Government of the People's Republic of Bangladesh

Department of Public Health Engineering (DPHE)

Union Wise Water Technology Mapping [Faridpur Circle]

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Union wise Water Technology Mapping
GOB - UNICEF Project Areas (Faridpur Circle)

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FOREWORD

Sanitation, Hygiene and Water Supply Project (GOB-UNICEF) has been approved with a boarder objective of reducing mortality by providing safe water, sanitation facilities to the communities and improving their hygiene behavior. Water supply is an important aspect of the project which should be free from bacteriological and chemical contamination. Rural water supply in Bangladesh is primarily dependent on low cost tubewell technology using ground water. The tubewell water received priority for being safe particularly from bacteriological contamination point of view. But identification of arsenic in ground water particularly in shallow aquifer appeared as a threat on the ground water based water supply system. This project also emphasizes on arsenic issue as well as safe water option for the community.

Water source of Bangladesh is complex in nature considering water chemistry and geology. As for example, spreading pattern of arsenic is not uniform. In one upazila, some unions are severally arsenic contaminated and some are not. However, arsenic contamination also varies with depth of aquifer for a particular place. Apart from arsenic, ground water source has been facing the problem of excessive iron, salinity and water table depletion. On the other hand, protected but perennial surface water source is not available in many parts of the country. So, one technology may not be suitable for the larger areas because of different hydro-geological situation. In that case the water technology is required to be identified on priority basis up to specific boundary, such as union boundary.

Under these circumstances, GOB – UNICEF Project decided in its 18th PMU (Project Management Unit) meeting held on 5th February 2008, to have good documentation of the valuable outcomes/contribution of DPHE on different issues concerning the WSS sector as DPHE publication, so that, these get preserved for future use and reference.

Based on the PMU decision initiatives have been taken to prepare union wise technology mapping to support the community for preparing their Community Action Plan (CAP) and selecting the suitable water option for that area. Under these initiatives DPHE Ground Water Circle prepared union wise technology mapping based on the available hydro-geological data, National Policy for Arsenic Mitigation 2004 and Implementation Plan of Arsenic Mitigation in Bangladesh and consultation with concerned DPHE field offices.

This document contains the basic concept along with advantages and limitations of different water options. It also gives an outline of different steps to be followed to select the options.

This is just a beginning, there might be some information gaps for selecting the suitable option. Moreover, people's acceptability is an important issue to be taken into consideration during implementation.

I would like to express my gratitude to UNICEF for providing necessary support in preparing this document. I also gratefully acknowledge the contribution of Mr. Sudhir Kumar Ghosh, SE, Ground water Circle, DPHE and Mr. Saifur Rahman, EE, DPHE, R & D Division for preparing this documentation I would. also like to thank DPHE field-level officers for their valuable contribution in the experience sharing workshop.

We hope, in course of time, this document will be updated and upgraded with more information and field experiences and this initiative will be instrumental in preparing union wise technology mapping for the whole country.

(Md. Nurul Islam)
Project Director, DPHE
Sanitation, Hygiene and Water Supply Project (GOB-UNICEF)

Table of Content

1.0 Background:

Sanitation, Hygiene and Water Supply Project (GOB-UNICEF) has been approved having boarder perspective of reducing mortality through providing safe water, sanitation facilities and improved hygiene behavior. Water supply is an important aspect of the project and supplied water should be free from bacteriological and chemical contamination as well.

Rural water supply in Bangladesh is predominantly based on ground water. But identification of arsenic in ground water particularly in shallow aquifer causes threat on ground water based water supply system. The project emphasizes on arsenic issue for providing safe water to the community. Arsenic has been identified in 271 upazilas of which 29% tube wells are found arsenic contaminated in terms of Bangladesh standard (50ppb). Spreading pattern of arsenic is sporadic, not uniform. In one upazila, some unions are severally arsenic contaminated and some are not like that. However, arsenic contamination also varies with depth of aquifer for a particular place.

The ground water of Bangladesh is extremely complex in terms of water chemistry and geology as well. On the other hand, protected but perennial surface water source is not available in many parts of the country. So, one technology my not be suitable for the larger areas because of different hydro-geological situation. In that case the water technology is required to be identified on priority basis up to specific boundary, such as union level.

According to project approach, water points will be installed through the process of community action plan (CAP). During preparation of CAP, the community should be provided with the understandable ideas about the water option so that they can rightly choice the option by themselves. In this regard Project Director, Sanitation, Hygiene and Water supply project vide his memo no 650 date 19 February 2007 requested DPHE Ground Water Circle to provide assistance in preparation of union wise technological map for the GOB – UNICEF project area.

In this context, initiatives have been taken by DPHE Ground Water Circle in consultation with SHWAB project and WES section of UNICEF to prepare the technological map for the project areas.

2.0 Objective of Task:

- Identification of the union wise water supply technology based on hydro-geological situation of the particular areas.
- Preparation of the GIS mapping on union wise water options.
- Provide information to the water user group for preparation of CAP

3.0 Project area:

The project area of the GOB-UNICEF project has been classified as follows:

- 1st Batch: 635 union of 60 upazilas
- 2nd Batch: 439 union of 44 upazilas
- 3rd Batch: 600 paras of 16 upazilas

Technology Mapping for the project upazilas has been planned to be done batch wise.

4.0 Adopted Procedure :

1. Union wise basic data regarding lowest water table, arsenic contamination, iron and salinity problem available in Ground Water Circle has been furnished in a table (Union wise technology 1993 as reference).

2. Based on basic information, a desk review has been made to primarily identify union-wise technology analyzing the hydro-geological situation of that particular area. In most cases particularly in the arsenic affected unions, two or more options were identified on priority basis. The forecasting of groundwater level inyear 2010 is considered as maximum water level in the area.

3. The primarily identified union wise technology list was provided to the DPHE SEs, EEs and SAEs to facilitate their participation in the workshop

4. DPHE Circle wise workshops were held with the participation of concerned Superintending Engineer, Executive Engineer, Assistant Engineer and Sub-Assistant Engineer. Representatives from Ground Water Circle, GOB-UNICEF project, personnel from WES section of UNICEF were present to facilitate the workshop.

5. The workshops discussed the experience and views of the field officer focusing on technology table prepared by DPHE Ground Water Circle and along with the policy guidelines particularly “National Policy for Arsenic Mitigation 2004 and Implementation Plan for Arsenic Mitigation in Bangladesh”.

6. Incorporating the findings of Workshop, the technology table has been send to concerned SEs, EEs and SAEs.

7. Based on the feed back from the field, technology table has been finalized, on basis of that GIS map for union-wise technology has been prepared.

5.0 Issue of the water source:

The problems of water source have been discussed which are as follows:

i. Lowering of water table
ii. Arsenic contamination in ground water particularly in shallow aquifer
iii. Salinity in ground water
iv. Iron & Manganese in ground water
v. Non availability of suitable aquifer or rocky/hard layer
vi. Non-availability of protected and perennial surface water source round the year

6.0 Arsenic Mitigation Option:

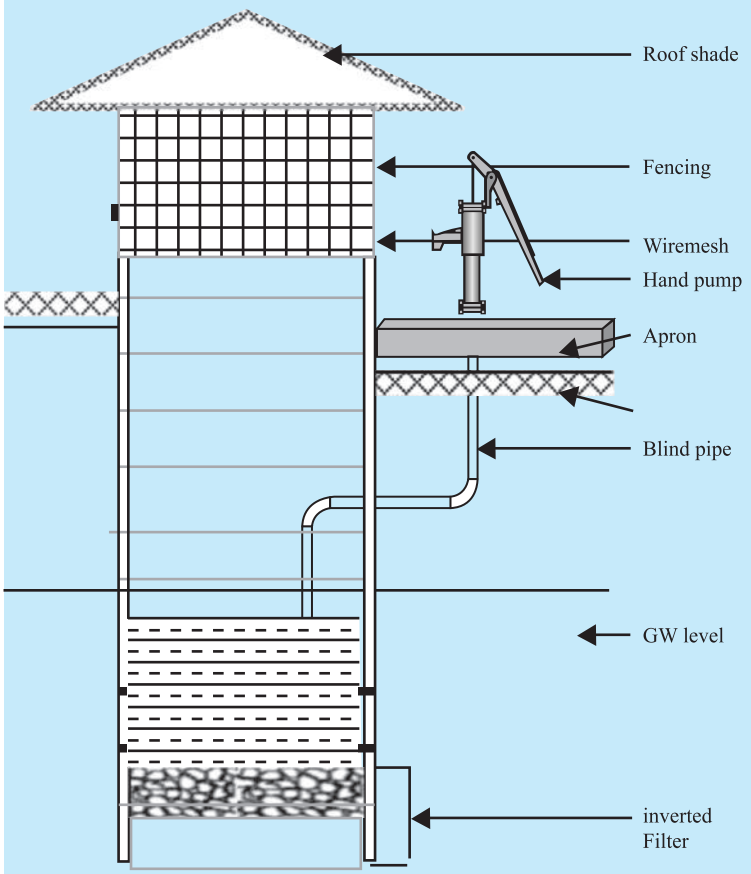
The project has given importance on arsenic mitigation approach as arsenic contamination emerges as a great concern for ground water based rural water supply system in Bangladesh. The project area and arsenic contamination is shown in Map as Annex- B. Different Arsenic mitigation options has been discussed following “National Policy for Arsenic Mitigation 2004 & Implementation Plan for Arsenic Mitigation in Bangladesh”. The mitigations options are:

- Dug/Ring Well
- Pond Sand Filter
- Deep Tubewell
- Rain Water Harvesting as promotional option and
- Arsenic Removal Technology (ART)

6.1 Criteria for Arsenic Mitigation Option:

Regarding identification of the Arsenic Mitigation Option, the criteria including the potentialities and limitation of each option were discussed in contrast with hydro-geological situation for the particular area considering the guidelines mentioned in the “National Policy for Arsenic Mitigation 2004 & Implementation Plan for Arsenic Mitigation in Bangladesh”. According to the said policy guidelines PSF and dug well will be tried first. If these technologies are found not feasible deep tubewell could be tried following the “Protocol for sinking Deep Tubewells in Arsenic contaminated areas”.

It was also advised that not only the technical aspect but O&M and user friendliness should be taken under consideration for selecting the options to make it sustainable. The main feature and basic criteria for each of the option are presented as follows:



Dug Well with Sanitary Protection

6.1.1 Dug Well:

Dug well is the oldest method of groundwater with-drawal for water supplies. The water of the dug well has been found to be free from dissolved arsenic and iron even in locations where tubewells particularly in shallow aquifer are contaminated.

