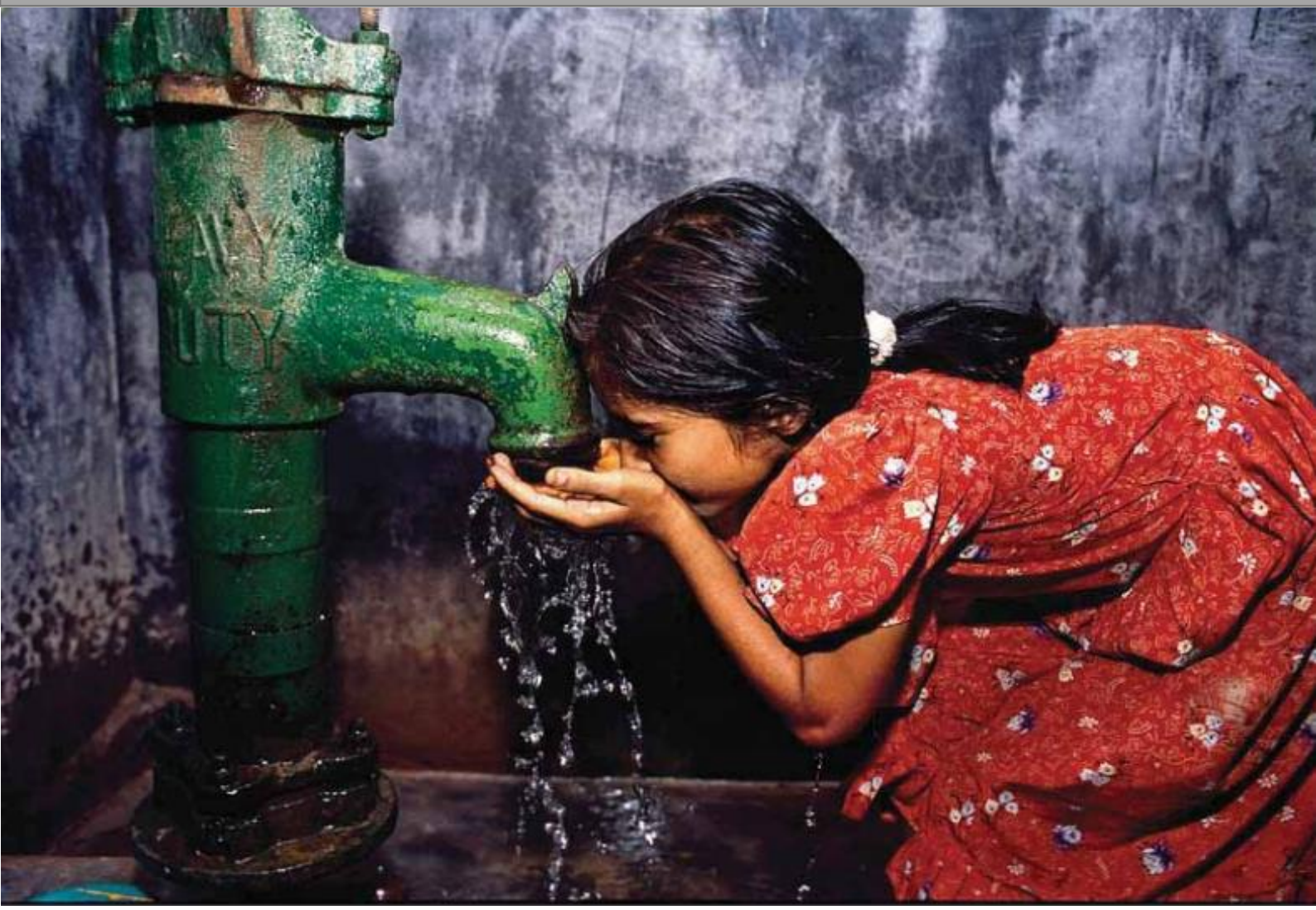
INSTITUTIONAL REFORM FOR COMMUNITY PARTICIPATION



Towards Community Adoption of Piped Water Supply Systems in Arsenic Affected Regions of Rural Bangladesh

TU Delft

Arushi Gupta

INSTITUTIONAL REFORM FOR COMMUNITY PARTICIPATION

Towards Community Adoption of Piped Water Supply Systems in Arsenic Affected Regions of Rural Bangladesh

By

Arushi Gupta

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Student Number : 4627741

Graduation Committee

Committee Chair : Dr.ir. Bert Enserink, Policy Analysis, TU Delft

First Supervisor : Dr.ir. Bert Enserink, Policy Analysis, TU Delft

Second Supervisor : Prof. Dr. Frances Brazier, Systems Engineering, TU Delft

External Supervisor : Dr Bilqis Amin Hoque, Env. and Population Research Centre, Bangladesh

An electronic version of this thesis is available at http://repository.tudelft.nl/.

TU Delft

Preface

This document in an end product of 7 months of research at Delft University of Technology in the field of water governance. It is intended for anyone interested in the Bangladesh rural water sector, specifically focusing on arsenic affected rural regions. It discusses the governance of rural piped water supply systems from the planning stage at central level to the sustenance stage at the community level. It focuses on analysing the effects of national policies, institutional rules and socio-cultural community attributes on these technical systems. A basic knowledge about the technical working of piped water systems and treatment technologies is expected. The institutional analysis done in this thesis can also be applied to other WASH sector activities of rural Bangladesh. People interested in adoption and sustainability of rural WASH projects can find this thesis interesting. The analysis is done from an institutional economic perspective using Elinor Ostrom's theories of institutional analysis as guidelines.

The thesis document is divided into 4 phases. Phase I provides the problem definition, research methodology used, a background on arsenic contamination in Bangladesh and a basic overview of piped water systems as an arsenic mitigation technology. Phase II discusses the field scenario in detail, describing the process of planning, designing, financing, constructing and sustaining these systems, followed by the strengths and challenges of the process of implementation. Phase III analyses each level of the design process using Ostrom's theories of institutional economics and proposes new institutional reforms for the sector. The final Phase IV concludes this research by suggesting strategies for increased community adoption and sustainability of piped water systems in rural Bangladesh.

The crux of this thesis lies in the application of the Institutional Analysis and Development (IAD) Framework applied at three tiers of governance – central-local and community level. The application of Ostrom's design principles that helped to come up with institutional reforms is also interesting to study.

To make the most of document, the reader should not skip chapters 5, 8(a, b and c) and 9. A reader with in-depth knowledge of the Bangladesh piped water sector can save time by skipping Chapter 3, 4 and 6. Chapter 11 can provide a starting point for those looking to work further in the areas of rural WASH in developing countries. The empirical insights available in Appendix A, gained from field interviews are valuable to anyone intending to carry out WASH research in Bangladesh. If anyone is interested in learning from case studies, Appendix D provides examples of successful community based institutional arrangements in water systems across the world. These case studies can be valuable to research groups, field workers and policy makers. Lastly, the executive summary would be enough for those are looking to get a brief overview of this research document.

Arushi Gupta
Den Haag,
September, 2018

Acknowledgement

When I chose this thesis topic I wanted to challenge myself. I had two criteria for choosing my topic: it had to be a real-life case scenario where I can create an impact and I wanted to be able to apply my knowledge of EPA as a policy analyst to a case scenario. It was difficult decision to choose an entirely qualitative approach in such a complex socio-political field, having had not much of an experience in qualitative work. Coming from a computer engineering background, I have always been exposed to the method of "one-right-answer.' So, when I began my initial research I found myself lost. I would like to mention my meeting with Diedre Casella who instilled in me the confidence to pursue a qualitative research. After 7 months of working on this research, adventurous field experience, no summer holidays, countless overnighters and high anxiety, as I write the final section of my research I feel overwhelmed. On this occasion, I would like to express my deepest gratitude to everyone who has supposed me in this wonderful journey.

Firstly, I would like to thank both my supervisors Prof. Bert Enserink and Prof. Fraces Brazier who agreed to work on this topic and continuously supported me throughout my field work. Especially Bert, who proactively responded my emergency situation in Bangladesh, always responded my complex emails timely and read all my last night draft versions even in a very short time span. Special thanks to Frances for being very kind to help me out financially when I was looking for funds for my field work and guiding be through the process whenever I felt lost or stuck.

An important person I would like to name is Dr Bilqis, my local supervisor and advisor in Bangladesh, who have been extremely supportive and kind, not only professionally but all personally throughout my thesis work. I cannot be more grateful to EPRC who has by all means supported me in my field work. I would further acknowledge the GARNET-SA fellowship provided by EPRC that allowed me to cover my field work costs in Bangladesh. A special thanks to all the interviewees; especially mentioning DPHE officials Mr Siafur Rahman, Mr. Russel Khan, Mr. Abdus Shahid; Mr. Ithishamul Huq from JICA; Mr. Waliul from Max Foundation; Mr. Osman from HYSAWA; Ms Akter from UNICEF and Mr Ahamed from World Bank who despite being high officials having busy schedules managed to give me time. This field work would not have been possible without Shamuil Bhai, field work assistant, would travelled with me to my interview meetings and helped me out with all the translations in Bengali.

My field experience in Bangladesh opened up new horizons for me and largely changed my perceptions about economic development and policy implementation. This field experience would not have been possible without the financial support of University Funds Delft, Delft Global Initiative and TBM funds for funding me take up a thesis project aborad. This acknowledgment would be incomplete without mentioning my three amazing friends, Nazifa Nawal, Maliha Nawal and Azima Shafaq and their families who hosted me in Bangladesh. I had an amazing time in Dhaka, thanks to the three of you. Those memories would remain unforgettable experiences. I would like to thank the DELTAP team, especially Annemarie and Kajol for providing me with the opportunity to work on this project and linking me up with EPRC. Thank you for being so kind, when I bothered you both a lot in the initial days.

Coming to my dear ones, firstly I would like to thank my parents for financially supporting me through this master's course and emotionally being there with me always. My motivation has remained strong because of my father. Paa, you have always taught me how to be a fighter, never give up in any situation and always trusted all my choices without questioning. You have made me who I am today, and I cannot be more thankful for having you in my life. Maa, your innocent words have always kept me smiling even through tough times. Lastly, my close friends Aakrati Goel and Zaid Qadri who have always stood by me through my tough times and whom I have bothered the most throughout the thesis process. And finally, my amazing EPA mates, "the Y-Group", for making me go through these two long years of EPA without giving up. I would like to specially mention Quinn Blanco who has been with throughout the thesis writing process spending long days, even nights at Wijnhaven campus. Without all your support, I would not have managed to make Netherlands my home.

"We value virtue but do not discuss it. The honest bookkeeper, the faithful wife, the earnest scholar get little of our attention compared to the embezzler, the tramp, the cheat." — John Steinbeck

Arushi Gupta
Den Haag,
September, 2018

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List of Abbreviations

As	Arsenic
BCSIR	Bangladesh Council of Scientific and Industrial Research
BDT	Bangladeshi Taka (Local Currency)
BRAC	Building Resources Across Communities
CBA	Cost Benefit Analysis
CBO	Community Based Organisation
CPR	Common Pool Resource
DANIDA	Danish International Development Agency
DPHE	Department of Public Health Engineering
EPRC	Environment and Population Research Centre
GBM	Ganga Brahmaputra Meghna Delta
GoB	Government of Bangladesh
IAD	Institutional Analysis and Development
iNGO	International Non-Governmental Organisation
IPAM	Implementation Plan for Arsenic Mitigation
JICA	Japan International Corporation Agency
JMP	Joint Monitoring Programme
LCG	Local Consultative Group
LGD	Local Government Division
LGI	Local Government Institution
MCL	Maximum Contaminant Level
MDG	Millennium Development Goal
MOTA	Motivation –Ability Framework
NFWSS	National Forum for Water Supply and Sanitation
NGO	Non-Governmental Organisation
NPAM	National Policy for Arsenic Mitigation
NPV	Net Present Value
NWRC	National Water Resource Council
O&M	Operations and Maintenance
PPP	Public-Private Partnerships
PSB	Policy Support Branch
PSF	Pond Sand Filters
PWS	Piped Water Scheme
R&D	Research and Development
RDA	Rural Development Academy
RDCD	Rural Development and Co-operatives Division
ROI	Return on Investment
RWH	Rainwater Harvester
SDC	Swiss Agency for Development and Cooperation
SDG	Sustainable Development Goals
SDP	Sector Development Plan
SHG	Self-Help Groups
UNICEF	The United Nations Children's Fund
UP	*Union Parishad*
WASA	Water Supply and Sewerage Authority
WASH	Water Supply and Sanitation
WATSAN	Water Supply, Sanitation and Hygiene
WHO	World Health Organisation
WHO	World Health Organisation
WSS	Water Supply and Sanitation
WTP	Willingness to Pay

Executive Summary

Arsenic contamination of groundwater in Bangladesh is one of the largest naturally occurring groundwater calamity in South Asia. 35-77 million people in Bangladesh are in the midst of a mass poisoning as they suffer a risk from arsenic contaminated drinking water. The rural people, about 64% of the population (104 million people) suffer the most as they are still heavily dependent on groundwater based tubewells. Post-independence tubewells were installed by the government as an initiative to provide clean drinking water to all. It was later discovered in 1993 that arsenic is present in groundwater, and it posed a huge health hazard on the people. With an intention to build the country's Water and Sanitation (WASH) sector and achieve the UN Sustainable Development Goal 6.1, the government has taken multiple steps to provide arsenic-free drinking water to these rural communities. Government interventions to switch to other arsenic mitigation technologies began in late 2000. The *Piped Water Supply* technology is considered to be a long-term feasible solution in arsenic-affected areas. Rural communities, however find it difficult to make the switch from tubewells to piped water due to issues of high costs, less demand and extensive monitoring requirements of these systems. To align itself with the SGD 6.1 along with the aim to climb JMP's highest ladder for drinking water ("safely managed drinking water from an improved water source located on premises, available when needed and free from chemical contamination"), the Government of Bangladesh has installed multiple *Piped Water Schemes* in water-stressed areas. These schemes are technically viable in water-stressed areas and financially supported by the World Bank, UNICEF, WHO and other global organisations. However, at community level, institutionally, they face the challenge of *Adoptability* and *Sustainability*.

This research emerged from the need to improve community adoption and sustainability of these systems, taking a case study approach. The goal of the research is to provide institutional insights to the client organisation (Environment and Population Research Centre, Bangladesh) about methods to increase adoption and sustainability of these systems at community-level. Thus, the main research question asked is:

Which strategies can be implemented to increase community adoption and sustainability of Piped Water Supply systems in the rural areas of Bangladesh to ensure arsenic-safe water in every household-tap?

The relevant policies in place to tackle arsenic mitigation are studied in detail to identify key policy elements for institutional planning and implementation of Piped Water Schemes. The stakeholder groups involved in the development of these schemes are identified to be:-

- Governmental Organisations – Department of Public Health Engineering
- International Developmental Partners – World Bank, UNICEF, WHO
- Non-Governmental Organisations – International and Local
- Community Based Organisations
- Private Sectors and
- Academic and Research Institutions

Stakeholders from each of these groups are interviewed to understand the current institutional setup, their roles and functions in decision-making and their perception of the problem. The field visit to a Piped Water Scheme area provides insights into the real situation and the strengths and challenges at community level. A comparison of the real on-field situation with the expectations of central-level stakeholders and findings from the policy document show that actual policy outcomes do not match policy expectations. The current policy outcomes are summarized as follows:

These publicly financed Piped Water Systems are built consuming government and international financial and institutional resources, adding to government budgets and are yet unable to be sustained well by the communities.

As policy expectations are disconnected from policy outcomes,

An institutional reform of current institutions is required to allow community-driven governance in some areas of decision making but remaining within the political-strategic framework developed.

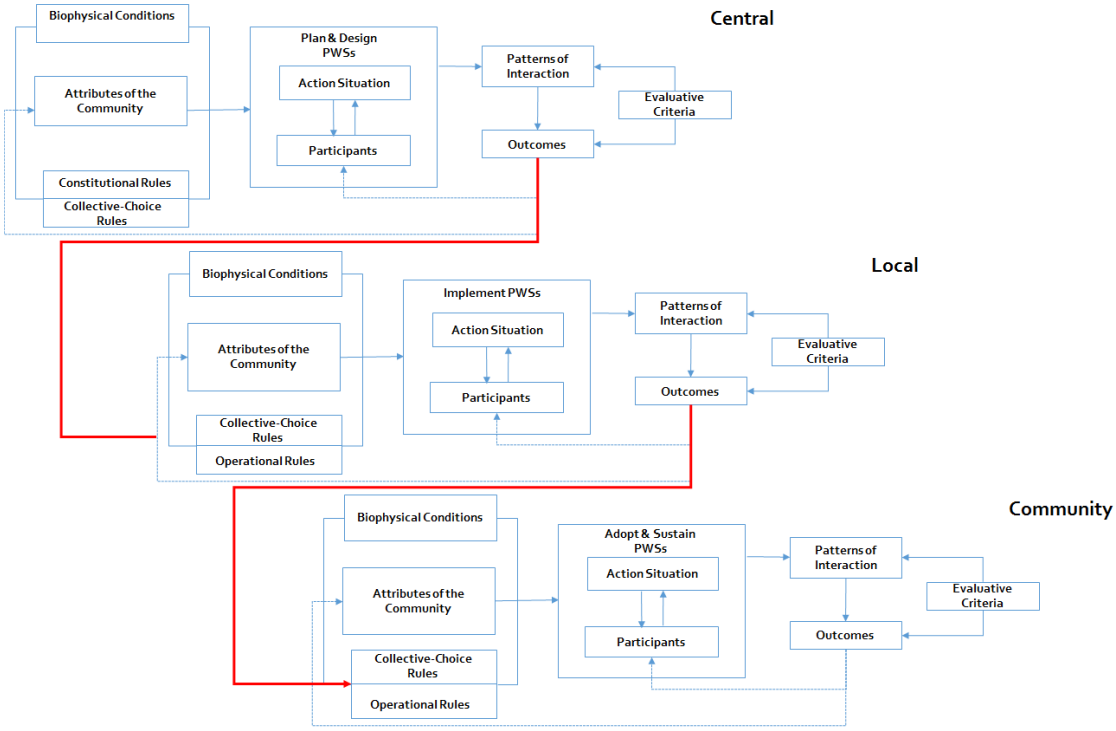
The Methodological Framework used for institutional analysis is a combination of two of Ostrom's theories used to suggest robust policy reforms, which are:

- The Institutional Analysis and Development Framework (IAD)
- Ostrom's Design Principles for Governance of Common Pool Resources

At first the IAD framework is applied for identifying and defining gaps between actual policy outcomes and expected outcomes. Then relevant Ostrom's design principles are used to bridge the gap between actual and desired policy outcomes and support robust institutional reforms. To apply the IAD framework, the first step is to conceptualise the action arenas based on the design process of rural Piped Water Systems. The conceptualization is done as such,

- Planning and Designing of Village Piped Water Schemes at the Central Level (Design and Finance)
- Implementation of Village Piped Water Schemes at the Local Level (Construct)
- Community Adoption of a Village Piped Water Scheme at the Community Level (Operate and Maintain)

Actions and interactions of stakeholders at each of the three steps of the plan-implementation process were analysed applying the IAD framework in such a manner,



The outcomes of actions of central level actors influence the local level actors and consequentially actions of the local level actors set the rules for community level actors. The outcomes of the IAD analysis at each level, are evaluated against six of Ostrom's evaluation criteria, the evaluation findings conclude:

- At the Central Level there is Low Adaptability, Low Economic Efficiency, Low Equity
- At the Local Level there is Low Accountability, Low Adaptability, Low Equity and Low Morality of actions
- At the Community Level there is Low Accountability, Low Adaptability, Low Economic Efficiency, Low Equity and Low Morality of actions

The design principles are applied to each of the findings to support the development of institutional reforms. These reforms are to be robust and sustainable through changing governments, environments and generations. The three most relevant design principles applicable to this case study are a) Collective-Choice Arrangements, b) Graduated Sanctions and c) Nested Enterprises. New institutional reforms are proposed which lead to forming policy recommendations and answering the research question.

Answering Research Question

Based on the findings of the institutional analysis, the strategies that can help to increase community adoption and sustainability of Piped Water Supply systems in the rural areas of Bangladesh ensure arsenic-safe water in every household-tap are as follows:

I. Creating a platform/consortium of central level actors where major organisations that design schemes are invited to share knowledge about the different lessons learnt from their models of implementation; and suggest key elements of successful implementation to others. This can allow organisations to learn from each other and replicate successfully implemented local/ international models.
II. Decentralizing the power to local DPHEs, constitutionally (as per policy) to change and adapt plans according to needs of the community. Local governments can decide on the contractor, entrepreneur, and also place a regulation on the number of privately owned tubewells in rural areas. This regulation should be implemented based on local conditions and not as per policy. If the local conditions demand that PWSs are sufficient to meet the demand of communities, then tubewell construction should be regulated with a licensed agreement.
III. Private sector interventions can be increased by incentivizing and subsidizing local companies to take up construction of PWSs. Construction of pipelines and building material can be outsourced to community members themselves.
IV. Defining specific roles for women in the policy to enforce women participation in decision-making. Formation of women only Self-Help-Groups (SHGs) /Committees at the local level would encourage women to abide by the policy and be responsible for O&M.
V. Formulating an efficient data collection mechanism to collect household data from communities at the pre-implementation phase. A shift from the traditional *Contingent Valuation Method* (data collection in the form of surveys) to the *Econometric Demand Method* (demand is calculated by studying community behavioural patterns, the water options they use and the ones they prefer most, the time spent collecting water and other social attributes) is required.
VI. Local governments should take actions to involve communities in construction, maintenance and operations of the piped water systems. Substitute initial down payments for labour.
VII. The willingness to pay and initial down payment costs should be determined using the normal distribution method, where households are required to pay based on their income levels.
VIII. To increase women participation at the local and community level, women only committees and SHGs should be formed with assistance from the *Union Parishad*.
IX. *Union Parishads* should allow community members to decide who can handle which aspects of the O&M. They should be allowed to choose tasks as per their strengths and choices.
X. Initiating a research on testing out village level micro-credit system for borrowing money to pay for the initial down payment required for PWSs or to handle technical O&M issues with the help of SHG setup.

Important Terms

Community Participation - Community Participation refers to the ability of rural communities (institutionally, financially and culturally) to participate in decision making in matters of water that affect them directly.

Participatory – It refers to the process of planning/decision or policy making that take into account the most vulnerable actors and their ability, resources and motivation. Participatory decision making need not necessarily mean complete bottom-up approaches. Top-down approaches can be made participatory by considering the abilities of affected/ sensitive communities when implementing these approaches.

Adoptability - Adoptability refers to the fact that communities are able to realise the need for a piped water connection in their household and be able to switch from all other water supply technologies to rely completely on household tap water for drinking.

Sustainability - Sustainability is when communities able to operate installed systems and maintain them for as long as they are technically capable of working (based on predicted average time of technical failures). They should be able to handle the operation and maintenance (cost wise and technology wise) by themselves without relying on external parties.

Scalability – Scalability is when demand is raised to a point when piped water systems become popular and replace preference of most other water technologies.

Zila - Refers to a district in Bangladesh

Upazila – Refers to a sub-district in Bangladesh

Upazila Parishad – It is the second lowest tier of regional administration in Bangladesh

Union Parishad – It is the smallest rural administrative and local government unit in Bangladesh

Economic Sustainability - the maintenance of an acceptable net flow of benefits from the projects investments after its completion, that is, after the project ceased to receive world bank financial and technical support.

Community Adoption - When a rural community is being able to realise the need for a piped water connection in their household, raise demand for it and sustain it by handling its operation and maintenance (cost wise and technology wise) until its technical maturity time as been reached.

Economic efficiency – Economic efficiency is determined by the magnitude of change in the flow of net benefits and costs associated with allocation or reallocation of resources or good. When an economy operates efficiently, no resource or good allocation will improve the welfare of some person without making someone else worse off.

Fiscal Equivalence – The concept suggests that those who benefit from a service or good should bear the cost of providing it in equal measure to benefits received from it. Those who derive greater benefits pay more than those who derive fewer benefits.

Distributional Equity – Equity individuals should contribute toward the cost of goods and services based upon their ability to pay for them.

Accountability – Accountability is the responsibility of officials to limit their ability to engage in opportunistic behaviour by increased information sharing, continued action evaluations of others, and monitoring behaviour of others.

General Morality – Refers to the moral behaviour of actors

Adaptability – The ability of individuals or adapt planning processes to changing environments and to learn from experiences.

Opportunity Costs – In microeconomic terms, opportunity cost is the cost incurred by organizations for the opportunity missed or chosen. In this research it is used to quantify cost of efforts (in terms of motivation and time), taken by actors to carry out a certain process or take a certain decision.

I

THESIS DEFINITION

1

Introduction

35-77 Million people in Bangladesh are at risk from arsenic-contaminated drinking water. Various Arsenic Mitigation measures have been taken by the Government of Bangladesh to reduce the number of arsenic-affected patients and also prevent the rest of the population from being affected. Various government policies and regulations are made to increase penetration of arsenic mitigation technologies in rural Bangladesh. But, the difficulty lies in adopting and sustaining these technologies for long-term in rural areas. Community Participation is often less focused on when setting up these regulations and policies. Section 1.1 of this chapter discusses briefly the societal problem and 1.2 talks about the use of the Piped Water Supply Systems as an arsenic mitigation technology in rural. Section 1.3 explains the challenges that the Piped Water Supply Systems technology is facing in the rural parts of the country followed by Section 1.4 which discusses shortly the context of the research carried out. The final Section 1.5 gives an overview of the upcoming chapters of this thesis. The detailed methodology used for this research is explained in the next chapter.

1.1 Societal Problem

Access to clean drinking water brings improved health and wellbeing, boosts a country's economic growth and greatly contributes to poverty alleviation. Despite these known advantages, even today, about 4 million people in Bangladesh still lack access to clean drinking water and 85 million lack improved sanitation(Water.org, 2018). Bangladesh, a country situated in the north-eastern part of South Asia with a population of roughly 163 million living within 57000 square miles, is one of the most densely populated countries in the world. Situated in a unique location, with three major rivers (Ganga-Brahmaputra-Meghna) flowing across its landmass, water is abundantly available in the country(Water.org, 2018). However, it's water resources have not been utilised to their full potential. The non-availability of safe drinking water in the country brings the burden of water-borne diseases caused due to poor water quality. The non-uniformity in the socio-economic development, differences in the level of education, lack of awareness and the poverty add to the complexity of this challenge.

Although Bangladesh has been endowed by an abundant rainfall, with the national average rainfall ranging from 1600 to 4000 mm per year(Qureshi & Ahmed, 2014), most of this rainfall is limited to the 3 to 4 month period of monsoon, with very high spatial variability within the country. The lack of adequate infrastructure to capture the maximum potential of this high rainfall, the non-perennial nature of the majority of the rivers, the shortage and inconsistencies in surface water supplies and other developmental and growth pressures have led the country to exploit its groundwater resources to fulfil its water requirements(Qureshi & Ahmed, 2014). Groundwater is the main source of water both in rural and urban areas of the country.

At a current rate of utilization of 76%(Qureshi & Ahmed, 2014), groundwater accounts for 97% of potable water supplies and irrigation sources in the country(Survey, 2001)(Plan, 2011). It serves as a water source that is more reliable in quantity and more stable in quality than surface water and thus has economic and operational advantages due to reduced treatment requirements(Qureshi & Ahmed, 2014). However, due to the geographical diversity of the country groundwater is not evenly distributed across regions. While some areas have access to clean groundwater to meet basic needs, water in other areas is contaminated. While

most of the surface water is contaminated with bacteria and viruses, the groundwater has issues of arsenic, salinity and manganese contamination. Other harmful chemicals such as ammonium, phosphate and nitrate are also present in some quantitates(Qureshi & Ahmed, 2014). Accessing drinking water continues to be a problem in itself, along with that assuring that it is safe becomes another challenge. Contamination of groundwater has been a result of multiple harmful substances including the natural release of harmful chemical elements such as arsenic during the oxidation process of the rocks of the Himalayas as they travel to the Bay of Bengal. The pollution and overexploitation of water resources add to the issues of water quality(Safiuddin & Karim, 2001).

Post-independence, the government has undertaken various initiatives to provide clean drinking water to all, especially focusing on the rural population. Policies and programmes have undergone a series of transition(JICA, 2008). The government began by setting up the physical infrastructure, tube-wells and hand pumps were installed across the country to provide bacterial free safe drinking water to all, especially considering that surface water was heavily contaminated. These tube-wells although provided a good alternative to surface water supply, as they allowed the extraction of water from subsurface alluvial aquifers leading to the reduction of incidences of waterborne diseases but posed a greater health risk. It was later discovered that the groundwater in many parts of the country contains arsenic concentrations above permissible levels and is unsafe to drink(Smith, Lingas, & Rahman, 2000).

Over the years, arsenic contamination of groundwater has been observed to be the major cause of impurity in drinking water. Most of the tube-wells installed contain water contaminated with varying concentrations of arsenic(Smith et al., 2000). The majority of the districts in Bangladesh have been exposed to drinking arsenic-contaminated water exceeding 50 µg/L of arsenic while the permissible limit set by the World Health Organisation is 10 µg/L (Johnston et al., 2014). These tube-wells and hand pumps that were once installed to contribute to a secure and reliable drinking water supply system have in fact made arsenic-contaminated water easier to access for the rural population(Smith et al., 2000). Chronic arsenic toxicity due to prolonged exposure to drinking of arsenic-contaminated water has led to instances of skin diseases, arsenicosis, bronchitis, pigmentation, and keratosis and skin cancer amongst the population (Smith et al., 2000). In areas where high levels of arsenic is found in the groundwater, people are at risk of being exposed to it not only while drinking the water but also indirectly by eating the food that was irrigated with or planted in soil which is arsenic-contaminated(Simon Kapaj, Hans Peterson, Karsten Liber & Bhattacharya, 2006). As a result of the contamination in most areas of the country, Bangladesh faces a long-term health epidemic of cancers and other fatal diseases(Ahmad, Goldar, & Misra, 2006).

Even though arsenic contamination of groundwater is a naturally occurring calamity, the behavioural shift from using arsenic prone unsafe drinking water supply sources to using alternate safe water options for the benefit of health remains an institutional challenge(Ahmad et al., 2006)(Hoque et al., 2006)(Ibrahim, 2004). There are multiple technologies available as alternate options for safe water supply sources but despite the technology being available, 35–77 million people are still chronically exposed to arsenic via drinking water (Qureshi & Ahmed, 2014). Addressing this issue, to a population that carries the burden of increasing competition for water sources, seasonal scarcity, threats of salinity, arsenic contamination and issues of water management, issues of awareness and trust amongst the population is a grand challenge itself. Water management is a complex, multi-actor issue that requires coordination which can be enabled by mutually agreed-upon institutions and an established governance structure. The issue of arsenic mitigation in Bangladesh is nested in a complex, convoluted institutional setup. In order to solve this problem, it is important to understand in-depth the institutional arrangement of the water sector in Bangladesh.

Water is key to national development. The critical global questions of food security, urbanization, economic development, energy, and public health are all tied together by water at the local and regional scales. Central

to the overall development of any country, lack of clean water imposes a huge social and economic cost on the population.

1.2 Technologies for Arsenic Mitigation - Piped Water Supply Systems

Aligning themselves with the UN Sustainable Development Goals (SDG) 6.1. And 6.2(UN Water, UNDESA, 2015), the Government of Bangladesh (GoB) has undertaken multiple steps to provide *"Clean drinking water for all"*. Ever since the discovery of arsenic in 1998, the government has invested in developing multiple technologies to mitigate the substance from groundwater. The National Policy for Arsenic Mitigation 2004 was setup to devise an institutional plan to tackle the situation at hand(*National Policy for Arsenic Mitigation 2004*, 2004). Numerous bilateral and international agencies, the government and NGOs (non-government organisations) are involved in arsenic research, testing and mitigation activities(Ahmad et al., 2006).

While several methods for treating arsenic from water are now made available, the government has considered Piped Water Supply Systems as a long-term solution, mainly in arsenic affected areas where most tube-wells within the depth of 10-70 metres have been found to be contaminated(Ibrahim, 2004). The Piped Water Supply Technology is considered to be the most feasible and desirable technology to help climb to the highest level of WHO/UNICEF's JMP ladder for drinking water(WHO/UNICEF, 2017). The country's desire to move towards sustainable piped water sources was first highlighted in the Arsenic Mitigation Policy which mentioned, *"Endeavor to promote piped water systems wherever feasible and such schemes must ensure that the poorest members of the community have access to safe water that meets the minimum service levels established by the Government. In case of piped water supply in the rural areas where the supply will be mainly for drinking and cooking, 8 litres of water per capita per day will be ensured and the service level in municipal areas will be determined by the respective municipal council/city corporations"*(*National Policy for Arsenic Mitigation 2004*, 2004).

In urban areas, the transition to Piped Water Systems from other water supply technologies has been a smooth one, owing to the considerably organised communal, political and institutional dynamics of governance. However, it's penetration in the rural areas of the country remains an exacting one. 64% of the population, which is about 104 million people, live in rural areas (Max Foundation, 2017). 97% of them are still dependent on tube-wells for drinking water and are highly likely drink to arsenic prone drinking water(Rahman, Rahman, Watanabe, & Yamamoto, 2001). Being an environmentally sustainable and technically viable option, many NGOs, international organisations and the government, in the last decade have tried to introduce rural piped water supply. Yet, only 1% of rural households have access to a piped water connection(Max Foundation, 2017)

This research is intended to focus on the utilization of piped water systems technology in the arsenic affected rural areas of the country for arsenic mitigation.

1.3 Piped Water Supply Systems: Why Not?

In the past few years, the GoB along with different organisations came forward to install a considerable number of rural piped water supply systems in different parts of the country to solve issues of water quality (related to arsenic, iron and salinity) and also water availability. While some involved high government investment and donor contributions, others required the community to bear certain costs of these systems. Despite many such innovative models been introduced, these projects have not been very successful in terms of implementation, continuation and scaling up(JICA, 2008). Rural infrastructure projects such as these are only considered successful if they are sustainable and scalable (technically, financially and institutionally) in the long run.

