur										Y-3							Y	
	DK-N-40	Bhuapur										Y-3							Y	
	DK-N-41	Dhanbari										Y-2							Y	
	DK-N-42	Elanga																		
	DK-N-43	Bashail																		
2. Sylhet Division																				
Hobiganj	SL-P-1	Hobiganj				Y		Y												
	SL-P-2	Madhabpur					Y												Y	
	SL-N-1	Chunarughat										Y-4								
	SL-N-2	Saistaganj										Y-1								
	SL-N-3	Ajmiriganj										Y-2							Y	
	SL-N-9	Nabiganj					Y												Y	

District	Ref. No.	Pourashava	Water Supply Sector															Infrastructure Development Project		
			Completed								On-going							On-going		
			DANIDA	Neitherland	DPHE	DPHE	DPHE	DPHE	DPHE	NGO	ADB	DPHE	UNDP	UNICEF	IDA	DPHE	Others	ADB	LGED	LGED
			Coastal belt	18 DTWS	BWSPP	Regen	60PS	37 DTWS	Individual project	Water Aid	STWSSSP	F/S	UPPR	SHEWA-B	MSP	Individual project	Others	UGIIP_II	UTIDP	DTIDP
Moulavibazar	SL-P-4	Moulavibazar		Y							Y			Y						
	SL-P-5	Sreemongal													Y			Y	Y	
	SL-N-4	Barlekha										Y-3							Y	
	SL-N-5	Kamalganj										Y-3							Y	
	SL-N-13	Kulaura					Y												Y	
Sylhet	SL-N-6	Zakiganj					Y					Y-3							Y	
	SL-N-7	Kanaighat										Y-1								
	SL-N-10	Biyanibazar					Y												Y	
	SL-N-14	Golapganj					Y											Y	Y	
Sunamganj	SL-P-9	Sunamganj			Y	Y		Y						Y				Y		
	SL-N-8	Jagannathpur										Y-3							Y	
	SL-N-11	Chattak					Y												Y	
	SL-N-12	Derai					Y												Y	
3. Chittagong Division																				
Bandarban	CG-P-1	Bandarban																		
	CG-N-31	Lama													Y				Y	
Brahmanbaria	CG-P-3	Brahmanbaria			Y	Y					Y							Y		
	CG-N-1	Kasba										Y-2							Y	
	CG-N-2	Nabinagar										Y-1							Y	
	CG-N-3	Akhaura										Y-3							Y	
Chandpur	CG-P-4	Chandpur			Y	Y		Y										Y		Y
	CG-P-5	Haziganj			Y														Y	
	CG-P-6	Saharasti					Y												Y	
	CG-P-7	Kachua																	Y	
	CG-P-8	Matlab																	Y	
	CG-P-9	Cengarchar					Y												Y	
	CG-N-4	Faridganj										Y-2								
Chittagong	CG-N-5	Satkania										Y-4							Y	
	CG-N-6	Rangunia										Y-3							Y	
	CG-N-7	Baraiarhat										Y-2							Y	
	CG-N-8	Mirsharai										Y-2							Y	
	CG-N-9	Chandanaish										Y-3							Y	
	CG-N-10	Banshkhali										Y-4							Y	
	CG-N-11	Fhatikchari																		
	CG-N-27	Shandia					Y													
	CG-N-28	Shitakunda					Y												Y	
	CG-N-29	Patia					Y												Y	
	CG-N-33	Rawjan					Y												Y	
Comilla	CG-P-14	Laksham																	Y	
	CG-P-15	Daudkandi					Y												Y	
	CG-P-16	Chandina																	Y	
	CG-P-17	Barora																	Y	
	CG-N-12	Debiddar										Y-2							Y	
	CG-N-13	Nagalcoat										Y-2							Y	
	CG-N-14	Homna										Y-2		Y					Y	
	CG-N-15	Chauddagram										Y-2							Y	
Cox's Bazar	CG-P-18	Cox's Bazar				Y		Y										Y		Y
	CG-N-16	Teknaf										Y-4							Y	
	CG-N-17	Moheskhali										Y-4			Y				Y	
	CG-N-32	Chakoria					Y												Y	
Feni	CG-P-20	Feni	Y		Y			Y												
	CG-N-18	Daganbhuiyan										Y-2							Y	
	CG-N-19	Parsuram										Y-4						Y	Y	
	CG-N-20	Sonagazi										Y-2							Y	
	CG-N-30	Cagalnaiya					Y												Y	
Khagrachari	CG-P-22	Khagrachari												Y						
	CG-P-23	Ramgarh																	Y	
	CG-N-34	Matiranga																	Y	
Lakshmipur	CG-P-25	Lakshmipur	Y								Y									
	CG-P-26	Raypur	Y																Y	
	CG-P-27	Ramganj	Y				Y												Y	
	CG-N-21	Ramgati										Y-2							Y	
Noakhali	CG-P-28	Chowmohoni	Y		Y						Y				Y			Y	Y	
	CG-P-29	Noakhali	Y															Y		Y
	CG-P-30	Kabirhat					Y												Y	
	CG-N-22	Sonaimuri										Y-2							Y	
	CG-N-23	Haita										Y-4								
	CG-N-24	Basurhat										Y-2							Y	
	CG-N-25	Chatkhil										Y-1							Y	
	CG-N-26	Senbagh										Y-2							Y	
Rangamati	CG-N-35	Baghaichari																		
	CG-P-32	Rangamati												Y						
4. Barisal Division																				
Barguna	BS-P-1	Barguna		Y				Y							Y			Y		Y
	BS-P-2	Amtali	Y																Y	
	BS-P-3	Patharghata	Y																Y	
	BS-N-1	Betagi										Y-4							Y	
Barisal	BS-P-4	Gowrnadi																	Y	
	BS-P-6	Bakerganj																	Y	
	BS-P-7	Mehendiganj					Y												Y	
	BS-N-2	Muladi										Y-1							Y	
	BS-N-7	Banaripara					Y												Y	
Bhola	BS-P-8	Bhola		Y				Y										Y		
	BS-P-9	Lalmohon													Y				Y	
	BS-P-10	Charfeshon																	Y	
	BS-P-11	Borhanuddin					Y												Y	
	BS-N-3	Doulatkhan										Y-4							Y	
Jhalakati	BS-P-12	Jhalakati		Y				Y										Y		
	BS-N-8	Nalchity					Y												Y	
Patuakhali	BS-P-14	Patuakhali	Y					Y												Y
	BS-P-15	Galachipa	Y																Y	
	BS-P-16	Kalapara	Y															Y	Y	
	BS-N-4	Bauphal										Y-4							Y	
	BS-N-5	Kuakata										Y-4							Y	
Pirojpur	BS-P-17	Sarupkathi					Y												Y	
	BS-P-18	Pirojpur				Y					Y									Y
	BS-N-6	Mathbaria										Y-1							Y	