Pre-requisite criteria

- There should be stable soil layer at the top (a clay layer is preferable)
- Presence of sandy layer within 9 to 12 m

Not Feasible

- Areas with the loose sandy soil
- Areas with more than 15m consolidated clay.
- Tidal zones of the costal belt.
- Areas of stony hills
- Area of peaty soil should be avoided for DW as these cause an unpleasant taste and smell.

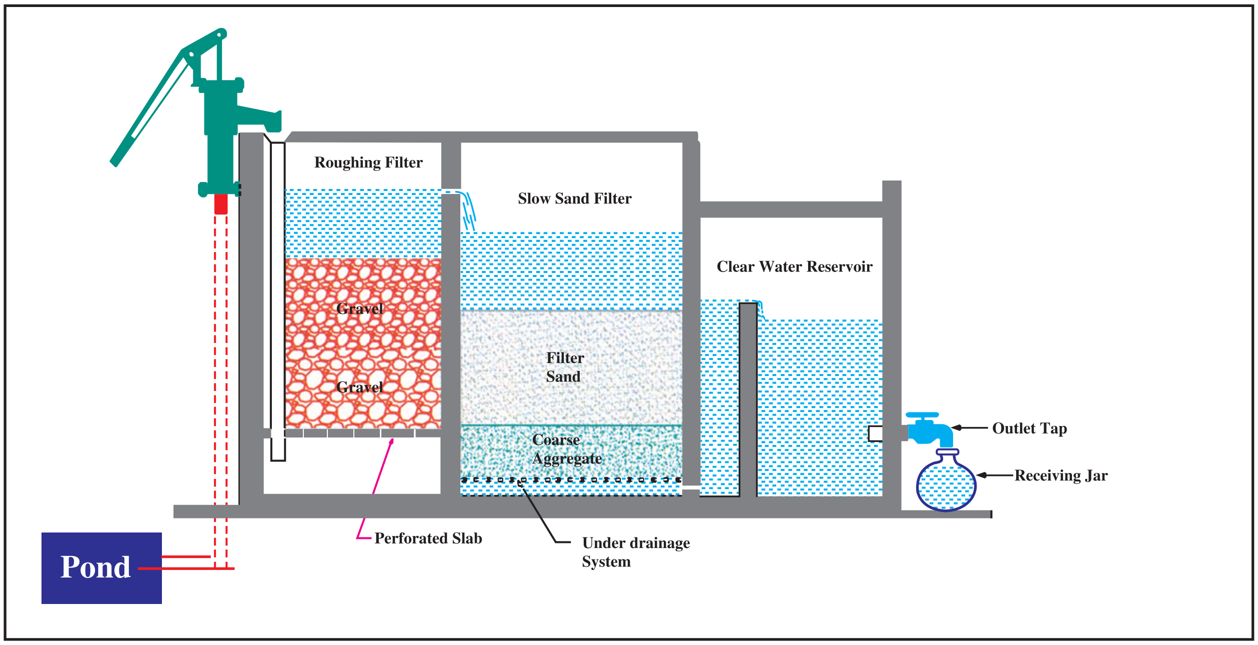
Design Requirements:

- Concrete rings of 1.0 to 1.2 m in diameter used as lining.
- Wells should be at least 1.0 to 1.5 m deeper than the lowest water table in the driest month.
- Dug well should be constructed in the dry season to ensure availability of water round the year.
- Test well is to be drilled prior to construction of ring well to make sure about the soil condition and water quality.
- The well lining should be extended at least 0.5m above the ground to form a 'head wall' around the outer rim of the well.
- A concrete apron, about 2 m in width, should be constructed on the ground surface extending all around the outer rim of the well.
- The intake of water from a dug well can alternatively be made using float.

Very Shrouded Shallow Tubewell (VSST) can be considered as option in the DW area at the same depth. The availability of water in saturated zone should be ensured in this case. The main feature of this technology is the shrouded with coarse sand around the filter area. This is a low cost technology. This technology is also used in the saline problem areas.

6.1.2 Pond Sand Filter:

Pond sand filter is a surface water treatment option which is primarily a slow sand filter unit. If the turbidity of water is high then, there is necessity to use horizontal roughing filter.



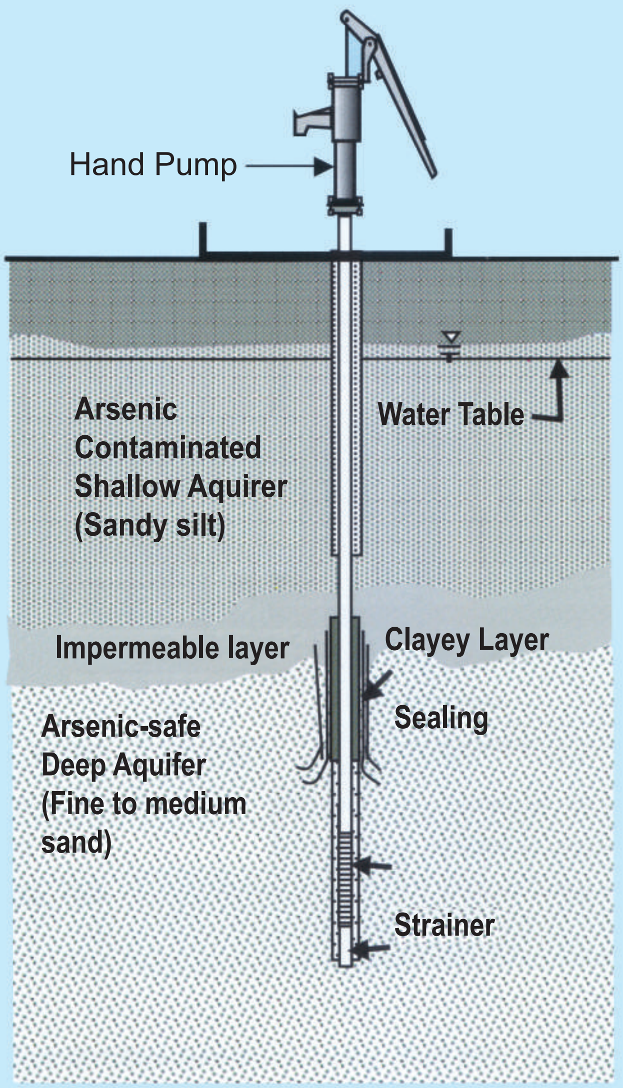
Raw water from pond is pumped up from a pond; the turbidity gets down through the roughing filter and then discharged into the filtration unit. The water is filtered and then collected in a clear water reservoir by an under drainage system. PSF is a good option for arsenic mitigation as well as for salinity prone areas

Pre- requisite criteria

- Viable alternative water supply option where perennial rivers, canals, fresh water lakes and ponds of acceptable water quality are available.
- Regular maintenance is crucial for the effectiveness of PSF
- Such maintenances need high level of community mobilization and proper attention to ensure safe water particularly from bacteriological contamination.

Design Criteria

- The horizontal roughing filter is divided into 3 parts: inlet tank, gravel zone and outlet tank. The gravel zone consists of 3 chambers loaded by different size of gravel (5-15 mm).
- The Sand Filter bed should be composed of 0.22 mm – 0.35 mm fine sand with a thickness of 60 to 120 cm. There is also a layer of coarse aggregate below the fine sand to support the sand against washing out through under drainage system. The uniformity coefficient should be from 2 to 3. The size of the gravel is 5-15 mm
- The filtration rate through SF is 0.2 – 0.3 m/hr and through roughing filters 1.5-2.0 m/hr.



Manually Operated Deep tubewell

6.1.3 Improved Deep Tubewell

The deep aquifers in Bangladesh have been found to be relatively free from arsenic contamination. The aquifers in Bangladesh are stratified and in some places the aquifers are separated by relatively impermeable strata. Deep tubewells installed in those protected deeper aquifers are producing arsenic safe water. Sealing in the impervious layer is done to prevent the leaching of arsenic through path way created during drilling of the well.

Pre-requisite criteria

- It can be installed where shallow aquifer is separated from deeper aquifer by substantially thick impervious layer.
- It can be installed in the coastal areas of Bangladesh having safe aquifer.

Design Requirements

- The entire tube well should be installed straight and vertically deep bore hole is required therefore.
- The annular space of bore holes of the deep tube wells are required to be sealed at the level of impermeable strata.
- The entire tube well should be installed straight and vertical.

6.1.4. Rain Water Harvesting

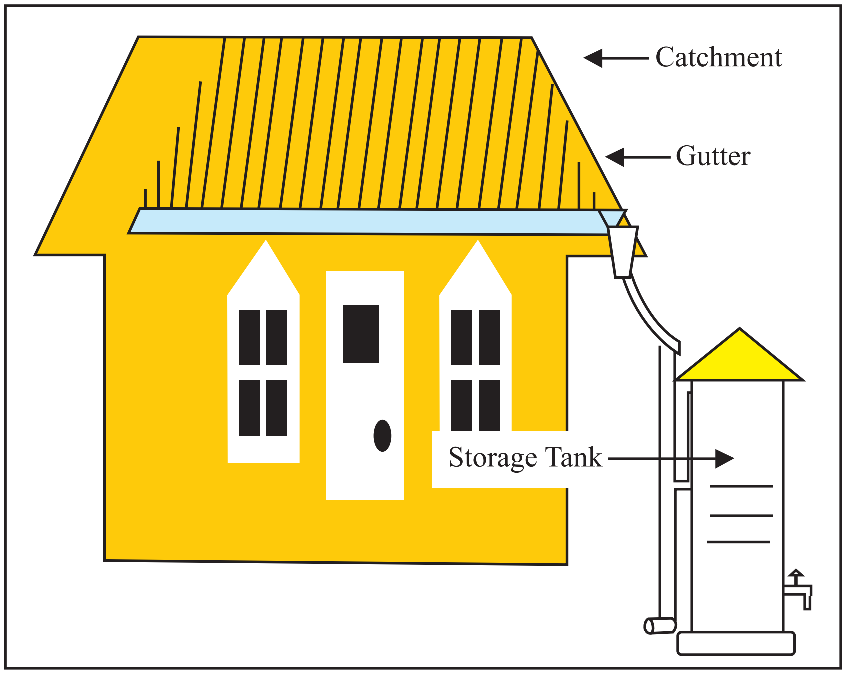
Rainwater harvesting is a technology to collect rainwater for its use in drinking purposes. About 203 cm rainfall occurs annually in Bangladesh. The rain water is safe if it maintained hygienically. The main limitation of this option is non-availability of rain water round the year. But it can be widely used as supplementary source. As per "National Policy for Arsenic Mitigation 2004 & Implementation Plan for Arsenic Mitigation in Bangladesh" the government's role is mainly to conduct promotional activities for RWH.