The government is willing to invest in rural piped water supply projects as a favourable environment exists for its implementation(Ibrahim, 2004). Piped systems have proved to be technically feasible in hard-to-reach areas: saline, arsenic and coastal areas of the country, and at the same time financially viable for them with the help of donor and NGO support, but these systems have not been institutionally successful(*Bangladesh Government Sector Development Plan (2011-2025) Water Supply and Sanitation Sector in Bangladesh*, 2011). Despite efforts made by the government and various international organisations to scale up these systems, they are unable to perform seemingly well at the community-level(*Bangladesh Government Sector Development Plan (2011-2025) Water Supply and Sanitation Sector in Bangladesh*, 2011). The main reasons identified for the inability of these systems to sustain and scale up are:-

- **Costs**: - The cost of building these supply system is very expensive. They are technically complicated and their installation costs are very high. Thus, it is important that these systems can be run smoothly and tariffs need to be such that operations and maintenance (O&M) of the systems is ensured. At the same time, tariffs should be fixed at a level that each household is willing and able to pay for it(Ibrahim, 2004).
- **Demand**: - The demand for these systems is directly proportional to the willingness to pay (WTP) for these systems. Communities, many times, are unable to understand the necessity for the system and lack awareness leading to low WTP. Demand also depends highly on the income levels of the community and the tariff rates of water charged to the community(Ibrahim, 2004).
- **Monitoring**: - The community is made responsible for the O&M of these systems. Often this means they are assumed to bear the costs for many repairs that the system requires and also handle technical issues. The installers rely on community involvement to solve such issues and it has been seen that participation in such scenarios is not very satisfactory(Ibrahim, 2004).

Not having met these conditions, these schemes are either left abandoned or not built due to less demand from the community. The main reason why rural piped water systems have not been able to gain the required momentum of success lies in the community adoption and sustainability of these systems. Two important factors that are key to the success of rural piped water systems in arsenic affected communities at the grassroots level are:-

- **Adoptability** - Community adoption of piped water systems technology in the villages refers to the fact that communities are able to realise the need for a piped water connection in their household and be able to switch from all other water supply technologies to rely completely on household tap water for drinking.
- **Sustainability** – This implies that communities should be able to operate installed systems and maintain them for as long as they are technically capable of working (based on predicted average time of technical failures). They should be able to handle the operation and maintenance (cost wise and technology wise) by themselves without relying on external parties. They should be able to have enough awareness to raise demand for a system based on requirement.

In order for these systems to be a long-term and successful solution to arsenic mitigation in the rural areas, there is a need to focus on "*What can be done to increase community participation in regard to rural piped water systems?"* This shift required from arsenic-prone tube-wells to arsenic-free robust and sustainable solutions within rural communities is currently met with a combination of challenges: awareness, affordability, preferences, conflicting perceptions and socio-cultural problems. There is a need to understand the institutional arrangement of the implementation of these piped water supply schemes to increase community participation from the grassroots level.

1.4 Context of the Research

The Dutch government recognises the need for investing in building a sustainable Water and Sanitation (WASH) sector to meet the UN Sustainable Development Goals 6.1 and 6.2. Bangladesh is one such country which has strong ties with the Netherlands. The country faces various water, sanitation and hygiene issues mainly in the area of sustainability. Multiple researches are carried out by Dutch research organisations and NGOs to help Bangladesh climb the JMP ladder for drinking water and sanitation. The Netherlands Organisation for Scientific Research (NWO Dutch: Nederlandse Organisatie voor Wetenschappelijk Onderzoek) under their project "DELTAP: an integrative approach for smart small-scale piped water supply in the Ganges-Brahmaputra-Meghna Delta" conducts a research on solutions to the arsenic mitigation problems of Bangladesh. The DELTAP team in collaboration with Environment and Population Research Centre (EPRC Bangladesh) has been working on the technical solutions to provide arsenic-safe drinking water to communities in Bangladesh.

This research has been carried out in collaboration with EPRC (Environment and Population Research Centre), a research institute in Dhaka, Bangladesh to provide socio-political insights to a highly technical problem area. The research scope and institutional dynamics were closely consulted with the head of the institute and local supervisor, Dr Bilqis Amin Hoque. It takes into account the context of research of DELTAP and its objectives to achieve arsenic-free communities in Bangladesh. Hence, for the rest of this research thesis, EPRC is considered to be the client organisation.

1.5 Storyline Ahead

The research document is divided into four parts as per the different phases of research carried out: defining the problem, understanding the problem area, applying methodologies and re-designing. Each part is further sub-divided into chapters. The figure below gives an overview of the storyline of this thesis.

Phase	Phase Title	Chapter	Chapter Title
I	Thesis Definition	1	Introduction
		2	Research Definition
		3	Arsenic Contamination: An Overview
		4	Rural Water Governance
II	Field Scenario	5	Data: Who, What and How?
		6	Observations: Good and Bad
III	Institutional Analysis	7	Conceptual Framework
		8	IAD Application
		8a	*Application at the Central Level*
		8b	*Application at the Local Level*
		8c	*Application at the Community Level*
		9	New Institutional Arrangements
IV	Conclusions and Recommendations	10	Discussions and Recommendations
		11	Limitations and Reflections

Figure 1.1 Thesis Storyline

2

Research Definition

This chapter lays down the project definition in detail from defining the problem statement to the methodology used to conduct the research. Although the societal problem was chosen, and the scope of the research was determined before-hand, the direction was not clearly known until the field visit took place. The research took a progressive path, first defining what is the problem, who is the problem owner, what is the expected goal and then later identifying which methodology would be best suited to analyse the problem. This chapter was re-visited and updated as the research progressed. Section 2.1 discusses the knowledge gap leading to the formulation of a problem statement. Section 2.2 discusses the research objectives followed by Section 2.3 that poses the research question to be answered with this research and the sub-questions it is broken down into. Section 2.4 describes the research approach and the research methods used in this research followed by its societal and scientific relevance in Section 2.5. Subsequently, the research scope and the assumptions made in this thesis are discussed in Section 2.6 and to finally Section 2.7 depicts a clear research flow diagram.

2.1 Research Gap

The subject of arsenic contamination in Bangladesh has received international attention ever since its discovery. It has been a widely explored and researched topic. The scale of the problem has attracted academicians, organisations, researchers, international and national non-governmental organisations across the world. However, solutions so far have mainly focused on issues of the "supply side"(Ahmad et al., 2006). Multiple researches have been conducted on the engineering aspects of various arsenic mitigation technologies to assess which technologies are most effective and the technological enhancements of alternate sources of water(Ahmad et al., 2006). The economic and institutional aspects of propagating a new technology into a community have largely been ignored(Ahmad et al., 2006).

Theoretically, piped water supply systems seem to be a feasible solution in arsenic affected areas and assumed to bring about significant benefits in the long run(Hoque et al., 2006). But, as discussed in section 1.3 of Chapter 1, the main challenge lies in the sustainability and of these systems at community-level. The adoptability and sustainability of these systems largely depend on understanding people's preferences for arsenic-free drinking water, whether they are willing to share the costs of these piped water schemes and if they have the knowledge and skill to handle these schemes(Ahmad et al., 2006). While many researches highlight the technological capabilities of these systems, little or no effort has been taken to understand the institutional challenges that lie at community-level that actually lead to the inability of this technology to integrate with communities(Ahmad et al., 2006).

During the literature review session, it was realised that many studies have been conducted on methods to improve water governance and WASH sector management in Bangladesh which helped giving some insights into issues of community participation in water management in general. However, very few researches in the existing literature explicitly highlighted the role of local people in the implementation and development of piped water schemes and their community institutional arrangements. While many organisations are involved in solving this issue, they mainly focus on how to carry out the development process and less attention has been given to the topic of the inability of technologies to integrate into communities due to

institutional reasons(Ibrahim, 2004). Most research carried out is generic in regard to WASH and no study focuses specifically on the institutional arrangements surrounding the governance of rural piped water supply schemes. Such literature is necessary to have concrete solutions for the success of rural piped water supply schemes. Thus, this lack of literature helped to define the research gap which will be studied in detail in this thesis.

1. There is no available literature on how the community demands for a piped water connection, how the technology is assessed to best fit their current needs, when people begin to find these schemes not fitting their demands and why they abandon them leading to project failures(Ahmad et al., 2006). There is no researches on what solutions can help to increase community participation in the process of implementation.
2. Lack of a detailed understanding of the stakeholders involved in the implementation of Piped Water Schemes (PWSs). Their power, influence, decision-making capacity, resources and capabilities are not known.
3. There is not enough data available in regard to the institutions (rules or arrangements) according to which the local communities behave.
4. There are some approaches developed and studied by Ostrom et al(Strom, Gardner, & Walker, 1994)for sustainable natural resource management but these approaches have not been applied for socio-technical systems such as the rural water governance sector of Bangladesh. Ostrom's theories of self-governing institutions do help to suggest institutional reforms but they have not been applied to dynamically changing socio-technical systems where community size, heterogeneity, cultural factors, changing governments and motivation of actors play a major role. Also, Ostrom's design principles for governing common pool resources have not been assessed and applied to such dynamically evolving community systems(Elinor Ostrom, 1990).

Thus, it can be stated that there is a clear societal problem;

Problem Statement

Piped Water Systems, as a technology to provide arsenic-safe drinking water to every rural household via a tap connection, has proven to be a technologically sustainable long-term solution in arsenic affected areas. In recent years it has been introduced and encouraged by the government via policy instruments. But it hasn't been able to perform significantly well in rural Bangladesh due to its extensive and complex implementation process. At community-level, it hasn't been well accepted, adopted and sustained by the locals. Thus, leading to many such systems being left abandoned.

There is a need for a solution to this problem. Various international and national organisations want to increase rural piped water coverage in the country. This would not only greatly reduce arsenic-related problems in the population but would also help solve other issues of women and children health. But to solve this problem, some information is required which may help make better decisions. However, this literally/scientific information (research gap) is missing which if addressed can help to contribute to solving this societal problem;

Research Gap

There is a lack of understanding of which factors affect community adoption and sustainability of piped water schemes and what are the rules that govern the institutional arrangements at the community-level leading to them being abandoned.

Hence, this research aims to close this research gap by carrying out a detailed institutional study only in regard to the governance of rural piped water schemes in the country to understand community involvement. In doing so, it also contributes to addressing a scientific research gap which is;

Scientific Research Gap

Applying Ostrom's theories of self-governing institutions to the socio-technical system of "*Piped Water Supply Systems Governance in arsenic affected rural regions*".

2.2 Research Objectives

In order to provide a solution to the problem statement, to improve piped water sustainability and increase piped water coverage, there is a need for an institutional reform of the current rural piped water scheme implementation process. The process should be such that there is increased community participation and less governmental intervention(Ahmad et al., 2006). But, suggesting institutional reforms requires a detailed institutional analysis of the current framework of implementation to understand which policy outcomes are not as per expectations and why. In the process of proposing institutional reforms, the existing research gap will also be closed. In line with the problem statement and the research gap, the research objective of this thesis is as follows:-

Research Objective

To expand insights on the key existing institutions constitutional, local and operational, that affect community adoption of Piped Water Systems; and propose institutional reforms to increase community adoption and sustenance using Ostrom's theories of self-governing institutions.

To achieve the desired research objective and to be able to suggest strategies for institutional reforms, a detailed study of the following needs to be carried out: -

1. A detailed understanding of the stakeholders involved in the implementation process of a rural piped water supply system. This would help understand the interactions between the actors, their motivation and abilities to carry out the planning, designing and implementation of these PWSs.
2. A policy analysis of the current policies in place their outcomes at grassroots level. It is important to study the results of policies implemented by the government in regard to piped water schemes and know which ones have performed fairly well and which ones have not been able to deliver desired outcomes.
3. An understanding of community perception, socio-cultural norms and economic factors of the community at grassroots level that affect the adoption of the technology and reasons for them not being able to sustain them.

Working towards this research objective would also allow to close the scientific research gap as well. The rural water governance model of Bangladesh would serve as a good frame of reference of a dynamically evolving socio-technical system to which Ostrom's theories can be applied to. This will help to access the framework's applicability to this context and also help to provide some scientific insights into social problems.

Scientific Research Objective

To assess the applicability of Ostroms's institutional analysis to analyse the socio-technical system of the "*Piped Water Supply Systems Governance in arsenic affected rural regions.*"

2.3 Research Question

Based on the research gap posed above and the research objective to be achieved, the following Main Research Question is formulated:

Which strategies can be implemented to increase community adoption and sustainability of Piped Water Supply systems in the rural areas of Bangladesh to ensure arsenic-safe water in every household-tap?

Sub-Research Questions

To answer the main research question systematically, it is further sub-divided into sub-questions that need to be addressed in the right order.

To set the foundations of this research, it is important to first develop an understanding of the stakeholders involved in setting up of piped water schemes in arsenic-affected rural areas of Bangladesh. Hence, the first step is to know the main stakeholders, their roles, responsibilities and resources and the power they have in the decision-making process.

Sub RQ1:- What are the roles and responsibilities of the stakeholders involved in supplying drinking water to arsenic affected regions of Bangladesh?

Research Deliverable: - A stakeholder map of the actors involved with a Power-Interest Grid and Formal Network Map. This deliverable is presented in section 5.1, 5.2 & 5.3 of Chapter 5.

After the stakeholders are known, the next step is to understand what the already existing policies and regulations for arsenic mitigation in Bangladesh are and how the current piped water system implementation process works under the influence of these regulations and policies. This step would set the foundation for the methodological framework used in this thesis. It would help to analyse which policy outcomes are as per expectation and which ones are not, allowing to zoom into critical areas that need a reform.

Sub RQ2: - What are the regulations and processes of development and implementation of rural Piped Water Supply Schemes in Bangladesh?

Research Deliverable: - A conceptual framework of implementation of rural Piped Water Supply Schemes presented in section 5.4 of Chapter 5 and a policy analysis of policy documents presented in Section 6.1 of Chapter 6.

After the implementation process is known, Ostrom's Institutional Analysis and Development(IAD) Framework is used to analyse the process from the planning stage to the operations and maintenance stage, step-by-step, to understand what is happening in the policy arena. This step would help to know which of the outcomes do not match with Ostrom's defined criteria for successful policy implementation and why.

Sub RQ3: - How can Ostrom's theories be used to understand which current institutional arrangements of the rural water sector affect community adoption and sustainability of Piped Water Supply Schemes?

Research Deliverable: - A multi-level analysis of the central-local and community level process of implementation of rural Piped Water Schemes using Ostrom's IAD Framework. This deliverable is presented in Chapters 8a, 8b and 8c respectively.

Once critical problem areas have been identified and compared with Ostrom's criteria of success, the next step is to identify which of her principles of common pool resource governance help to suggest new institutional reforms.

Sub RQ4: - Which new institutional reforms can increase community participation in the implementation of rural Piped Water Supply Schemes and how?

Research Deliverable: - A set of new institutional reforms along with stakeholder validation presented based on Ostrom's design principles**.** This deliverable is presented in Chapter 9

The final step towards answering the research question is to integrate all the findings, validate the suggested reforms with the help of Dr- Bilqis, the expert and then recommended strategies which are backed by empirical findings. A set of policy recommendations backed by field research, scientific analysis and reflections to the research is presented in Chapter 10.

2.4 Research Methodology

This section highlights the research approach used for this thesis and reasons for choosing the research approach. The next sub-section explains the research methods used to answer each of the sub-questions and reasons for choosing those research methods.

2.4.1 Research Approach

This research takes a case study approach, as it is intended to solve the purpose of EPRC (the client). Using a case study enables the possibility to study the applicability of a research method or phenomenon in a real-life context, providing richer results(Yin, 2014). This research aims to investigate the research method (the institutional analysis theories of Ostrom) within its real-life context (the implementation of rural piped water supply systems in Bangladesh) to provide appropriate contextual insights(Yin, 2014)(Eisenhardt, 1989). A case-study approach to this problem allows a real-life problem situation to be benefitted from research; and at the same time allowing to assess if and how particular institutional economic theories are well suited to be applied to real-life case studies.

Qualitative Research Approach

The choice of using a qualitative approach was best suited for this research as the research seeks to explore, explain and understand current institutional design in detail(Creswell, 2013). The research is conducted to provide valuable additional social and political insights to a technical civil engineering issue at hand. As most of the data collected is in the form of stakeholder interviews and observations and the results expected were in the form of values, experiences and impacts it was most appropriate to carry out a qualitative research(Eisenhardt, 1989)(Creswell, 2013). However, if specific user behavioural data patterns were studied and the data gathered is more user-specific an extension of this research could be carried out using quantitative agent-based modelling techniques in the future.

2.4.2 Research Methods

This research is carried out in four phases: Desk Research, Stakeholder Interviews & Field Observations, Institutional Analysis and Stakeholder Validation. Figure 2.1 gives a brief overview of how these phases are applied sequentially. The first phase involves gathering existing relevant information available online to understand the problem situation in detail and identify key knowledge gaps. It helps to understand the timeline of the evolution of the problem, uncertainties and causal relations. This phase allows to gather background information that helps to structure interviews. The second phase involves a field visit to Bangladesh to understand and observe the on-ground situation, meet EPRC- Dr. Bilqis in person, and conduct stakeholder interviews to gather empirical insights of the different perceptions of the problem at hand. The third phase involves gathering and compiling all available data and analysing the problem using Ostrom's theories of institutional analysis and design. The Institutional Analysis and Development Framework developed by Elinor Ostrom(Polski & Ostrom, 1999) and her colleagues have been used to structure the problem, identify gaps in the current implementation process and understand action situations that make

actors behave in certain ways they do resulting in current outcomes. Ostrom's design principles(Elinor Ostrom, 1999) of governing the commons are used to bridge the gaps between the current reality and the expected reality and provide the basis for recommending policies for institutional reform. The final phase involves validation of assumptions made during the process of institutional analysis and validation of realistic possibly of the institutional reforms suggested with the help of expert knowledge and suggestions. Taking these suggestions into account final policy recommendations are proposed.

Various concepts from different subjects from the Engineering and Policy Analysis Masters course have provided the basic background that helped to analyse the problem. Some of the methods are taken from courses of *Interviewing Techniques, Multi-actor Systems, Intercultural Relations and Project Management, Actor and Strategy Models and Cost-Benefit Analysis*. The reader will come across some of relevant concepts as the document progresses.

Specific research methods were employed for answering each of the research questions. Table 1 below shows the different methods that are applied to answer each of the research questions.

	Research Question	Research Method
RQ1	What are the roles and responsibilities of the stakeholders involved in supplying drinking water to arsenic affected regions of Bangladesh?	Literature Review and Stakeholder Interviews
RQ2	What are the regulations and processes of development and implementation of rural Piped Water Supply Schemes in Bangladesh?	Desk Research at EPRC Bangladesh, Field Observations and Stakeholder Interviews
RQ3	How can Ostrom's theories be used to understand which current institutional arrangements of the rural water sector affect community adoption and sustainability of Piped Water Supply Schemes?	Institutional Analysis and Development Framework
RQ4	Which new institutional reforms can increase community participation in the implementation of rural Piped Water Supply Schemes and how?	Evaluation of IAD outcomes, design of reforms supported by Ostrom's Design Principles and Stakeholder Validation

Table 2. 1 Research Sub-Questions

The field interviews and the IAD Framework form the backbone of this thesis. While the application of the IAD is central to the analysis of this research, the field interviews provide the input that is required for the IAD analysis. The IAD analysis helps to analyses how the current policies have performed and if they have been able to meet the desired outcomes. Ostrom sets aside six evaluation criteria for analysing the policy outcomes. The gap between the outcomes and the evaluation criteria are bridged with the help of Ostrom's design principles. They provide the basis for recommending institutional reforms.

The steps below highlight the steps carried out in each phase and their relevance in the research, that have helped to answer each of the sub-research questions.

Phase 1: - Desk Research and Literature Review

The literature review included studying the causes of arsenic contamination, the reasons for choosing the piped water systems technology and studying the timeline of all the policies implemented from the discovery of arsenic mitigation until date. The desk research gave a basic background of who are the key stakeholders involved in the process. The policy document analysis provided an understanding of what the expected policy outcome of each policy or regulation set is. This phase helped to structure the field interviews.

Parts of RQ1 and RQ2 are answered with the help of literature review and desk research. Each of these sub-questions asks questions related to what is already studied and known about the topic(Bryman, 2012). Hence, the literature review was the best-suited method to answer these questions. Theories from *Policy Analysis of Multi-Actor Systems* and *Actor and Strategy Models* are used to for mapping stakeholder power relations, their

interdependencies and the formal network amongst these actors(B. Enserink, L.Hermans, J. Kwakkel, W.Thissen, J. Koppenjan, 2010)(Hermans, Cunningham, & Reuver, 2016).

Phase 2: - Stakeholder Interviews and Field Observations

Semi-structured and unstructured field interviews are carried out in Bangladesh with the relevant stakeholders involved in the arsenic mitigation and rural piped water supply sectors to identify stakeholder perceptions, their view of the problem situation and their in-depth role in the process of setting up of the systems. The Field visit to *Manikganj* (an area in Bangladesh where a piped water system is installed) and interviews carried out with the local communities helped to study the behaviour of the rural communities and understand the formal and informal rules that govern the community which affect the ultimate adoption of these piped water system. These field interviews and analysis of field situation carried out in Bangladesh provide the input to the next phase of the research, Institutional Analysis.

RQ2 is a broad question which requires some background research of the stakeholders which was obtained from the desk research, a field understanding of the technical system and its functioning and also stakeholder interviews to understand their role in setting up of the system, which was obtained from this phase of the research. A mix of both methods helped to answer RQ2. Parts of RQ1 also require to validate the stakeholder map and the interdependencies on-ground that so far have only been studied using online resources. Stakeholder perspective of the problem situation itself, as to how they view the problem and what is the main cause according to them is key to understand how the problem evolves. Methods from *Interviewing Techniques* are used to choose the type of interview to be conducted and to frame the interview questions(A.Hannan, 2007)(B.McLaughlin, 2006). The reason for using semi-structured and unstructured interviews is that the exact information to be obtained and the answered required is not known. Hence, using fully structured interviewing techniques would constraint the interviewer from gathering the variation in information during the interview(Bryman, 2012). There might be some interesting insights from interviewees that be missed out. The interviews were conducted in different rounds as seen from the table below: -

	Interviewee	Reason for Interviewing
Round 1	Interview with experts in the Netherlands Interviews with Client (Informal Interviews)	Understanding Problem Situation Identifying Knowledge Gap
Round 2	Interviews with key selected informants involved in policy making at National Government Level (Semi-structured formal interviews)	Identifying Expected Policy Outcomes Understanding Government Expectations Understanding Policy Planning Process
Round 3	Interviews with local government and non-governmental actors (Semi-structured formal interviews)	Tracking down policy implementation process Identifying formal and informal institutions
Round 4	Interviews at community-level including field visit at *Manikganj*. Interviews around and away from piped water systems including men and women focus groups (Unstructured Informal interviews)	Understanding community perception of the problem, reasons for non-adoptability and non-sustainability Identifying current policy outcomes Identifying formal and informal rules that govern the community.

Table 2. 2 Interview Rounds

The interviewees only represent a portion of the entire WASH sector of Bangladesh. Thus, using the semi-structured interviewing method with most interviewees at national and sub-national level allowed to gather as much information as possible in the particular area of research leaving room for additional discussions without completely changing the researcher's line of interest(Bryman, 2012). However, the unstructured interview technique was most suitable for the community-level research area where it is difficult to gather information easily from communities and cross-questioning is required(Halcomb & Davidson, 2006). It also helped to keep the discussion open-ended so that community members can add valuable information that is not known from the central or local level.

Processing of Interviews

The 6 step data management and data processing method suggested by Halcomb and Davidson(Halcomb & Davidson, 2006) is used to process the interviews.

1. Audiotaping of interviews and concurrent note taking
2. Reflective journalizing immediately after the interview
3. Listening to the audiotape and amending/ revising field notes and observations
4. Preliminary content analysis
5. Secondary content analysis
6. Thematic review(Halcomb & Davidson, 2006)

Steps 1, 2 and 3 are meticulously followed while Step 4,5 and 6 are followed superficially by dividing the data into relevant themes and verifying the themes with the help of the client – Dr Bilqis. The thematic information is not evidently present in this thesis as it was done mainly for the purpose of the next phase of this research and is integrated into it. This data processing answers RQ2 and leads to the next phase of the research.

Phase 3:- Institutional Analysis – IAD Framework and Design Principles

Ostrom's theories of institutional economics are best suited to exploring this problem because they discuss in detail the main criteria for governing community resources such as the piped water systems in this case. They also suggest main reasons of failure of such systems discussing examples from a wide range of successful and unsuccessful projects carried out world over. The traditional approach of looking at such top down approaches often ignores institutions at govern communities at the bottom of the pyramid which Ostrom's theories account for. They help to provide the right kind of socio-political insights needed for governing such socio-technical systems.

The Institutional Analysis and Development Framework confers a promise of providing a structural approach to generically identifying action situations in complex policy situations by breaking them down into manageable sets of practical activities(McGinnis, 2011)(Cole, 2014). Applying the IAD framework in the case of analysing the institutional challenges that the Bangladesh rural water sector faces in mitigation of arsenic from their groundwater is an effort to zoom into problem areas that are often overlooked by technical analysts, whose focus is just to provide technical solutions to community problems. The IAD provides a set of current outcomes that may or may not comply with the expected policy implementation situation. Although it does provide a basis for building consensus for coordinated action among the stakeholders that are involved in the problem, it doesn't take into account the most factors that would help in designing of a robust policy design that would allow equitable and sustainable management of the Common Pool Resource – Piped Water Systems. Here, the main challenge faced by the government is in sustaining such systems over a long period of time in complex uncertain and interdependent environments where individuals continuously faced substantial incentives to behave opportunistically. Thus, Ostrom's design principles are used to bridge the gaps between the current outcomes and expected outcomes and propose robust institutional reforms.

RQ3 and RQ4 are both answered using the IAD and the design principles respectively. Stakeholder behaviour and informal rules of the community are analysed using concepts of cultural behaviour from *Cultures and Organisations: Software of the Mind*(Hofstede, 1991). Also, some theories of *Cost-Benefit Analysis* (Boardman, Greenberg, Vining, & Weimer, 2010)help to analyse the Willingness to Pay factor in-depth which help in supporting the arguments for new institutional reforms.

Phase 4: Stakeholder Validation

The final phase involves another interview session; round 5 of the interview session, conducted with a few field experts and the client. This was done to verify the assumptions made during the institutional analysis step and to validate the institutional reforms and ensure that they are applicable and possible with the on-

ground situation. These validations and verifications are made by presenting the output to EPRC, stating these validations in the form of client validation. If the assumptions are wrong they are corrected and if the reforms are abstract or enigmatic they are adapted when suggesting policy recommendations.

After validation, final policy recommendations are made. This phase of the research concludes the research by answering the main research question.

2.5 Research Relevance

This research covers both scientific relevance and societal relevance. Scientifically, it would help to close the research gap by providing some insights into the institutional and community aspects of arsenic mitigation. Most research that is carried out from the institutional aspects of Bangladesh generally talks about WASH sector as a whole. This is one of the few researches which attempts to explore the socio-political side of the arsenic contamination problem focusing specifically only on the governance of piped water systems in much detail. It aims to combine four main topics; Arsenic Contamination, Piped Water Systems Technology, Rural Water Governance, Role of Communities, which are more often than not discussed individually in most researches and not a combination. Addressing a portion of each the technological, societal and governance aspects in combination may help to provide better knowledge from all areas about how to solve the problem. Secondly, it is one of the few attempts to use the methodology of IAD to analyse a socio-technical system such as this one. It combines the IAD framework with Ostrom's design principles to bridge together current and expected policy outcomes.

From the societal perspective, it contributes to helping the government in realizing a future of nation-wide piped water coverage. It is a future vision for the GoB to reach the highest level of the JMP ladder for drinking water and provide safely managed drinking water to all. Having an improved source of drinking water located in a community/household premises with water available as and when required is essential for rural economic development and is possible with the help of a piped water connection(WHO/UNICEF, 2017). Institutional insights can better the policies made in regard to piped water systems and help the government come closer to their goal.

2.6 Research Scope and Assumptions

The assumptions made and the scope decided for the research may affect the quality and exhaustiveness of the concepts discussed in this thesis.

This research is limited to discussing the use of piped water systems technology in arsenic affected areas only. Although, it is known that it may serve as a good solution in saline areas, hill tracks and other heavily contaminated areas as well, discussions about its use in these areas is kept out of the scope of this thesis. Also, there are other technologies apart from piped water systems, which may also serve as good solutions in some arsenic affected areas considering local solutions, but they are not the focus of this research. It focuses only on piped water systems technology for arsenic-affected rural areas only. This choice has been made considering an attempt to provide valuable insights to EPRC that will be beneficial for them.

The technical details of other technologies used in arsenic affected areas, the advantages and disadvantages of each technology type and the scale(small-medium-large) of piped water supply system have been left out of the scope of this thesis due barriers in background and knowledge about water engineering.

The limited time on the field may have affected the variety of stakeholders chosen. An attempt has been made to pick the relevant stakeholders from each stakeholder group (further described in section 4.3) to cover most actors involved perceptions. But, there may be some key stakeholders that have been missed

out due to limited time. The role of NGOs in the policy making and the institutional setup of the WASH sector has not been discussed in detail as not much has been known about their activities on field level .

The field interviews with local communities have been carried out only in *Manikganj* area, one of the many arsenic affected areas of the country. The sample size of the community interviews is small. Hence, it should be considered that the perceptions and ideas about the technology that communities have in *Manikganj* is assumed to be similar in other areas as well. The technological and environmental and political conditions of *Manikganj* maybe be slightly better than some areas in the north of the country, due to its proximity with the capital city. Similar, environmental, political and technological conditions for other arsenic affected regions may not exist.

2.7 Research Flow Diagram

Figure 2.1 depicts the research flow diagram which shows the step-by-step development of this thesis and summaries the research methodology as explained in section 2.4. It covers the main elements of the research. Chapters are sub-divided into sub-chapters depending on the research activity that is conducted to the answer each of the sub-research questions. The deliverables of RQ1 and RQ2 are not directly available based on chapters but are a result of the build of the activities done in Chapter 3, 4 and 5. RQ 3, is answered in Chapters 8a, 8b and 8c. RQ4 is answered in Chapters 9 and finally Chapter 10 answers the main research question.

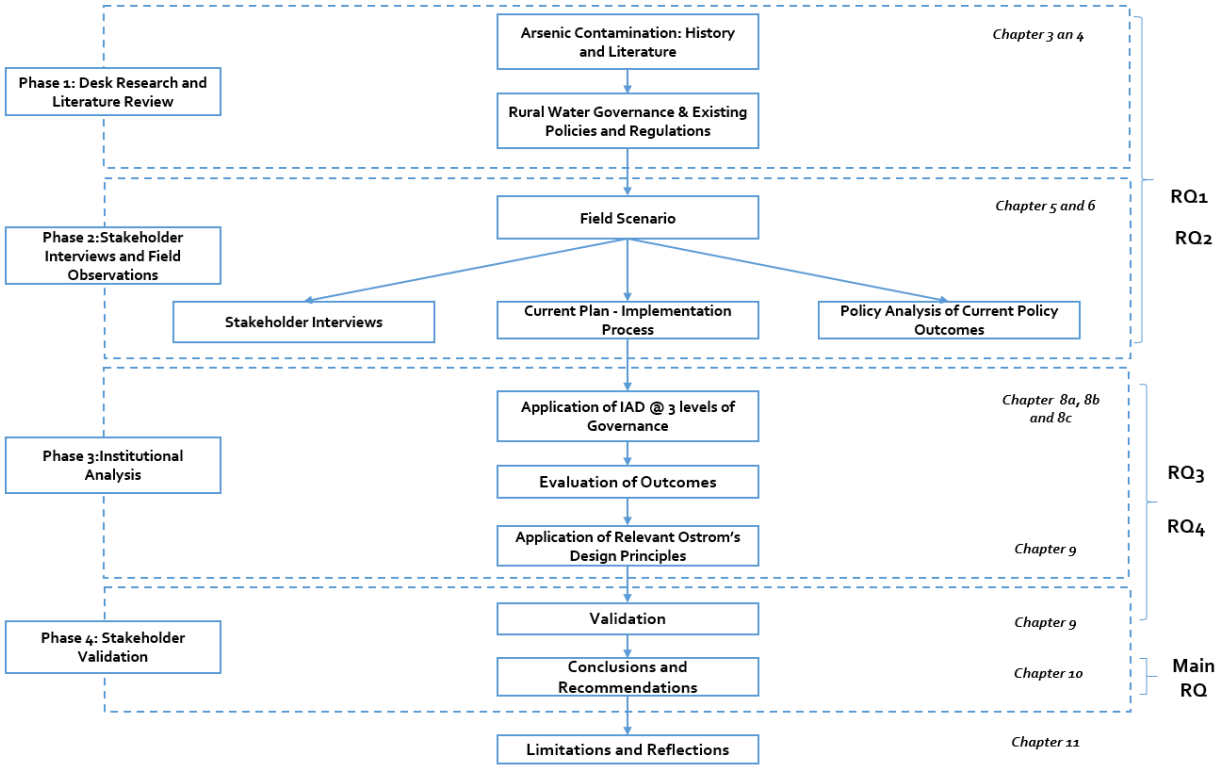


Figure 2. 1 Research Flow Diagram

3

Arsenic Contamination: An Overview

A review of all literature available is always important to know more about the topic. A thorough literature review of the arsenic contamination problem in Bangladesh is done, identifying major areas affected, the causes and effects of contamination. Section 3.1, 3.2 and 3.3 provide the basic background, of reasons for arsenic contamination, areas affected and causes and health effects of arsenic mitigation respectively. Section 3.4 discusses the history of the problem since its discovery. Subsequently, Section 3.5 discusses the safe water technology options that are currently in use in Bangladesh and Section 3.6 further discusses the technicalities of piped water systems, reasons for choosing piped water systems over other systems and also provides a brief description of the challenges that piped water systems face in Bangladesh.