District	Ref No	Pourashava	Water Supply Sector															Infrastructure Development Project		
			Completed								On-going							On-going		
			DANIDA	Netherland	DPHE	DPHE	DPHE	DPHE	DPHE	NGO	ADB	DPHE	UNDP	UNICEF	IDA	DPHE	Others	ADB	LGED	LGED
			Coastal belt	18 DTWS	BWSPP	Regen	60PS	37 DTWS	Individual project	Water Aid	STWSSSP	F/S	UPPR	SHEWA-B	WSP	Individual project	Others	UGIIP_II	UTIDP	DTIDP
5. Khulna Division																				
Bagerhat	KN-P-1	Bagerhat			Y													Y		Y
	KN-P-2	Monglaport							Y *1										Y	
	KN-N-16	Morolganj					Y												Y	
Chuadanga	KN-P-4	Chuadanga			Y			Y							Y					Y
	KN-N-1	Alamdanga										Y-1							Y	
	KN-N-12	Jibonnagar					Y												Y	
	KN-N-13	Darshana					Y												Y	
Jessore	KN-P-7	Jessore				Y					Y		Y							
	KN-P-8	Noapara					Y												Y	
	KN-P-9	Zhikargacha					Y												Y	
	KN-N-2	Benapol										Y-2						Y		
	KN-N-3	Chaugachha										Y-3								
	KN-N-4	Manirampur										Y-1							Y	
	KN-N-5	Bagherpara										Y-3							Y	
	KN-N-15	Keshobpur					Y										Y *4		Y	
Jhenaidah	KN-P-11	Jhenaidah									Y				Y			Y		Y
	KN-P-12	Kothchandpur																	Y	
	KN-P-13	Mohespur																	Y	
	KN-P-14	Saitakupa																	Y	
	KN-P-26	Kaliganj																	Y	
	KN-N-6	Harinakunda										Y-3							Y	
Khulna	KN-N-8	Chalna										Y-3								
	KN-N-17	Paikgacha					Y			Y									Y	
Kushtia	KN-P-16	Kushtia						Y					Y							
	KN-P-17	Kumarkhali																	Y	
	KN-P-19	Bheramara																	Y	
	KN-N-9	Khoksa										Y-4							Y	
	KN-N-14	Mirpur					Y												Y	
Magura	KN-P-20	Magura		Y	Y			Y												Y
Meherpur	KN-P-21	Meherpur		Y				Y						Y	Y					
	KN-N-10	Gangni										Y-3							Y	
Narail	KN-P-22	Narail		Y				Y										Y		Y
	KN-P-23	Kalia					Y							Y					Y	
	KN-N-11	Lohagara										Y-2							Y	
Satkhira	KN-P-24	Satkhira		Y				Y							Y			Y		Y
	KN-N-18	Kalaroa					Y			Y									Y	
6. Rajshahi Division																				
Bogra	RJ-P-1	Bogra				Y		Y					Y							
	RJ-P-2	Santahar					Y												Y	
	RJ-P-3	Gabtali					Y												Y	
	RJ-N-1	Sherpur										Y-2							Y	
	RJ-N-2	Nandigram										Y-4							Y	
	RJ-N-3	Sariakandi										Y-3							Y	
	RJ-N-4	Dhupchachia										Y-4							Y	
	RJ-N-5	Sonatala										Y-4							Y	
	RJ-N-6	Shibganj										Y-3		Y					Y	
	RJ-N-7	Kahaloo										Y-4							Y	
	RJ-N-8	Talora										Y-4								
	RJ-N-9	Dhunat										Y-3							Y	
Jaipurhat	RJ-P-4	Jaipurhat		Y							Y									
	RJ-N-10	Panchbibi										Y-4							Y	
	RJ-N-11	Akkelpur										Y-4							Y	
	RJ-N-12	Kalai										Y-4							Y	
	RJ-N-42	Khatlal																		
Naogaon	RJ-P-6	Naogaon		Y				Y					Y							Y
	RJ-P-7	Najipur																	Y	
	RJ-N-13	Dhamirhat										Y-4							Y	
Natore	RJ-P-8	Gurudaspur					Y												Y	
	RJ-P-9	Singra					Y												Y	
	RJ-P-10	Natore									Y							Y		Y
	RJ-N-14	Gopalpur										Y-3								
	RJ-N-15	Bonapara										Y-4								
	RJ-N-16	Naldanga										Y-4								
	RJ-N-17	Bagatipara										Y-3							Y	
	RJ-N-18	Baraigram										Y-4								
Chapainawabganj	RJ-P-11	Chapainawabganj			Y			Y					Y							
	RJ-P-12	Rahanpur					Y												Y	
	RJ-N-19	Shibganj										Y-1							Y	
	RJ-N-20	Nachole										Y-3						Y		
Pabna	RJ-P-13	Pabna						Y												
	RJ-P-14	Bera					Y												Y	
	RJ-P-15	Ishwardi													Y				Y	
	RJ-P-16	Chatmohar														Y*3			Y	
	RJ-P-17	Bhangura														Y*3			Y	
	RJ-P-18	Shathia					Y												Y	
	RJ-P-21	Sujanagar										Y-2				Y *3			Y	
	RJ-N-22	Faridpur			Y							Y-4			Y				Y	
	RJ-N-23	Atghara										Y-4								
Rajshahi	RJ-P-22	Charghat										Y-3			Y				Y	
	RJ-P-23	Mundumala										Y-3							Y	
	RJ-P-24	Naohata										Y-2			Y					
	RJ-N-24	Godagari										Y-1							Y	
	RJ-N-25	Taherpur										Y-2							Y	
	RJ-N-26	Tanore										Y-2							Y	
	RJ-N-28	Bhawaniganj										Y-3								
	RJ-N-29	Bagha										Y-3			Y				Y	
	RJ-N-30	Kakanhat										Y-3							Y	
	RJ-N-32	Puthia										Y-3							Y	
	RJ-N-34	Katakhali										Y-3							Y	
	RJ-N-35	Keshorehat										Y-3							Y	
	RJ-N-36	Arani										Y-3								
	RJ-N-37	Durgapur										Y-3							Y	
Sirajganj	RJ-P-19	Sirajganj			Y	Y					Y		Y	Y				Y		
	RJ-P-20	Shahjadpur					Y												Y	
	RJ-N-38	Belkuchi										Y-2							Y	
	RJ-N-39	Royganj										Y-3								
	RJ-N-40	Kazipur										Y-3							Y	
	RJ-N-41	Ullahpara										Y-3							Y	