Pre- requisite criteria

- Feasible where average rainfall is 1600 mm per annum.
- There should have required catchment area for rain water harvesting

Design Criteria

- Rain water has 3 basic units. 1. The catchment area (like corrugated roof top) and 2. Supporting collection system (gutter and collection pipe) and 3. Storage tank.
- Catchment zone can be a corrugated tin-shed, sloped flat roof top, polythene sheet etc.



- The tank can be made of GI, ferro-cement, burned clay (motka), plastic etc.
- The collection pipe should have an exit way beyond the connection with storage tank to let the first flush flow away.
- The down pipe should have net to bar mosquitoes, flies from entering into the storage tank.
- There should be an end plug to stop flush discharge to enter water into the storage tank after flushing.
- The location should be so selected that it allows accessibility of people.

6.1.5 Arsenic Removal Technology (ART):

ARTs are the chemical options which remove arsenic mainly using media. Four options are certified by BCSIR of which three are house hold and one is community based. These can be selected as a last effort particularly where deep tubewell and Dug well is not feasible. Filter media have to be changed after the media being clogged. The quality of raw water is specified for each technology.

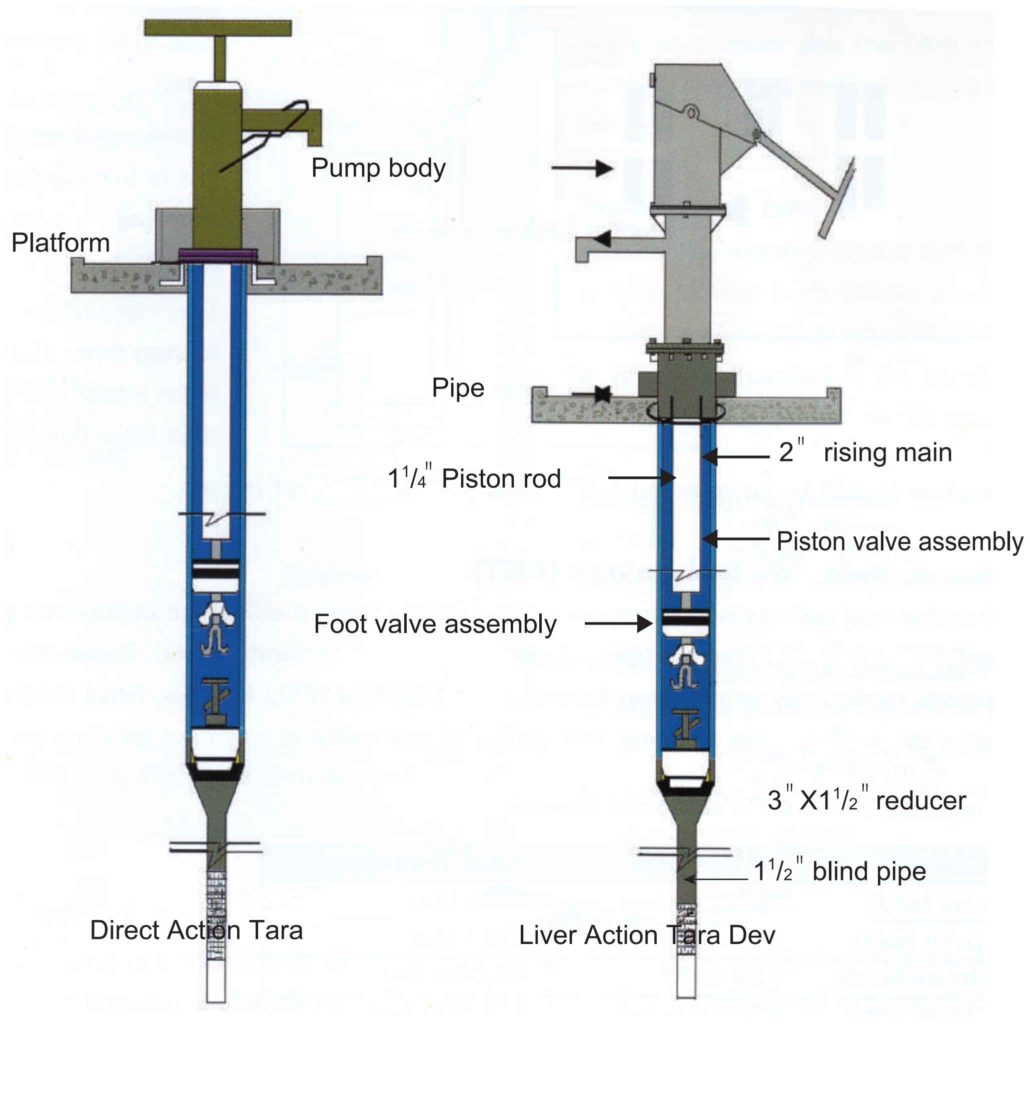
The main features of the ARTs are given below:

Name of ARts	Filter rate	Total Treatment
Sono (House hold)	16 lit/hr	8100 liter
Alkan (House hold)	120 lit/hr	8100 liter
Read-F (House hold)	60 lit/hr	40,000 liter
SIDKO (Comm unity)	240 liter/ hr	1,21, 500 liter

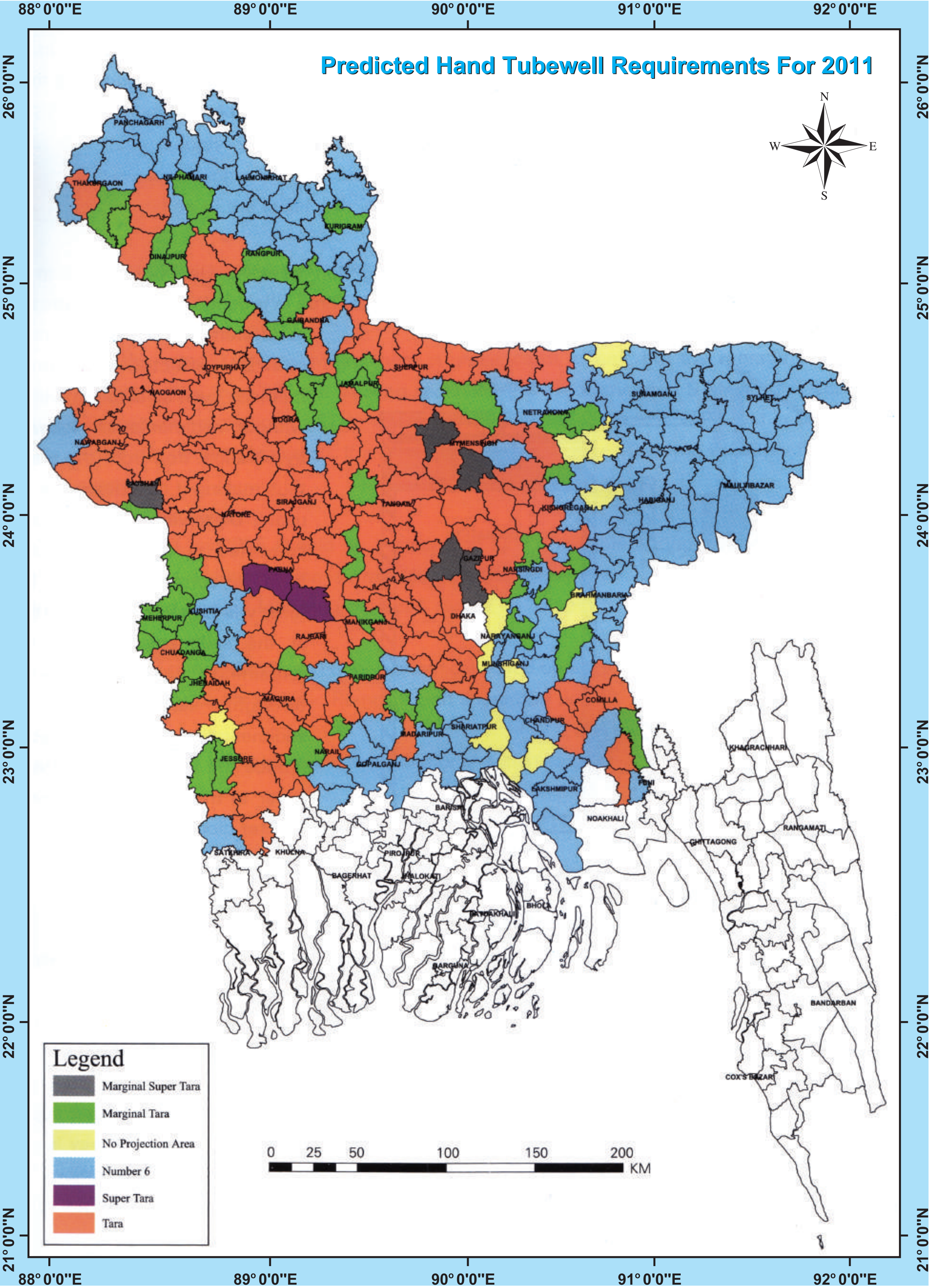
Note : 2 (two) more technologies Nelima and Shodesh have further been cerfified by BCSIR

7.0 Low Water Table Technology:

Lowering of water table is big issue for the tubewell based rural water supply. In view of low cost, easy to O&M and availability in the market, suction mode number 6 pump is widely used as the tubewell technology. But its limitation is that it can not abstract water beyond the 26 ft depth of water table. In that case force mode pump has to be used. Earlier direct action pump was used. In some cases where the depth of water table is marginal, in that case Tara tube well may be given preference. Now Tara-dev head pump (lever action) is being used which can abstract water upto 80-90 ft depth of water table. The component of direct action & Tara dev pumps are shown as below:



In selecting the areas of low water table in the project upazilas, the study on forecasting groundwater level declination in Bangladesh conducted in early 1990 has been used and the delineated low water table map for 2010 is considered as the reference of maximum depth to water level. The pump technology is then selected for the union.