3.1 Areas of Arsenic Contamination

The Ganges Brahmaputra Delta, also called the Ganges Delta, Sundarbans Delta or Bengal Delta is situated in the Indian sub-continent where the Ganges and Brahmaputra rivers discharge into the Bay of Bengal. It is the world's largest Delta, with a surface area of 100,000 km²('Delta Alliance - Ganges–Brahmaputra Delta', n.d.). Bangladesh covers two-thirds of the delta and the rest lies in the state of West Bengal in India. The delta is a floodplain of three major rivers namely, the Ganges, the Brahmaputra and the Meghna. Bangladesh is located in the lowermost reaches of the Ganges-Brahmaputra-Meghna river delta comprising of only 8% watershed(Qureshi & Ahmed, 2014). These rivers support the country's lifeline by contributing to the agriculture, transportation and industry sector, providing livelihoods to its inhabitants.

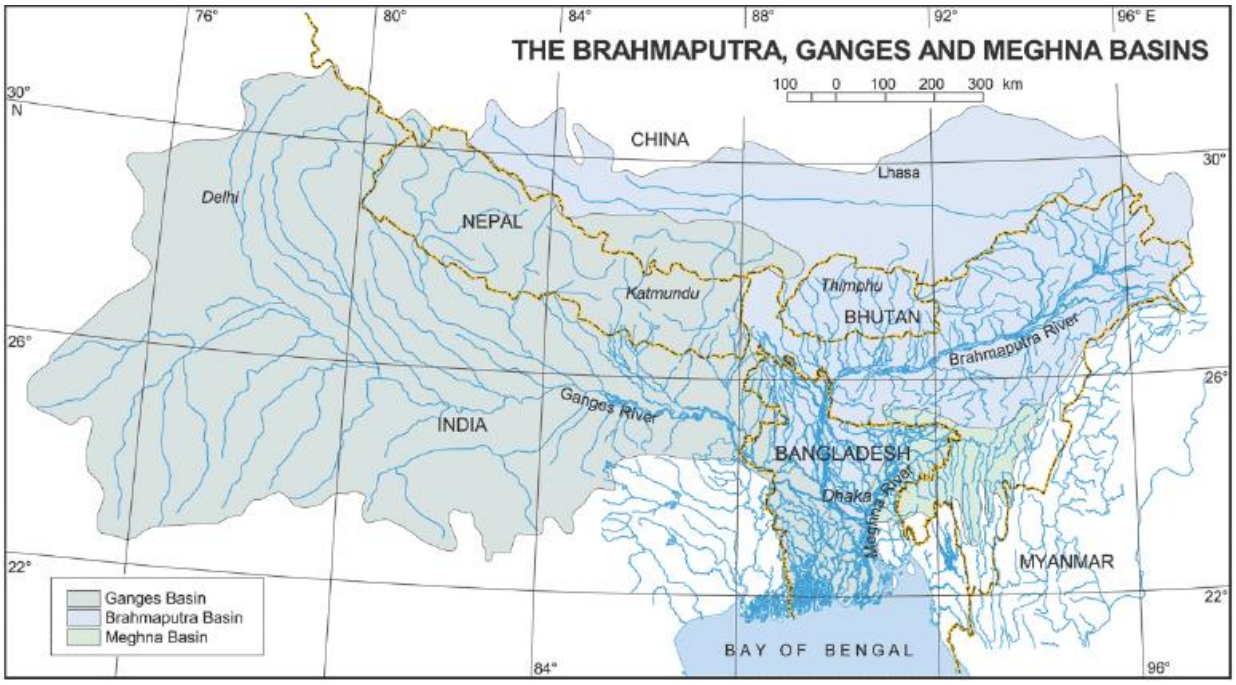


Figure 3. 1 The Ganges-Brahmaputra-Meghna Delta(Bangladesh Government Sector Development Plan (2011-2025), 2011)

As surface water cannot be properly utilized for the purpose of drinking due to the high costs associated with its treatment process and the poor management of surface water resources, groundwater serves as the main source of drinking water in Bangladesh. With the exponentially rising population, its usage has increased dramatically over the last three decades(Qureshi & Ahmed, 2014). Arsenic toxicity in groundwater in the southern and eastern parts of Bangladesh was first recognised in 1993(Chowdhury et al., 1999).

Some amount of Arsenic (As) is always present in groundwater. According to the standards of the World Health Organisation the acceptable level of As in drinking water can be up to 10 µg/L(Smith et al., 2000). Water containing As above this level is considered harmful for human intake and hence is arsenic-contaminated. The government of Bangladesh has set a permissible level of 50 µg/L of arsenic in drinking water, which is higher than that set by the World Health Organisation(Smith et al., 2000). Although, the guideline values set by the WHO are not binding limits, they are intended for use as a basis for the development of national standards, in the context of local or national environment, social, economic and cultural conditions('Arsenic Mitigation in Bangladesh', n.d.).

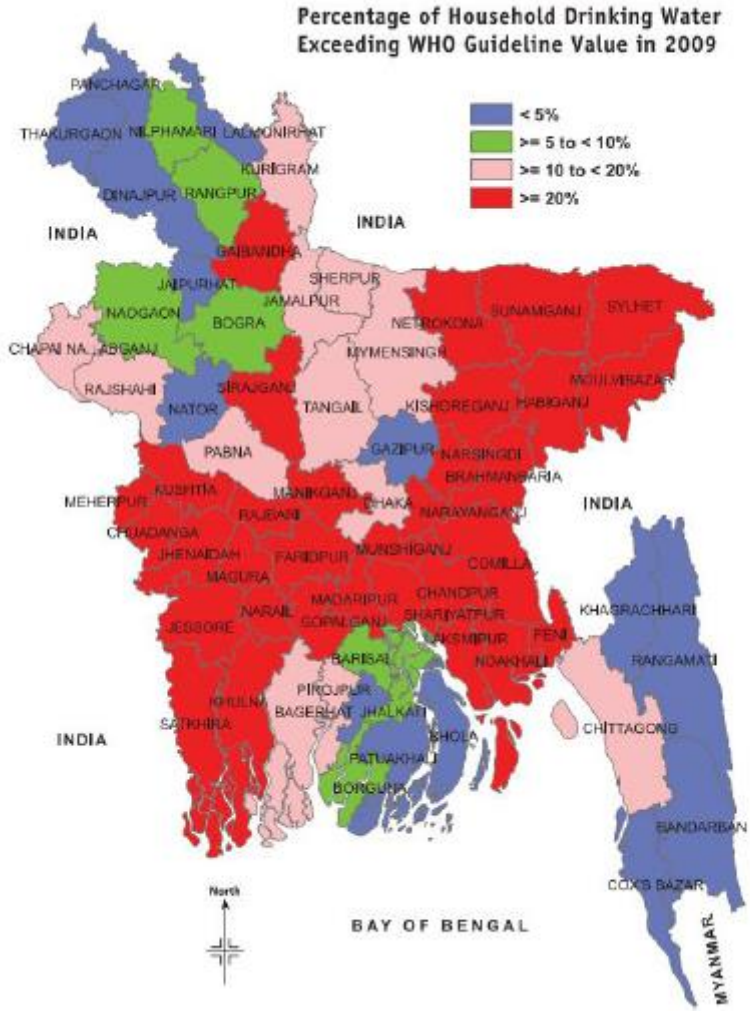


Figure 3. 2 Map showing Arsenic contamination of household drinking water in Bangladesh in 2009(National Strategy for Water Supply and Sanitation 2014, 2014)

Arsenic contamination of groundwater in the Ganga- Brahmaputra-Padma-Meghna(GBM) fluvial plains in Bangladesh and its consequences to the human health have reported to be one of South Asia's biggest natural

groundwater calamities(Ghosh, Scientist, & Singh, n.d.).The magnitude of this contamination in Bangladesh has surpassed the aggregate problem of all the twenty countries of the world where groundwater arsenic contamination has been found. It has been reported to be the worst case of mass poisoning the world has ever experienced(Safiuddin & Karim, 2001). The specific areas that struggle with severe levels of arsenic are the central parts of the country, stretching from Chapai Nawabganj in the west to Brahmanbaria in the east. The greater Sylhet area is also affected. Isolated cases of arsenic contamination have been found in the northern and coastal areas of the country. At present 61 out of 64 districts of the country have been marked with the prevalence of As in the drinking water, which includes the salinity prone areas as well('Arsenic Mitigation in Bangladesh', n.d.). However, the degree of contamination may vary from 1% to over 90% contamination(Smith et al., 2000).

A survey conducted by the British Geological Survey and later by UNICEF confirmed that as of date there are 283 arsenic affected sub-districts (*Upazila*s) out of 463 sub-districts. Majorly of the affected districts are Chandpur, Munisganj, Gopalganj, Madaripur, Noakali, Satkhira, Comilla, Faridpur, Shriatpur, Meherpur, *Manikganj*, Bagerhat and Laxmipur. Nearly about 35 million people are at risk from arsenic, as concentrations in drinking water have exceeded 50 µg/L, which is the maximum contamination level(MCL) used in Bangladesh. If the limit set by the World Health Organisation has to be considered, about 77 million people would be considered at risk(Qureshi & Ahmed, 2014). Most of this contamination is limited to shallow aquifers with a depth of less than 100m(Qureshi & Ahmed, 2014).

3.2 Causes of Arsenic Contamination

Arsenic is a naturally occurring chemical element found in rocks and minerals, soils, natural waters and organisms. It is mobilized in the environment through a combination of natural processes such as weathering reactions, biological activities and volcanic emissions. It is released into water through natural activities such as hydrothermal action and dissolution of rocks. The arsenic present in the GBM delta came from the erosion of the Himalayan rocks(MD. Anwarul Abedin, Umma Habiba, 2014). Thousands of years ago, due to the excessive erosion of rocks rich in arsenic from the Himalayan belt and other highlands deposited in the delta along with sands, gravels, silts and clays. These arsenic-bearing sediments became buried in the earth's crust forming part of the aquifers that are now being utilized for water resources.

Arsenic is released into the groundwater in Bangladesh by a natural chemical reaction called "Oxyhydroxide Reduction"('Arsenic Mitigation in Bangladesh', n.d.). A very small percentage may also come from human led activities such mining activities, combustion of fossil fuels or from arsenic-containing insecticides, herbicides or rodenticides(MD. Anwarul Abedin, Umma Habiba, 2014).

Agricultural and drinking water requirements in most of the rural areas in Bangladesh are met from groundwater. The arsenic affected groundwater is used for drinking purposes resulting in excessive amount of arsenic (As) content in the body.

3.3 Manifestations and Health Impacts of Excess Arsenic

Chronic arsenic exposure can cause server health issues, which will be noticeable in both short and long-term. As arsenic is naturally present in the environment as a substance, it tends not to accumulate in the body but is excreted naturally('Arsenic Mitigation in Bangladesh', n.d.). But, if it is ingested faster than it is excreted and in higher constitution than normal, it can accumulate in the body. It may attack internal organs without causing any visible external symptoms, making arsenic poisoning difficult to recognize. Early symptoms include skin disorders like hyperpigmentation and keratosis which are external manifestations of arsenic poisoning. Over time, continued exposure can lead to respiratory diseases, problems within the nervous system; lower IQ or weakened memory, reproductive effects such as; stillbirths and even carcinogenic effects on the lung, bladder or skin(Simon Kapaj, Hans Peterson, Karsten Liber & Prosun, 2007). In severe cases, skin

cancer can occur or internal organs can be affected by gangrene. According to the World Health Organisation, a daily intake of 10 µg/L of arsenic, already influences your health(Smith et al., 2000). Currently, the arsenic concentrations found in contaminated areas in Bangladesh varies between 50-100 µg/L(Johnston et al., 2014).

The challenge is that it is impossible to detect arsenic without a testing kit, since it is a taste-, odour- and colour-less substance and thereby unrecognizable to the human senses. It is estimated that it can take between 5 to 10 years of constant exposure until any symptoms of arsenic poisoning can be detected. Hence, it is hard for the people to identify the problem at an early stage and by the time it becomes apparent it is difficult to cure. Hence, more focus has to be given to prevention than cure. Prevention can only be obtained by increasing the awareness of the population or by finding alternate supplies of water.

3.4 History of the Problem

The first cases of As-induced skin lesions were identified in 1983 in the western part of the delta in West Bengal, India. By 1987, several cases from Bangladesh and India were reported following which its causes were investigated(Smith et al., 2000). When the water sources of these patients were analysed, the presence of arsenic in these water supply systems was found. The primary drinking water sources for most communities were tube-wells which drew water from underground aquifers. Tubewells were used in Bangladesh since the 1940s to provide drinking water since surface water was not always available or heavily contaminated(Smith et al., 2000). The microbially contaminated surface water caused a huge burden of disease and mortality. To solve this problem, during the 1970s, the UNICEF worked in collaboration with the Department of Public Health Engineering (DPHE) to install tube-wells in large scale across the nation to provide, a presumably secure and reliable drinking water supply to all (Smith et al., 2000)('Arsenic Mitigation in Bangladesh', n.d.). By, 1972, there were approximately 135,000 tube-wells in Bangladesh. At that time, it meant that there was 1 tube-well for every 400 people('Arsenic Mitigation in Bangladesh', n.d.).

These wells, both shallow and deep, are usually dug deep underground and served as a good alternative to surface water supply reducing drastically the occurrence of bacterial diseases. Hence, the initial goal of providing a safe drinking water to all was achieved until arsenic was recognized as a problem in the water supplies. Initially, standard water testing procedures did not include arsenic tests(*National Policy for Safe Water Supply & Sanitation 1998*, 1998). After several investigations done by the Department of Occupational and Environmental Health and results collected by the WHO, arsenic contamination of water in tube-wells was confirmed in 1993(Smith et al., 2000). It was concluded that about 29% of all tube-wells were As contaminated(Smith et al., 2000).

Suffering most from this problem are rural poor. Most of the tube-wells installed are in the rural parts of the country. They make up the largest section of the population, lack awareness and at the same time have less access to societal resources.

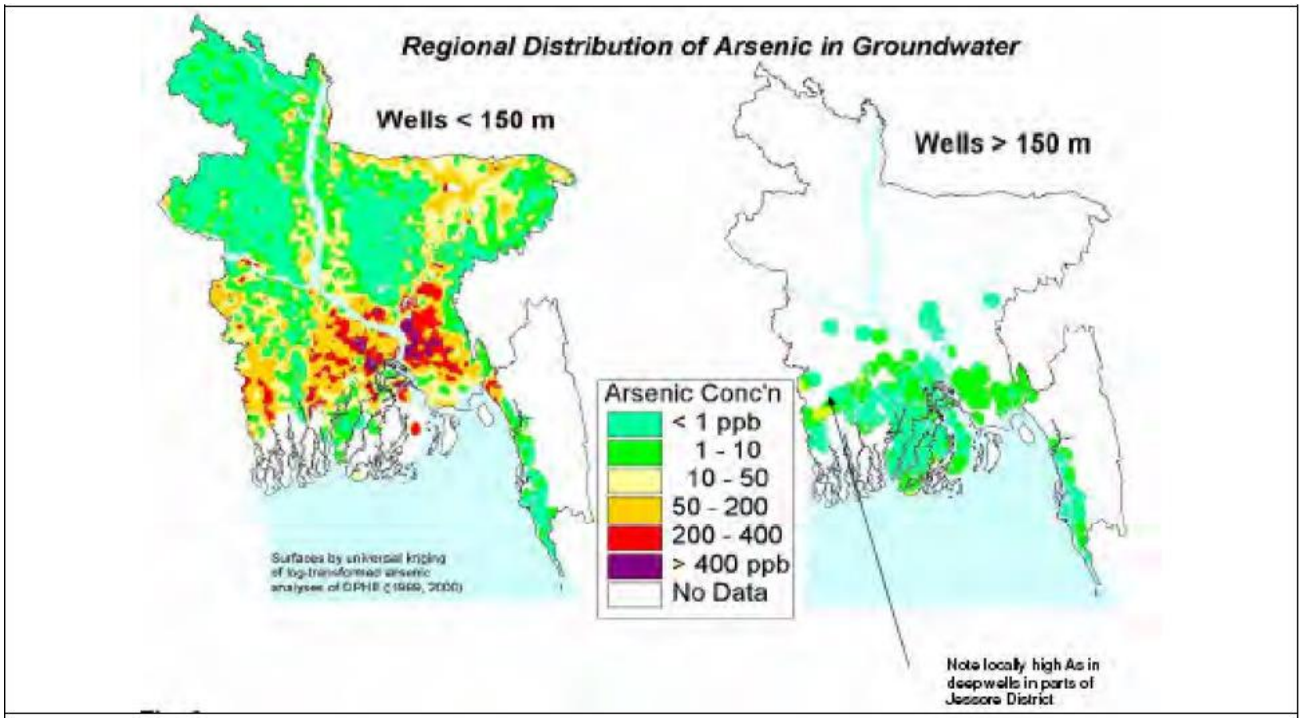


Figure 3. 3 Distribution of arsenic in tubewells with depths within 150 m (left) and above 150 m (right)(Bangladesh Government Sector Development Plan (2011-2025), 2011)

3.5 Safe Water Supply Technologies in Bangladesh

After the magnitude of the problem was realized in the early 2000s, the government began to look for solutions for arsenic mitigation. Multiple nationwide surveys were carried out by the Department of Public Health Engineering (DPHE) with the help of other international organisations where the drinking water supply sources in the rural areas were tested for the presence of As. Various activities such as marking contaminated tubewells with a red mark were conducted to increase the awareness about arsenic within the communities('Arsenic Mitigation in Bangladesh', n.d.). An important method for arsenic mitigation was to provide alternative water options to the people in the villages so that they relied less on the contaminated water. To provide safe drinking water options various arsenic mitigation technologies began developing. These were of two kinds:

1. **Treatment technologies to remove arsenic from groundwater** – This was done by providing anti-arsenic or anti-ferric treatment of the water.
2. **Alternative sources of water which are arsenic-safe** – Many alternative sources of drinking water which do not contain arsenic were researched(Hoque et al., 2006).

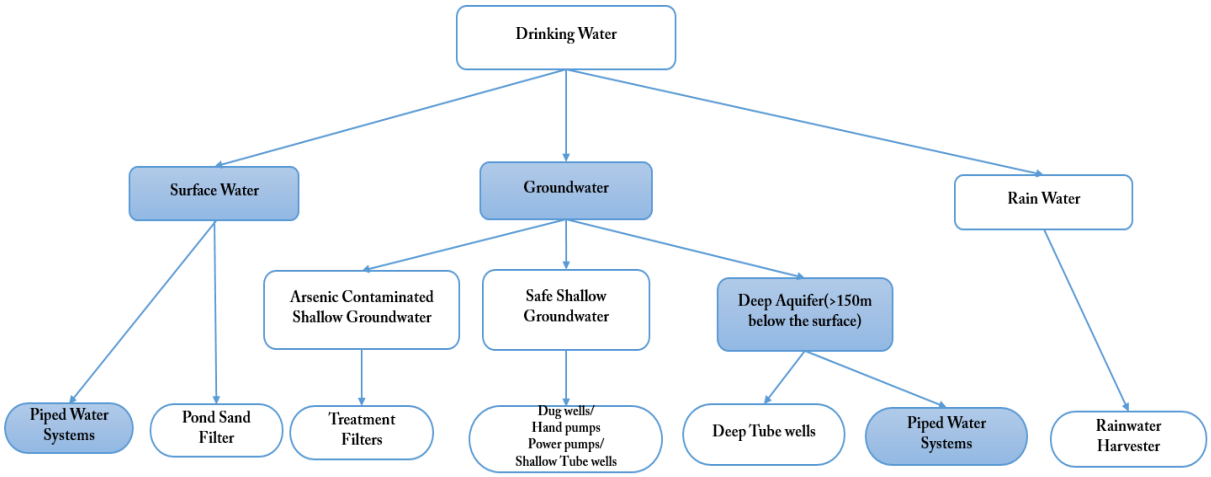


Figure 3. 4 Currently promoted arsenic mitigation technology for rural water supply in Bangladesh(Hoque et al., 2006)

Figure 3.4 above gives a brief overview of the presently most promoted arsenic mitigation technologies for providing safe drinking water in Bangladesh. While every technology has its own advantages and disadvantages and preferred by communities based on area, costs and reasons such as easy installation, Piped Water based technologies continue to be the most feasible one to achieve the goal of a "safely managed water source in every household.(WHO/UNICEF, 2017)" This thesis discusses in detail Piped Water Systems: Groundwater-based or Surface- water based.

Amongst all the three sources of water available, groundwater is the primary source of water used for drinking and irrigation purposes. Surface water sources such as rivers and lakes are heavily polluted, and the treatment of surface water would require a very high quality of treatment before it can become available for drinking and irrigation. This is the main reason Bangladesh hasn't been able to utilize its surface water capacities despite surface water being abundantly available with 3 major rivers flowing into the country. Ample amount of Rainwater is also available but its availability during the dry seasons remains a challenge especially in some areas(Qureshi & Ahmed, 2014). Hence, groundwater is currently being utilized to its maximum capacity. Although groundwater is a major source of drinking water in the country, the depletion of groundwater tables at an alarming rate continues to be a worldwide concern, and thus multiple drillings for individual households poses a major threat to the depleting groundwater(Qureshi & Ahmed, 2014). Hence, there are uncertainties in considering deep tube-wells as a long-term source of arsenic-free water(*Bangladesh Government Sector Development Plan (2011-2025)*, 2011). Adding to this issue, there is a risk of having newly found arsenic in some years' time, in areas which are now considered arsenic free, as groundwater shifts over time. Thus, the government has been taking steps, which is evident from the policy documents, to move towards surface-water based water supply options.

The major advantage that Piped Water Systems have over other mentioned technologies are: -

1. Water is delivered to the consumers in the closest possible way. It can be available in each household tap via a pipeline.
2. As the system is well protected and water is treated, there is minimum contamination possible and water quality is ensured.
3. Multiple drillings, as in the case of privately owned tubewells, can be avoided.
4. Serves many people at a single time(Hoque et al., 2006)(Ibrahim, 2004).

In conclusion, the use of Piped Water Systems technology as an arsenic mitigation measure is well suited for long-term sustainability. Hence, the emphasis lays on moving towards piped water.

3.6 Piped Water Supply Systems: Ensuring a Safely Managed Water Source for all

A piped water supply system consists of a source of water having an overhead tank for storage of water, a pump to lift the water against gravity and a pipe network that delivers water to the consumers. Treatment units are often installed to treat the water for any kind of contamination and purified water is delivered to households via pipelines(JICA, 2008). Figure 3.5 is a picture of a general piped water supply system build in an area and water is supplied to the households in that locality with pipelines built that connect to the household taps.

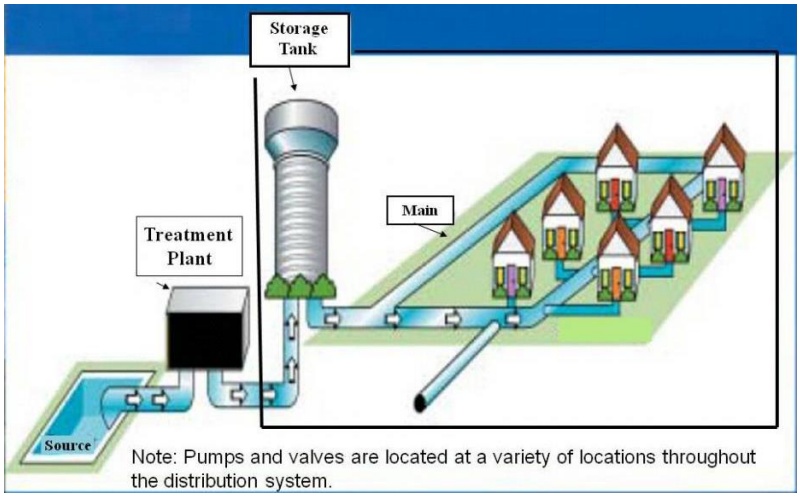


Figure 3. 5 Piped Water Distribution System(Agency, n.d.)

The source of water used can be of two types: Groundwater or Surface Water. In general, two types of piped water supply systems are available:

1. Surface water based piped water systems – The water is obtained from rivers, lakes, ponds or springs. It is purified using treatment device, pumped using a low-lift pump, stored in an overhead tank of large-scale capacity and then delivered to homes via pipelines.
2. Groundwater-based piped water systems- The water is pumped from deep underground, usually 150-200m below the surface of the earth, using a power-pump and stored in an overhead tank and then delivered using pipelines(Qureshi & Ahmed, 2014).

In Bangladesh, most of the piped water supply systems are groundwater based. Although, there is an emphasis on moving towards surface-water based systems but the progress is slow, the main reason being that the construction of surface water based systems would highly increase the costs for consumers and that would further discourage its use.

Figure 3. 6 A Groundwater-based PWS in Manikganj, Bangladesh

The main advantages that piped water systems have in Bangladesh is that:

1. These systems have proven to be technically feasible in water quality stressed areas: saline areas, arsenic and other pollutant affected areas, hilly areas where various kinds of water treatments are required. Those treatments at household levels have been found to be expensive and difficult as the chemicals are not locally available.
2. Biological safety of between discharge and consumption in regard to contamination at source and recontamination during handling can be optimized through chlorination or disinfection process. The scope of these water safety concerns is usually more feasible in pipe water supply systems than with tubewells, rainwater-based systems or other systems.
3. Only the required amount of water can be collected as and when required, hence reducing water wastage.
4. Timely monitoring of water quality doesn't pose a major challenge, unlike monitoring a large number of tubewells installed. Monitoring of tubewells across a region becomes a huge task and requires much more resources than just monitoring a couple of large-scale supply systems in an area.

Bangladesh has always shown its commitment towards the SDGs, by organizing its policies and national development frameworks to be in line with the SDG. Goal 6.1 and 6.2 of the SDGs prove to be the major underlying benchmarks on which most WASH decisions are taken, and policies are formulated(WaterAid, 2015). To monitor the SDG targets in WASH services, the WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) was established in 1990(UN, 2017). A baseline JMP ladder is established which determines the accessibility of the drinking water service to a community. The JMP's objectives were to provide a monitoring mechanism that would allow comparing the level of services between countries over time. The JMP ladder for drinking water mentions a "Safely Managed Drinking Water", at its highest level, making it the target that most countries strive to achieve(WHO/UNICEF, 2017). According to that, a safety managed drinking water service is one which satisfied all these three criteria: -

1. It should be accessible on premises
2. Water should be available when needed
3. The water supplied should be free from contamination.

As per this definition, a piped water supply proves to have the highest technological potential to supply safe drinking water within the country in light the SDG's JMP ladder of drinking water(WHO/UNICEF, 2017). Thus, to strive to reach this level, the GoB is also making efforts by various policy interventions, setting up infrastructure with the help of the World Bank, other donor organisations and NGO support. Various policy interventions have been made to ensure arsenic-safe villages, encouraging the use of piped water technologies in rural areas wherever feasible.

Despite these efforts made by the government, there are major institutional, social and economic challenges that hinder their success in the rural areas. As explained briefly in section 1.3, there are various challenges that need to be encountered at community level to make these systems successful. Some of the main challenges are briefly discussed below.

1. The main competition for piped water system is the deep tubewells. Many of these tubewells were built before the discovery of arsenic. Communities now are habituated to drinking water from tubewells. They can be easily installed and are not so expensive. As per the 2016 statistics, there are 12 million installed tubewells(*Bangladesh Government Sector Development Plan (2011-2025)*, 2011). This includes, privately installed, government installed, and NGO installed tubewells. The costs involved in the O&M of these tubewells is almost negligible and, they are easier to manage. On the other hand, a PWS involves higher costs, difficult O&M, water is supplied fewer hours and higher capital costs. Considering all these benefits the community is unable to foresee the advantages of a PWS connection over the tubewell connection.
2. The willingness to pay for a piped water connection depends on the community's motivation to have the system. Oftentimes, communities are not made aware of its advantages or they have other

concerns which seem more important to address rather than attending to the issues of water. The WTP factor is a very important aspect which influences any community's decision to adopt a PWS. This is will be discussed in detail further, during the institutional analysis in Phase III of this thesis.

3. Issues of sustainability are related to the inability of the community to handle the O&M of the system. This involves treating the water regularly, changing filters, water quality testing and other maintenance issues which are not only expensive for the people but also technically complex. Sometimes, an operator is hired to manage these systems, but he also cannot handle very complicated technical issues.
4. Collection of tariffs from households is a challenge. Tariff payments depend on factors such as income levels of households, ability to pay for such a system, influence of neighbours and the person in charge of collecting the tariffs(*Bangladesh Government Sector Development Plan (2011-2025)*, 2011)(JICA, 2008).

All these issues multiply greatly affecting adoptability and sustainability of PWSs. In conclusion, although piped water supply schemes are technically feasible and serve as a good alternative in arsenic affected regions, they need to be institutionally well managed, economically affordable and societally acceptable and adopted by rural communities. Bangladesh as a country has the vision to move towards large-scale adoption of piped water supply systems whereby every household shall have access to arsenic-safe drinking water from the tap. But, for this vision to be realised, these issues need to be tackled first.

4

Rural Water Governance

Understanding the administrative structure of Bangladesh and the water governance is essential to know the stakeholders involved. The past and current policies in place for arsenic mitigation help to understand what the policy objectives are and how much importance is given to rural piped water schemes. The desk research was done on the administrative structure and the policy understanding help to identify the stakeholder groups and later relevant actors involved in the process. The basic stakeholder analysis was done before going to Bangladesh for data collection. Section 4.1 discusses the administration of Bangladesh followed by Section 4.2 where all policies and regulations formulated for arsenic mitigation are explained in detail. The last two sections, Section 4.3 and 4.4 explain the stakeholder analysis.

4.1 Administration of Bangladesh

Administratively, Bangladesh is divided into 7 Divisions (States), 64 Zilas (Districts), 492 *Upazila*s (Sub-districts) and 4573 Unions(CLGF UK, 2013).

Each level is governed by a local government body. The rural governance has a three-tier system:

1. The *Zila Parishads* (Governing the Districts)
2. The *Upazila Parishads*(Governing the Sub-districts)
3. The *Union Parishad* / Union Council(CLGF UK, 2013)

The *Union Parishads* form the lowest administrative unit of rural. They play a major role in coordinating development activities at the village level and communicating directly with the local communities at village level responsible for their well-being. Typically, a Union is made up of nine Wards. Usually, one village is designated as a ward or sometimes, depending on the geographical region, a Ward may even consist of 2/3 villages together. A Union Council consists of a chairman and twelve members including three members exclusively reserved for women. These councils are formed under the Local Government of the particular district they are located in(CLGF UK, 2013).

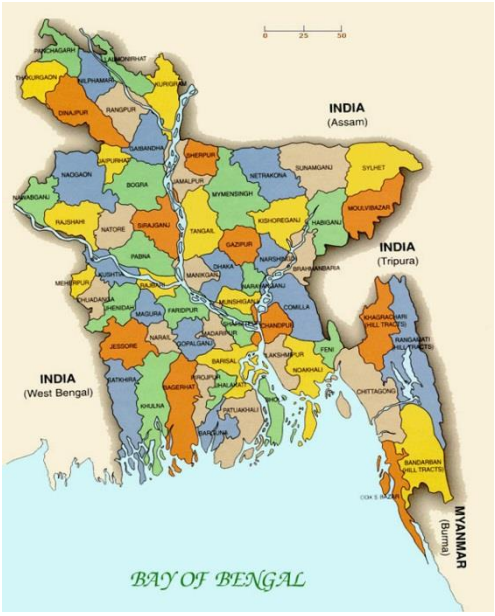


Figure 4. 1 Map of Bangladesh(Sanitation, n.d.)