District	Ref. No.	Pourashava	Water Supply Sector															Infrastructure Development Project		
			Completed								On-going							On-going		
			DANIDA	Neitherland	DPHE	DPHE	DPHE	DPHE	DPHE	NGO	ADB	DPHE	UNDP	UNICEF	IDA	DPHE	Others	ADB	LGED	LGED
			Coastal belt	**18 DTWS**	**BWSPP**	**Regen**	**60PS**	**37 DTWS**	**Individual project**	**Water Aid**	**STWSSSP**	**F/S**	**UPPR**	**SHEWA-B**	**MSP**	**Individual project**	**Others**	**UGIIP_II**	**UTIDP**	**DTIDP**
7. Rangpur Division																				
Gaibandha	RP-P-1	Gaibandha						Y						Y				Y		
	RP-N-1	Sunderganj										Y-2							Y	
	RP-N-2	Gobindaganj										Y-2							Y	
	RP-N-3	Palashbari																		
Rangpur	RP-P-2	Rangpur						Y					Y	Y	Y			Y		Y
	RP-N-4	Haragacha										Y-4							Y	
	RP-N-5	Badarganj										Y-3							Y	
Dinajpur	RP-P-3	Dinajpur						Y					Y					Y		Y
	RP-P-4	Birampur					Y												Y	
	RP-P-5	Parbatipur				Y													Y	
	RP-P-6	Setabganj					Y												Y	
	RP-P-7	Fulbari					Y			Y									Y	
	RP-N-6	Ghoraghat										Y-4								
	RP-N-7	Hakimpur										Y-4							Y	
	RP-N-8	Birganj										Y-2							Y	
Thakurgaon	RP-P-8	Thakurgaon		Y				Y										Y		Y
	RP-N-9	Pirganj										Y-4							Y	
	RP-N-10	Ranisankail										Y-4							Y	
Nilphamari	RP-P-9	Sayedpur																	Y	
	RP-P-10	Nilphamari		Y				Y												Y
	RP-N-11	Jaldhaka										Y-4							Y	
	RP-N-12	Domar										Y-4							Y	
Kurigram	RP-P-11	Kurigram			Y	Y		Y										Y		Y
	RP-N-13	Nagashwari										Y-2							Y	
	RP-N-14	Ulipur										Y-2							Y	
Panchagarh	RP-P-12	Panchagarh		Y				Y						Y						
	RP-N-15	Boda										Y-4							Y	
Lalmonirhat	RP-P-13	Lalmonirhat		Y				Y												
	RP-N-16	Patgram										Y-3							Y	
TOTAL	-	-	11	18	23	18	60	36	1	4	16	146	13	16	21	5	1	34	220	23