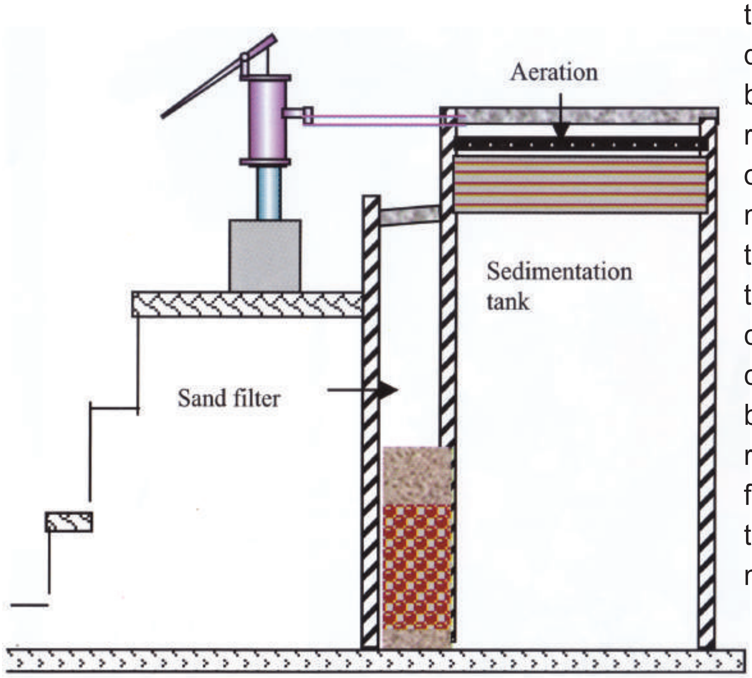

Predicted Hand Tubewell Requirements For 2011
88° 0'0"E
89° 0'0"E
90° 0'0"E
91° 0'0"E
92° 0'0"E
26° 0'0"N
25° 0'0"N
24° 0'0"N
23° 0'0"N
22° 0'0"N
21° 0'0"N
N
S
E
W
Legend
Marginal Super Tara
Marginal Tara
No Projection Area
Number 6
Super Tara
Tara
0 25 50 100 150 200
KM

8.0 Salinity problem:

Salinity problem is now not limited in the coastal belt rather salinity intrusion is now expanded in the various part of the country. Deep tubewell and PSF are the best feasible option in this area. It is to be mentioned that RWH is a suitable option as average rainfall is high in the coastal belt. The VSST is also an option in the coastal belt.

9.0 Iron Removal Technology:

Iron content exceeding 5mg/l will require treatment using Iron Removal Unit (IRU). It is to be mentioned that concentration of Iron varies with different aquifer. Iron in ground water may be present in different forms and its removal can be effected by simple methods such as aeration with or without sedimentation followed by filtration. iron from the water, thus making it acceptable for the users. Dissolved iron in water is converted in to insoluble ferric form in contact with air. This form will be removed by settling in the sedimentation tank and remaining by the filtration through sand filter. The sedimentation tank is required to reduce the load on sand filter in order to minimize the frequency of filter clogging.



10.0 Union Wise Technologies:

A set of technologies has been recommended for each union on priority basis based on the available hydro-geological information, the views of field personnel & policy guidelines. However, these technologies have to be implemented systematically ensuring the participation of communities. According to the project guidelines the water options will be selected following the community action plan ensuring the active participation of community. So proper knowledge about the option shall have to be provided to the community so that the option can meet the basic criteria of the water supply such as safe, adequate and reliable round the year. It is to be mentioned that if a technology is new for the particular area, utmost care should be taken for its implementation and replication. The experience regarding implementation of the technologies in the field will be helpful for upgrading the technological mapping and for proper application of the technologies.

11.0 Use of Union wise technology Mapping document:

It has been proved from different studied that hand pump system of water options particularly Shallow and Deep hand pump tube wells are very much popular among the community. But the arsenic contamination in groundwater compelled the implementer of water supply to switch over to different alternative water supply options in the arsenic affected areas. The technology in a union has been recommended considering the Arsenic Policy 2004 and its Implementation Plan along with other particular information of the locality. In implementing water supply options the following steps should be followed:

a) In all cases arsenic and other required water quality parameters need to be tested before the system is bought to operation.

b) In the villages/unions where there is presence of arsenic but the average contamination level is less than 5%, the existing technology is recommended STW. In that case, before going for installation of STW, testing of arsenic of 5 to 10 tube wells within 500 meters of the site need to be tested. If any tubewell shows arsenic >0.01 mg/L, follow the alternative option.

c) Dug well and PSF should be investigated as the feasible option of alternative of STW. If sufficient documentation is available about its failure in the locality then Deep tubewell with modified design(following protocol) should be adopted.

d) In case of non-successful of non chemical based option (STW, DW, PSF and DTW) chemical based option for Arsenic Removal Unit should be used as the technology.

e) In all cases in problem areas promotional activities on RWH should be done.

Annex - A

Upazila Project area
of
Sanitation, Hygiene and Water Supply (GOB-UNICE F) Project
under

Faridpur Circle

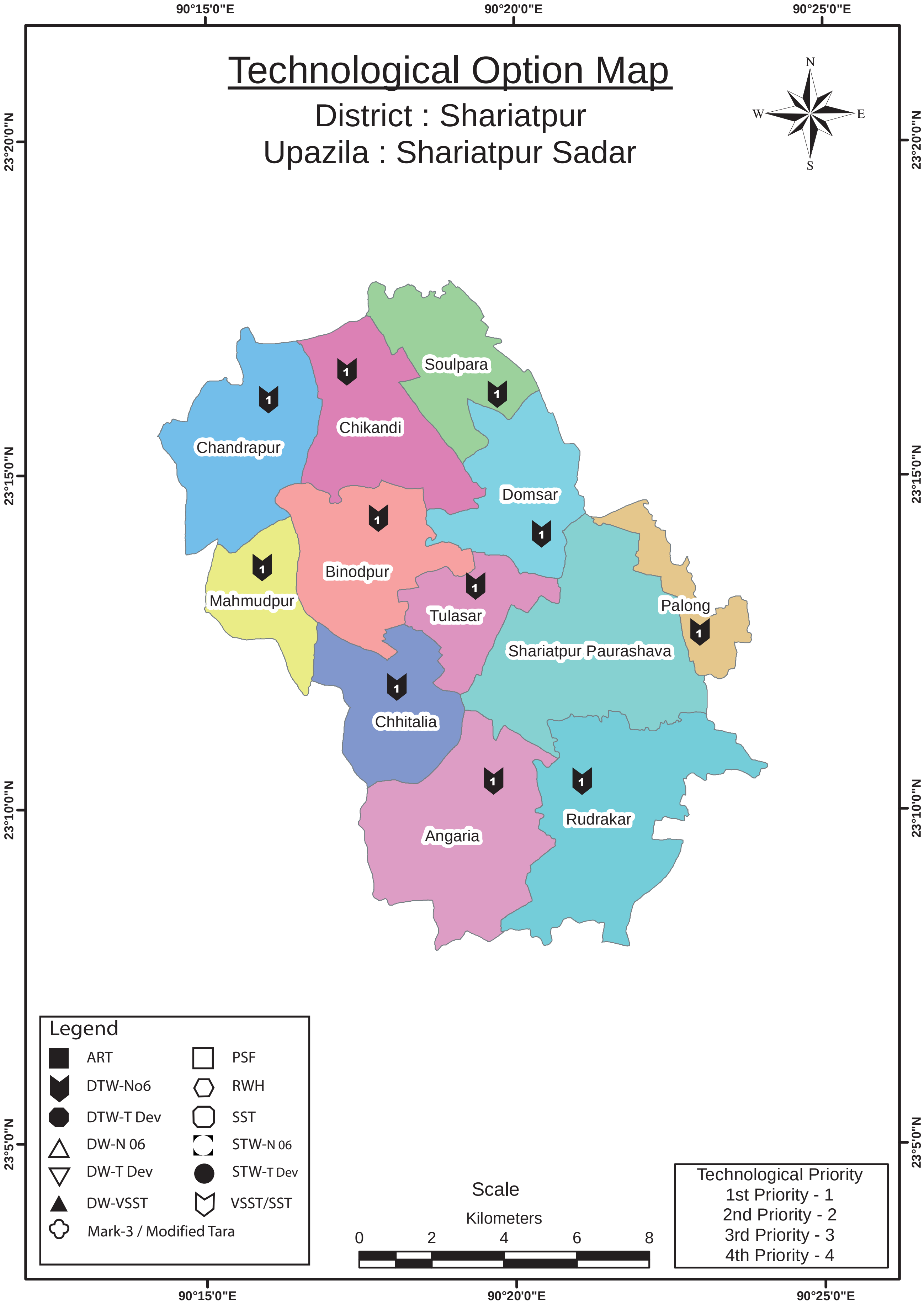
Serial No	Name of District/Pourashava	Name of Upazila	No of Union	Total no of UPs
1	Shariatpur	Shariatpur Sadar	11	27
2	Shariatpur	Goshairhat	08	
3	Shariatpur	Damudya	08	