Figure 4.2 below shows the structure of rural water governance within the country. The National Water Resource Council, headed by the Prime Minister of the country is the national level body in charge of handling all water, agriculture, and environment and health-related issues national wide. Under the NWRC, the Ministry of Local Government, Rural Development & Cooperatives which takes the responsibility of regional and rural policy-making, city administration and finances('Cabinet Division-Government of the People_'s Republic of Bangladesh', n.d.). The Ministry of Local Government, Rural Development and Co-operatives has two main bodies functioning under it:

1. Local Government Division (LGD)
2. Rural Development and Co-operatives Division. (RDCD)

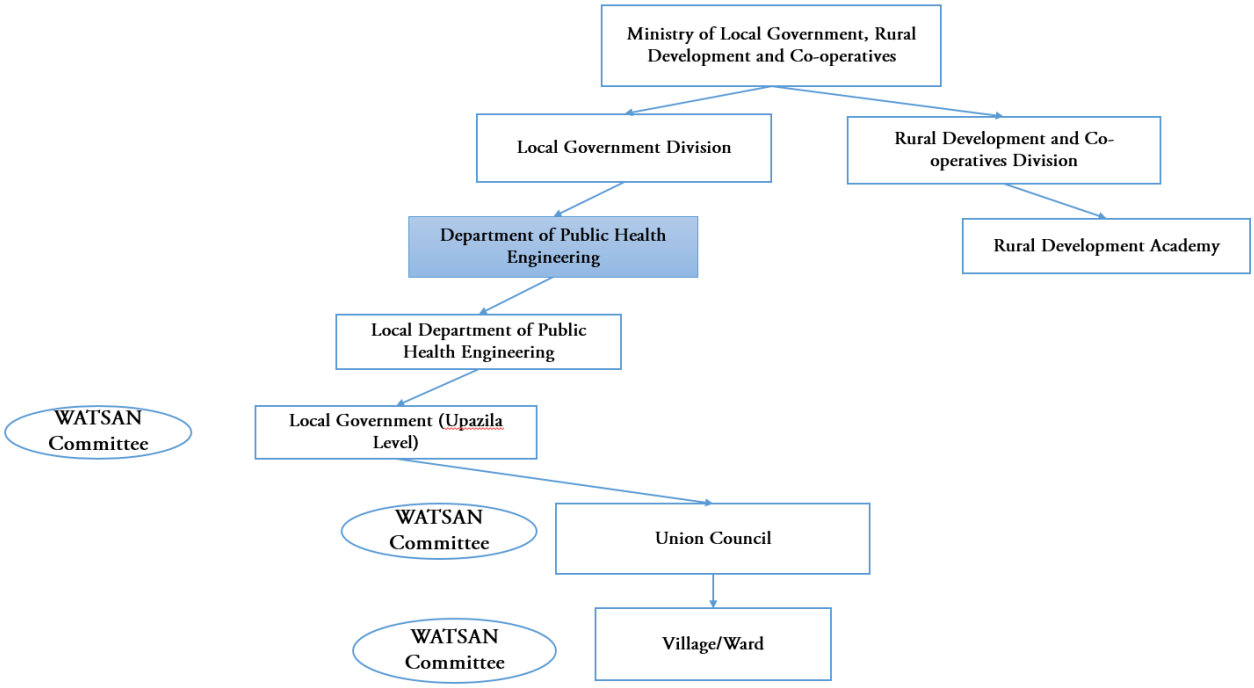


Figure 4. 2 Structure of Water Governance in Bangladesh

As a legislative body, it has allocated the task of enhancing local governance and socio-economic development in both urban and rural areas to the LGD and the task of handling rural economic development to the RDCD. It takes actions to recruit members of these organisations, defines their vision and goal, authorizes them to formulate and issue policies and laws, execute development programs, administer their governance and monitor their activities in each of their respective areas(Ministry of Local Government, 2017).

The Local Government Division (LGD) works towards improving socio-economic development in urban and rural areas by implementing social security schemes and supporting programmes that stimulate societal development. With a vision to establish participatory and effective local governance, the LGD aims to raise the standards of living by improving overall infrastructure. Hence, the LGD has organised itself into multiple agencies or corporations that handle various elements of infrastructure and environmental development(Ministry of Local Government, 2014). The LGD has the authority to issue the national policies and implementation plans. It also sets the institutional arrangement that the stakeholders will operate in, mobilizes resources for them to operate. It defines clear objectives of every implementation plan, describes how the policy will be implemented and sets targets for the organisations under it. Water and Sanitation facilities being a key element of urban and rural socio-economic development is the responsibility of the Department of Public Health Engineering (DPHE) and Water Supply and Sewage Authority (WASA) under the LGD(Ministry of Local Government, 2014).

The Department of Public Health Engineering (DPHE) under the LGD engineering department is the national lead agency for the provision of drinking water supply and waste in the country except in areas where WASA operated (mostly the cities). It is mandated to provide advisory service to GoB in framing policy and action plans for the Water and Sanitation (WSS) and provides support to the Local Governmental Institutions (LGIs) in the development and O&M of the water & sanitation facilities. It is the main government body dealing with the rural drinking water supply sector of the country. Hence, all execution of decisions regarding the drinking water sector, from technical information to advice and coordination is the authorized responsibility of the DPHE(DPHE, n.d.). To strengthen their coordination activities at the local level, the DPHE has set up local

DPHE offices at the district level. They help coordinate governance between the sub-districts and the central DPHE. Apart from that, Water and Sanitation Committees (WATSAN) are formed at the sub-district (*Upazila*), Union and Village level to and enable community participation at grassroots level. The committee includes important members from each level and women representation. The head of the WATSAN committee of each level is present in the board of the WATSAN committee at the level above.

The RDCD alongside is also working in areas of rural development initiating programmes to develop rural infrastructure. Water is an important aspect of rural growth and hence providing water supply systems goes hand in hand with rural development. Apart from the DPHE, certain other agencies under the RDCD, such as the Rural Development Academy (RDA) also deal with rural water supply if authorized to do so under the policies of RDCD.

4.2 Policies and Regulations Relevant for Arsenic Mitigation

After the issue of arsenic contamination came to light, the subject experienced a huge international hue and cry worldwide, which drew the attention of policy makers and planners to develop policies for arsenic mitigation. A series of regulations were established to address the emerging challenges of the WASH sector while capitalizing on the opportunities that were evident. Important policies and plans that played a key role in defining the issue of arsenic mitigation at the central level and establishing an important agenda were: -

- National Policy for Safe Water Supply & Sanitation – 1998
- National Policy for Arsenic Mitigation (NPAM 2004)
- Implementation Plan for Arsenic Mitigation (IPAM 2004)
- 7th Sector Development Plan (SDP 2011-2025)
- National Water Supply & Sanitation Strategies (2014)

4.2.1 National Policy for Safe Water Supply & Sanitation (NPSWSS1998)

The National Policy for Safe Water Supply and Sanitation was formulated with the intention to transition from the traditional service delivery arrangement of water and sanitation facilities to a more decentralized planning method, whereby user participation in planning, implementation, management and cost sharing would be focused on. It aimed to improve the standards of public health and to ensure a safe environment for water and sanitation facilities by making sure that all citizens have access to basic levels of water supply and sanitation facilities(*National Policy for Safe Water Supply & Sanitation 1998*, 1998).

Objective of the Policy: - In regard to rural water services the policy aimed to increase its coverage of safe drinking water by lowering the average number of users per tube-well installed(*National Policy for Safe Water Supply & Sanitation 1998*, 1998).

Key Policy Highlights: - Upon implementation, the policy set out to achieve

1. Community-focused activities with private sector and NGOs providing coordinated inputs.
2. Increasing user demand in rural areas and introducing cost-sharing mechanisms for water supply technologies installed.
3. Making user communities responsible for operations and maintenance of water supply facilities (in terms of total responsibilities and total costs)
4. Increased women participation in decision making during planning, operations and maintenance
5. Sharing of experience regarding technology packages: especially by DPHE, NGOs and CBO
6. Increased focus on under-served areas.
7. Increased campaigns for awareness and social mobilization through training in villages.

4.2.2 National Policy for Arsenic Mitigation (NPAM 2004)

After the scale of arsenic poisoning was realized and its elimination became a priority for the country, the National Policy for Arsenic Mitigation was formulated in 2004 as a guideline to mitigate the effects of arsenic on people and environment. This policy was the first step towards discussing the issue of arsenic mitigation

at central level and setting rules for it' mitigation. The policy aimed to steer the debate for governance in arsenic affected areas while still building upon the NPSWSS 1998 to fulfil its goals of public health and poverty alleviation(*National Policy for Arsenic Mitigation 2004*, 2004).

Objective of the Policy: - The policy set out with the objective of ensuring access to safe water for drinking and cooking to all through the implementation of alternative water supply options in all arsenic affected areas of the country. It also discussed effective management of patients of arsenicosis and other such arsenic-related diseases(*National Policy for Arsenic Mitigation 2004*, 2004).

Key Policy Highlights: - Upon implementation, in regard to the rural water supply sector, the policy set out to achieve:

1. Identify affected areas, the nature of the problem and the extent of the problem countrywide.
2. Screen and monitor all already existing sources of water in rural areas, mainly tubewells and demarcating safe ones from unsafe ones. This was done to prevent further health damage to the population and to identify priority problem areas.
3. Awareness in all directions: about the impact of arsenic on health, about the availability of arsenic-free water sources, about remedial measures for arsenic poisoning and about its non-contagious nature.
4. Increased use of surface water over groundwater as a source of water supply.
5. Ensured on an emergency basis, safe source of drinking water at a reasonable distance.
6. Asses the needs for water supply intervention based on the status of the contaminated village.
7. Increased use of piped water systems wherever feasible for cooking and drinking purposes – a minimum of 8 litres/capita/day.
8. Increased local capacity and community capacity for installation, operation and maintenance of water supply options including monitoring, information management and reporting.
9. Regulated use of groundwater activities of exploration, exploitation and management.
10. Centralized management of knowledge and information about research and technology, with ready accessibility.

The policy laid down specific institutional arrangements for effective coordination of activities to respond as promptly as possible to the problem, and to address the shortcomings of the previous policy. The institutional arrangements laid out where as follows:

1. High-Level Committee to oversee activities, implementation programmes in accordance to the policy.
2. National level expert committee to provide advice and support in the field of arsenic mitigation.
3. National level government agencies to coordinate activities in their mandated field
4. Local Government Institutions (LGIs) to plan locally and deliver safe water options, while technical support from relevant government agencies. LGIs to be involved in mobilizing resources, monitoring and information management such as registration and monitoring tubewells in an area.

4.2.3 Implementation Plan for Arsenic Mitigation for Water Supply (IPAM WS 2004)

The Arsenic Mitigation Implementation Plan was an extension of the NPAM 2004, to provide an implementation guideline on how to go about initiated policies. The main reason for recognizing the need for an implementation plan and formulating a guideline was to explain the "How" aspects of NPAM 2004.

Plan Objective: - The IPAM emphasized that arsenic contamination of groundwater water as much as a water supply issue as it was a health and environmental issue. Hence, the plan aimed to bring together multi-sectoral stakeholders from water supply, health and agriculture sectors and provide an overall framework for the working of the relevant ministries and agencies. The overall coordination of activities was the

responsibility of a national level committee for Arsenic(*Implementation Plan for Arsenic Mitigation in Bangladesh*, 2004).

Key Plan Highlights: - In regard to the rural water supply sector the IPAM mentioned the short-term and long-term goals of the sector and assigned roles and responsibilities to relevant important local level stakeholders. It discussed the following: -

1. The screening and monitoring activities were mainly focused on deep tubewells and sub-district laboratories were made in charge of handling the water quality testing activities of tubewells in the sub-district.
2. Various alternative technology options were taken into consideration and piped water systems was said to be the long-term goal of the plan. Surface water based small scaled piped water systems were the focus in the rural parts of the country.
3. The criteria for village selection was defined by the number of tubewells contaminated in that village. If more than 80% of the tubewells in the village were contaminated, it was an area that required emergency response.
4. It specified that operations and maintenance was the responsibility of the community and they were expected to bear the costs of O&M.
5. It gave the responsibility of the handling public water sources and maintaining them properly to the women members of the *Union Parishad*.
6. Site selection was the responsibility of the *Union Parishad*, with overall supervision from women members of the *Union Parishad* and respective Arsenic Mitigation Committees.
7. It focused on the need to move from individual to community-based water supply systems, with the LGIs, DPHE and private sector playing a major part in helping the government with this transition.

4.2.4 7th Sector Development Plan (SDP 2011-2025)

The 7th Sector Development Plan SDP 2011-2025 was issued to provide a framework for planning, implementing, coordinating and monitoring all activities in the Water and Sanitation sector. As a strategic planning document, it addressed the current and future challenges of the WSS sector. Of the SDP, Rural Water Supply is an important part. It provides a planning guideline for the rural water supply areas to follow for the coming years(*Bangladesh Government Sector Development Plan (2011-2025)*, 2011).

Plan Objective: -

The SDP aimed to make all WSS related national and sectoral policies and strategies and international commitments aligned with the SDP by carefully accessing all the policies, strategies and existing legal instruments and streamline them to address the same problem areas. With respect to rural water supply coverage, it aimed at addressing how to increase rural water supply coverage. The plan did not set out to establish any new policies or implementation procedures but rather consolidate all the data from the different thematic sectors of WSS-Arsenic Mitigation from groundwater being one of them.

Key Plan Highlights: -

Two important things that the SDP highlighted were: -

1. The increased use of surface water sources in arsenic affected areas. It emphasized that when two or more arsenic mitigation technologies appeared technically feasible, the surface water-based technology should be chosen due to its: - (i) chemical and biological safety of the water; (ii) cost; (iii) social acceptability; and (iv) temporal reliability of the water source;
2. It also mentioned that rural piped water systems had achieved a mixed success. While most of the systems were using arsenic-free groundwater, a few systems were using surface water as well.
3. The plan also mentioned the need for an improved Implementation Plan under the NPAM 2004 that focused on increased coordination mechanisms, and increased support to LGIs as and when required.

4.2.5 National Policy for Safe Water Supply & Sanitation (NPSWSS 2014)

The NPSWSS has been formulated to revise the NPSWSS 1998, considering that changes that have taken place in the last 16 years in the WSS sector. When the 1998 policy was formulated, the issue of arsenic was just on the brim of being recognized, the large number of NGOs, private sectors and international donor interest in the sector was not part of the picture. Hence, this policy aimed to take into account all the major changes of the last 15 years and provide a uniform strategic guideline to the sector stakeholders, including the government institutions, private sector and NGOs, for achieving the sector goal(*National Strategy for Water Supply and Sanitation 2014*, 2014).

Policy Objective: - In the rural water supply sector, the policy aimed to prioritize arsenic mitigation in rural areas of the country and undertake specific approaches for hard to reach areas and vulnerable people of the country. To achieve success in rural areas it emphasized the importance of private-sector participation and gender mainstreaming in policy decisions.

Key Policy Highlights: - Upon implementation, regarding rural water supply sector, the policy set out to achieve:

1. Increased use of surface water-based systems when other types of arsenic mitigation technologies appeared to be equally technically feasible.
2. Increased use of piped water supply systems in arsenic affected rural areas.
3. Increased private sector intervention in rural water supply and sanitation.
4. The policy recognized the need for coordinated activities in the country regarding WSS sector and emphasized sector coordination amongst government agencies, NGOs and private sector at different levels, from national to the union.
5. It also decided to implement the learning approach of "what works where" with attention to adopting different approaches considering the local infrastructure, cultural values and socioeconomic status of communities. The focus lied on hard to reach areas where safe water options were limited.
6. It aimed to increase gender mainstreaming encourage participation of women in planning, implementing and operation and maintenance of WASH services and increasing women representation in the CBOs and WATSAN Committees.
7. Provide support to the private sector by building their capacities technically, financially and marketing support. It established the need for linking the private sector with appropriate financial institutions who are dealing with small businesses.
8. This policy was the first policy to formally realise the need to subsidize capital costs for vulnerable people, in hard to reach areas, arsenic affected areas and in locations where the cost of technologies are high and unaffordable for the common people.

4.3 Stakeholder Groups

The WASH sector of Bangladesh has attracted the attention of a diverse group of stakeholders including international organisations. Various scientific and humanitarian organisations worldwide have carried out activities at different scales. Multiple stakeholder groups are involved in the sector. Much of their activities are discrete, disjointed and rather uncoordinated but each of them played an important role. The SDP 2011-2015 attempted to consolidate these multiple actors into key stakeholder groups that have continuously contributed to the water supply sector(*Bangladesh Government Sector Development Plan (2011-2025)*, 2011). These stakeholder groups are: -

1. **Government and Semi-Government Organisations**: Main stakeholder involved in planning, regulating, implementing and monitoring the development works.

2. **Development Partners**: The DPs make significant contributions to the sector through technical and financial assistance. They can choose to assist government agencies or directly support NGOs.

3. **Non-Governmental Organisations (NGOs):** NGOs have been working to increase participation of the local people at the grassroots level in different areas. Both, international and national NGOs are involved, carrying out activities in coordination with *Union Parishads*.

4. **Community-Based Organisations (CBOs)**: The CBOs, in the rural areas, operate and maintain handpumps, tubewells or other water points through their elected committees and groups.

5. **Private Sector and Individuals**: Many private sector entities like private contractors, suppliers, manufacturers, hardware shops, and consultants are involved directly or indirectly in the WSS sector development.

6. **Others**: Other organisations like the academic and research institutions, civil society, media, construction and consulting companies, sector professionals and individuals are directly and indirectly involved in the research and development of the sector.

4.4 Stakeholder Analysis

The stakeholder involvement in both rural drinking water sector and the arsenic mitigation sector of Bangladesh is very complex. The stakeholder analysis is done with careful literature study and with consultation with Dr. Bilqis. Multiple agencies at different tiers of government interact to make safe water available to the rural population. These stakeholders can be fitted into three different categories:

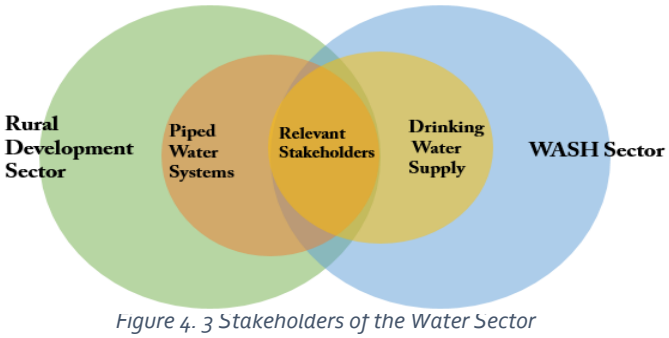


Figure 4. 3 Stakeholders of the Water Sector

1. Stakeholder of the Arsenic Mitigation Sector – Providing safe drinking water
2. Stakeholder of the Rural Water Supply – Providing rural water supply
3. Stakeholder of the Piped Water Supply – Building rural infrastructure

The stakeholders of the WASH Sector interact with stakeholders of the Rural Development Sector to provide safe drinking water in rural areas of Bangladesh. Of these stakeholders, while some deal with arsenic-safe water options others deal with piped water systems. The stakeholders chosen for analysis are the relevant ones identified from each sector that play a key role in the development of piped water systems in arsenic affected rural areas. Representatives from each group of stakeholders are chosen to be interviewed for the data collection process. The choice of stakeholders considered for interviews is decided based on priority of their role, and limited for the purpose of scoping. They are: -

1. **Central Department of Public Health Engineering (DPHE) (Dhaka)** – The Central DPHE is the governmental organisation responsible for implementation of WASH projects in the rural and urban areas excluding areas where WASA operates. In urban areas, except Dhaka and Chittagong, the DPHE functions jointly with the *Paurasabhas* (City Corporations). It oversees technical planning and designing of projects. To implement these projects, it collaborates with the private sector, NGOs and CBOs.

2. **Local Department of Public Health Engineering (DPHE)**- The Local (District Level) DPHE coordinates the activities of the central DPHE with the *Union Parishads*, NGOs and other stakeholders. The Local DPHE plays the role of a communicator between the *Upazila Parishads* and *Union Parishads* in the district and the central DPHE, communicating the issues related to the WASH sector to the central department. It is in-charge of mobilizing resources, monitoring and information management

amongst Unions; more specifically registration and monitoring of drinking and cooking water quality of their region.

3. **The *Union Parishad* (Council)** – The *Union Parishad* is the lowest level of a governmental organisation functioning at the village level. They are in charge of implementing water and sanitation projects in coordination with the NGOs, overseeing the screening process, selecting sites for construction of WSS projects and addressing the problems of local communities related not only to the WSS sector but other issues as well.
4. **The WATSAN committees**- The Water Supply and Sanitation (WATSAN) Committees are formed at the village level, ward level, union level and the *Upazila* level to coordinate the activities of water and sanitation, build awareness about the issues of WATSAN, organise training for capacity building and encourage people to participate in participatory activities. They facilitate groundwork for the central department. They are mandated to have some women representation to attract more people to understand the problems related to WSS. The head of each lower level WATSAN committee gets a seat in the committee at a level higher.
5. **International Developmental Partners** – These organisations are international organisations, for example, World Bank, UNICEF, JICA, DANIDA etc. who support the water sectors by providing consultancy in the form of assisting in decision making, sharing knowledge from other countries, technical advisory and financial assistance to build projects. The support for these development partners is very important to carry out these projects at a large scale.
6. **Local Entrepreneur/Contractor (Private Sector)** – The private companies act as contractors, builders, manufacturers who help to build the infrastructure required for the water supply systems. They usually acquire the projects via a tendering process from the government and are licensed by the government to handle the technicalities of a project. The government accesses their capabilities before the projects are handed out to them.
7. **International NGOs** – International NGOs such as Water Aid, Practical Action, etc. have the freedom to conduct awareness campaigns, grassroots level activities to build awareness and capacity amongst the rural communities in collaboration with local NGOs. They carry out assessment studies and publish feasibility reports on their projects. They are also involved in constructing their own water systems sometimes by collaborating with the local governmental authorities.
8. **Local NGOs** – Local NGOs actively perform a number of successful community-based workshops and meetings to raise awareness about water quality issues and issues of water scarcity. Their main aim is to be able to make the communities capable of handling these water and sanitation systems on their own without the assistance of any higher authority. They also involve communities in site selection processes to allow them to participate in decision making. They can operate independently or in collaboration with international NGOs.
9. **Local communities (Rural Communities)/End Users** – They are the main stakeholders who are on the receiving end of the system. They are the resource users who are being affected by the arsenic crisis.

II

FIELD SCENARIO

5

Data: Who, What and How?

Data collection in an essential part of any research. The data collection process was carried out in Bangladesh in collaboration with EPRC. The field visit brought new information to add to the literature review. The piped water scheme plan-implementation process was known in detail. Section 5.1 discusses the stakeholder organisations that were interviewed and their role in the plan-implementation process. After stakeholder interviews were done, an actor analysis is done and the Power-Interest grid is formulated. Section 5.2 shows the PI grid and Section 5.3 shows the formal network map showing the interactions various actors have with each other. Section 5.4 discusses the process of implementation in detail and Section 5.5 concludes with the problem at hand.

5.1 Stakeholder Interviews

Phase 2 of this research involves the data collection process. Key stakeholders involved in the rural water supply sector, each representing a group of stakeholders were interviewed. Most interview sessions conducted were open interviews with a pre-define guideline of the type of questions prepared. A representative from each stakeholder group, involved in dealing with rural water supply and arsenic mitigation, both fields, was interviewed. The details of the interviews conducted, and the questionnaire can be found in Appendix A of this document. Table 5.1 below lists the organisations interviewed, the type of stakeholder and the role of each organisation. As explained above, a sample size of representative organisations was chosen from a large number of stakeholders, with knowledge and guidance from the field expert – Dr. Bilqis Amin Hoque, who are the local partners of the research and extensively involved in carrying out multiple researches in the rural WASH sector. Field interviews were carried out in sub-district *Manikganj Sadar* in the district of *Manikganj*.

Stakeholder Type	Representative Organisation	Role of Organisation (in regard to rural drinking water supply)
Governmental Organisation	Central Department of Public Health Engineering(DPHE) Dhaka – Head Office	Ministry in-charge of water supply and sanitation sector (WASH) throughout the country excluding the areas where WASA operates.
Governmental Organisation	Policy Support Branch (PSB)	Policy and Plan formation and issuing branch for ministries under the Local Government Division(LGD).
Governmental Organisation	Local Department of Public Health Engineering(DPHE) District Office *District: Manikganj*	Representative Branch of DPHE at District/Sub-District Level handing implementation coordination of WASH facilities
Governmental Organisation	*Union Parishad* Office Union*: Betila-Mitra* Sub-district: *Manikganj Sadar*	Responsible for coordination WASH sector activities at the union level.
Local Community/End Users	Village*: Barai Vikora & South Mitra*	End-users of the technology with high interest but very low power who are directly or indirectly affected by arsenic water consumption.
International Developmental Partners	UNICEF	UNICEF is one of the first of Bangladesh's international development partner and actively involved in the arsenic mitigation issue since it was found in groundwater. It acts as DPHE's operational advisor in issues of water contamination, providing both financial and operational support.

International Developmental Partners	World Bank	DPHE's main financial partners and advisor in maintaining financial sustainability of rural infrastructure projects. They mobilize financial resources for building rural water supply infrastructure, set up financial models for execution and overlook project sustainability.
International Donor Organisation	Embassy of the Netherlands in Dhaka	Represents a donor organisation, partnering with UNICEF and other international organisations to provide financial support to water projects in Bangladesh.
International Developmental Partners	Asian Development Bank(ADB)	Represents Bangladesh's development partner in areas of energy, water resource management and infrastructure management.
Entrepreneur/Contractor	SIDKO	Only government approved technology company responsible for setting up community-based treatment plants in arsenic affected areas.
International NGO	MAX Foundation	An international NGO actively working in the rural water supply field, implementing water supply projects in collaboration with DPHE and other stakeholders.
International NGO	Practical Action	International NGO involved in the rural WASH sector development of the country, working at the grassroots level to build community initiative.
Private Organisation (Funded by International Donors)	HYSAWA	Government-initiated non-profit financing organisation set up to mobilize resources for supporting capacity development of local governments and communities to empower them to manage decentralized WASH systems. It works directly with the *Union Parishads* (Village Governments) without interacting with any central-level third parties.
International Developmental Partners	JICA	Assistant partner to DPHE helping to improve management capacity. It acts as a technical consultant, participating in all central level meetings held by DPHE focusing on developing the technical guidelines for water supply projects, helping to prepare sector development plans, improving the technical capability of DPHE and selecting feasible technical options.
Local Developmental Partners/Research Institute	Environmental and Population Research Centre (EPRC)	EPRC is a multi-disciplinary research, education, training and networking non-government and non-profit organisation with a vision to develop Bangladesh's rural WASH sector. This research has been carried out in collaboration with EPRC.

Table 5. 1 Stakeholder Interview Table

For details of stakeholders interviewed and their roles please refer to Appendix A.

5.2 Power-Interest Grid

Based on their interest in the piped water issue and the power they are assumed to have (as per the law) to take actions, a Power – Interest Grid is mapped out. The Power-Interest grid shown in Figure 5.2, allows to understand where each of these stakeholder groups stands (in terms of their resources and ability) in the context of the country's rural drinking water sector.

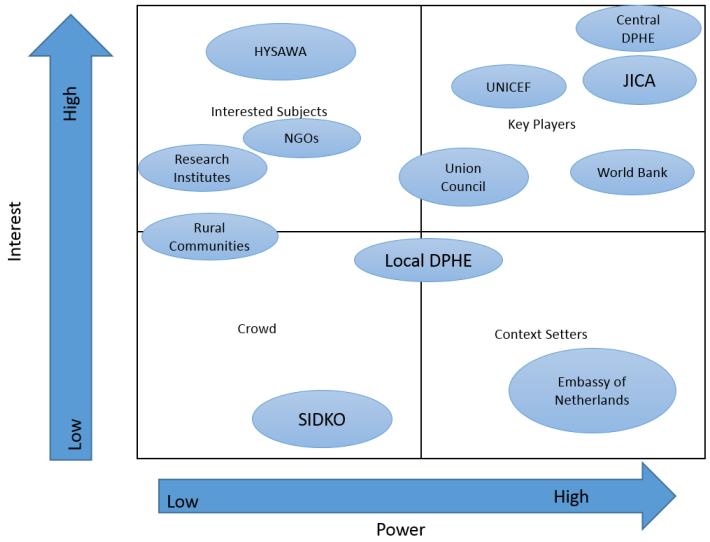


Figure 5. 1 Power-Interest Grid

The P-I grid indicates that rural communities, the most affected actors, have a medium interest in the problem but least power, while the Central DPHE is the organisation having high interest and high power in the problem. The key players of the game are Central DPHE, JICA, World Bank and the Union Council. The rest of the actors mostly organise themselves as interested subjects, context setters or crowd.

5.3 Formal Network

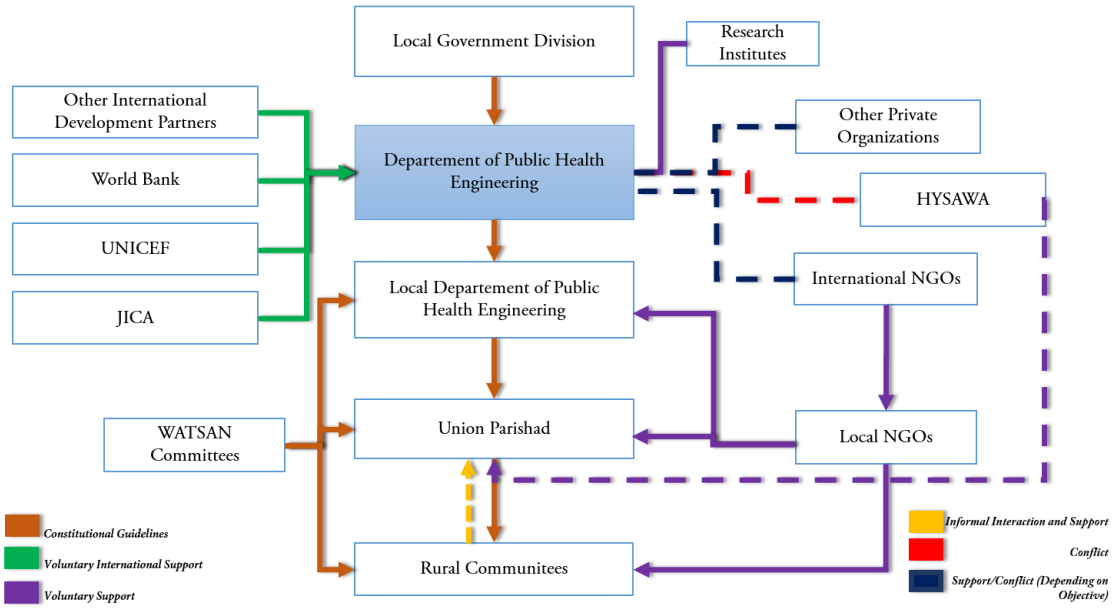


Figure 5. 2 Formal Network Map

A formal mapping of the actor functions, characteristics, resources and strategic objectives (refer to Appendix B) helps to draw to a basic network of how these actors interact to achieve the common goal of supplying arsenic-free water to rural communities.

This formal network map shows the connections that bind these actors together. While governmental organisations are bound by constitutional guidelines, most donor organisations choose to provide voluntary donor support, as per their organisation's mandate. The NGOs, local and international offer voluntary help to the government or choose to carry out activities independently depending on their abilities and resources. NGOs and other private organisations such as HYSAWA may also be in conflict with the DPHE, if they are carrying out activities in parallel to the DPHE without interacting with them. The conflict situation will be described in detail in the next section of this chapter.

5.4 Process of Implementation

5.4.1 Plan Implementation Process of a Village Piped Water Supply Scheme

Based on the data gathered from the interviews, a clear picture of the process of implementation of a rural piped water scheme is known. The plan implementation process of the installation of a rural piped water supply scheme is described below. Figure 5.3 below gives a brief overview of the complete process. This explanation is based on perception and verified by Dr. Bilqis, the local expert.

DPHE Model of Implementation

After the discovery of arsenic in 1993, DPHE-UNICEF carried out a nationwide survey to identify areas across the country which were arsenic affected. All existing tube-wells were tested and the ones' contaminated with arsenic were marked red to help the villagers identify and differentiate them from the safe water sources. The data gathered from this survey is available online and the details of each of the villages where arsenic is present and it's quality can be easily accessible to all via the online database.

Based on this data available from the UNICEF database, the international or national NGOs target a village and the arsenic screening and analysis of the village is done. A technical feasibility review is carried out based on the geographical areas to know which alternative source water supply technology will be most suitable for that village. If a piped water supply scheme is appropriate for that region, geographically, then a feasibility study is done by the NGO testing three most important factors:

1. Willingness of the community to pay for piped water
2. Availability of land
3. Number of people benefitting from the technology

These factors are considered to determine the sustainability of the project once the construction has happened and to test the demand for such a system. If these factors are positive, then the village WATSAN committee chairman raises a demand for a piped water supply scheme to the UP chairman. The UP Chairman applies to the local *Upazila* DPHE office. The local DPHE communicates with the Central DPHE for the demand for a water supply system. Accordingly, the technical review team of the DPHE with the team of engineers review the site and assess which would be the best suited technology for that region. Once the appropriate technology is selected, multiple participatory tools are used by the NGO and with the help of the UP Chairman, a site is selected for the installation of the piped water system.

A majority of the funding for construction and installation of the water supply scheme comes from donor organisations, For DPHE it is mostly UNICEF and World Bank. As per the NPAM 2004, the operations and maintenance costs of the system are the responsibility of the consumers. This is so, to encourage communities to be actively involved in the process of water related to them and participate in decision making.

These O&M costs are paid by them as monthly tariffs which are deposited in a bank account and used for maintaining the system, treating the water on time and paying for the system caretaker. The DPHE tests the initial enthusiasm and willingness to pay the monthly tariffs for the piped water supply by asking the UP to show a certain amount of money deposited in the account by the community members (usually, about 10,000 BDT). Once the money is in the account, the construction is approved.

The contract for constructing and installing the piped water supply scheme can be outsourced to a private sector company by the DPHE or according to a recently introduced scheme, a local entrepreneur from the village with required skills can also be involved (depending on the situation). The construction design, methodology and the technical specifications are provided by the DPHE. Although, they are not involved in the construction process, the technology type and the treatment kind used by the third-party contractor is verified thoroughly by DPHE engineers. The engineers at the district DPHE closely supervise the project and make sure that there are no technical issues in the system. After the system has been constructed, the central DPHE carries out a quality assessment check to make sure the system meets the performance standards set by the government.