Water Supply Sector

Coastal belt	Water Supply and Sanitation in Coastal Belt Project, 1997-2008
18 DTWS	18 District Town Water supply by Dutch Embassy, 1996-1999
BWSPP	Bangladesh Water Supply Program Project, 2005-2010
Regen	Repair, Rehabilitation and Development of Water Supply system in Pourashavas including regeneration of Production Tube Wells, 1997-2008
60PS	Environmental sanitation and Water Supply with Piped Network in Thana Sadar and Growth Center Pourashavas, 1st Phase, 2000-2008
37 DTWS	37 District Towns Water Suppy Project, 2010-2014
STWSSSP	Secondary Towns Water Supply and Sanitation Sector Project, 2007-2013
F/S	Groundwater Management and TPP for Survey, Investigation and Feasibility Study in Upazila and Growth Center Level Pourashava having no Piped Water Supply System
UPPR	Urban Partnerships for Poverty Reduction 2008-2015
MSP	Municipal Services Project, Phase I: 1999-2011, Additional: 2011-2012
Indivisual Project *1	Water Supply and Environmental Sanitation Project in Mongla Pourashava. 2004-2008
Indivisual Project *2	Kotalipara and Tongipara Pourashava Water Supply and Environmental sanitation Development Project, 2009-2012
Indivisual Project *3	Piped Water Supply and Environmental Sanitation Project at Sujanagar, Vangora, Chatmohar Pourashava, Under Pabna District, 2010-2013
Indivisual Project *4	Keshobpur pipe line water supply project, 2010-2012, funded by Aurora Petroleum Trading & Supply, SA

Infrastructure Development Project

UGIIP_II	Urban Governance Infrastructure project II, 2009-2014
UTIDP	Upazila Towns Infrastructure Development Project
DTIDP	District Towns Infrastructure Development Project, 2004-2012