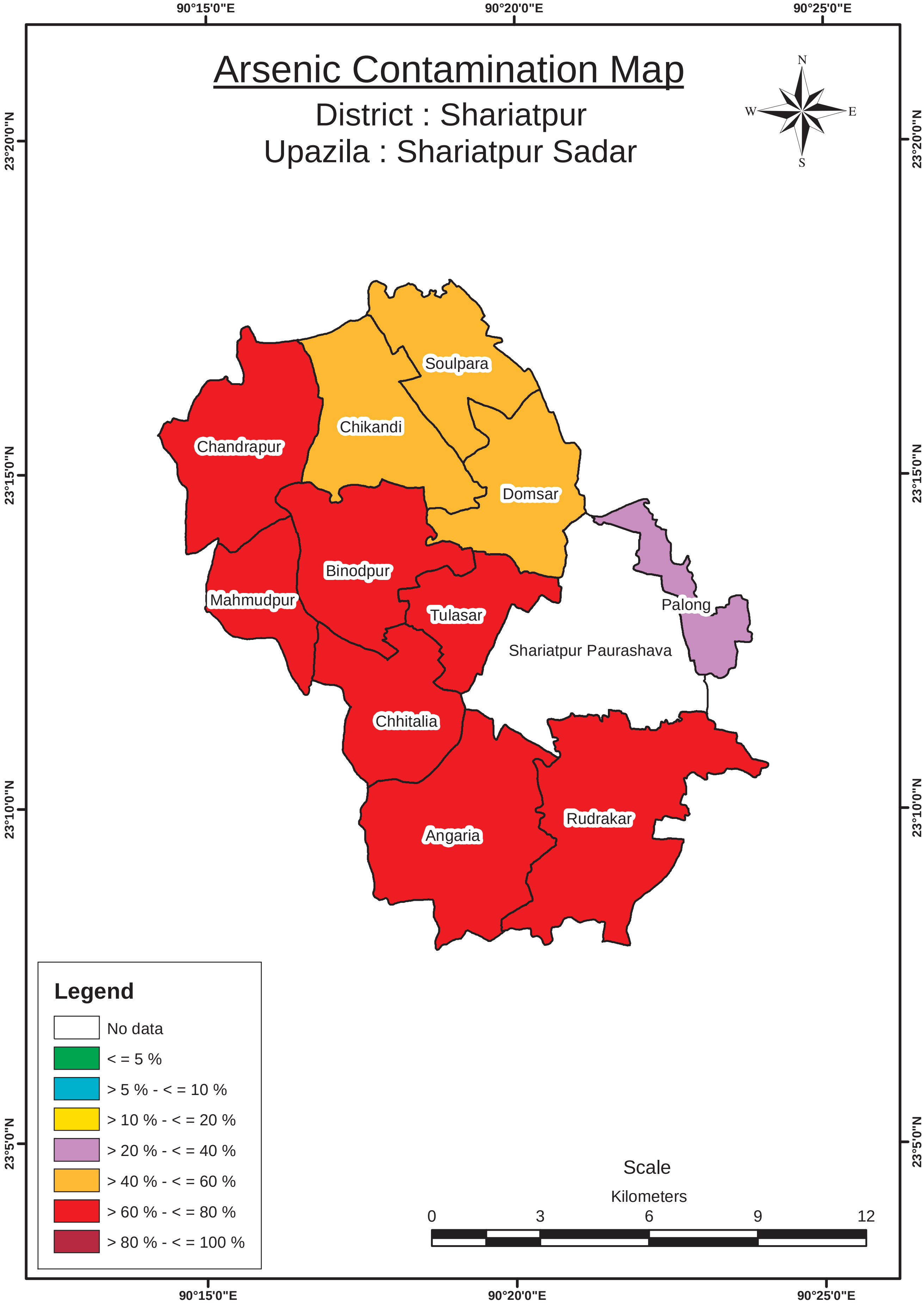
District: Faridpur

Upazila: Shariatpur Sadar
Goshairhat
Damudya

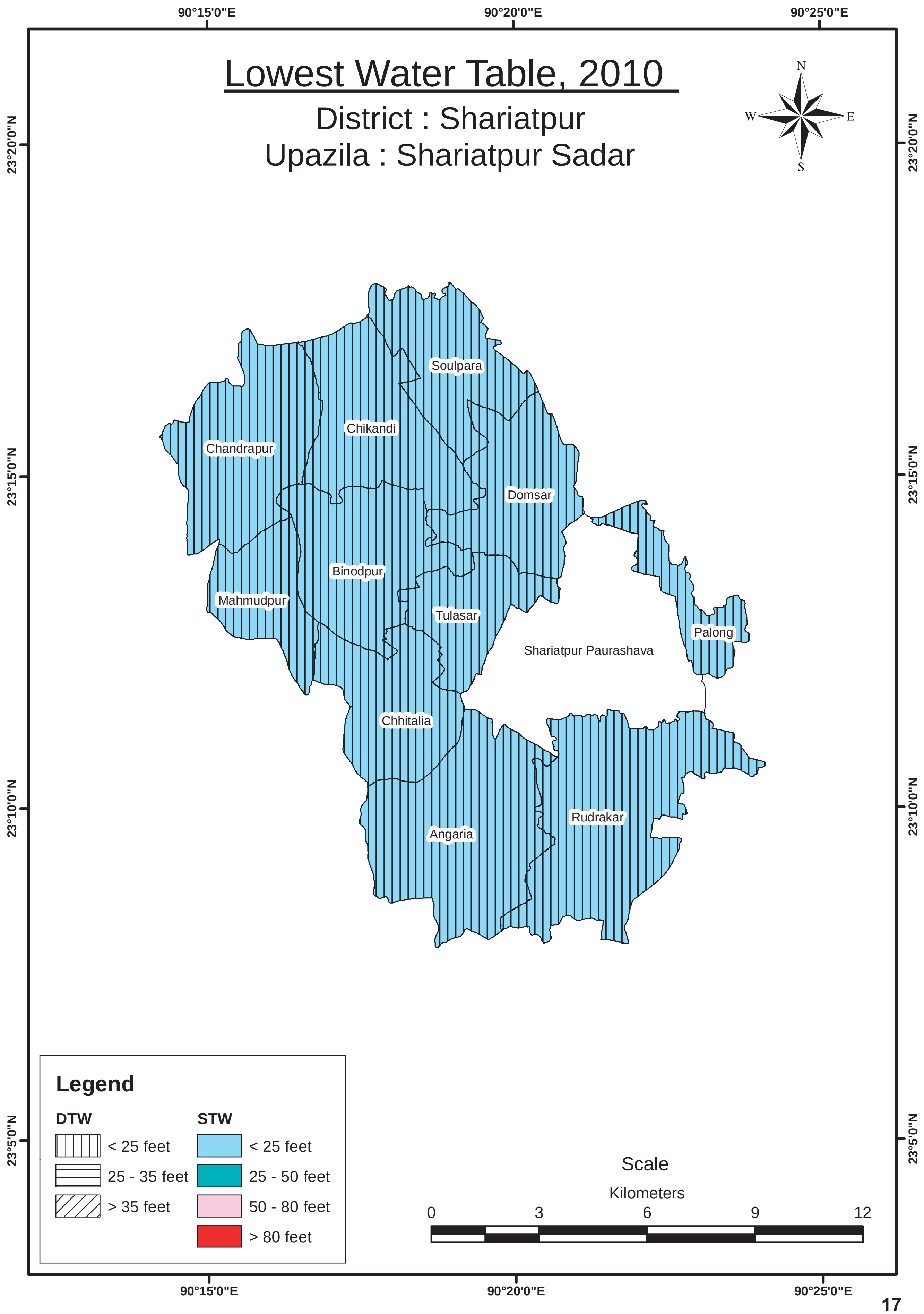
Table
For
Mapping on 'Water Supply Technology' under "GOB-UNICEF Project"

District	Upazila	Union	Lowest Water Table in 2010, ft		As Contamination %	As Contamination		Fe, Problem(>5 ppm)		Cl Problem (>600ppm)		1993 Technology Option	Average Depth of TW, ft		Recommended Priority Options STW: Shallow Tubewell, No6/T.Dev DTW: Deep Tubewell, No6/T.Dev DW: Dugwell (Ringwell) PSF: Pond Sand Filter ART: Arsenic Removal Technology			
			STW	DTW		STW	DTW	STW	DTW	STW	DTW		STW	DTW	1	2	3	4
Shariatpur	Shariatpur Sadar	Palong	20	16	32	Y	N	Y	Y	N	Y	STW/DTW	75	820	DTW-No6	-	-	-
Shariatpur	Shariatpur Sadar	Chandrapur	16	14	69	Y	N	Y	Y	N	Y	STW	70	820	DTW-No6	-	-	-
Shariatpur	Shariatpur Sadar	Mahmudpur	15	17	70	Y	N	Y	Y	N	Y	STW	80	820	DTW-No6	-	-	-
Shariatpur	Shariatpur Sadar	Rudrakar	13	14	67	Y	N	Y	Y	N	Y	STW	80	820	DTW-No6	-	-	-
Shariatpur	Shariatpur Sadar	Soulpara	16	20	58	Y	N	Y	Y	N	Y	STW	75	820	DTW-No6	-	-	-
Shariatpur	Shariatpur Sadar	Angaria	13	15	69	Y	N	Y	Y	N	Y	STW	70	820	DTW-No6	-	-	-
Shariatpur	Shariatpur Sadar	Chhitalia	12	15	67	Y	N	Y	Y	N	Y	STW	75	820	DTW-No6	-	-	-
Shariatpur	Shariatpur Sadar	Binodpur	14	15	71	Y	N	Y	Y	N	Y	STW	80	820	DTW-No6	-	-	-
Shariatpur	Shariatpur Sadar	Chikandi	15	15	59	Y	N	Y	Y	N	Y	STW	70	820	DTW-No6	-	-	-
Shariatpur	Shariatpur Sadar	Domsar	12	15	55	Y	N	Y	Y	N	Y	STW	75	820	DTW-No6	-	-	-
Shariatpur	Shariatpur Sadar	Tulasar	13	14	66	Y	N	Y	Y	N	Y	STW	70	820	DTW-No6	-	-	-


90°15'0"E
90°20'0"E
90°25'0"E
23°20'0"N
23°15'0"N
23°10'0"N
23°5'0"N
Technological Option Map
District : Shariatpur
Upazila : Shariatpur Sadar
N
W
E
S
Soulpara
Chikandi
Chandrapur
Domsar
Binodpur
Mahmudpur
Tulasar
Palong
Shariatpur Paurashava
Chhitalia
Rudrakar
Angaria
Legend
ART
PSF
DTW-No6
RWH
DTW-T Dev
SST
DW-N 06
STW-N 06
DW-T Dev
STW-T Dev
DW-VSST
VSST/SST
Mark-3 / Modified Tara
Scale
Kilometers
0
2
4
6
8
Technological Priority
1st Priority - 1
2nd Priority - 2
3rd Priority - 3
4th Priority - 4



90°15'0"E
90°20'0"E
90°25'0"E
23°20'0"N
23°15'0"N
23°10'0"N
23°5'0"N
Arsenic Contamination Map
District : Shariatpur
Upazila : Shariatpur Sadar
N
W
E
S
Soulpara
Chikandi
Chandrapur
Domsar
Binodpur
Mahmudpur
Tulasar
Palong
Shariatpur Paurashava
Chhitalia
Rudrakar
Angaria
Legend
No data
< = 5 %
> 5 % - < = 10 %
> 10 % - < = 20 %
> 20 % - < = 40 %
> 40 % - < = 60 %
> 60 % - < = 80 %
> 80 % - < = 100 %
Scale
Kilometers
0
3
6
9
12