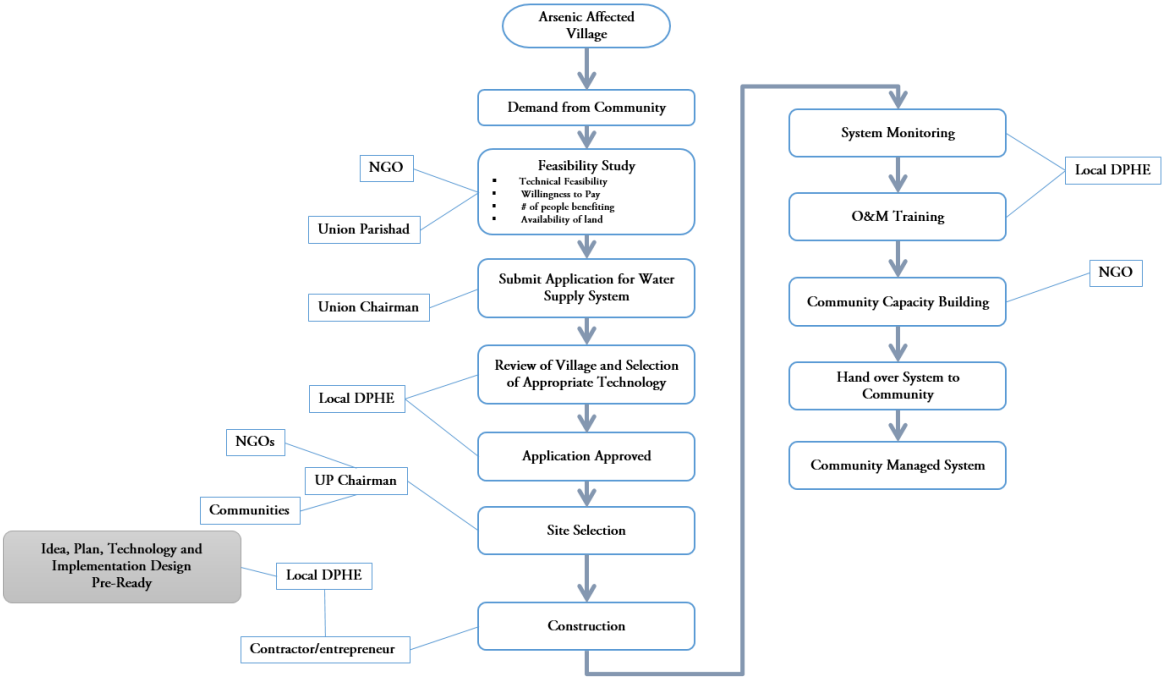


Figure 5. 3 Plan Implementation Process of a Rural Piped Water Scheme

Recently, the World Bank in collaboration with DPHE introduced a new model wherein, the World Bank contributes 70% of the funding while a local entrepreneur contributes 30% of the funding. He is selected from the local community itself by the local DPHE office via a bidding process and he constructs and installs the system. Based on his technical capabilities the project is given to him. He invests in the project and is wholly responsible for the O&M costs of the system, with the intention of receiving his investment in the form of monthly revenues within a span of 12-18 years. After the contract ends and the initial investment is recovered, then he also handover the system to the community itself. The advantage of this system is that, it not only builds trust in the minds of the villagers as the contract is from the village itself but also relieves the pressure of O&M from them.

Since, the operations and maintenance of the system is the responsibility of the consumers (in this case the rural community members), an O&M training and Water Safety Planning training is provided to the community members of the village by the DPHE engineers. Usually, a member of the village is selected by the village head who is reliable, trustable and volunteers to take up the job. He is responsible for taking care

of the switching-on/off timings and treating the water regularly as required. He can also handle basis repairs and fixes but when there is a major breakdown in the system, he reports to the *Union Parishad* about it. Any major technical breakdowns are fixed using the monthly tariff that is deposited in the account by the community members regularly.

After all performance criteria are met and trainings provided the system is handed over to the community and a monitored and evaluated on a yearly basis by the DPHE. Awareness raising, capacity building and encouraging more village members to raise demand; these activities are later carried out on a regular basis by the local NGOs.

Other Models of Implementation

The DPHE model of village piped water scheme implementation is the most common one but there are many other implementation models which are running parallel to that of the DPHE model. Although the DPHE is mandated to deal with rural drinking water supply in the country, there are other organisations both private and governmental, who can also participate in the rural drinking water supply sector voluntarily. The NPSWSS 1998 mentions that "*Local government bodies in village, union and thana level shall have a direct role in planning, implementation and maintenance of rural water supply and the activities of public and private sector agencies will be coordinated accordingly*". Following this policy, many organisations have the freedom to deal directly with the *Union Parishad* without having to dealing the DPHE. Hence, multiple models are running in parallel to each other.

Rural Development Academy Model[1]

As mentioned above, even though DPHE is the official organisation dealing with rural piped water supply schemes, other governmental organisations can also choose to participate in rural piped water activities if they have the capacity to manage them. They play the role that DPHE would play in such scenarios. The Rural Development Academy is one of them. The Rural Development Academy is a specialized rural development institution situated in Bogra District in the north-west zone of the country. It is an autonomous body officiated with the Rural Development and Co-operatives Division of the Ministry of Local Government, Rural Development & Co-operatives (LGRDC) to deal with the challenges of that zone. Many NGOs in that region, including the Max Foundation work with them when dealing with the north-west zone of the country. RDA is responsible for providing technical support mainly for design, construction and operation of rural multi-purpose piped water schemes being implemented under the project. It basically takes the role of DPHE in Bogra district and implements a slightly different model which runs parallel to that of the DPHE model of implementation. The RDA deals directly with the *Union Parishad* and does not interact with the DPHE.

Private Organisations Model

HYSAWA[2]is a local non-profit private financing organisation (private organisation) that aims at mobilizing resources for and supporting capacity development of local governments and communities to self-manage water and sanitation facilities. Many private organisations like HYSAWA who are directly supported by

[1] **The Rural Development Academy** was chosen as an example of a governmental organisation apart from the DPHE who also works in rural piped water supply systems. There may be other governmental organisations under the Ministry of Local Government, Rural Development and Co-operatives working with rural piped water systems but all of them are not considered in the scope of this research. RDA is an important partner organisation of Max Foundation, an international NGO working with rural piped water systems which was interviewed during the data collection process and hence is chosen.

[2] **HYSAWA** is one of the many other private organisations that is also practicing a similar model. HYSAWA is chosen because it was interviewed during the data collection process.

German/Dutch and Danish embassies and get favourable international support from European and American organisations run their own implementation models which deals directly with the *Union Parishad* and doesn't deal with any other governmental organisation like the DPHE. In this model, the *Union Parishad* chairman directly interacts with the private organisation and schemes are developed independent of the higher authorities of government.

Similar to these models, there are many other models that run absolutely independent of each other dealing directly with communities at grass-root level and these models do not interact with each other to share knowledge or discuss.

5.4.2 Identification of Community and it's Need

In order to reach out to a village, based on the data available from the DPHE baselines surveys, the area is investigated for arsenic contamination. An arsenic screening of the villages in those areas is carried out to see which areas are arsenic prone. The high arsenic prone areas where more than 80% of the tube-wells are contaminated with arsenic fall under the category of emergency response area. The village is selected based on its listing in the arsenic response priority zone, the social and demographic attributes of the community, the types of alternate water source available and the distance of water access for the communities. The community cluster is identified based on the secondary data of households available from the *Union Parishad*. These community clusters are demarcated based on road partitions, rivers, canals, wetlands as well as cultural boundaries. Once the village area is fixed, then certain village committee elders, influential social and religious leaders are selected to help with organizing workshops for awareness building. The date and location of the workshops are fixed based on the convenience of all. The *Union Parishad* members are also invited to participate in these events. These workshops are done to first discuss the problems they face in their daily lives which affects their accessibility to safe water and the type of water options that are available to them. Situation analysis is done to understand community attributes and their perception towards piped water. It is important to know whether the community will accept a technology or not.

Then the facilitators organise activities to create awareness about arsenic in their water and methods they should adopt to avoid being at risk. Once the community is willing to pay for the piped water and a considerable number of people are benefitting from a particular project, community perception mapping is done to identify the economic status of the households, the location of tube-wells and other sources. An appropriate site is chosen which is convenient for all. When they agree on the location and the demand is raised on paper, which the UP chairman requests to the Local DPHE office for a piped water system. Post construction courtyard meetings are carried out with a lesser numbered focus group to motivate them take responsibility of the system's operations and maintenance. Trainings are given to the community members for O&M and monthly motivational activities are continued to attract more people towards using it and to keep the people motivated enough to continue paying tariffs regularly.

5.5 Problem at Hand

Despite such a complex and nationally governed implementation process in place for the promotion and development of rural piped water supply schemes, these systems have not performed up to expectations. Single-use piped water systems have not been able to be well adopted and sustained by the communities. The Sector Development Plan (2011-2025) highlighted that "*A review conducted of 120 schemes showed that about half of those schemes were not functioning because of poor O&M and inadequate institutional settings.*(*Bangladesh Government Sector Development Plan (2011-2025)*, 2011)" A JICA report, of a nation-wide evaluation of 120 Village Piped Water Supply Schemes claimed that out of 120 schemes, 35 systems were not functional from the beginning and 12 systems became functional non-functional after the installation in different time durations. 73 of those schemes were partially or completely functional and the rest were abandoned(JICA, 2008). Sometimes, the implementation site is not appropriately selected, or the

communities are not able to sustain them well due to various socio-economic factors. These scheme that are built with huge investments made and consuming national and international resources eventually do not achieve the required amount of success and popularity that they should. The next chapter examines why these institutional challenges, what are the main challenges faced in installing these systems how can they be tackled.

6

Observations: Good and Bad

The field visit allowed to observe the on-ground situation, compare it to the expectations set in the policy documents and understand strengths and weaknesses of the process of implementation. This chapter describes the observations made that helped to lead way to institutional analysis. Section 6.1 shows the differences in field reality and policy objectives. A thorough policy analysis is done to identify policy strengths and weaknesses. Section 6.2 describes the strengths and weaknesses of the plan-implementation process based on observations made. Following up, Section 6.3 reasons why an institutional analysis is needed and Section 6.4 emphasizes why institutional reform is required to improve current situation.

6.1 Policy Analysis (Policy Objective Vs Field Reality)

To assess how successful the current implementation process of PWSs has been and to discuss the strengths and challenges, at first, the gap between the policy objective and reality must be studied. The outcomes of government regulations have to be analysed to understand the reasons for current situation. The two key questions answered in this section are: -

1. *How do observed outcomes compare to what is expected as per policy?*
2. *Which outcomes are satisfactory? Which are not?*

Findings from the stakeholder interviews, field observations and relevant stakeholder statements, help to answer these questions. It is important to discuss again the policies reviewed in section 4.2 to study their outcomes in reality. A discussion of these policies below highlights the gap between the current "as-is" situation and the expected policy outcome. The actual policy outcomes discussed are based on observations from the field and stakeholder statements. These policy gaps help to identify the strengths and weakness discussed in the next section.

6.1.1 National Policy for Safe Water Supply & Sanitation (NPSWSS 1998)

This policy was formed in the pre-1998-time period. The issue of arsenic just come into light and was more on the scientific analysis and geographical mapping phase. Hence, the arsenic mitigation was not the focus of this policy. However, regarding rural water supply, the policy mainly aimed to give local government bodies in the villages, unions and sub-district level a direct role in the planning, implementation and maintenance of rural water supply systems. Although the policy did focus on decentralized planning with a focus on communities, it did not set clear rules or definitions of what kind of roles will be assigned to which actor. For example, it did mention the increasing role of women in decision making but it did not define which roles at which position would bring the most benefit to the sector. Overall this policy set a benchmark in the direction of decentralization of WASH sector activities to local governments and the need for covering more number of rural people with safe drinking water, especially in underserved areas. Other policies followed and addressed the short-comings of this policy(*National Policy for Safe Water Supply & Sanitation 1998*, 1998).

Table 6.1 highlights relevant policy elements that when implemented will contribute to policy objective, the actual outcome of the policy element implemented and finally, the stakeholder statement that supports the actual policy situation.

Expected Policy Outcome	Actual Policy Outcome Situation	Stakeholder Statement
Increased women participation in decision making during planning, operations and maintenance.	Although the policy specifies an increased role of women in decision making, specifically at the Union Council level, in reality, the situation is different. Multiple stakeholders mentioned that oftentimes women do not come to meetings that they are invited for. The number of women who actually decide rules for the local water governance are very limited. This may be due to cultural issues or no incentive to participate.	*"The actual women turnout on ground is very low. Oftentimes, women are discouraged to represent themselves, or they do not enough recognition in the meetings held, discouraging their participation in planning and implementation."*
Sharing of experience regarding technology packages: especially by DPHE, NGOs and CBO	Knowledge sharing of technologies used by the DPHE, NGOs and other organisations has been encouraged by the policy. But, not much initiative has been taken in this regard by the main sector stakeholders.	*"DPHE usually has their set of technical ideas and they can share their knowledge when any organisation is partnering with them. But, we don't partner with DPHE, we do not know which model they are implementing and how."*
Decentralized planning with local governments is to be implementation	Although the policy's focus is on decentralized planning with local governments and local level decision making, in reality, the situation seems quite clearly a top-down planning system with the local governmental partners having little or no capacity: technical and financial, to actually carry out decentralized planning.	*"Institutionally, the local DPHE has the power to carry out decentralized planning, however financially and technically they don't. Hence, actually decentralized planning doesn't really happen in reality"*

Table 6. 1 Observed Policy Outcomes for NPSWSS 1998

It can be seen from the table that, there is a clear gap between what the policy says and what is actually happening in reality.

6.1.2 National Policy for Arsenic Mitigation (NPAM 2004)

This policy set the foundation of most institutional arrangements in regard to handling the rural water supply sectors. The arsenic was discovered in groundwater, the main target of the government was to be able to identify all the priority zones and make sure all individuals, specifically in the villages, have some alternative source of safe drinking water. Hence, most of the resource mobilization was done mainly in creating awareness about arsenic, testing unsafe tubewells, monitoring all sources of water supply and making sure every village has at least one safe water source available. The contaminated tubewells demarcated red colour to make it easier to differentiate with the safe water ones. Although the policy did mention the reduced use of groundwater, increased surface water supply use and promotion of piped water systems in villages, that wasn't the focus of the government at that time. Issues of identification and awareness still needed to be addressed and piped water systems seemed a long-term plan for the government rather an immediate action to carry.

Followed by the policy, the implementation plan (IPAM 2004) was an attempt to clearly define the government's agenda or handling the arsenic mitigation problems. But the focus of the plan was mostly towards the urban water supply. Rural water supply issues were vaguely mentioned and not well thought out. The plan was published mainly for the urban areas and its development. It did promote safe water options in rural areas but, considering the complexity of the situation in rural areas, it emphasized that LGIs and private sector take responsibilities of rural water supply. Thus, the plan did specify, "small scaled piped water systems" use in rural areas as a long-term goal but did not mention how it was planned to be carried out. The gaps between expected policy outcome and real outcomes is highlighted in Table 6.2(*National Policy for Arsenic Mitigation 2004*, 2004).

Expected Policy Outcome	Actual Policy Outcome Situation	Stakeholder Statement
Effectively tackle duplication of activities and conflicting strategies by increasing knowledge sharing amongst actors and effective data management.	Although in the policy document the government has recognized this issue of multiple agencies with conflict interests pursuing separate programmes, it hasn't yet proposed a solution to this growing problem area. To consolidate the tasks of so many organisations and the different kinds of programmes they pursue is a massive task and no resources have been spent in deciding what the best possible solution to solve this issue is.	*"Yes, multiple models are running, there are many sectors working together on it and not all interact and discuss. Knowledge sharing "does not exist."*
Increased use of surface water over groundwater as a source of water supply.	While the policy does emphasize the use of surface water over groundwater, there are more disadvantages to it technical, financially and institutionally than advantages. Surface water in most areas is highly contaminated and unfit to be directly used. It needs to be treated with heavy chemicals and requires various expensive technologies, making it an expensive commodity for the common people. In reality, using surface water is not feasible in most cases.	*"Using surface water has many other challenges to it that need to overcome. It is not as simple as specified in the policy."*
Regulated use of groundwater activities of exploration, exploitation and management.	There is no such policy or regulation as of now to control groundwater activities in rural areas, thus making tubewells most easily available and popular technology in rural areas.	*"There is no control over the number of tubewells that can be installed in the rural areas."*

Table 6. 2 Observed Policy Outcomes for NPAM 2004

6.1.3 National Policy for Safe Water Supply & Sanitation (NPSWSS 2014)

This policy was formulated after having recognized challenges of the sector from the last 15 years. Thus, it did address most shortcomings of the NPSWSS 1998 and the NPAM 2004. It focused on the increased role of women, giving them more representation in decision making, in the *Union Parishad* and in the WATSAN committees. It also recognized the need for increased focus on piped water systems considering the reducing groundwater tables. However, the policy did not mention some critical aspects such as how it plans to tackle the increased role of the private sector, as that would increase coordination activities for the government as well. According to the policy, the private sector should begin taking the role upfront while the government provides technical support and donors provide financial instruments. But this hype to increase private participation may need to be rethought as privatization of water would mean increased cost for the local people and that could have other socio-economic impacts on the community. Also, gender mainstreaming has been mentioned multiple times in most plans and policies, however, gender mainstreaming is more complicated than it is assumed to be. It is deep-rooted in the cultural attributes of the society and increased women participation may need to be organised differently than how it is currently. Table 6.3 shows that there is a clear gap between key policy elements and reality(*National Strategy for Water Supply and Sanitation 2014*, 2014).

Expected Policy Outcome	Actual Policy Outcome Situation	Stakeholder Statement
The responsibility of the handling public water sources and maintaining them properly is for the women members of the *Union Parishad*. The Site selection is the responsibility of the *Union Parishad*, with overall supervision from women members of the *Union Parishad* and respective Arsenic Mitigation Committees.	Women participation, in reality, is low. Women usually don't select the site, rather the UP chairman mostly –male) does it himself in most cases.	*"The actual women turnout on ground is very low. Oftentimes, women are discouraged to represent themselves, or they do not enough recognition in the meetings held, discouraging their participation in planning and implementation."*
Increase gender mainstreaming encourage participation of women in planning, implementation and sustainability of WASH services	In reality, WATSAN committee is not active.	*"WATSAN committees are mostly inactive. There is no incentive for them to be active."*

Assess the needs for water supply intervention based on the status of contamination at village level	This may not always be the case. Many a times, the water supply intervention is based on what the community demand (rather the economically well-off sections of the community demand) rather than what they need.	*"Sometimes, a technology comes, and we just have to accept it because the donor wants to install that technology only."*

Table 6. 3 Observed Policy Outcomes for NPSWSS 2014

6.2 As-Is Situation

These policy gaps discussed above help to identify strengths and challenges of the "as-is" situation, critical areas that are underperforming and relevant methodologies that would be well-suited to analyse this problem. This leads way into the institutional analysis of this problem. The plan implementation process of rural Infrastructure projects such as piped water systems can be divided into four phases:-

- Design
- Finance
- Construct
- Operate and Maintain(E Ostrom, Schroeder, & Wynne, 1993)

The different stakeholders are involved at each phase to carry out a successful PWS implementation, some actors playing overlapping roles at each phase. The *Design* and *Finance* phases of the implementation process are centrally governed while the *Construct* and *Operate and Maintain* phases are handled by the local governments and the communities.

6.2.1 Strengths

The strengths lie in the *Design* and *Finance* phase of the implementation process.

1. Areas favourable for the installation of a piped water connection are pre-identified. The technology and the treatment process to be used to improve water quality is well identified.
2. The technical design and the scale of the piped water scheme to be installed, based on the number of people it must serve, is well researched.
3. There are continuous efforts being made by research universities to improve the technology and the treatment process and ways to make it cheaper.
4. Donor support is willingly available. Apart from international organisations offering financial support to the central DPHE in all ways, various international NGOs, foreign governments open to the idea of and wanting to invest in PWSs provided end-user satisfaction is guaranteed.
5. Rural infrastructure projects such as these, are highly encouraged by the government. The government is willing to collaborate with various private sector organisations to ensure project financial sustainability in the long run.

6.2.2 Challenges

Most of the challenges identified at field level, were at the *Construct* and *Operate and Maintain* phase of the implementation process.

1. The local government doesn't seem to have the capacity to carry the implementation process single-handed. It is tasked with responsibilities of hiring a contractor or entrepreneur, overlooking the construction process, ensuring technical feasibility of the project, monitoring the project post-implementation, coordinating activities of awareness and capacity building and handling technical failures when any. The local government doesn't have the human resource capacity to handle so many responsibilities.

2. WATSAN committees in different areas are not active. Issues of corruption within local governments which are prevalent. Construction sites are sometimes selected with some bias.
3. Communities are unable to take the responsibility of handling the O&M, in many cases also afford the O&M costs. The issues of sustainability arise due to inadequate operations and maintenance provided to these systems.
4. An enormous number of tubewells are already present and installing a tubewell is technically and financially seen to be much easier than having a PWS. Most communities are adapted to using the tubewell technology. They see more benefit from tubewells than PWSs. Hence, the switch to piped water connection is hard.
5. At community level, there are issues of willingness to pay, fewer women participation, trust and awareness.

These strengths and challenges will be analysed at each level and discussed in much detail in Phase III of this thesis.

Most of the strengths lie in the design and finance phase while most challenges identified were at the construct, implement and community management phase. This indicates that the process of plan implementation is a clear top-down process where the central government actors are able to execute the design and finance phase fairly well but it is the latter phase that is often neglected. Hence, concluding from these findings is that although these systems are technically feasible and financially (design and finance phase being strengths) able to receive donor support, they haven't been able to prove themselves institutionally (construct, operate and maintain phase being weaknesses).

The current process of implementation, rather than being a participatory process, as claimed, seems to be more of a planned process whereby roles are assigned to organisations by the central policy-making bodies based on their assumption of community preferences and do not actually consider their socio-economic conditions, motivations and financial and technical abilities. The plans are rather developed outside the community and participation is equated to communities having to consent to the plans(Nigussie et al., 2018).

While a lot of effort has been taken on the part of the developed countries to assist developing countries like Bangladesh in speeding up the process of economic development, most of these initiatives are based on mental models, which hold that solutions to difficult and complex problems can only be generated by scientifically trained analysts and implemented by impartial, national-level officials. Solutions based on these mental models may have accurately pointed out the problem area but not much improvement has been achieved in sustaining such solutions for long(Polski & Ostrom, 1999). These models often ignore community participation in decision making, their involvement in implementing technical solutions and their abilities(E Ostrom et al., 1993). This is why, despite having a technically feasible and well-designed solution in place, rural communities in Bangladesh are not able to take advantage of it and still not have access to a safely managed water supply source.

Another reason for the underperformance of such infrastructure projects is the blueprint approach(Polski & Ostrom, 1999). It is often seen that policymakers take successful policy models, in the case of WASH projects, many western country approaches are used as a blueprint model and applied broadly(E Ostrom et al., 1993). Although adapting a tried and tested successful approach is tempting, the problem arises when that model may not work in a different political-economic situation.

6.3 Why Institutional Analysis?

The "as-is" situation describes the problem as an institutional challenge. Problem identification is often easier than suggesting solutions for such problems. In this case, understanding the problem to be an institutional challenge could easily evoke an image of institutional redesign as a straightforward task. However, institutions are often hard to change. They are highly abstract and frequently invisible elements of the policy environment(Polski & Ostrom, 1999). Before proposing an institutional change, a detailed institutional analysis of the policy environment is required to bring structure to the problem area. According to Ostrom, institutional analysis can be appropriate in three situations: -

1. When complexity is involved – Multiple actors with multiple perspectives are acting at multiple levels. The activities of the actors at multiple levels overlap.
2. When multiple models are involved - Various mental models and different problem perceptions of the problem create new problem situations
3. When a blueprint approach is used (Polski & Ostrom, 1999)

Institutional challenges of these rural piped water schemes are complexly wrapped in issues of socio-economic feasibilities, low government human resource capacity, corruption, awareness and trust. The problem area discussed qualifies for all reasons why an institutional analysis study of each aspect of the design-finance-construct-operate and maintain phase is needed, to identify critical problem areas. Ostrom proposes the use of frameworks, which when applied to institutional environments make the policy area clear and structured.

The Institutional Analysis and Development (IAD) Framework developed by Ostrom and her colleagues is chosen the for institutional analysis. Ostrom suggests that IAD can be appropriate in two situations: -

1. When analysing a well-established policy situation where an existing policy has not been able to deliver desired outcomes. In this case, a reform of the existing policy or a contemporary new policy is needed.
2. When developing new policy initiatives or comparing alternative policy designs to decide if a new policy will be able to deliver required results(Polski & Ostrom, 1999).

In the situation of Bangladesh's rural piped water supply schemes, it can't be said that it is a policy failure as most policies have only focused on direct and immediate access to safe drinking water to the rural population in the best way possible. The policies have recognised the need of moving towards piped water connections in water stressed areas, by highlighting their importance in different policy elements. But, the main priority has always been accessibility of safe water rather by means of any technology possible. Thus, this policy situation cannot be regarded as a complete policy failure.

However, Section 6.1 has highlighted that there is a gap between expected policy outcomes and actual policy outcomes. Following that Section 6.2 has shown how the process is clear a top-down implementation process. From both these section results, it can be concluded that the established policy objectives have not entirely been met. The policies have received mixed success and have not been able to deliver desired outcomes. Current policy outcomes can be summarised, in one sentence, as

These publicly financed Piped Water Systems are built consuming government and international financial and institutional resources, adding to government budgets and are yet unable to be sustained well by the communities.

This policy outcome fits well into Ostrom's first category *"Analysing a well-established Policy Situation"* and thus carrying out an institutional analysis using Ostrom's the IAD as a diagnostic tool is well suited to analyse this policy situation in detail and suggest policy reforms.

6.4 Why Institutional Reform?

As explained in Section 6.2, the process of implementation is a top-down process where the community is left out of the picture, but the technology is designed for the community. Institutional reform may be desired, when systems need new institutional arrangements, when systems have to be integrated, when systems do not have the right scale, or when actors want to change the rules of the game to their own advantage(Groenewegen & Koppenjan, 2005).

In this case, the plan-implementation process is not participatory in nature. Although, Ostrom suggests that majority of rural infrastructure projects are top-down initiatives and that may be beneficial considering the technical nature of these projects. However, participatory need not necessarily mean completely bottom-up initiatives(Elinor Ostrom & Janssen, 2004). A complete bottom-up approach of handing over water systems to communities without any government interventions can be a risk too. At the same time, complete state-run or complete market-driven models may do more harm than good(Elinor Ostrom, 1990). Policy initiatives that are antagonistic to household-level motivations can reduce implementation effectiveness and render such top-down investments redundant(Smajgl et al., 2015). Participatory can mean top-down approaches which take into account household abilities and motivation when making decisions or policy. In this case, a mixed approach where some actions are state driven while other actions are community driven is required(Elinor Ostrom & Janssen, 2004).

Institutional decentralization within the national strategic framework would be a better model for implementation of these systems. These top-down initiatives have to be redesigned to develop institutions that would alter individual's decisions by developing self-governing institutions while still keeping the overarching the policy framework.

In conclusion,

An institutional reform of current institutions is required to allow community-driven governance in some areas of decision making but remaining within the political-strategic framework developed.

III

INSTITUTIONAL ANALYSIS

7

Conceptual Framework

The conceptual framework allows to lay down the methods applied for the institutional analysis of the problem at hand. The framework helps to understand why and how the methods chosen will be applied. Section 7.1 and 7.2 describe briefly the frameworks used and the reasons for choosing those frameworks for the analysis. Section 7.3 then briefly talks about the theoretical foundations needed to understand its application. Finally, Section 7.4 describes the conceptual framework, and how the combination of both these frameworks is applied to solve the research question.

A combination of two of Ostrom's Frameworks of institutional economics are used to do the institutional analysis.

- Institutional Analysis and Development Framework
- Ostrom's Design Principles

7.1 Institutional Analysis and Development (IAD) Framework

If any policy needs to be evaluated, designed, or reformed, first, a systematic way to analyse existing arrangements and to generate and compare alternatives is needed(Polski & Ostrom, 1999). The Institutional Analysis and Development (IAD framework) was developed by Elinor Ostrom and her colleagues at the Centre for the Study of Institutions, Population and Environmental Change (CIPEC) at the Indiana University(Elinor Ostrom, 2005). The framework is best viewed as a systematic method to enable policy analysts to analyse institutionally-oriented complex policy challenges. It aims to provide a structured approach to generically identified rules and action situations in complex policy arenas by breaking them down into manageable sets of practical activities(Elinor Ostrom, 2005). It doesn't replace other techniques but considering its method of working with multiple participants/actors, analysts have a better chance of avoid oversights and simplifications that lead to policy failures.

7.1.1 Why IAD?

Before deciding on the method to use for institutional analysis, this thesis poses the following questions: -

1. *What has been the objective of the already established policies for arsenic?*
2. *What is happening in reality?*
3. *How do observed policy outcomes compare with the objectives of the policies implemented?*
4. *Have actual policy outcomes matched with their objectives?*
5. *Is there a need for redesigning existing institutions or creating complementary institutions?*

Observations made from chapter 5 and chapter 6 have shown that the institutional challenge organizing and sustaining rural piped water systems in Bangladesh is a complex situation and requires specific analysis of each of the phases of implementation (Design-Finance-Construct-Operate&Maintain). Section 4.2 highlight the policy objectives. Section 5.4 shows that the plan-implementation process is institutionally complexed. Section 6.1 highlights that there is a gap between existing policy outcomes and expected outcomes.

Challenges discussed in Section 6.2 show that policy outcomes have not matched objectives. Section 6.3 shows that the overall outcome of all policies has not have the required satisfactory result and Section 6.4 concludes that an institutional reform for participatory governance is required.

Ostrom suggests the IAD framework is well suited for analysing well-established policy situations where existing policies need to be reformed or new complementary policies have to be created(Polski & Ostrom, 1999). Analysing the outcomes of a policy situation is about analysing the performance of the policy.

Thus, the IAD Framework is chosen to be the best method for this institutional analysis. The concepts of the framework will be described in section 7.3.

7.2 Ostrom's Design Principles

Developing institutions that are long-lasting and self-sustaining is a challenge. Common Pool Resources are often hard to govern and face challenges of complexity, uncertainties and changing environmental conditions(Elinor Ostrom, 1999). Institutional economics defines Common Pool Resources as "*any good or service consisting of a natural or human-made resource whose size or characteristics makes it costly, but not impossible, to exclude potential beneficiaries from obtaining benefits from its use.*(E Ostrom et al., 1993,p. 73)" Successful governance of CPRs require some set of rules or principles. Ostrom has studied multiple long-lasting systems, both successful and unsuccessful, where CPRs are governed. After carefully analysing these systems under complex, uncertain environments, she sets aside 8 design principles that when taken into account during reforming institutions or creating new institutions will help to propose robust policies(Elinor Ostrom, 1999). "*A design principle is defined as a conception used consciously or unconsciously by those constituting and reconstituting a continuing association of individuals about a general organizing principle*"(Elinor Ostrom, 1999,p.1). These 8 design principles characterize most robust user-organised systems. The goal of considering these design principles in any policy situation is to create robust institutional reforms that will sustain through generations in changing governments and fluctuating human behaviour.

7.2.1 Why Design Principles?

By the definition of CPRs, rural infrastructure projects such as piped water systems can be considered as CPRs. Piped water systems are goods of high subtractability, low excludability and difficult to measure(E Ostrom et al., 1993). They are publicly provided goods that yield benefits to many, their consumption cannot be withheld from any individual for humanitarian reasons and individuals have little choice about their consumption. They are difficult to provide, and plan and benefits are hard to measures. Thus, they qualify for being a CPR.

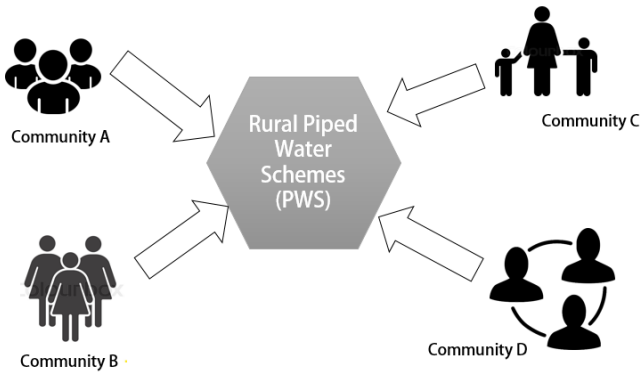


Figure 7. 1 Rural Piped Water Systems as a Common Pool Resource

The main concern with piped water systems is sustainability of these systems. The outcome statement of Section 6.3 suggests that if communities are able to sustain these systems, the policy objectives would be achieved. The responsibility of sustaining these systems is given to the communities. So, the actions of communities directly affect these systems and their lives are dependent on these systems. All actors involved in their governance have their own interests, develop their own rules and practice their own norms. Thus, making a PWS a complexly governed CPR. To ensure policy success is to ensure sustainability of these systems in complex, changing uncertain environments. Although the IAD would provide clear structured outcomes of stakeholder actions, ensuring the robustness of these institutional reforms would be hard. Thus, Ostrom's design principles are chosen to support proposed new institutional reforms such that they are robust enough to allow PWSs to be successfully governed through generations.

7.3 Brief Theoretical Foundations

7.3.1 IAD Framework

Ostrom defines institutions as '*the set of rules actually used (working rules or rules-in-use) by a set of individuals to organise repetitive activities that produce outcomes affecting those individuals and potentially affecting others*(E Ostrom, 1992, p.19)'. These institutions define and limit the set of choices that individuals have. Most humans interact and behave within this framework of institutions. They may constrain some individuals or enable others. Figure 7.2 below depicts a schematic representation of the framework. It conceptualizes a situation focusing the analyst's attention to look at policy processes and outcomes from the lens of four important variables (1) attributes of the physical world (biophysical attributes), (2) attributes of the community within which actors are embedded, (3) rules that create incentives and constraints for certain actions, and (4) the action arena that constitutes the actions that individuals take and lastly (5) interactions with other individuals. Most policy processes can be broken down to fit these variables.