Appendix D

Background Data for Identification of Pourashavas Hard to Assess to Safe Water

1. Identification of Pourashavas Hard to Access to Safe Water based on Questionnaire Survey

Division	District	Pourashava	Piped / Non-piped	Difficulty	Deep Well		River	
					Salinity	Arsenic	No Perennial river	Saline
Dhaka	Faridpur	Nagarkanda	Non-piped	1 - 1	O		O	
	Shariatpur	Goshairhat	Non-piped	2	O			
	Madaripur	Shibchar	Non-piped	1-3	O		O	
	Gopalgonj	Gopalgonj	Piped					O
	Gopalgonj	Tongipara	Piped					O
	Gopalgonj	Kutalipara	Piped	1-3	O		O	
Barisal	Barguna	Betagi	Non-piped					O
	Bhola	Daulatkhan	Non-piped					O
	Patuakhali	Kuakata	Non-piped	1-3	O		O	O
	Pirojpur	Mathbaria	Non-piped					O
	Patuakhali	Kalapara	Non-piped	1-2	O			O
	Barguna	Barguna	Piped	1-2	O			O
	Barguna	Patharghata	Piped					O
	Gouranadi	Gouranadi	Piped	2	O			
Khulna	Khulna	Chalna	Non-piped					O
	Khulna	Paikgacha	Non-piped					O
	Bagerhat	Morolganj	Non-piped					O
	Narail	Narail	Piped					O
	Narail	Kalia	Piped					O
	Bagerhat	Bagerhat	Piped					O
	Bagerhat	Monglaport	Piped					O
	Jessore	Manirampur	Non-piped	1-3	O		O	
	Satkhira	Kalaroa	Non-piped	1-1	O	O	O	
	Meherpur	Meherpur	Piped	1-1	O	O	O	
	Satkhira	Satkhira	Piped	3		O	O	
	Chuadanga	Chuadanga	Piped	3		O	O	
Chittagong	Cox's Bazar	Moheshkhali	Non-piped	1-2	O		O	
	Noakhali	Hatia	Non-piped	1-1	O	O		O
	Noakhali	Senbagh	Non-piped		O		O	
	Cox'sBazar	Teknaf	Non-piped					O
	Chittagong	Shandia	Non-piped					O

2. Pourashavas Hard to Access to Safe Water Based on Evaluation Results of Pourashava Water Quality Database

a) Pourashava whose deep groundwater contains high Concentration of average EC (Top 10)

Division	District	Pourashava	Piped / Non-piped	Seriousness	Average of EC (mg/L)	Perennial river	Saline of river
Dhaka	Shariatpur	Damoda	Piped	2	3850	Yes	
	Madaripur	Madaripur	Piped	2	2300	Yes	
	Shariatpur	Naria	Piped	2	2100	Not clear	
Barisal	Pirojpur	Pirojpur	Piped	2	3100	Yes	
	Patuakhali	Kuakata	Non-piped	1-2	1975	Yes	Yes
	Barisal	Muladi	Non-piped	2	1433	Yes	
	Jhalakati	Jhalakati	Piped	2	1280	Yes	
Khulna	Jessore	Benapol	Non-piped	2	1945	Yes	
	Jessore	Manirampur	Non-piped	2	1634	Yes	
	Jessore	Bagherpara	Non-piped	2	1293	Yes	

b) Pourashavas whose deep groundwater contains high concentration of average arsenic (Top 10)

Division	District	Pourashava	Piped / Non-piped	Seriousness	Average of Arsenic (mg/L)
Dhaka	Kishorganj	Bhairab	Piped	3	0.100
	Manikganj	Manikganj	Piped	3	0.041
Khulna	Chuadanga	Jibonnagar	Non-piped	3	0.053
	Jessore	Chaugachha	Non-piped	3	0.095
	Chuadanga	Chuadanga	Piped	3	0.078
Chittagong	Noakhali	Kabirhat	Piped	3	0.113
Sylhet	Sunamganj	Chattak	Non-piped	3	0.342
	Sunamganj	Sunamganj	Piped	3	0.070
	Sylhet	Kanaighat	Non-piped	3	0.067
Rajshahi	Sirajganj	Shahjadpur	Piped	3	0.062

c) Pourashavas whose deep groundwater contains high concentration of iron (Top 10)

Division	District	Pourashava	Piped / Non-piped	Seriousness	Average of Iron (mg/L)
Dhaka	Narayanganj	Gopaldi	Non-piped	4	9.6
Chittagong	Noakhali	Sonaimuri	Non-piped	4	10.9
	Noakhali	Noakhali	Piped	4	6.6
	Chittagong	Banshkhali	Non-piped	4	6.6
Sylhet	Sylhet	Kanaighat	Non-piped	4	10.3
	Moulavibazar	Barlekha	Non-piped	4	9.3
	Sylhet	Biyanibazar	Non-piped	4	8.4
	Sunamganj	Jagannathpur	Non-piped	4	7.5
Rajshahi	Bogra	Sherpur	Non-piped	4	7.1
Rangpur	Gaibandha	Palashbari	Non-piped	4	26.7