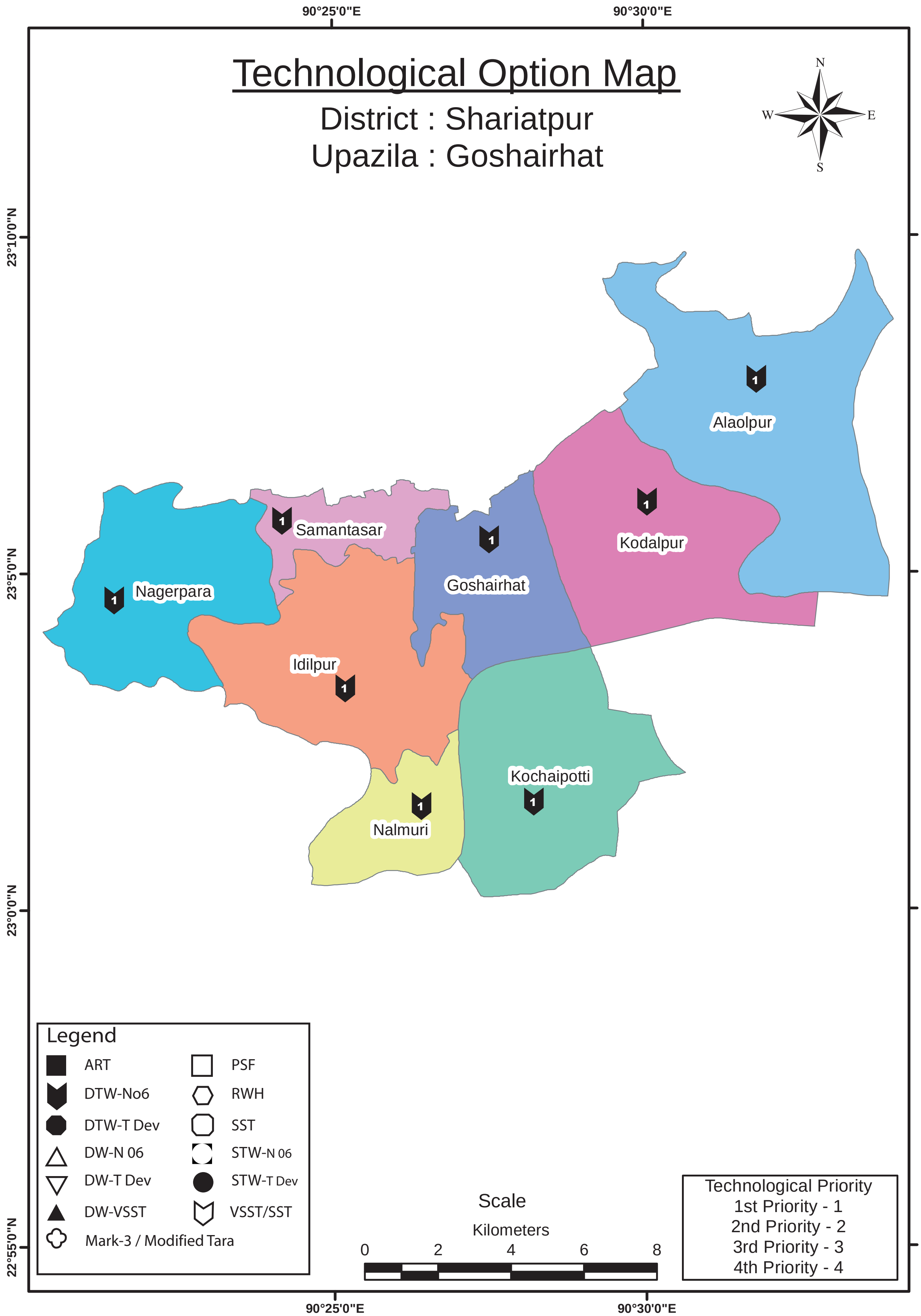
Lowest Water Table, 2010
District : Shariatpur
Upazila : Shariatpur Sadar
90°15'0"E
90°20'0"E
90°25'0"E
23°20'0"N
23°15'0"N
23°10'0"N
23°5'0"N
N
S
E
W
Soulpara
Chikandi
Chandrapur
Domsar
Binodpur
Mahmudpur
Tulasar
Palong
Shariatpur Paurashava
Chhitalia
Rudrakar
Angaria
Legend
DTW
< 25 feet
25 - 35 feet
> 35 feet
STW
< 25 feet
25 - 50 feet
50 - 80 feet
> 80 feet
Scale
Kilometers
0
3
6
9
12

Table

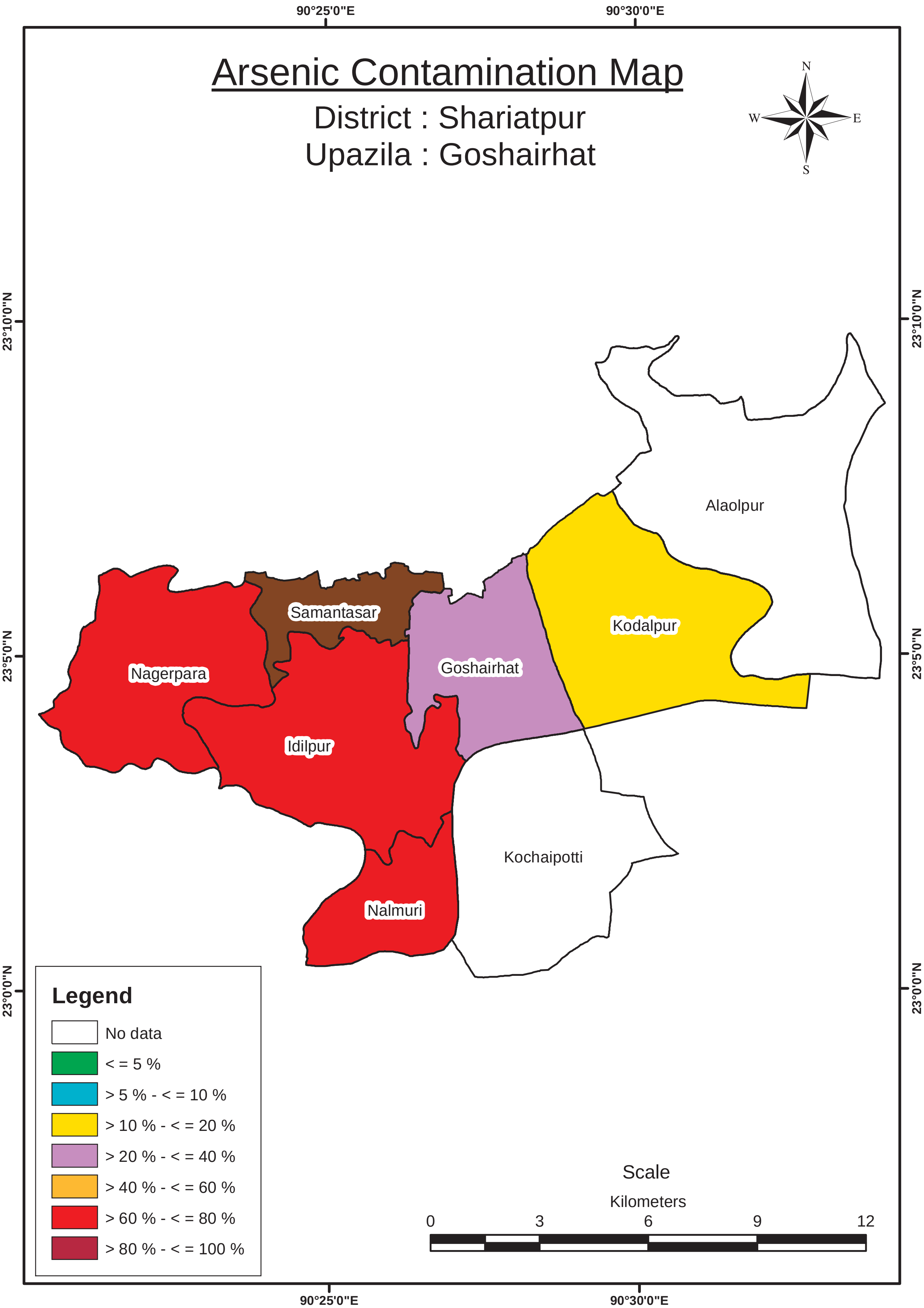
For

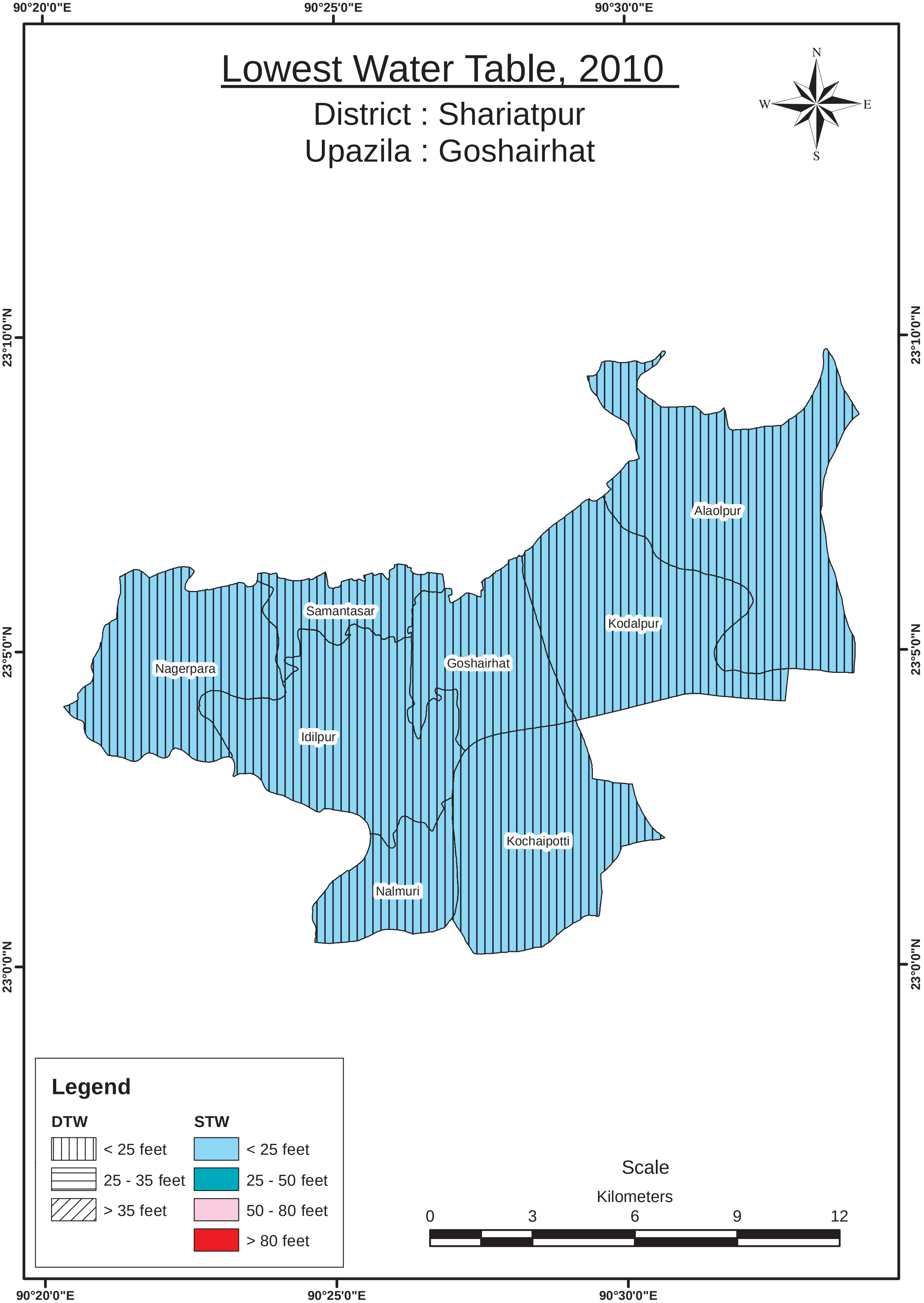
Mapping on 'Water Supply Technology' under "GOB-UNICEF Project"