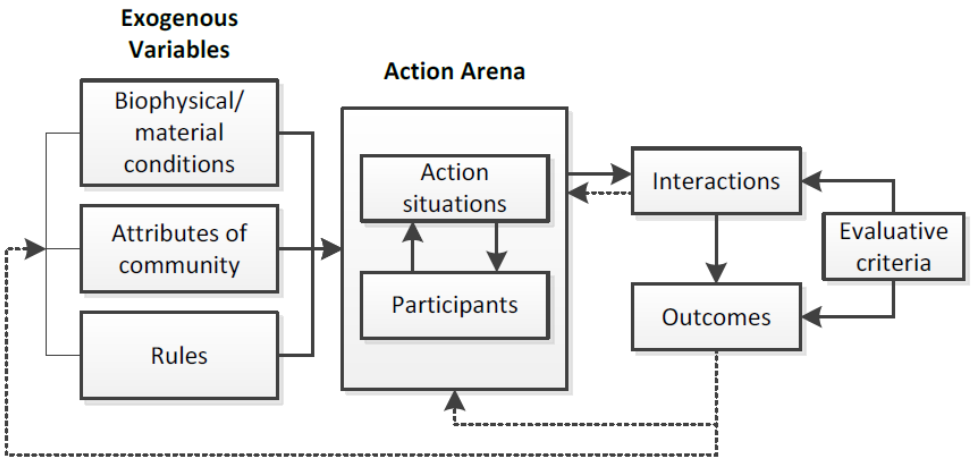


Figure 7. 2 Schematic Diagram of the IAD Framework(McGinnis, 2011)

The Exogenous Variables

Biophysical Conditions: - is the physical world to which the actions are related. For example:- a fishery or a forest.

Attributes of the Community: - The social and demographic attributes of the community involved in the action situation

The Rules in Use: - Rules are nested within different levels of operation. Three vertical levels of rules that cumulatively affect the action situation and the outcomes obtained in any setting are:-

a) Constitutional Choice Rules – The top-tier of rules determining the framework of lower-level rules.
b) Collective Choice Rules – Determine the framework of formal rules that the local community operates in. They are made by officials in order to determine, enforce, continue or alter actions authorised within institutional arrangements.
c) Operational Rules – Affect the day-to-day decision making of individuals. They may or may not be formal rules.

The Action Arena

The action arena includes two elements: action situation and the participants in that situation. An action arena is any place or medium in which interactions between participants occur. The structures of these arenas are affected by some exogenous variables, generating interactions that produce outcomes. Evaluative criteria are used to evaluate the performance of the system by examining the patterns of interactions and the outcomes. The framework recognizes the prospect that the outcomes of interactions feed back into the system and may transform the participants and/or the action situations over time(McGinnis, 2011)(A. Smajgl, A. Leitch, 2009).

The action situation is a state in which two or more individuals are "faced with a set of potential actions that jointly produce outcomes." The structure of the situation can be described and analysed using a set of variables which altogether shape the structure of an action situation, as depicted in Figure 7.3. Those variables given are:-

1. the set of participants;
2. the positions to be filled by participants;
3. the potential outcomes;
4. the set of allowable actions and the function that maps actions into realized outcomes;
5. the control that an individual has in regard to this function;
6. the information available to participants about actions and outcomes and their linkages (to decide if participants interact in the same action situation, and if these participants have the access to some common information);
7. the costs and benefits which serve as incentives and deterrents in a situation(McGinnis, 2011).

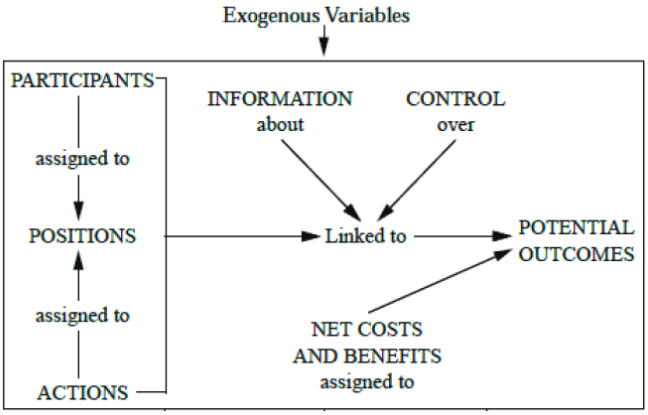


Figure 7. 3 Action Situation(A. Smajgl, A. Leitch, 2009)

This action situation is governed by a set of rules. These rules are classified based on the elements in the action situation that they have most impact with, although some rules can indirectly affect other components. The rules are briefly summarised in Table 7.1.

Rules	Definition of Rule
Boundary Rules	Specify the participants chosen in the action arena.
Position Rules	Establish positions that actors hold, e.g. financer, seller, developer, etc. Each of them has a unique combination of resources, opportunities, preferences and responsibilities. Participants enter or leave a position based on position rules.
Authority Rules	Assign sets of actions that participants in positions must, may, or may not take.
Information Rules	Specify the amount of information that can be available to each position, the channels of communicating and the kind of information that can be shared amongst participants in certain positions.
Scope Rules	Delimit the potential outcomes that can be affected and delimit actions linked to a specific outcome.
Aggregation Rules	Specify the amount of control actors have on their actions in certain position and how they affect outcomes.
Payoff Rules	Specify the net benefits and costs to the particular combinations of actions and outcomes; establish the incentives and deterrents for actions.

Table 7. 1 Rules of the Action Arena

Interactions and Outcomes

The physical conditions, community attributes, rules-in-use combine to create the incentives and constraints for participants in the action situation. Participants interact according to the actions they take and generate current policy outcomes.

Evaluation Criteria

The evaluative criteria are used to evaluate the outcomes determined from the action arena. Ostrom suggests 6 criteria to evaluate these outcomes(Polski & Ostrom, 1999). They are: -

1. Economic efficiency – Marginal social benefit associated with allocation of resources should at least equal the marginal social costs of allocation.
2. Fiscal equivalence - Those who benefit from the good or service should bear the cost of providing it in equal measure to benefits received from it. Those who derive greater benefits should pay more than those who derive fewer benefits.
3. Distributional equity- Individuals should contribute towards the cost of the good or service based upon their ability to pay for them.
4. Accountability – (i) the extent to which the policy context should facilitate low-cost information sharing or transparency, (ii) the relative capacity or skill of participants to evaluate the actions of others in the policy situation, and (iii) the extent to which participants should have ready access to mechanisms that permit them to monitor and sanction one another for opportunistic behaviour(Polski & Ostrom, 1999)(E Ostrom et al., 1993).
5. Conformance to general morality – Rules that improve relationships over time should be present such as rewarding those who keep commitments and keeping a check on practices of cheating, favouritism or free riding.
6. Adaptability – Policy context should encourage sustainability through innovation and adaptation in response to change(Polski & Ostrom, 1999).

These basic rules of the components of the IAD are applied in the next chapter to analyse the governance of PWSs.

7.3.1 Ostrom's Design Principles

Ostrom has identified 8 such design principles, using case studies that are essential for designing robust institutional systems. Robustness is defined as "*maintenance of some desirable system characteristics despite fluctuations in the behaviour of its component parts or its environment*(Elinor Ostrom, 1999)". These principles are defined below(Elinor Ostrom, 1999):-

Number	Design Principle	Explanation
1.	Clearly Defined Boundaries	Individuals or households who have rights to withdraw resource units from the CPR must be clearly defined, as must the boundaries of the CPR itself.
2.	Congruence Between Appropriation And Provision Rules And Local Conditions	Appropriation rules restricting time, place, technology, and/or quantity of resource units arc related to local conditions and to provision rules requiring labour, material, and/or money.
3.	Collective-Choice Arrangements	Most individuals affected by the operational rules can participate in modifying the operational rules.
4.	Monitoring	Monitors, who actively audit CPR conditions and appropriator behaviour, are accountable to the appropriators or are the appropriators.
5.	Graduated Sanctions	Appropriators who violate operational rules are likely to be assessed graduated sanctions (depending on the seriousness and context of the offense) by other appropriators, by officials accountable to these appropriators, or by both.
6.	Conflict-Resolution Mechanisms	Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.
7.	Minimal recognition of rights to organise	The rights of appropriators to devise their own institutions are not challenged by external governmental authorities.
8.	For CPRs that are parts of larger systems: Nested enterprises	Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities arc organised in multiple layers of nested enterprises.

Table 7. 2 Ostrom's 8 Design Principles

From these 8 design principles, the ones which are most relevant to the evaluated outcomes (from the IAD analysis) are applied to develop robust institutional reforms. The section below explains how both these frameworks are in combination applied to the problem situation.

7.4 Conceptual Framework

Figure 7.3 is an overview of how the combination of frameworks is applied. At first, the IAD is applied to study the plan-implementation process, from the policy-making stage to the community level stage. The framework is used as a diagnostic tool, working backwards, studying outcomes, then actions that create these outcomes, then the stakeholders involved in these outcomes and eventually the social attributes of communities involved in the policy scenario(Polski & Ostrom, 1999). The thesis poses the following questions,

1. *What is happening in the action arena?*
2. *Which outcomes are satisfactory, and which are not?*
3. *Do observed policy outcomes match expectations?*

To answer these questions, action situations are formulated, for each level of the plan implementation process (central – local – community). The outcomes of action situations and the interactions at each level of analysis are compared with Ostrom's criteria for policy evaluation (discussed in Section 7.3.1). The IAD helps to identify clearly, which outcomes are satisfactory, and which are not. If outcomes of the action situation do not satisfy the six evaluation criteria for successful policy performance, there is a gap between actual policy outcomes and expectations. This needs to be bridged.

After the gap is identified, the design principles help to bridge that gap, between actual and desired policy outcomes by helping to propose new institutional reforms that are robust. The thesis then poses the questions,

1. *Which identified outcomes indicate that the evaluation criteria is not satisfied?*
2. *Which design principle is relevant in the context that can help to propose new institutional reforms that will bridge the gap between actual outcomes and desired outcomes?*

To answer these questions, at first outcomes of the action situation at each level of analysis are compared with the 6 criteria and discussed to understand why they don't fulfil the criteria. Then design principles that are context specific and most suited is used to support the formation of a proposed new institutional reform that is robust.

Not all of the design principles are applied to each of the findings of the evaluation. Only the ones which are considered most suited and relevant to bridge the gap of the resultant outcomes were chosen and then applied.

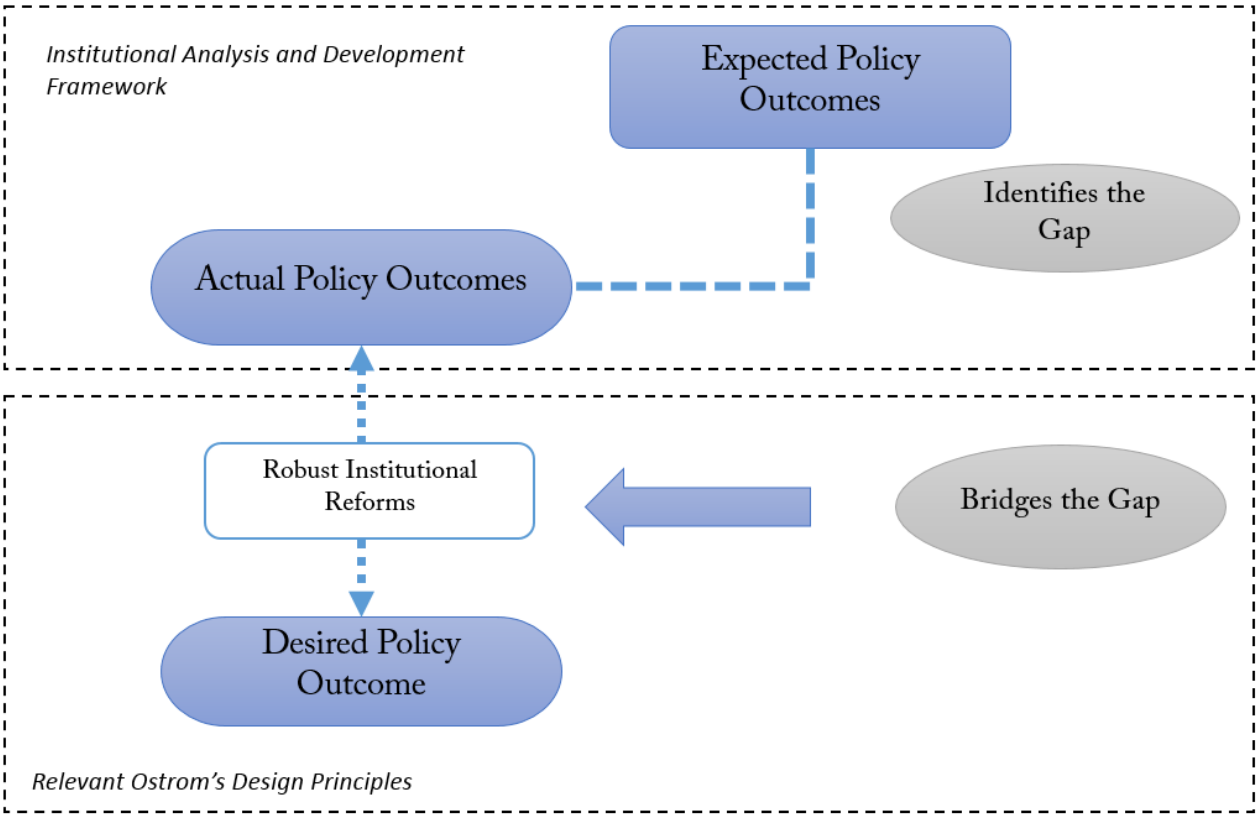


Figure 7. 4 Conceptual Framework

8

IAD Application

This chapter is dedicated to the application of the IAD framework to identify the outcomes of current institutional arrangements and then define the gaps that exists between the expected policy outcomes and current outcomes. The IAD is applied in three stages as described in Section 8.1 where the action arenas are. This chapter is then further sub-divided into three sub-chapters 8a, 8b and 8c. Chapter 8a discusses the action arena at the central level. Chapter 8b discusses the action arena 2 at the local level (Manikganj District) and Section 8.c discusses the action arena 3 at community level (union in Manikganj Sadar sub-district). Each of these subchapters explain the different components of the IAD.

8.1 Conceptualization of Action Arenas

The field situation analysis in Section 6.2 shows that the governance of Piped Water Systems in Bangladesh is a top-down implementation process, divided into four phases, governed by a three-tier government, with multiple actors involved at each stage. As per Ostrom, It can be characterized as a polycentric governance system. Authorities from overlapping jurisdictions interact to determine the conditions to which citizens will be subjected (McGinnis, 2011). The system is:

1. Multi-level: Local, provincial, national, regional, global units of governance are involved
2. Multi-sectoral: Public sector, private sector, NGOs and communities are involved
3. Multi-functional: Incorporates different goals of different actors, requires donor financing, production is complex, coordination, monitoring, sanctioning, and dispute resolution is required.

In such a multi-tiered complex governance structure(McGinnis, 2011), the situation has become a set of overlapping action arenas that need to be linked sequentially. To analyse this complex situation, the action arenas are divided into three levels – Central- Local- Community. The flow of events is from top to the bottom. The complex institutional analysis situation is divided into three levels of action arenas which will each be analysed independently through the IAD lens. Each of the four phases of development are handled by the three different tiers of government. The design and finance phase is usually handled by the central government and its partners in collaboration and therefore, both phases are combined together. Figure 8.1 gives an overview of the three action arenas. They are as follows:-

1. Planning and Designing of Village Piped Water Supply Schemes (Central level)
2. Implementation of Village Piped Water Supply Schemes (Local level)
3. Community Adoption of a Piped Water Scheme (Community level)

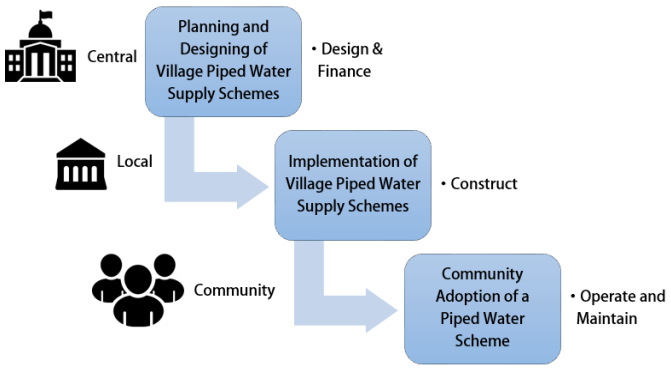


Figure 8. 1 Three Policy Arenas

The IAD framework is used to analyse the contextual factors affecting each action arena in its respective level. Figure 8.2 below gives a brief overview of the IAD's application at each level. The planning and designing of these systems takes place by the head-offices/main governmental organisations in Dhaka city (the capital). Field interviews were carried out in *Manikganj* district office and thus, governance at *Manikganj* is used as the basis for analysing the implementation process at the local level. Not all districts may have the same action outcomes as those highlighted for the local governance in *Manikganj*, but a generalization of the major identified problems can be made based on the field experience in *Manikganj*. Similarly, community interviews were carried out in two villages in the union of *Betila Mitra* situated in sub-district *Manikganj Sadar* in the district of *Manikganj*. Not all communities may have the same action outcomes as those highlighted for the communities in *Betila Mitra*, but a general perception of the major difficulties faced by the communities can be gauged based on the field experience in the villages in *Betila Mitra.*

The outcomes of the actions of the central level actors influence the local level actors. These outcome situations at the central level set the rules for the local level operates and consequentially the actions of the local level actors set the rules under which the community operates.

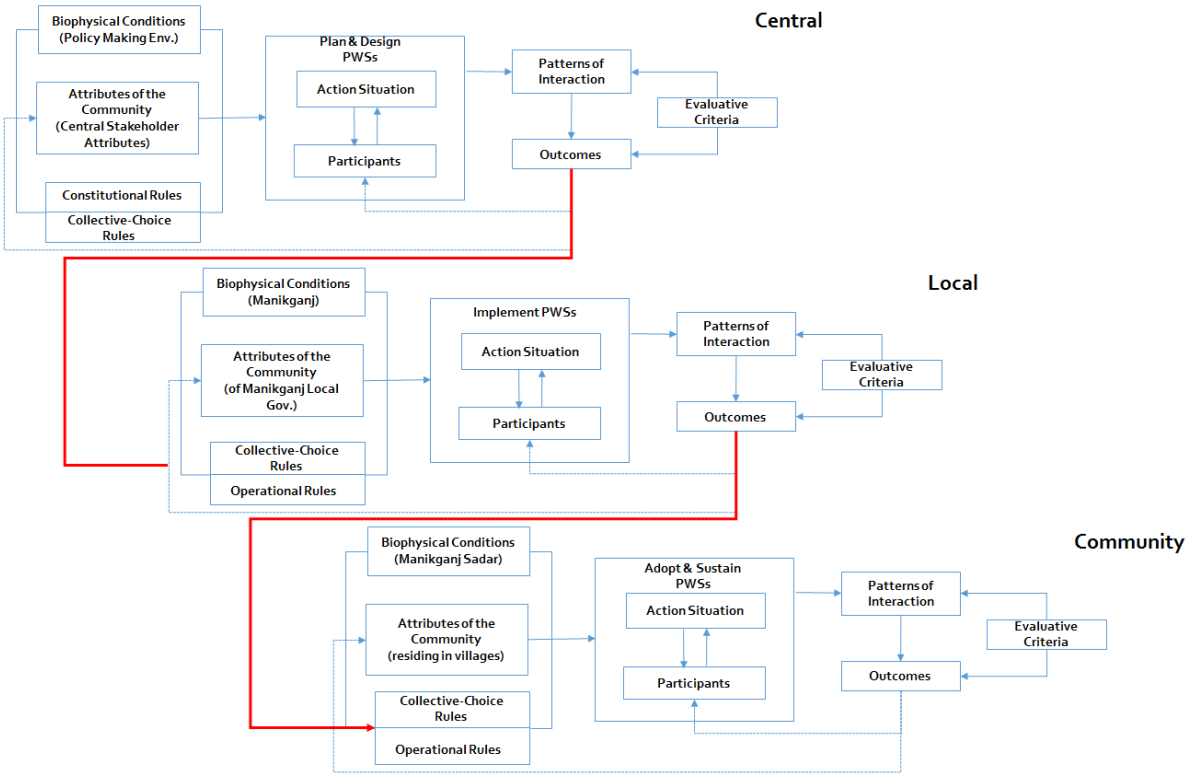


Figure 8. 2 Application of the IAD at three levels of implementation

Each action arena discusses the biophysical attributes, the community attributes, the rules (institutions) and the actors involved at each level that influence the action arena. The outcomes of each action arena are discussed in detail in the upcoming sub-chapters below. These outcomes are later evaluated for their performance against Ostrom's evaluation criteria and the relevant design principles used to propose new institutional reforms are discussed further in Chapter 9.

Figure 8. 3 Brief Overview of sub-chapters

8a

Application at the Central Level

Action Arena: Planning and Designing of Village Piped Water Supply Schemes

This sub-chapter discusses the IAD components of the action arena. Section 8a.1 discusses the exogenous variables that affect the structure of the action arena. Section 8a.2 discusses the action arena (rules of the action arena, positions, actions, information, participants and control, net costs and benefits) that make up the action arena. Section 8a.3 discusses how the exogenous variables and action area combine into patterns of interactions that determine the dynamics of an institutional setting. Finally. Section 8a.4 discusses the different outcomes that these interactions produce.

8a.1 Exogenous Variables

The exogenous variables that affect the action situation are the physical conditions surrounding it, the attributes of the community and the rules that govern the behaviours of the actors involved in this level.

8a.1.1 Conditions for Decision Making

The central decision-making body for decisions related provision of basic services (water supply, sewage network, electricity supply etc.) is the Ministry of Local Government, Rural Development and Co-operatives. DPHE is under the Local Government Division (LGD). As mentioned, the DPHE is mandated to be in-charge of the water supply in rural areas. It provides advisory service to GoB in framing policy and action plans for the WASH sector and provides support to the local governmental institutions (LGIs) in the development and O&M of the water & sanitation facilities(DPHE, n.d.).

UNICEF and The World Bank Group are major partners of the DPHE. UNICEF supports arsenic mitigation activities at the national and sub-national level. It assists the DPHE in testing of existing wells, identifying safe sources of water, providing alternative water sources, arsenic-related healthcare management and in awareness campaigns. The World Bank works largely in the areas of cost determination, financing, sustainability aspects of projects. JICA is the technical assistance partner of DPHE, helping them to develop concrete technical plans for water supply projects, building their technical capacity, and carrying out nationwide surveys for critically affected areas and suitable technical options in different areas. The Policy Support Branch (PSB) functions under the Water Supply Wing of the LGD. It brings together all central level decision makers organises workshops, steers discussions about policy and strategy development, reviewing and revision of documents (refer to interview).

DPHE, JICA, UNICEF and World Bank form the major decision-making bodies at central level involved in the planning and designing of the rural piped water supply systems(refer to interview). Other donor organisations such as Embassy of Netherlands, HYSAWA and other International NGOs work in assisting the DPHE or in parallel to the DPHE but are not constitutionally abided to do so. They are not directly part of the meetings and workshops held. They may or may not be invited to participate in decision-making workshops and policy formulation discussions. These organisational or constitutional policies are the basic decision making conditions of the central level.

8a.1.2 Attributes of the Community

The dominant policy-making community of the rural water supply sector consists of DPHE in consultation with JICA, World Bank and UNICEF. Other important players that plan, design and operate rural piped water schemes are the Rural Development Academy (RDA), donor organisations such as Embassy of Netherlands and private organisations such as HYSAWA, International and Local NGOs. Academicians, technical experts, from technical institutes consult decision makers about technicalities of treatment technologies and difficulties for future planning.

The Policy Support Branch organises a forum called Local Consultative Group (LCG) for Water Supply, which brings together all the essential stakeholders to come together and share updates on the progress of the WASH sector. Important local level stakeholders, Local DPHE, *Upazila* and *Union Parishad* chairman and Local NGO heads etc. are also invited to share field experiences before policies are devised. Policies and plans are all discussed, proposed, developed, revised and presented in the forum meetings which are held quarterly by the PSB. After discussions and coming to a consensus , final draft document is then reviewed by the National Forum for Water Supply and Sanitation (NFWSS). After approval, these policies are again discussed with all stakeholders from ground level to national level, a final consensus is reached, and the policy is drafted and published (refer to interview).The process of policy making is participatory, in the sense that, important members of LGIs and NGOs etc. are invited to be present in workshops and meetings and share their opinions about the field situation and community perceptions at grassroots level. Once the regulations have been formalized and published, all actors in the network function in line with the policy and plan.

DPHE is the focal agency for providing technical information to implementers of PWSs, carries out the tasks of coordinating the overall rural water supply programs. JICA is responsible for carrying out the initial surveys and maps out locations where PWSs are possible to be built without many technical difficulties. Based on the results from these feasibility studies and lessons learnt from the past, a financial model is proposed by the World Bank. Currently, the 30-70 (Entrepreneur-Donor) model is being implemented by the DPHE after multiple studies done and lessons learnt from the 120 previously implemented PWSs (refer to interview). Once the amount of donor support is decided, the central DPHE dedicates a team of engineers to carry out the project and they plan and design the PWS. When there is a request from the Local DPHE office for a PWS for a particular village, a contractor/entrepreneur is hired to build the system. The construction activities are overlooked by the project's technical team. Although the management plan of a PWS and the capacity of the tank would differ location wise, the basic plan and design would remain similar for all PWSs. Treatment solutions installed would differ based on the problem area and the contaminants present in the groundwater of that region.

8a.1.3 Rules in Use

The actors at this level operate under two levels of rules: constitutional rules and collective-choice rules. Operational rules are not applicable at the central level, as the day-to-day decision making of organisations and the informal institutional arrangements do not affect the overall outcomes of the action situation.

Constitutional Level Rules

This is the top tier of rules, under the framework of which the national government formulates policies. These are the:-

1. Constitution of Bangladesh - It is obligated to ensure equitable distribution, efficient development and use of water to address poverty, giving priority to domestic uses.(Sanitation, n.d.)
2. UN Millennium Development Goal 7: - It obligates signatory nations to target to "halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation(WHO, 2013)."

3. UN Sustainable Development Goal 6.1: - It obligates signatory nations to "achieve universal and equitable access to safe and affordable drinking water for all, by 2030(UN Water, UNDESA, 2015)."
4. WHO/UNICEF JMP Ladder for drinking water – It encourages signatory nations to climb the highest ladder for drinking water services –which is a safety managed drinking water source is every premise(WHO/UNICEF, 2017).

The **Ministry of Local Government, Rural Development and Co-operatives** acts upon these rules to create policies for national action.

Collective Choice Level Rules

National policies are formulated under which the national government has to operate. They are: -

1. National Policy for Safe Water Supply & Sanitation (NPSWSS 1998)
2. National Policy for Arsenic Mitigation (NPAM 2004)
3. National Water Supply & Sanitation Strategies (NPSWSS 2014)

The actors at the national level operate under the institutional arrangement mentioned in these policies. These three national policies affect the actions the participants of the action arena will take, which will be seen in the next section.

8a.2 Action Arena

Planning and Designing of Village Piped Water Supply Schemes

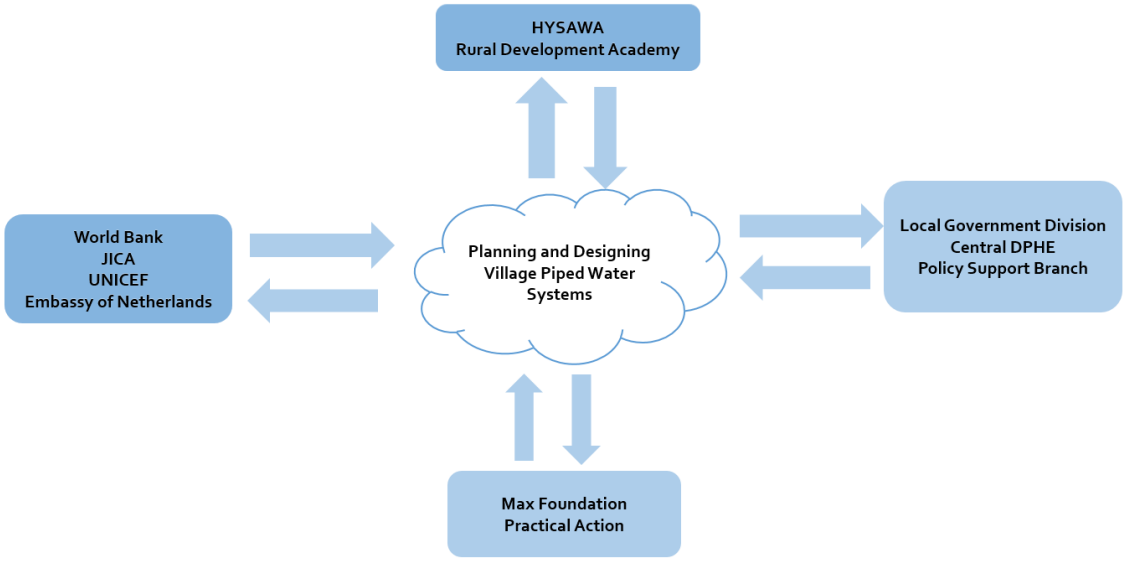


Figure 8. 4 Action Situation and Participants Involved

8a.2.1 Rules of the Action Arena

The action situation is governed by a set of working rules that determine who is eligible to make decisions, what actions are allowed or constrained, what procedures must be followed, what information should be available and what costs are associated with these actions. They help to define the boundaries of the action arena. Actions not in line with the rules of the arena change the outcomes of those actions. These working rules must be determined before discussing the action situation. The working rules for this action situation

are briefly summarized below. These rules are defined based on the definition of these rules set by Ostrom as described in Section 7.3.1.

Rule	Definition of Rule for the Action Arena
Boundary Rules	The participants are chosen based on the roles and responsibilities formally assigned to them by the LGD. Some organisations who are not mandated to carry out responsibilities but voluntarily do so are chosen if they play an essential role in the planning or designing of the system.
Position Rules	The positions chosen are executor, developer, steering committee, financer and advisor. Refer to Appendix C for the function associated with each position.
Authority Rules	The actions actors take are either specified by the policy or the organisation's agenda. The actions of governmental actors are determined by the institutional arrangements mentioned in the policy. The actions of other actors can be driven by the organisations' vision or a humanitarian motive.
Information Rules	The information shared, the channels of communication and the kind of information that is to be shared with each participant in the action situation is determined by the policy. Formal information is shared by formal methods of communication (meetings, workshops) as directed by the law. Informal methods of information sharing are a result of bureaucracy and socio-cultural attributes of the community.
Aggregation Rules	The control each actor has over its actions is determined by their organisational policy in line with the national strategic framework. The scope of actions of non-governmental actors is guided by the policies of their respective government or organisation if it aligns with the national policies.
Scope Rules	They determine the scope of actions that the participants are allowed to take within their organisational framework.
Payoff Rules	The payoff rules are determined by the costs and benefits of actions that participants take. The costs and benefits of actions affect the outcomes. All costs involved are borne by each party based on their financial arrangement with DPHE. Organisations that work in parallel the DPHE chose to have their own financial arrangements. The benefits they get from their actions are dependent on what outcomes they expect from their actions.

Table 8. 1 Rules of Action Arena at Central Level

8a.2.2 Participants and Positions

Following the rules, the participants are chosen and positions are assigned to them as shown in the table below.

Participant	Function	Position
Local Government Division	Responsible for issuing the policy documents and setting up the framework that dictates the role of all other actors in the action arena.	Executor
Central DPHE	The positions chosen are executor, developer, steering committee, financer and advisor. Refer to Appendix C for the function associated with each position.	Main Developer
World Bank	Mandated by the LGD to provide technical support in planning, designing, construction and operation of rural piped water schemes.	Financer and Advisor
JICA	Provides technical and financial assistance based on its directives and policies.	Advisor
UNICEF	Interested in the health aspects of women and children, provides technical guidance and financial support to the DPHE for building PWSs in arsenic affects regions.	Advisor and Financer
RDA	Responsible for providing technical support for the design, construction and operation of rural multi-purpose piped water schemes- irrigation, drinking etc. The RDA is chosen because it works in partnership with NGO- Max Foundation. RDA is another organisation under the ministry working in parallel to the DPHE to implement schemes.	Developer
Embassy of Netherlands (Donor Organisation)	Represents many such foreign donor organisations (DANIDA, SDC etc.) who finance WASH projects in Bangladesh.	Financer
HYSAWA (Private Organisation)	A representative of a private organisation directly dealing with the *Union Parishad*. It plans and designs its own rural water supply systems, financed by donor organisations. It runs a model parallel to that of DPHE.	Developer

Max Foundation, Practical Action (NGOs)	These are two of the multiple International NGOs working in the rural water supply sector. They represent the role of an iNGOs role in the sector. They plan and design their own PWSs for certain districts and install them in partnership with the local government of the district without dealing with DPHE. They are encouraged to do so by the policy to ease the burden on DPHE and allow Public-Private Partnership (PPP). They also carry out participatory and motivation activities to build awareness and capacity of the local community in collaboration with local NGOs.	Developer
Policy Support Branch	Organises stakeholder meetings and workshops to set up policies, strategies and plans for the water sector.	Steering Committee

Table 8. 2 Participants Involved in Action Arena at the Central Level

8a.2.3 Actions of Participants

The participants are chosen each carry out different actions which influence the action situation, some negatively and some positively. These actions are described in detail below.

The Executor: Local Government Division

All the above mentioned national policies, implementation plans, and sector development plans related to arsenic mitigation were issued by the LGD. In these policies, it has encouraged participation of private sector and iNGOs in the implementation of piped water systems. The institutional setup of these policies has allowed them to operate directly or in partnership with DPHE or any other government organisation as long as the implementation is carried out directly in collaboration with *Union Parishads* and not overlooking the union level government.

The Main Developer: Central DPHE

The DPHE at the central level has taken up the role of a developer in executing a plan of PWSs in the villages. It has the authority to conduct universities and research centres to carry out experiments, build durable treatment technologies and set up laboratories for testing of arsenic-safe technologies. It also has the freedom of choosing its development partners and financial partners. Following this role, the DPHE began by implementing village PWSs. It has chosen JICA, UNICEF and World Bank as its main developmental and financial partners to install village PWSs. 120 village PWSs were installed at first and evaluation of these schemes was conducted by JICA(JICA, 2008). As mentioned by one of the engineer at DPHE in the interview,

"In 2004, the government constructed 90-99 piped water supply schemes. Those were mini projects with less number of households. Those were in collaboration with UNICEF, World Bank and DANIDA and other NGOs. In total at that time, there were 120 schemes. The evaluation was done by JICA and there is a publication available about the lessons learnt. After the lessons were learnt, the other schemes were introduced with different models- some are direct UP managed, others are community managed models, and some are sponsor managed models. While some of these systems have turned out to be successful, many have yet to be planned better (refer to interview)"

To ensure sustainability, the Central DPHE conducts their ground staff at the local level to carry out an initial study within the community to test how willing the community is to have the system. They ask for an initial amount to be deposited into the bank before the installation begins. When this amount is deposited in the bank, they instruct the contractor to begin the installation. But, they do not place any checks and balances to ensure if the contribution was from one person in the community or every person in the community. The superintending engineer at the central office mentioned in the interview session that, *"An initial down payment is required from the community (Around 10000 BDT/system). Whenever in the account, the Union Parishad chairman says that they have accumulated a minimum of 10000 BDT, then we know that there is a willingness to pay and have the system. Then we take that area into consideration. The down payment is collected in total from the community and is not per family. So, if one person contributes more than the others, it doesn't matter to them. That is an internal village matter. In the end, the community should be able to show their*

interest by having deposited the money in the bank account. It can come from 1 person, 5 people or the whole community, it doesn't matter to us (refer to interview)."

The Advisor: JICA

Acting along its organisation agenda, JICA takes actions to monitor the success of the project by monitoring the number of people continuing to pay for the system and continuing to use it, at least until its technically defined duration. Many times, post-monitoring it found that systems are abandoned, the main reason being that it is very easy to install a privately owned tubewell with minimum investment. Although the central decision-making organisations-DHPE, JICA and UNICEF understand the need to control the number of drillings and reducing the number of privately owned tubewells, there has not been a policy or regulation introduced to control the number of drillings in rural areas. The number of people choosing tubewells over PWSs is more as they see more benefit from tubewells over PWSs. This has been highlighted by multiple interviewees during conversations including personnel from DPHE, JICA and Max Foundation.

"The reason it hasn't expanded rapidly because each house has his/her own water supply system. It is very easy to install a tubewell to a low-cost pump and water is available in each household. Once communities build up their own system, interest for PWS or any network from the government becomes very low. The main challenge is to convince an entire community to pay for the water supply. Some people find alternatives and build their own individual systems and want to avoid subscriptions. They build their own tubewells (JICA interview)*."*

*"As the country is moving to a middle-income country, every household wants to have their own tubewell. There is no policy to restrict the number of tubewells that each household can install in the rural areas. In urban areas, the policy exists but not in rural areas. In the rural areas, the UP has no capacity to ensure drinking water supply through piped water thoroughly in all regions. So, the private sector has intervened, and they want to sell their technology individually to households and their no authority to control the number of drillings. (*Max Foundation interview*)."*

The Financer and Advisor: World Bank

The World Bank's role as a financer of piped water systems is limited to lending funds to the DPHE, sometimes as loan and sometimes as a grant to enable them to mobilise resources, carry out research on the technology and for the construction of the project (refer to interview). It advises DPHE in choosing the optimized financial models to ensure financial sustainability of the projects. This was highlighted in the interview session, where the World Bank WASH sector official stated that *"Our role is only in the institutional side of the projects. We ensure financial sustainability of projects on which we partner with DPHE. This is usually done by suggesting a few financial models, and choosing the most appropriate one, based on some trial projects and lessons learnt*. (World Bank interview)*."*

The World Bank deals only with the Central DPHE. As per the organisation's mandate, the World Bank can only channel it's assistance to governmental agencies of respective countries and is not authorized to work directly with private sector organisations. But, it does encourage fiscal decentralization and promotes Public-Private Partnership (PPP) to build local capacity of the country (refer to interview). Earlier, contractors were directly hired by the DPHE, they built the system and their costs were covered by the DPHE. World Bank contributed part of the costs. In this design, the main flaw was that the O&M became the responsibility of the community and they did not have the technical know-how to handle the system. To solve this problem, the private sector was encouraged to participate as an entrepreneur and invest 30% of the money from their side to build the system and earn money from monthly tariffs, while the bank would contribute 70% of the money. The Bank has now introduced the 30-70 partnership model within the DPHE whereby, a local entrepreneur is selected via a bidding process by the Local DPHE who has the technical capability to construct the scheme and he handles the O&M for the community for a period of 12 years. He gets a return on his investment within

the span of 12 years via monthly tariffs (refer to interview). They are bound by the project period and do not follow up on monitoring the scheme after the project is over. If the scheme is running and financially sustainable within the period of their project, the project is considered successful for them. In recent years the bank is opting to work with the RDA as another government partner but hasn't yet carried out any major project with them. It is their plan for the future, considering the success that RDA has received in irrigation-based PWSs (refer to interview).

The Financer and Advisor: UNICEF

UNICEF, apart from financing many of DPHE's projects also acts as a major operational advisor to DPHE. They have developed and implemented the Water Safety Plans in collaboration with DPHE to improve household drinking water quality. They are working with schools, mainly in low-income communities and villages, to engage children as change agents in their homes and communities to increase the awareness and demand for safe water. Many of these plans have shown positive results. It also shares its training tools and strategies with DPHE to improve monitoring. But, they only carry out the monitoring of the project until the project period and follow up only until 2 years after the construction has ended which is not enough time to know if the system managed to be sustained or not. This issue was highlighted by the UNICEF official during the interview session where she mentioned that *"Planning, implementation and monitoring activities are only carried out until the project period. We are not mandated to do long-term monitoring of the piped water schemes. That is a major drawback from our side as then we cannot know how successful and beneficial the project was for the people* (refer to interview)*."*

Their recent project with DPHE is a step ahead as they are working towards building a data management system, monitoring system and water quality surveillance system for DPHE which will be accessible to all stakeholders(refer to interview). This will allow more coordination and interaction between the parallel models of PWSs implemented haphazardly across the country. Although, UNICEF works with DPHE as their major implementation partners. It also aids international and national NGOs, mainly supporting the BRAC, but also research organisations such as EPRC and CBOs.

The Financer: Embassy of Netherlands

The Embassy of Netherlands has been an active donor in the rural WASH sector of Bangladesh mainly focusing on difficult and hard-to-reach areas. They support projects financially only and do not involve themselves in planning and implementation. Most of their projects are in coordination with UNICEF, WHO and DPHE (refer to interview).

The Developer: RDA

The Rural Development Academy (RDA) is another governmental organisation that is now actively getting involved in the rural water supply sector to achieve its goals of rural economic growth and development. The RDA is another agency just like the DPHE who also has the authority to deal with planning and designing of piped water systems in rural areas only. They have taken actions to develop successful irrigation based piped water systems in rural areas which also supply drinking water after treatment. They work together with international NGOs such as Water Aid and Max Foundation to implement these schemes. Due to their success in sustaining some of those systems, they have attracted the attention of the World Bank. This was mentioned by a World Bank official in the interview session, *"So far we have only been dealing with the DPHE but we are now looking to partner with the RDA to explore new partnerships. The RDA has a successful model for PWSs for irrigation purpose and these schemes can also be used for WASH activities* (refer to interview)*."*

Max Foundation, a Dutch NGO has also been partnering with the RDA in a project where the RDA is providing technical support mainly for design, construction and operation of rural multi-purpose piped water schemes in Bogra district, as mentioned by an official from Max Foundation that, *"In this project, we have a three-party*

partnership. Our technology provider partners are RDA. We are not dealing with DPHE and DPHE's role is replaced by RDA. RDA's main mandate is to provide irrigation water. Domestic water is a by-product from the same scheme (refer to interview)."

The Developers: Max Foundation and Practical Action

Multiple international NGOs (iNGOs) are working in Bangladesh to improve living conditions and increase economic growth. Max Foundation and Practical Action are just two of many NGOs interviewed to understand the basic role that they play in the context of rural water supply. All NGOs working in the water sector have their own specific goals to follow but they all carry out basic participatory activities to create awareness, build community capacity by instilling ownership in them and train them to carry out O&M themselves. In recent times, many of the NGOs have begun to build piped water schemes themselves with support from the local governments of districts and the *Union Parishad*. These PWSs are financed by their own government or some funding agency, they hire a contractor to construct the system and they take the support from LGIs and UPs to run the system. In this way, they can serve hard-to-reach communities in areas where there is an actual demand for the system in as less execution time as possible. *Union Parishads* also prefer to work with NGOs because their request for a scheme is approved faster not having to go through the bureaucracy when involving the DPHE. The NGOs also prefer not to deal with the DPHE in many cases. Max foundation is one such NGO. They were involved with the DPHE for many projects but are now planning to shift their partner organisation to RDA. Practical Action still deals with the DPHE.

The Developer: HYSAWA

HYSAWA was formed to be a company that would directly support local governments at the union level to build WSS infrastructure. The aim was to decentralize activities and create ownership amongst communities. It receives funds from multiple donor organisations and directly develops a plan to be executed by the *Union Parishad* without having to deal with the DPHE. A private sector company is given the contract to build PWSs and NGOs are mobilized for field activities. Using this model, they have implemented 237 PWSs throughout the country. 37 of these systems were implemented in partnership with the RDA and the rest were carried out directly in collaboration with the *Union Parishads*. They believe, this model has been able to ensure financial accountability amongst the ground level staff, improve the institutional capacity of LGIs and helped them budget themselves and plan. They do not deal with DPHE as they as they do not want to go through the bureaucracy (refer to interview). Dealing with the UPs directly gives them accountability of their funds and they are able to monitor the system better. As mentioned by an official interviewed from the organisation, *"We prefer to deal directly with the Union Parishad chairman. We practice this model of implementation as it gives us financial accountability for our money and we can see the progress of our invested money. Donors then begin to trust us more. Dealing with DPHE involved a lot of approvals and sanctions. That also wastes a lot of time. We prefer not to deal with that* (refer to interview)."

The Steering Committee: PSB

The Policy Support Branch mainly plays the role of a coordinator bringing together all of the other stakeholders to formulate policies and revise them timely. Its actions mostly entail that of a secretariat in a large organisation that organises meetings, writes meeting agendas, steers discussions when required and makes sure all documents are correctly issued. Although the PSB's role is not so significant in impacting the action situation, it does play a role in bringing together policy makers to make policies that affect the action situation.

8a.2.4 Information about Actions

Actions of these participants indicated that most of the communication takes place formally as according to the institutional arrangements in the policy. Informal communication channels at this level are hard to

identify as most activities at the central level are decision-making activities and come across as per however the policy conducts them to be. However, there are information gaps identified amongst the stakeholders who are not officially a part of the DPHE umbrella and are running their own models of implementation. The stakeholders who are also not involved in the decision-making forums organised by the PSB are not involved in the policy-making and that creates a major information barrier. Although they function according to the policy, all of them are not aligned to the same vision of making PWS successful and popular across the country.

The Central DPHE is responsible for sharing all arsenic-related information publicly. All research organisations or individual researchers who carry out research on arsenic-related issues in Bangladesh are mandated to share their findings with the centre. These findings from universities and research centres are required to be properly documented for dissemination to all stakeholders. Apart from that, the DPHE carries out its own research in technology testing and finding new, economical treatment solutions (refer to interview). All this data, including the survey data of all arsenic zones and areas of the country, is made available to all governmental agencies, development partners, NGOs and CBOs, private organisations. UNICEF has taken the responsibility to build this data management system for the DPHE that is made available to all. Hence, it can be concluded that the information flow amongst the Ministry of Local Government, LGD, DPHE, World Bank, UNICEF and JICA is quite smooth and direct. Some interviewees did point out the lack of information sharing on the post-project monitoring aspects of PWSs from the side of the DPHE. But these gaps can be overlooked when there are huge knowledge sharing barriers between the RDA and DPHE or HYSAWA and DPHE. These gaps and their consequences will be explained further when patterns of interactions are discussed. The Figure 8.5 highlights the barriers in communication amongst the central level stakeholders.

8a.2.5 Control over Actions

The control that each of the participants has on their actions affect the outcome of the action situation. The formation of the policy and how plans should be executed depends on the LGD and RDA. Similarly, the LGD with the support of the PSB can only develop policies but the execution is up to that of the DPHE. The LGD sets targets but the planning is done by the DPHE. DPHE relies on the LGIs to make implementation and full-scale installation possible. UNICEF and World Bank are limited by the scope of their project periods for project monitoring and that affects the outcomes of their investments. The systems financed by them cannot be monitored for the long term. That eventually affects their decision to invest in the project again. Similarly, donor organisations are limited to financial agreements with the DPHE or private organisations and cannot provide support outside of their organisations' guidelines. NGOs have a relatively free hand in their actions and more control over their actions in choosing their partner organisations to work with as compared to other participants of this action arena.

8a.2.6 Net Costs and Benefits

Huge costs are involved in the planning and implementation. The construction of these schemes requires investments of large amounts and organisations are constantly spending money on testing appropriate technology for arsenic treatment, carrying out feasibility studies to identify relevant technologies for different regions and hiring contractor or entrepreneurs to construct systems. Water tariffs for communities are determined to keep in mind the affordability index households determined from feasibility studies. These PWSs are a huge investment into securing a future for drinking water in rural Bangladesh but their benefits are not yet visible. Although its benefits are realised by the central stakeholders, its high costs and less community adoption overlooks all of its benefits. There have been some successful systems with satisfactory performance but the benefits of all the actions of these stakeholders on a large scale are yet to be seen.

8a.3 Patterns of Interaction

Figure 8.5 depicts a clear picture of the patterns of interaction of the participants in this action situation. Stakeholders JICA, UNICEF, World Bank interact directly with the DPHE. DPHE is by law mandated to interact with LGD and the Policy Support Branch intervenes in all policy related discussions of the LGD. Organisations such as HYSAWA are directly dealing with the LGD. NGOs may or may not choose to deal with DPHE as they are independent entities. DPHE is not in any form interacting with the RDA model. World Bank is progressively building its alliance with RDA but there is no direct interaction. The two most commonly implemented models are not directly interacting in any form. This has created a huge information gap in the stakeholder interaction at the central level as all these interactions are not coordinated. All their activities are directly or indirectly influencing the *"Planning and Designing of PWSs."*

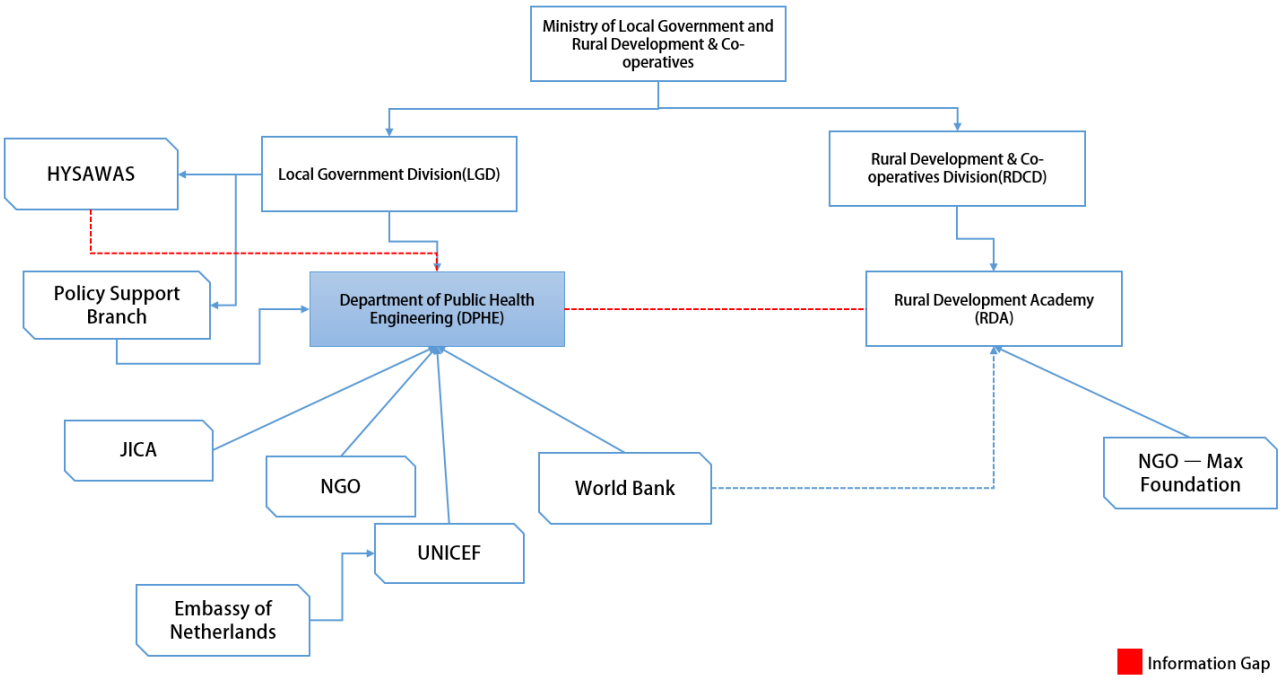


Figure 8. 5 Patterns of central level stakeholder interactions

8a.4 Current Institutional Outcomes

The outcomes of interactions are not only shaped by the action situation but also by the exogenous variables. The outcomes of all the actions that these stakeholders carry out results in *"Planning and Designing of Piped Water Schemes"* that become ready to be implemented by the Local DPHE members along with another set of stakeholders in the villages. Some of the actions of all the participants and the physical environment that they are operating in, result in favourable outcomes, some fail to deliver the outcomes expected while some actions that are not executed also affect the outcomes of the action arena. The section below highlights some of these outcomes.

Outcomes that affect the Action Situation Positively

1. Efforts taken by the DPHE and JICA to carry out an evaluation study of the 120 implemented Piped Water Schemes and study the lessons learnt have affected the decisions made regarding planning out new PWSs. The study has highlighted the main reasons for failure in sustainability of these schemes and the design flaws from the previous model have been considered in the new project that has been introduced by the DPHE. Officials say that the new model is hoped to be more sustainable in the long run.

2. The 30-70 model introduced by the DPHE on the advice of the World Bank has helped developed trust and ownership at community-level, as that has allowed the O&M to be handled by the entrepreneur. That has helped communities to deal with technical difficulties of O&M of the system and it makes it less prone to be abandoned.

3. RDA's initiative to make irrigation based piped water systems in villages also suitable for drinking has attracted many stakeholders towards their model. Some officials mentioned that they believe the model has been working well and they are interested in working with the RDA to implement more such models. Their design can be a positive addition to DPHE's design model.

4. The initiative of UNICEF to build a data management system and a water quality surveillance system that would be accessible for all stakeholders, when implemented, would allow for more coordination of information amongst stakeholders and reduce the information gap that actors such as RDA, HYSAWA etc. have with DPHE.

5. HYSAWA's method of dealing directly with the *Union Parishad* without involving many actors and keeping the model less complex can prove to be more impactful.

Outcomes that affect the Action Situation Negatively

1. The system is designed to be a "participatory process" but only at the central level. The plan is developed outside the community and participation is viewed as consenting to the plan by the community members. Stakeholders are involved in the decision making and encouraged to participate in the DPHE model. But, it seems more like a situation wherein the technological design is prepared by the DPHE along with consultancy from JICA, UNICEF, World Bank, the plan is mapped out and ready to be implemented at a desirable location that is suitable for a Piped Water Scheme. The feasibility study is done by the Local DPHE to ensure community members will pay monthly tariffs and the plan is implemented. The scheme is not designed keeping in mind the socio-cultural community attributes, how many people and areas it can serve, which communities in which areas would it be more beneficial and how the community would respond to it. Sometimes, schemes are implemented in areas where there are multiple privately owned tubewells already present and then the scheme is not used by many, leaving it abandoned after a few years. In conclusion, the design process has not been an engaging process where all stakeholders are kept involved.

2. All policies and regulations encourage the private sector and NGOs to participate in the drinking water sector to assist the government. The government supports plans of international NGOs to develop and implement PWSs in the villages. Following the policy, NGOs and private organisations have begun to develop their own models of implementation and execute them with the help of LGIs and *Union Parishads*. This has resulted in multiple models implemented, running in parallel to the DPHE model of implementation. Many of these stakeholders do not interact with the DPHE at all and carry out their own execution with their own form of technologies. The information gap between some participants is large and there is knowledge sharing amongst stakeholders. This has also resulted in duplication of projects being carried out at times, conflicts amongst some participants and overuse of resources with not many results obtained. Knowledge sharing of the success and failures of different models can be a very important lesson in designing better models of implementation. The policy of Arsenic Mitigation (NPAM 2004) did highlight that **"***The variety of ways arsenic affects life and people have attracted the attention of a diverse group of stakeholders. Different ministries and government agencies, academics, NGOs and bilateral/multi-national development partner agencies are pursuing separate programmes without any coordination. This is resulting in duplication of activities and conflicting strategies that inhibit synergy and optimal use of scarce resources*(*National Policy for Arsenic Mitigation 2004*, 2004)*."* But as of now, no such steps have been taken by the government to bridge these gaps and encourage knowledge sharing sessions.

3. The 30-70 model that has been introduced by the DPHE has managed to add the private sector intervention and is a step ahead from the previous model, but it doesn't seem to be very participatory. The entrepreneur is selected via a bidding process, allowing for them to prove their technical capabilities and encouraging private sector participation but oftentimes, only one entrepreneur shows up for the bidding process and he is given the project if he can handle the construction process. The main reason behind the low participation of private sector organisations in the sector of rural water supply is that the return on investment is very low, and the payback period of the investment is too long. This issue was highlighted during the interview session with the World Bank. *"Competitive bidding was introduced amongst the sponsors in this project. The sponsors had to win the contract from DPHE. The level of participation was very low. In many schemes, only one bidder showed up, sometimes two of them. But they were qualified, they were given the work order. This is business is not profitable for them in rural areas. Recouping the investment of 30% over 12 years is a long time for them. But if you reduce the time, the tariff rate will go up. But that would be unreasonable for the communities. Earlier a 50-50 financial model was proposed, but no one showed up for bidding for that project. So, that % was lowered and a 30-70 financial model was agreed upon* (refer to interview)*."*

4. The method that the Central DPHE uses to test the willingness to pay and the interest of communities in PWSs, whereby an initial amount is required to be deposited in the bank does encourage corruption. There is no checks and balances placed on where this amount comes from a couple of economically well-off people of the community who can afford it or the community as a whole. This could also mean that those who deposit the initial amount claim ownership of the system leaving the people who need clean drinking water out of the system.

5. Most stakeholders mention the issue of increasing number of privately installed tubewells in rural areas that are affecting the interest of people in the piped water. It is also making it difficult to monitor the water quality from all these tubewells, increasing the number of drillings in certain areas leading to depletion of groundwater tables in the long run. But, currently, there is no system in place to regulate the number of drillings per household and per area. There is no policy that limits the number of tubewells households can have in an area. This policy exists for the urban areas implemented by the city corporation but doesn't exist for the rural areas. A system of introducing a regulatory process by the district level government can be introduced. The actions of these participants that lead to outcomes of this action arena set the rules for operation at the local level of analysis which will be carried out in the next section. The patterns of interactions create an environment which would affect the actions that the local level stakeholders will carry out. Analysing these outcomes means analysing the performance of the policy system.

8a.5 Summary

This chapter is intended to carefully analyse the contextual factors that affect the design phase of the process of implementation of rural PWSs. It begins with analysing the exogenous variables that create the environment for decision makers to create policies for the designing process of the PWSs. Then it describes the actions that each stakeholder takes, sometimes in line with the policy, while sometimes not. It discusses the information available to these actors, the costs and benefits of activities they carry out and the amount of control they have over their actions. The patterns of interactions amongst these actors lead to the outcomes of the action situation. These outcomes will be evaluated against Ostrom's to see if they successfully qualify all criteria that make them successful outcomes. This will be discussed further in Chapter 9. Figure 8.6 summarizes the action arena.

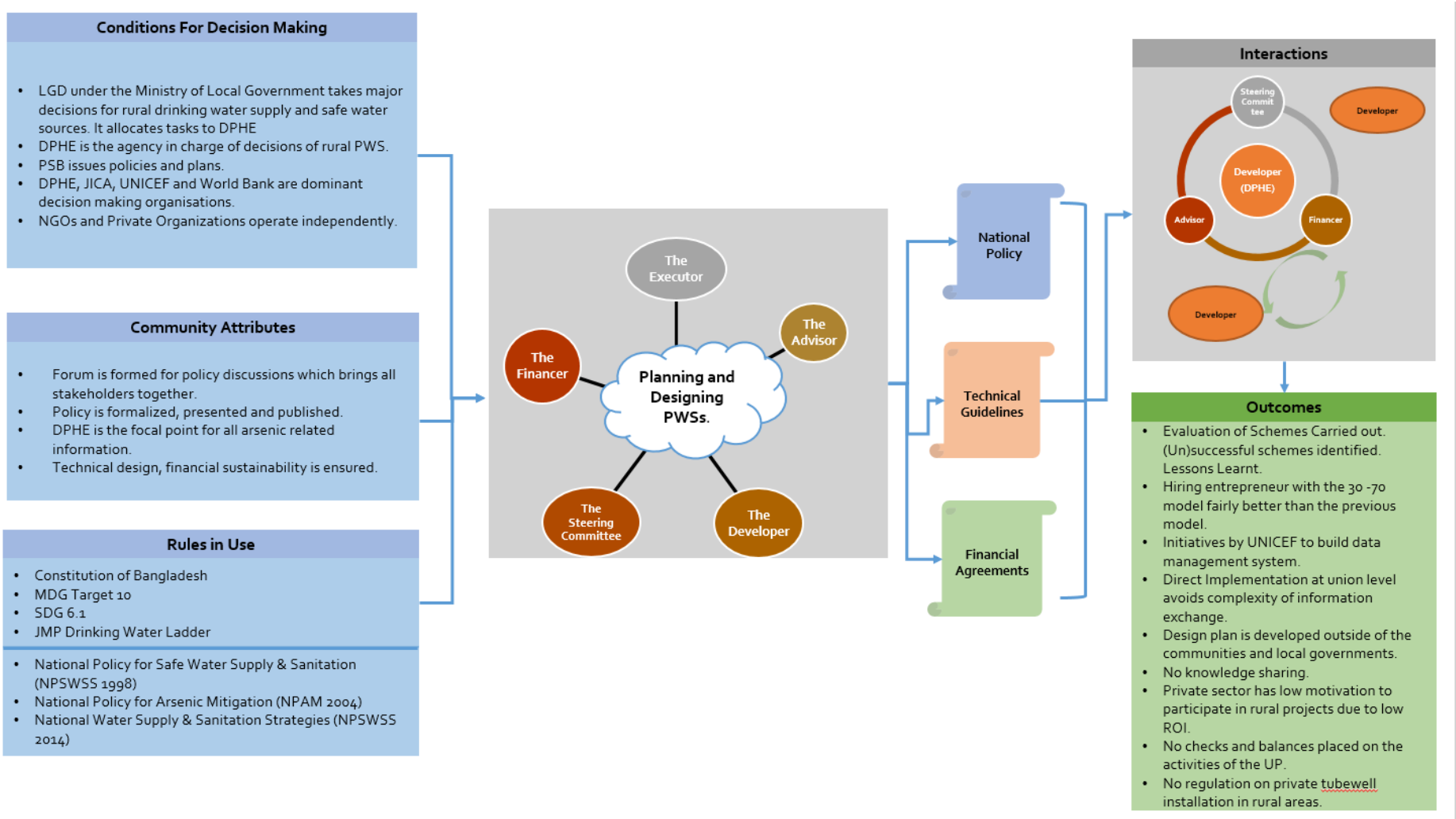


Figure 8. 6 Summary of the Action Arena "Planning and Designing of PWS"

8b

Application at the Local Level

Action Arena: Implementation of Village Piped Water Supply Schemes

This sub-chapter discusses the IAD components of this action arena. This action arena analyses the local level based on the situation at the Local DPHE office in Manikganj Sadar in the district of Manikganj and the situation at the union office in the unions of Manikganj Sadar. The problem areas identified are specific to the region but do allow to gauze the general outcomes of actions of stakeholders at local level in other districts as well. The field perception of the problems identified allows to make conclusions which may be generalized for other rural regions. Section 8b.1 discusses the exogenous variables that affect the structure of the action arena. Section 8b.2 discusses the action arena (rules of the action arena, positions, actions, information, participants and control, net costs and benefits) that make up the action arena. Section 8b.3 discusses how the exogenous variables and action area combine into patterns of interactions that determine the dynamics of an institutional setting. Finally. Section 8b.4 discusses the different outcomes that these interactions produce.

8b.1 Exogenous Variables

The exogenous variables that affect the action situation are the physical conditions surrounding it, the attributes of the community and the rules that govern the behaviours of the actors involved in this level.

8b.1.1 Biophysical Conditions

Manikganj is a district under the division of Dhaka, situated in central Bangladesh, with an area of 1,384 km^2. It receives an annual average rainfall of 2,376 mm. 5 river tributaries flow into the district and water is available in abundance in the district. There is plenty of rainfall occurs during the months of May to July. The annual rainfall recorded in 2011 was 2376 millimetres(Planning, Of, People, & Of, n.d.). The district is divided into 7 *Upazila*s or Sub-districts. *Manikganj Sadar* is one of them. These *Upazila*s are further divided into 65 Union Councils or 1660 villages(Planning et al., n.d.). 5 out of 7 *Upazila*s in *Manikganj* suffer from the threat of water quality as high concentrations of arsenic between the ranges of 0.27 to 1.96 mg L^{-1} have been found in the groundwater of the region(Akter, Mia, & Zakir, 2015). Currently, the most commonly adopted technology for water source is deep tube-wells amongst the community members as it is easily available and cheaper to construct. There are 3 groundwater based PWSs running in 2 different *Upazila*s (refer to interview). The challenge lies in increasing this number to suffice the demand of the population of the region. As of now, 1 piped water scheme covers up to 200 households, but the demand is much higher than that (refer to interview). Due to the insufficient number of piped water systems, the communities have to rely on deep aquifers but also sometimes arsenic contaminated shallow tube-well water for drinking and cooking.

8b.1.2 Attributes of the Community

Demographic Attributes

As per the 2011 census data, the population of *Manikganj* is about 1.4 million with a population density of about 1007 persons/ km^2(Planning et al., n.d.).The average size of households in every *Upazila* is about 4 persons. The population of females is slightly higher than the population of males with an about 50-50 M/F sex ratio. The literacy rate has been recorded to be 49.2%, with more number of females being educated than males. The economy of *Manikganj* is predominantly agricultural. Out of total 293,977 holdings of the District,

58.19% holdings are farms that produce varieties of crops(Planning et al., n.d.). Agriculture, poultry farming and dairy farming are the most common occupations. There is not much engagement in non-farm activities such as manufacturing, construction and trade(Planning et al., n.d.).

Social Attributes

Social and cultural attributes of a society play a very important in how organisations function and deal with formal institutions. Bangladesh is a society with high power distance, where the hierarchal organisation of rules is considered very important(Hofstede, 1991). People accept and mostly treat formal rules from a higher organisation as instructions to follow rather than teamwork to realise a common goal. The hierarchical order of instructions with not much room for justification is common. This high power-distance has a negative impact on the action situation, as it has widened the information gap between the different tiers of the government- the Central DPHE-Local DPHE-*Union Parishad*. The actions of the Local DPHE and the *Union Parishad* will reflect on this attribute in further sub-sections. Another important attribute is the high masculinity index. It affects the participation of women in meetings and workshops held by the *Union Parishads*. This has an impact on the site selection for water supply system construction.

8b.1.3 Rules in Use

The actors at this level operate under two levels of rules: collective-choice rules and operational rules. Constitutional rules are not applicable at the local level, as they do not directly have any impact on the local governance and day-to-day decision making of organisations.

Collective-Choice Level Rules

The national policies define specific institutional functions for the local governments to follow. The actors at this level operate under the framework of national policies, as per the tasks assigned to them by the central stakeholders. Non-governmental stakeholders may operate independently from the local government but are still restricted by the roles assigned to them as per the policies. These collective-choice level rules are:-

1. Representation of Central DPHE at the district level to ease communication and coordination activities and eventually move towards decentralized planning and delivering safe water options through grassroots level local government institutions (LGIs).
2. Local DPHE is directly responsible for district-level identification of arsenic regions, coordinating the scheme construction, providing the technical guidelines to contractors or entrepreneurs and monitoring schemes post-implementation.
3. The *Union Parishad*, the lowest level of government representation in rural areas, would be the main government organisation governing local communities without any third-party involvement. The UP chairman would head all the villages in that union and communicates directly with the village people via group discussions, meetings and workshops.
4. In the NPSWSS 1998, the Union was given the power to "*have a direct role in planning, implementation and maintenance of rural water supply and the activities of public and private sector agencies will be coordinated accordingly*(*National Policy for Safe Water Supply & Sanitation 1998*, 1998) ." The aim was to allow all implementation of rural water supply to be done by a government organisation that has direct contact with the communities.
5. The *Union Parishad* has the choice of selecting either public or private or both sectors to carry out rural water projects.
6. According to NPAM 2004, the UP has the lead role in initiating the overall arsenic mitigation program(*National Policy for Arsenic Mitigation 2004*, 2004). They are responsible to carry out actions for arsenic treatment taking assistance from NGOs and technical support from the Local DPHE office

as and when required. As an emergency response to arsenic, they also have to coordinate patient management.

7. The site selection of a new safe- water source option is their responsibility.
8. The NGOs can coordinate with the Local DPHE or UPs or both as per their convenience.

Operational Level Rules

The operational level governs the day-to-day decision making of the organisations participating at this level. These rules are not defined by the policies but are institutions formed in the society and accepted as informal working rules. These rules are influenced by the demographic and social attributes described above. They are:-

1. Fewer women participation in UPs and WATSAN Committees due to restrictions in recognizing women's role in society. This operational rule reflects the highly masculine society.
2. Site Selection will be done by the chairman and other respected village elders as they are respectable, elderly and have more knowledge. The UP chairman is in a higher position than others and has the right to choose the area for construction. This operational rule reflects the high power distance in the society.