District	Upazila	Union	Lowest Water Table in 2010, ft		As Contamination %	As Contamination		Fe, Problem(>5 ppm)		Cl Problem (>600ppm)		1993 Technology Option	Average Depth of TW, ft		Recommended Priority Options STW: Shallow Tubewell, No6/T.Dev DTW: Deep Tubewell, No6/T.Dev DW: Dugwell (Ringwell) PSF: Pond Sand Filter ART: Arsenic Removal Technology			
			STW	DTW		STW	DTW	STW	DTW	STW	DTW		STW	DTW	1	2	3	4
Shariatpur	Goshairhat	Idilpur	10	10	77	Y	N	N	N	N	Y	STW	80	820	DTW-No6	-	-	-
Shariatpur	Goshairhat	Nagerpara	10	10	80	Y	N	N	N	N	Y	STW	85	820	DTW-No6	-	-	-
Shariatpur	Goshairhat	Samantasar	10	10	82	Y	N	N	N	N	Y	STW	85	820	DTW-No6	-	-	-
Shariatpur	Goshairhat	Nalmuri	10	10	75	Y	N	N	N	N	Y	STW	80	820	DTW-No6	-	-	-
Shariatpur	Goshairhat	Goshairhat	10	10	29	Y	N	N	N	N	Y	STW	85	885	DTW-No6	-	-	-
Shariatpur	Goshairhat	Kodalpur	10	10	11	Y	N	N	N	N	Y	STW	100	920	DTW-No6	-	-	-
Shariatpur	Goshairhat	Alaolpur	11	11	NA	Y	N	N	N	N	Y	STW	100	820	DTW-No6	-	-	-
Shariatpur	Goshairhat	Kochaipotti	10	10	NA	Y	N	N	N	N	Y	STW	100	820	DTW-No6	-	-	-



90°25'0"E
90°30'0"E
Technological Option Map
District : Shariatpur
Upazila : Goshairhat
N
W
E
S
23°10'0"N
23°5'0"N
23°0'0"N
22°55'0"N
Alaolpur
Kodalpur
Samantasar
Goshairhat
Nagerpara
Idilpur
Kochaipotti
Nalmuri
1
Legend
ART
PSF
DTW-No6
RWH
DTW-T Dev
SST
DW-N 06
STW-N 06
DW-T Dev
STW-T Dev
DW-VSST
VSST/SST
Mark-3 / Modified Tara
Scale
Kilometers
0
2
4
6
8
Technological Priority
1st Priority - 1
2nd Priority - 2
3rd Priority - 3
4th Priority - 4


90°25'0"E
90°30'0"E
Arsenic Contamination Map
District : Shariatpur
Upazila : Goshairhat
N
W
E
S
23°10'0"N
23°5'0"N
23°0'0"N
Alaolpur
Kodalpur
Samantasar
Goshairhat
Nagerpara
Idilpur
Kochaipotti
Nalmuri
Legend
No data
< = 5 %
> 5 % - < = 10 %
> 10 % - < = 20 %
> 20 % - < = 40 %
> 40 % - < = 60 %
> 60 % - < = 80 %
> 80 % - < = 100 %
Scale
Kilometers
0
3
6
9
12

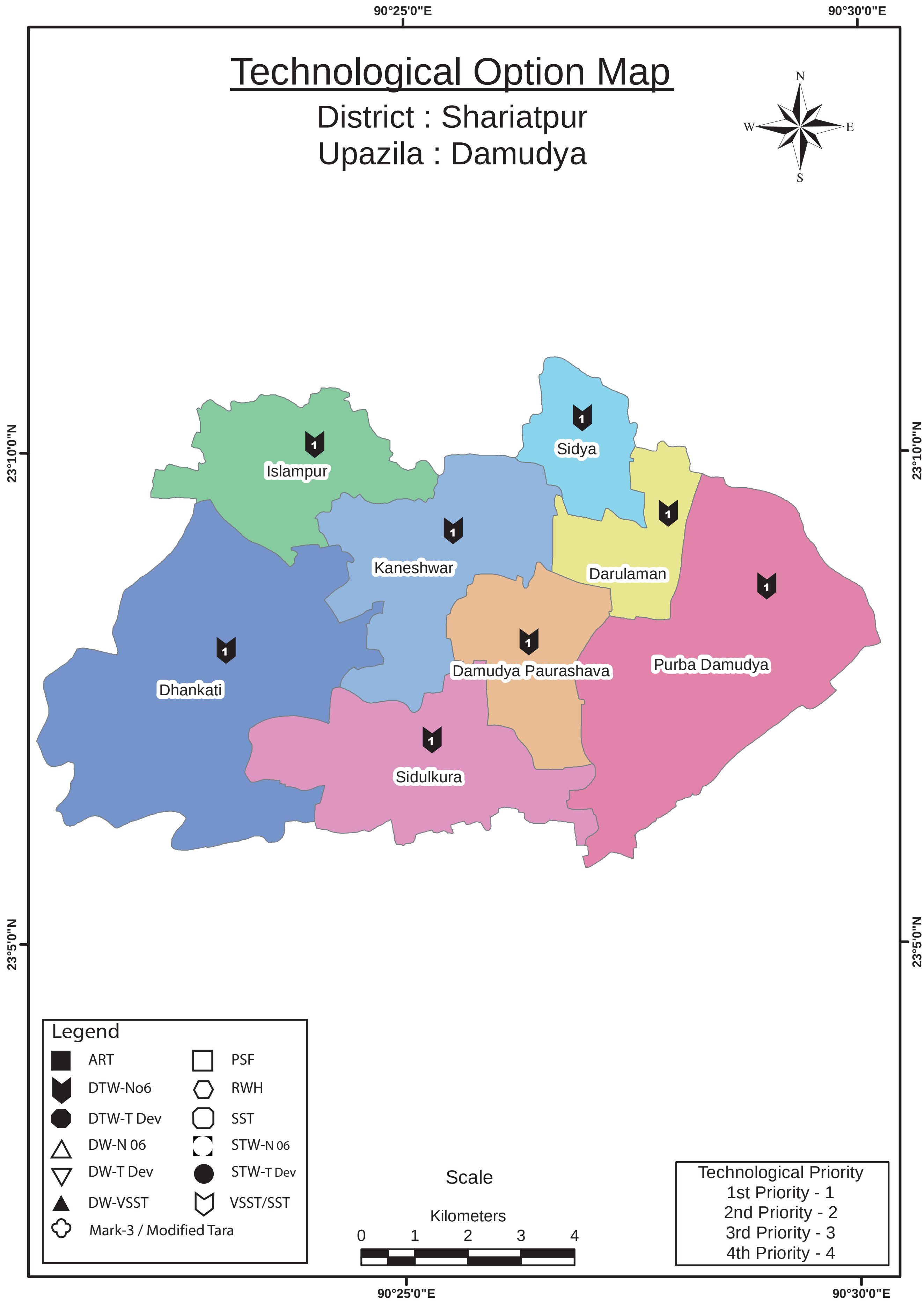

Lowest Water Table, 2010
District : Shariatpur
Upazila : Goshairhat
N
W
E
S
90°20'0"E
90°25'0"E
90°30'0"E
23°10'0"N
23°5'0"N
23°0'0"N
Samantasar
Nagerpara
Goshairhat
Idilpur
Alaolpur
Kodalpur
Kochaipotti
Nalmuri
Legend
DTW
< 25 feet
25 - 35 feet
> 35 feet
STW
< 25 feet
25 - 50 feet
50 - 80 feet
> 80 feet
Scale
Kilometers
0
3
6
9
12

Table

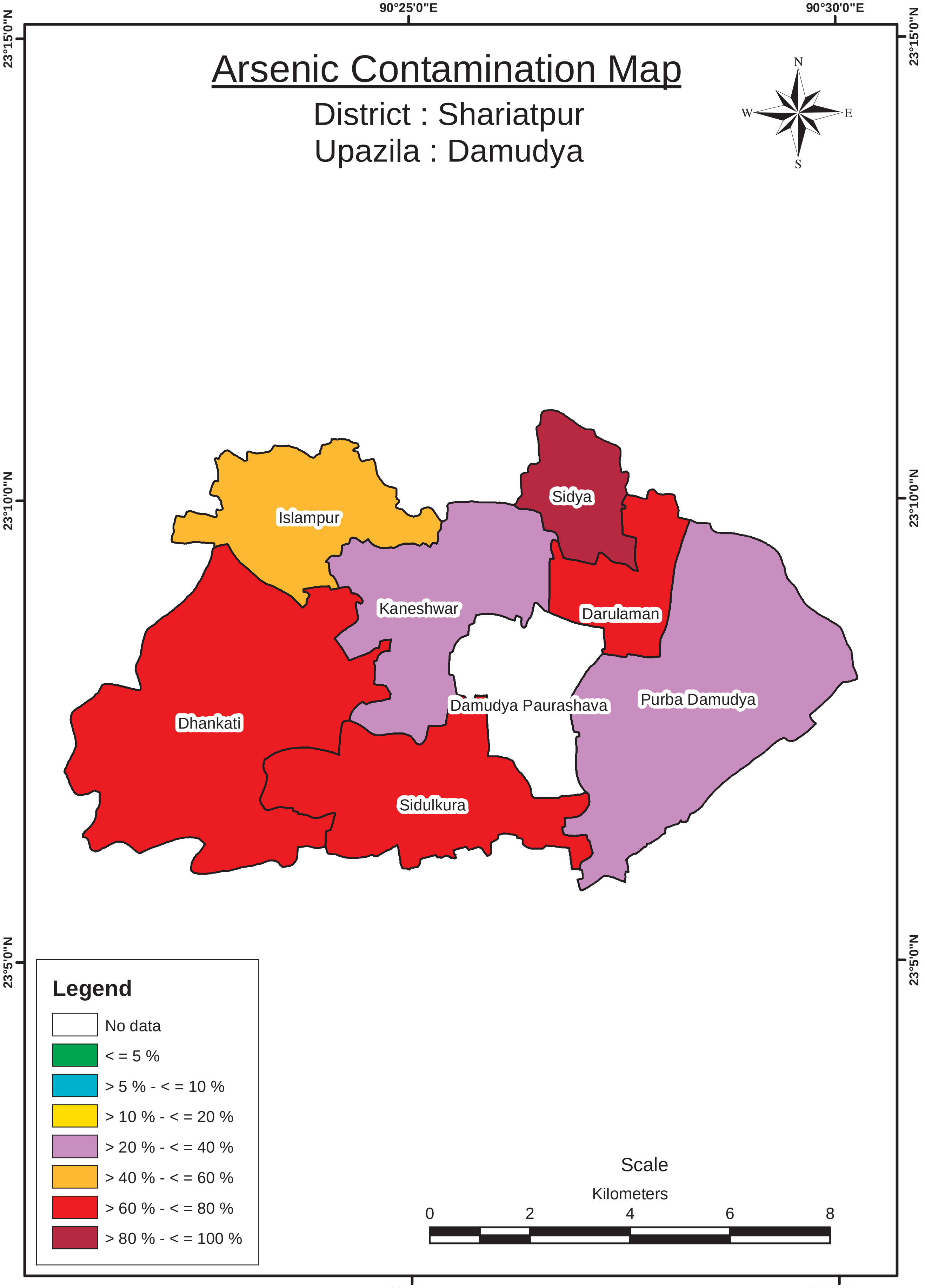
For

Mapping on 'Water Supply Technology' under "GOB-UNICEF Project"

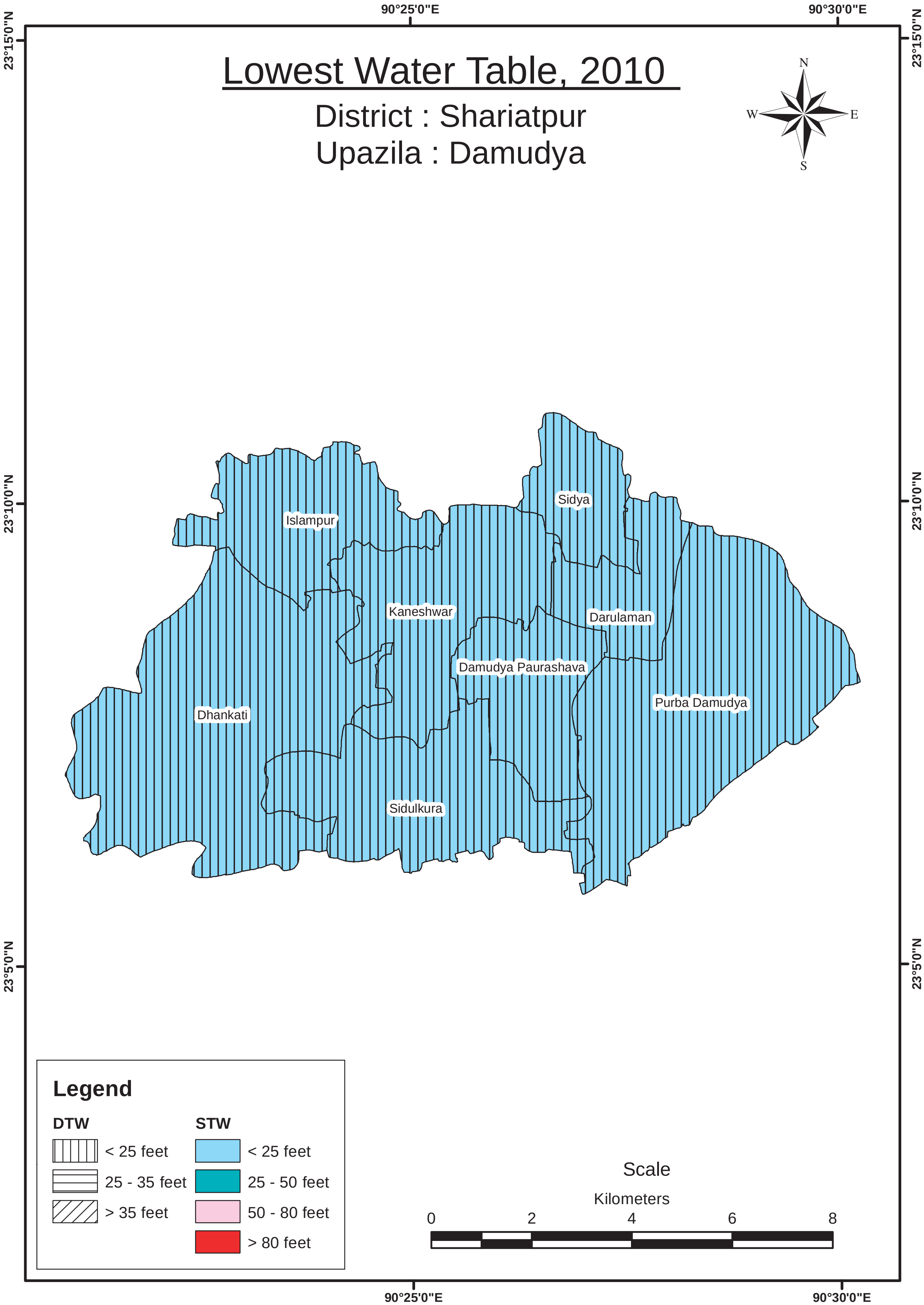
District	Upazila	Union	Lowest Water Table in 2010, ft		As Contamination %	As Contamination		Fe, Problem(>5 ppm)		Cl Problem (>600ppm)		1993 Technology Option	Average Depth of TW, ft		Recommended Priority Options STW: Shallow Tubewell, No6/T.Dev DTW: Deep Tubewell, No6/T.Dev DW: Dugwell (Ringwell) PSF: Pond Sand Filter ART: Arsenic Removal Technology			
			STW	DTW		STW	DTW	STW	DTW	STW	DTW		STW	DTW	1	2	3	4
Shariatpur	Damudya	Darulaman	12	11	68	Y	N	Y	N	N	Y	STW	90	820	DTW-No6	-	-	-
Shariatpur	Damudya	Dhankati	11	11	68	Y	N	Y	N	N	Y	STW	90	820	DTW-No6	-	-	-
Shariatpur	Damudya	Kaneshwar	12	12	38	Y	N	Y	N	N	Y	STW	120	820	DTW-No6	-	-	-
Shariatpur	Damudya	Purba Damudya	12	12	28	Y	N	Y	N	N	Y	STW	85	820	DTW-No6	-	-	-
Shariatpur	Damudya	Islampur	12	12	56	Y	N	Y	N	Y	Y	STW	90	820	DTW-No6	-	-	-
Shariatpur	Damudya	Sidulkura	12	11	77	Y	N	Y	N	N	Y	STW	75	820	DTW-No6	-	-	-
Shariatpur	Damudya	Sidya	11	12	80	Y	N	Y	N	N	Y	STW	100	820	DTW-No6	-	-	-
Shariatpur	Damudya	Paurashava	12	12	NA	Y	N	Y	N	N	Y	STW	140	820	DTW-No6	-	-	-



Technological Option Map
District : Shariatpur
Upazila : Damudya
90°25'0"E
90°30'0"E
23°10'0"N
23°5'0"N
N
S
E
W
Islampur
Sidya
Kaneshwar
Darulaman
Dhankati
Damudya Paurashava
Purba Damudya
Sidulkura
1
Legend
ART
DTW-No6
DTW-T Dev
DW-N 06
DW-T Dev
DW-VSST
Mark-3 / Modified Tara
PSF
RWH
SST
STW-N 06
STW-T Dev
VSST/SST
Scale
Kilometers
0 1 2 3 4
Technological Priority
1st Priority - 1
2nd Priority - 2
3rd Priority - 3
4th Priority - 4



Arsenic Contamination Map
District : Shariatpur
Upazila : Damudya
N
W
E
S
90°25'0"E
90°30'0"E
23°15'0"N
23°10'0"N
23°5'0"N
Islampur
Sidya
Kaneshwar
Darulaman
Dhankati
Damudya Paurashava
Purba Damudya
Sidulkura
Legend
No data
< = 5 %
> 5 % - < = 10 %
> 10 % - < = 20 %
> 20 % - < = 40 %
> 40 % - < = 60 %
> 60 % - < = 80 %
> 80 % - < = 100 %
Scale
Kilometers
0
2
4
6
8


90°25'0"E
90°30'0"E
23°15'0"N
23°10'0"N
23°5'0"N
Lowest Water Table, 2010
District : Shariatpur
Upazila : Damudya
N
S
E
W
Islampur
Sidya
Kaneshwar
Darulaman
Damudya Paurashava
Dhankati
Purba Damudya
Sidulkura
Legend
DTW
< 25 feet
25 - 35 feet
> 35 feet
STW
< 25 feet
25 - 50 feet
50 - 80 feet
> 80 feet
Scale
Kilometers
0
2
4
6
8