8b.2 Action Arena

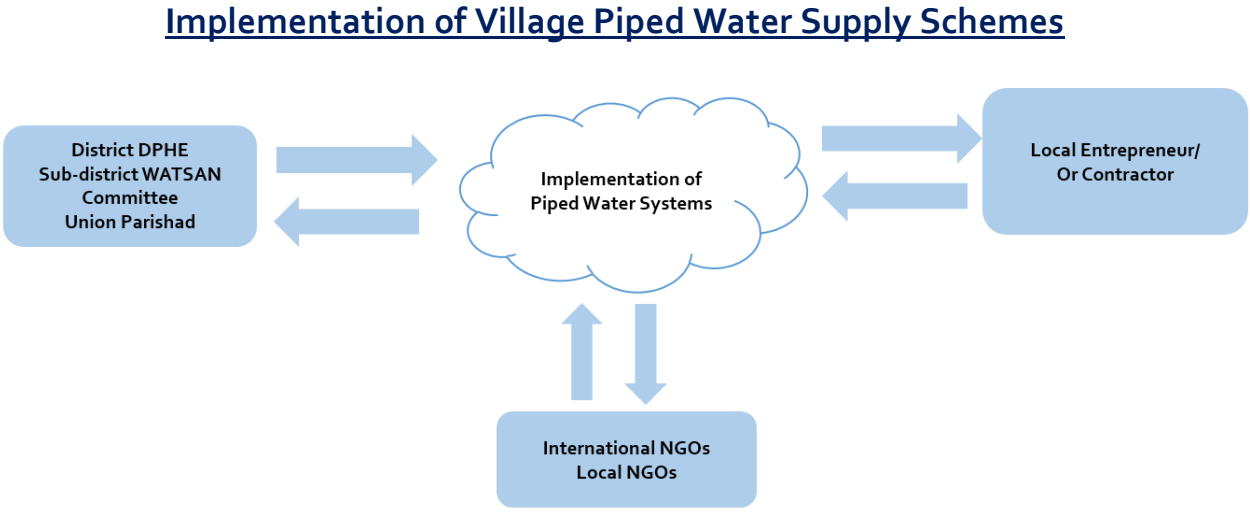


Figure 8. 7 Action Situation and Participants Involved

8b.2.1 Rules of the Action Arena

The action situation is governed by a set of working rules that determine who is eligible to make decisions, what actions are allowed or constrained, what procedures must be followed, what information should be available and what costs are associated with these actions. The working rules for this action situation are briefly summarized below. These rules are defined based on the definition of these rules set by Ostrom as described in Section 7.3.1.

Rule	Definition of Rule for the Action Arena
Boundary Rules	The participants for this action situation are chosen based on the important stakeholders highlighted during interview sessions with central-level participants. Most participants at this level function based on the tasks assigned to them by the central level. Not all participants chosen were interviewed but if their role is important to understand the outcome situations, they are considered in the action arena.
Position Rules	The positions chosen for the participants of this action arena are implementer, seller, motivator and coordinator. Refer to Appendix-C for the function associated with each position.

Authority Rules	Actions of participants are determined with by the organisation's goals and targets it aims to achieve. The actions of local government organisations are institutionally defined in the policies and guided by instructions from central stakeholders. The actions of other non-governmental actors can be driven by humanitarian motives or financial gains.
Information Rules	The participants of this level act as a bridge between the central decision-making organisations and the local communities. Most information available to participants at this level comes from the local communities. They receive relevant instructions from the central bodies. They mediate information accordingly between the central level and the local communities. Information sharing with central stakeholders happens via formal methods of communication, but most communication with local communities is informal. The social attributes of the community and the cultural dimensions affect the methods of communication.
Aggregation Rules	The control each actor has over its actions is determined by their organisational mandate. The non-governmental actors are controlled by contractual agreements with governmental actors.
Scope Rules	They determine the scope of actions that the participants are allowed to take within their organisational framework.
Payoff Rules	The payoff rules are determined by the costs and benefits of actions that participants take. The costs involved in carrying out actions in these action situations are borne by the higher authorities of the government. Some of these costs are also retrieved from community members in the form of tariff rates, as in the case of the local entrepreneur in this action situation.

Table 8. 3 Rules of the Action Arena at the Local Level

8b.2.2 Participants and Positions

Following the rules, the participants are chosen, and positions are assigned to them as shown in the table below.

Participant	Function	Position
District DPHE	The main organisation representing Central DPHE at the district level. There is usually one local DPHE office the in a district managing 5-7 sub-districts/*Upazila*s.	Implementer
WATSAN Committee (*Upazila* Level/ Sub-district level)	Fromed in every sub-district coordinates activities of the DPHE, the NGOs and other stakeholders to the *Union Parishads*, under that sub-district. It bridge the gap between the local DPHE and the UPs. The head of each sub-district WATSAN committee communicates with the local DPHE chairman.	Coordinator and Motivator
***Union Parishad* (UP)**	Communicates between the union and the local DPHE. Most communication between the rural communities and the local DPHE happens via the UP chairman.	Implementer, Coordinator and Motivator
Local Entrepreneur (LE)	The LE is selected by the local DPHE chairman for building the PWS and handling O&M of the system. He has the technical capability to construct the system following the guidelines from local DPHE engineers.	Seller
SIDKO(Contractor[3])	A representative of contractors who is hired to construct the water supply systems and the treatment plants in arsenic affected regions.	Seller
NGOs (International and Local)	International NGOs are mainly involved in development and design of the system. They collaborate local with NGOs to help raise awareness about arsenic, the types of technologies available and create demand for a community-based PWS.	Motivator

Table 8. 4 Participants Involved in Action Arena at the Local Level

[3] A contractor is usually hired by an NGO or a private organisation such as HYSAWA to build the system. Developers who develop the system without DPHE involvement prefer to directly hire an external contractor rather than a local entrepreneur. DPHE also sometimes directly hired a contractor to build a scheme without a bidding process. The model of hiring a local entrepreneur to do the same job, was introduced only recently. The difference between the entrepreneur and the contractor is that, the entrepreneur stays involved in the project for some years post implementation while the contractor serves his project period and then leaves the site.

8b.2.3 Actions of Participants

The participants chosen each carry out different actions which influences the action situation, some negatively and some positively. These actions are described below.

The implementer: District/Local DPHE

The local DPHE in *Manikganj* carries out activities of mobilizing resources for testing water quality in the different sub-districts, communicating the need for safe water options to the central DPHE, hiring the contractor as and when required and monitoring the construction process. When a request for a PWS is received via the *Union Parishad* chairman, they raise the request to the central office. Once the request is approved, with the help of the local government they organise a bidding process to hire an entrepreneur who is given the construction assignment if he can handle the technicalities of the project. The site selected by the UP chairman is also evaluated by them to check if it is technically feasible to build a scheme at the particular location. When the construction begins, they monitor the process of pipeline construction and the design plan. Once the project is completed, it is handed over to the UP chairman. As of now, they have implemented only 3 PWSs in *Manikganj* district of which 2 have been fairly performing (refer to interview). They have also taken regular monitoring activities for these systems to ensure they are working well and the community is not facing any technical difficulty. The interview with the local DPHE engineer gave an impression of them following the instructions of the central DPHE and not really having scope to carry out many activities. The engineer mentioned in the interview that, *"The Central DPHE has the decision-making power. We assist in ensuring quality and implementation. We at Local DPHE only help to implement and we do not play any major role in the decision-making process* (refer to interview)*."*

He also emphasized the need to realize a system which is more participatory with the local government and caters to the need of the communities.

"The main flaw in this system is that the donor has this idea wherein he says this is my system and you find the place where it will be most successful. So, we have to find a spot where it will be sustained by the community and not find a spot where it is actually needed. This system is not participatory at all. This process needs to change. We have to cater to the needs of the people, so the system should be designed by them (refer to the interview)."

The local DPHE in *Manikganj* does not carry out any feasibility studies to ensure the need for the system (refer to interview). If a demand is raised by the UP chairman, then accept that request as a community request and raise the request form at the central office. There is not enough member staff at the local office to carry out a feasibility study or to verify if the demand is coming from the community or an individual who can afford to pay the entire costs. There are just about 4 members in the office at the local level and they must manage activities related to water, sanitation and hygiene all by themselves. The issue of an understaffed local DPHE was raised by multiple interviewees including the World Bank official. Max foundation and HYSAWA explained that one of their reasons for directly collaborating with the UPs is that they believe that DPHE doesn't have the human resource to handle so many activities and stakeholders.

"DPHE is a one-man show. There is not enough staff at the ground-level to handle so many issues. They handle multiple activities of a WASH for an entire district and only 4-5 members are sitting in the office. There is too much burden on them to coordinate multiple stakeholders (Max Foundation interview)".

"DPHE is good at handling technical activities. But they are unable to carry out pre-motivational activities and monitoring activities. There are very fewer people at ground level to handle a large district area (HYSAWA interview)."

The DPHE is also many times unable to handle large-scale technical difficulties such as broken pipelines in particular areas. This issue was highlighted by the Village Piped Water Committee head in *Manikganj Sadar* district where a PWS is installed. He mentioned that,

"There is a less number of trained people for repairing the pipelines or any other damages. More people are required for proper construction activities and to fix the broken pipelines. When these repairs take a longer time to be fixed the motivation of people to use the system also decreases. It brings issues of trust amongst communities and then they would prefer to rely on tubewells (refer to interview)."

The DPHE organises some campaigns or drives to spread arsenic awareness in the district. This usually happens once or twice in a year. This is done with the help of the WATSAN committees at the *Upazila* level. But usually, they rely on the local NGOs to handle the motivational aspects of the problem. They mostly get requests for deep tubewells and not PWSs. The main reason being that the communities are unwilling to pay for water. As mentioned in the interview,

"Deep tubewells are cheaper to install and communities don't have to pay monthly tariffs. So they prefer deep tubewells. If we are able to find a spot at a certain depth where is no arsenic, then we install it there. There is not much demand for PWSs. This has also lead to many tubewells installed in the area and it is getting difficult to continue monitoring the water quality for so many tubewells (refer to interview)."

The implementer: *Union Parishad*

The *Union Parishad*'s role in the constitution is explicitly defined and responsibilities are assigned to them by the policies. Giving them so many responsibilities requires increasing their financial management and social mobilization capacity, but this is no the ground reality. The *Union Parishad* office visited had just the chairman and the secretary handling all responsibilities of the local WASH activities. Despite their lack of human resource, their role has increased acquiescently over the years. Private organisations want to work with them directly. Organisations such as HYSAWA and NGOs like BRAC have provided them logistics support, management and resources to execute their plans. They accept or allow these organisations which much resistance and thought, with the intention that they will bring rural development.

Site Selection

Site selection for the PWS is important for the success of schemes. As per the policy site selection is supposed to be done by the community members themselves allowing them to choose a location convenient for all under the overall supervision of women members of the *Union Parishad*/WATSAN Committee, keeping in mind access to as many people as possible. It should ensure close proximity to households who are not participating in the system so that they have access to safe water via the point source, especially women and poor households. The Union chairman has a major say in the site selection. But, there have been multiple cases of site wrongly selected in a location where not many communities reside. These schemes may not be able to serve some households due to the inability to build pipelines in certain regions. Building schemes in such regions means excluding people who need safe water. Sometimes, the site is selected close to a landowner's residential vicinity. This issue was pointed out by a DPHE official at the central level who mentioned that *"Many times, site selection is not in our hands. The WATSAN Committee at the Union Parishad level decides the site. Sometimes, it happens that they can say that we need the piped water system in this area that may not be an affected area. It can be that the population in that part of the village is not much. Still that site is selected. So, the plan is ready, and the scheme is ready but, the site selection is not in their hands. Hence, the plant is set up in places where there is not so much crisis. If the site is wrongly selected, the system fails in 2 years* (refer to interview)*."*

Also, the role of women in choosing the site has been highlighted by the. The on-ground situation is such that women members of the WATSAN committees are often not even present at meetings. The socio-cultural attributes of the community are reflected here, as masculinity score of Bangladesh is relatively high and active role of women in the society is not encouraged. Inactive women participation could mean that women don't feel the need to represent themselves in decision making. The union's actions to select the site may differ per union but it is their most important responsibility to make sure the scheme is sustainable over the long run.

The Coordinator and Motivator: WATSAN Committee (*Upazila* Level)

The WATSAN Committee at the sub-district (*Upazila*) Level should ideally function as a bridge between the sub-district and the district level DPHE office. It should gather information from all the unions under it and communicate with the local DPHE, organise awareness campaigns to motivate people to participate in WASH activities and support unions in their awareness tasks. However, the WATSAN committee at the *Upazila* level is practically inactive. They only become active when events are organised, or workshops are held by the central DPHE. Few members of the committee show up at these events. This problem has been mentioned by multiple interviewees, *"WATSAN committee is not so active. Unless they have been asked to carry out activities from the central level, the WATSAN committee usually remains inactive. There is no extra incentive for them to focus on WASH activities".* The inactive WATSAN committee creates a huge information gap between the sub-district government and the local DPHE which will be discussed in detail in Section 8b.2.4.

The Seller: SIDKO[4]

SIDKO is hired to set up community-based treatment plants to filter out arsenic and Iron from the water. Similar to SDIKO, contractors are usually hired via a tendering process to build the scheme or only treatment plants for the scheme. They have the treatment technology and are willing to sell their skills and technology for financial profit. Their technology is approved by a research board under the government (in this case it is BCSIR). They get paid for the project depending on the kind of agreement they have with the developer. SIDKO, for example, is hired by UNICEF and the site is chosen and given to them. DPHE engineers get involved once they begin the construction. The initial investment is from the organisation itself and they are reimbursed once the project is completed and the system is thoroughly checked by local DPHE engineers. NGOs can also directly hire them for the same. The contractor's willingness to participate in the bidding process very high as it is a business for them. They have to ensure well-installed systems with a 2-year post-implementation monitoring facility to get more business. Only technically sound systems can get them more projects (refer to interview).

The Seller: Local Entrepreneur

The local entrepreneur has the same tasks as that of the contractor. He builds the system when hired by the developer. The major difference is that he invests 30% of the money himself which he expects to get back from the communities and not the developer. In this World Bank introduced model, the 30% of the investment comes back to the entrepreneur in the form of water tariffs that he collects from users within a period of 12-18 years. In return, his responsibility is to handle the O&M of the system and any other technical difficulties. All PWSs in *Manikganj* have been constructed by the LE. The advantage of having a local

[4] SIDKO does not operate in *Manikganj* district but it was interviewed to get a perspective on the actions that contractors take. A contractor can be an important participant to consider in this action situation, because even though it does carry out functions *Manikganj* district, it may in other districts. Understanding the contractors role can help to understand better the outcome situations at the local level.

entrepreneur instead of the contractor to build the system is that he is locally hired from within the district (usually a local construction company with some technical knowledge). Since he/she lives within the area, the community is familiar with him and can place trust in him, especially when it comes to matters of money. This helps to tackle the issue of trust within communities well and lets ownership get decentralized to the bottom of the pyramid. The issue of trust is an important one when it comes to paying the initial down-payment. This was highlighted by the local DPHE and a fieldwork expert from EPRC.

"People are very sceptical to pay for the system. They want to be able to receive the service before they pay for it. Sometimes, people feel exploited, especially when a local person is not involved. If any NGO official is asking them for money, they are not sure if their money is in the right hands (refer to interview)."."

The Motivator: NGOs (Local and International)

The NGOs work at grassroots level. They first identify relevant problem areas and community clusters where the technology is yet not available and needed. They organise workshops to create awareness about water quality, help them to analyse the need of the village and raise demand for a water supply system. These NGOs usually have their own set of participatory tools which they use to identify peculiar community attributes, perceptions, economic status and site selection mapping. Max Foundation, for example, uses a MAX-WASH approach to raise awareness about WASH activities. Posters, maps extra are sometimes used to communicate better with the community, especially for site selection. Once the demand for a scheme is realized, they help communicate the message to the UP chairman and also coordinate certain activities with the local DPHE. Most NGOs operate as per their organisation's goal.

NGOs at this level may also choose to play the role of the implementer themselves if they are directly dealing with the union for implementation. They may or may not partner with the DPHE for their operations of implementation.

8b.2.4 Information about Actions

The communication amongst the participants comes across as a combination of formal and informal decisions. At the central level, the methods of information communication are very procedural/ policy guideline-based. But, at the local level, the information channels are both conventional and informal, reason being, it deals with both the communities and the central DPHE. The central DPHE takes a very top-down instructional approach while the *Union Parishads* are *Upazila Parishads* are informally organised and following a combination of formal informal rules.

All information that is passed on to the local DPHE is related to the implementation procedure of the water supply system only. There is technical guideline setup for the local DPHE to follow and tasks are executed as per instructions. The local DPHEs are invited to participate in the central level meetings as and when required but are not part of the planning and designing process. This was communicated during the interview process with the local DPHE. From the on-ground situation, it is identified that there is a huge communication gap between the central DPHE and local DPHE. The local DPHE mentioned in his interview that *"We at Local DPHE only help to implement and we do not play any major role in the decision-making process. The design and instructions are given by the DPHE and we follow those* (refer to interview)*."*

At the same time, an officer from the central DPHE mentioned,

"Yes, there is a gap. There is not much communication. At this moment, JICA is trying to build the information gap. Local DPHE, Upazila and Union, Parishad, they meet monthly so definitely, amongst them the information flow is stronger than between local and central DPHE. We do not meet often to discuss (refer to interview)."

The information gap between the central and local DPHE does have institutional reasons for it as the meetings between them are not organised frequently but can also be attributed to the societal attribute, high-power distance. The centre expects that local DPHE has enough instructions to take charge of the situation and the local DPHE believes in following instructions from the centre without giving much feedback about the local situation or community problems.

Similarly, the information flow between the local DPHE and the *Union Parishad* is also very haphazard and uncoordinated. The WATSAN committees at the *Upazila* level are inactive and the local DPHE in *Manikganj* is directly dealing with the *Union Parishads*. 65 Union Councils having to deal directly with one local office with very less staff for issues of maintenance, site approval and technical difficulties. This adds a lot of burden on the local DPHE. The information gap between these organisations is highlighted in figure 8.8 below. It shows that the local DPHE has to deal directly with the union councils of *Manikganj Sadar* sub-district with any intermediary body. A similar situation can be replicated for the seven other sub-districts of *Manikganj*.

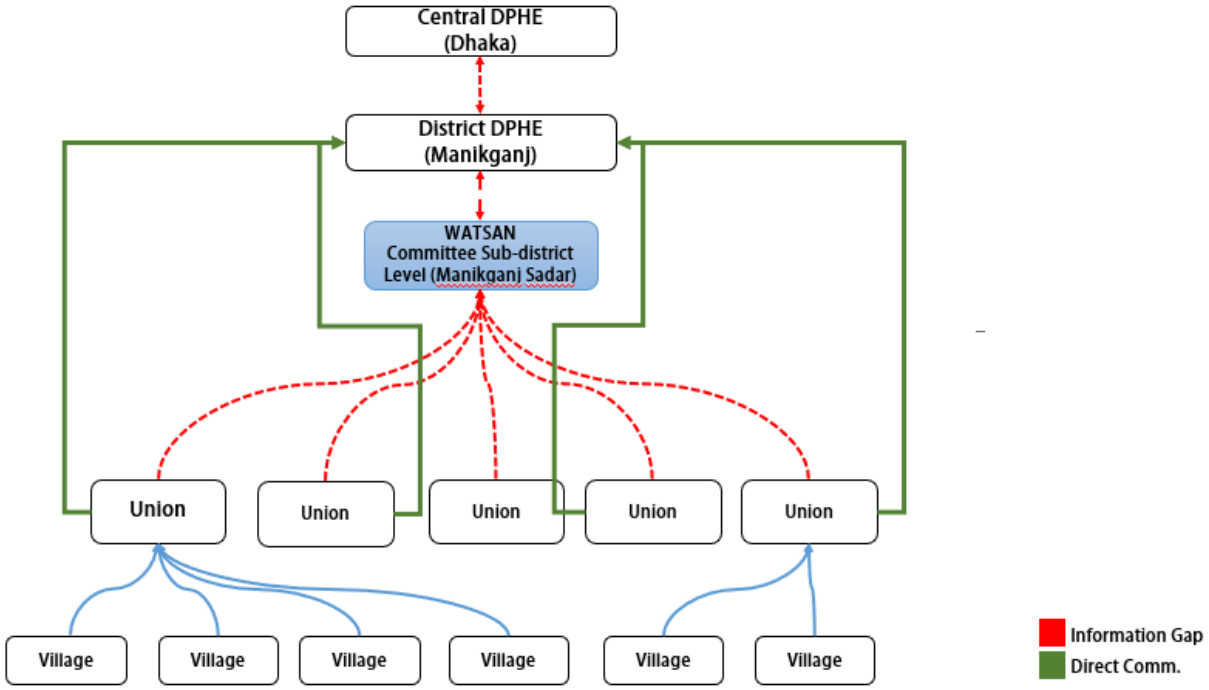


Figure 8. 8 Information Gaps due to inactive WATSAN Committees

The information flow between the sellers and the implementers are usually smooth as the sellers have to directly deal with them for their payments and technical assistance.

8b.2.5 Control over Actions

As per the policy guidelines, the local level organisations have a wide scope for taking control of the on-ground situation which is encouraged by central DPHE. This scope is expected to increase as the government stressed on decentralized planning as much as possible. The limitations of the actions that the local DPHE can take are only restricted to following a technical design plan. They have the freedom to work with NGOs, *Union Parishads*, carry out awareness campaigns and motivational activities, to make implementation successful. As observed from the field situation, the local DPHE doesn't seem to have enough manpower to carry out the activities it can. Due to an inactive WATSAN committee, it's the main function becomes mostly to coordinate tasks between the union council and the central DPHE with the limited amount of information it has. The local DPHE does have control of who to choose as the local entrepreneur to build the system. Local

DPHE, unlike the central DPHE, is not limited to project timelines to carry out monitoring work post-implementation, but it doesn't have enough capacity for it.

Contractors and local entrepreneurs are also limited to the scope of their project period including monitoring tasks, which is usually 2 years for the contractor and 12-18 years for the local entrepreneur depending on the situation after which the scheme is handed over to the community to take over.

Union Parishads and NGOs, on the other hand, have a lot of control over their actions. UPs are given control over all the actions of the private and public sector, by the policy itself. NGOs have the choice to take control of situations as and when required.

8b.2.6 Net Costs and Benefits

The actions that each participant in this action situation is meant to carry out involves high monetary costs but also opportunity costs of which they do not see much benefit yet(Boardman et al., 2010). This is the main demotivation for actors to take initiatives to improve situations despite having the freedom to do so. *Union Parishads* and Local DPHE functioning at this level can organise awareness campaigns and local workshops with support from NGOs much more frequently. The UPs can have a lot of influence and play a major role in shaping the mindset of communities, but they don't see much incentive to do so, as they don't see the benefits of their actions yet. The have financial and technical resources to do so. The WATSAN committees are not active as there isn't any incentive for them to operate. In conclusion, in order to invest in their actions, the benefits need to be realized by all the participants operating at this level.

8b.3 Patterns of Interaction

Figure 8.9 shows the patterns of interaction of the participants in this action situation clearly. Local DPHE has bilateral interactions with all stakeholders to coordinate the tasks of implementation. The *Union Parishad* also interacts directly with the NGOs and the Local DPHE. The WATSAN committee, if active, is expected to be the link between the local DPHE and the U.P. In this action situation it is inactive and hence their interactions are depicted in dotted lines. These interactions have outcomes that affect the action situation, some positively while others negatively.

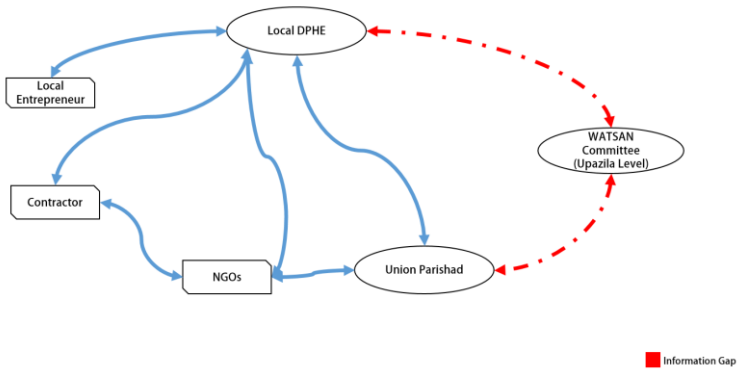


Figure 8. 9 Patterns of Stakeholder Interactions at the local level

8b.4 Current Institutional Outcomes

The outcomes of all the actions that participants carry out results in the *"Implementation of Piped Water Schemes"* that become ready to be used by communities in villages. Some of the actions of all the participants and the physical environment that they are operating in, result in favourable outcomes, some fail to deliver the outcomes expected while some actions that are not executed also affect the outcomes of the action arena. These outcomes are:-

Outcomes that affect the Action Situation Positively

1. The local-entrepreneur model introduced has been able to handle the issue of trust within communities positively. This model should be encouraged further by the central DPHE.
2. The bottom-up flow of information to raise a request for the implementation of PWS at the Local DPHE office is well coordinated with NGOs, UP and Local DPHE. Major challenges in this process have not been identified.

Outcomes that affect the Action Situation Negatively

1. The Local DPHE only plays the role of a coordinator at the local level. It is not involved in the design process and merely follows tasks as and when instructed to do so. The high-power distance attribute in the society is reflected here as there is no institutional mechanism of information sharing between the district DPHEs and the central DPHE.
2. The issue of less DPHE man-power has been highlighted by many stakeholders and also seen on-ground where an office of the local DPHE was staffed with only about 5 members. These 5 members are responsible for handling the entire WASH sector of the district. Due to this reason, there is an overlap between the roles and responsibilities of the Local DPHE and *Union Parishads*. This problem has been identified by the LGD and highlighted in the SDP 2011-2025(*Bangladesh Government Sector Development Plan (2011-2025)*, 2011).
3. There is a preference for tubewells over any other technology in *Manikganj*. This has been reported to be the case in other districts as well. Despite this known problem, until now there is no policy for controlling or regulating the number of tubewells installed in an area. The number of privately installed tubewells is increasing rapidly in the district leading to groundwater in the region drying up. Many tubewells have been reported to have completely dried up.
4. Inactive WATSAN committees are a result of no incentives/motivation to function. The inactive WATSAN committees and the hierarchical nature of the problem have widened the gap between the local and central DPHE.
5. The role of women in site selection procedures is minimal due to cultural influences. Women don't participate in committee meetings with the union and local DPHE, even though they have 30% reservation constitutionally. Less women participation will be explained in detail in the next action arena (community-level scenario).

8b.5 Summary

This chapter is intended to carefully analyse the contextual factors that affect the construction phase of the process of implementation of rural PWSs. It begins by analysing the exogenous variables that create the environment for local governments act. Then it describes the actions that each stakeholder takes, the expected results of their actions and the actual results of their actions. It discusses the information gaps amongst the actors at this level, the costs and benefits of activities they carry out and the amount of control they have over their actions. The patterns of interactions amongst these actors lead to the outcomes of the action situation. These outcomes will be evaluated against Ostrom's evaluative criteria further in Chapter 9. Figure 8.10 below summarizes the action arena.

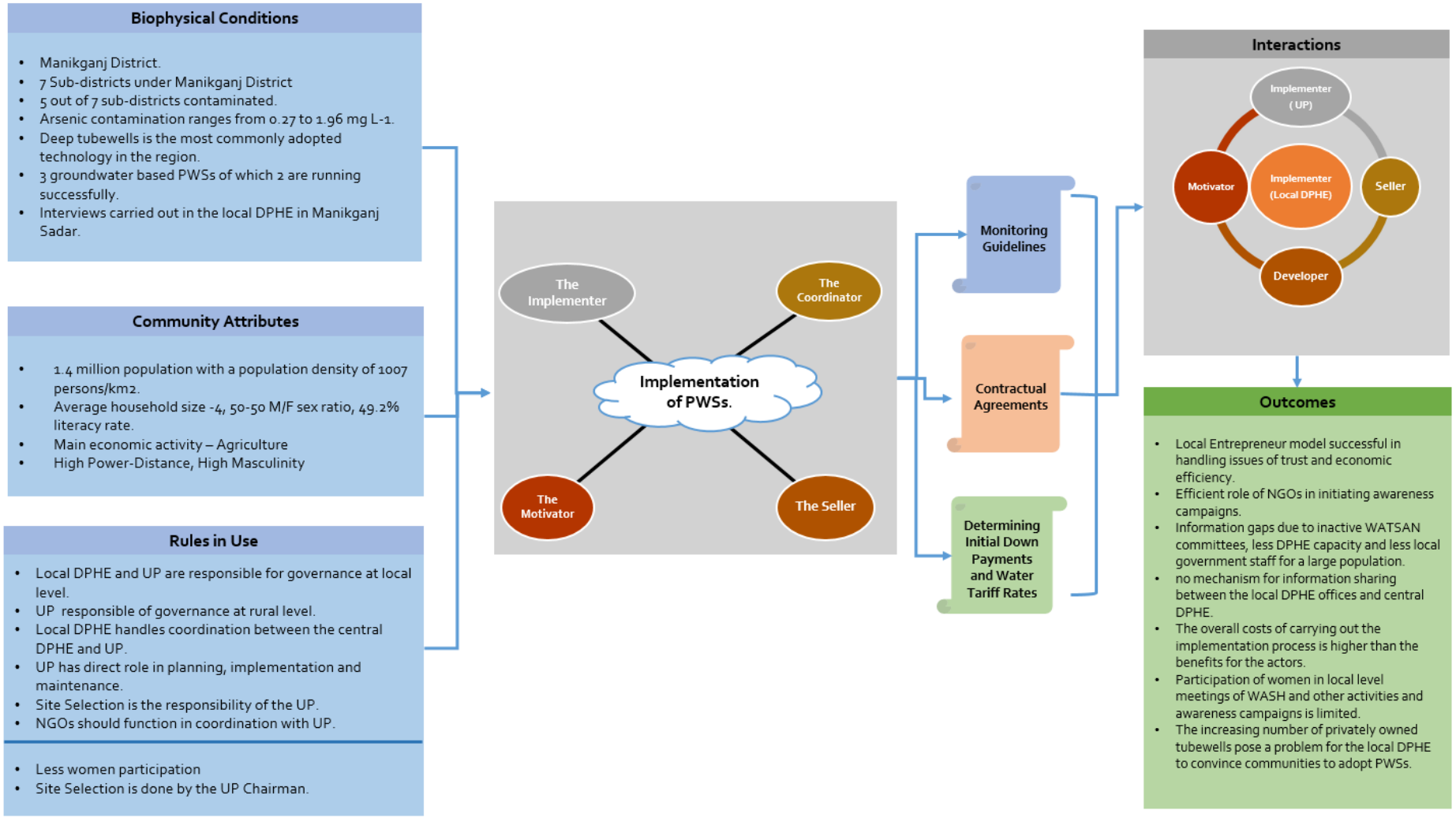


Figure 8. 10 Summary of the Action Arena "Implementation of PWSs"

8c

Application at the Community Level

Community Adoption of Village Piped Water Scheme

This sub-chapter discusses the IAD components of this action arena. This action arena analyses the community level situation based on the conditions in the villages – Barai Vikora and South Mitra located in the union of Betila Mitra in the sub-district of Manikganj Sadar. Interviews with the Union Parishad office were carried out in the Union Betila Mitra in the sub-district of Manikganj Sadar. Community interviews were carried out in the villages – Barai Vikora nd South Mitra. The problem areas identified are specific to the region but do allow to gauge the general conditions at community level in other unions. The field perception of the problems identified allows to make conclusions which may be generalized for other rural regions. Section 8c.1 discusses the exogenous variables that affect the structure of the action arena. Section 8c.2 discusses the action arena (rules of the action arena, positions, actions, information, participants and control, net costs and benefits) that make up the action arena. The action arena at this level is divided to tow sub-action arena – Adoptability and Sustainability. Each of these sub-action arenas and the outcomes of their actions are discussed in sub-sections of 8c.2. Section 8b.3 discusses how the exogenous variables and action area combine into patterns of interactions that determine the dynamics of an institutional setting. Finally. Section 8b.4 discusses the overall outcomes the combined action situation.

8c.1 Exogenous Variables

The exogenous variables that affect the action situation are the physical conditions surrounding it, the attributes of the community and the rules that govern the behaviours of the actors involved in this level.

8c.1.1 Biophysical Attributes

Manikganj Sadar is a sub-district in *Manikganj* district with an area of 214.81 km^2. It has 10 unions under its administration, *Betila Mitra* being one of them. *Betila Mitra* is a small union with a population of 20,576. Of these about 50.2% are males and 49.8% are females (Census data 2001)('*Manikganj Sadar Upazila* - Banglapedia', n.d.). The literacy rate of the union is about 52.66%, which implies that the population of the union is fairly educated and aware('*Manikganj Sadar Upazila* - Banglapedia', n.d.). There is no clear demarcation of the villages, most of the community households are scattered across the area but the union has about 25-30 villages under it. There is one PWS installed in this union in the village *Barai Vikora*. The scheme was implemented by an NGO (Muslim-Aid, UK) in collaboration with the World Health Organisation and DPHE and it serves about 200 households in the vicinity. The most commonly adopted water supply technology is deep tube-wells amongst the community members as it is easy to avail and cheap. The demand for piped water systems is there, as more and more households water a tap-water connection. As of now, the communities are relying on deep aquifers but also sometimes arsenic contaminated shallow tube-well water for drinking and cooking in other village areas. The community of the village of *South Mitra*, on the other hand has no PWS installed and does not receive piped water. It is mostly reliant on tubewell water, which is safe to drink but is slowly drying up over

Figure 8. 11 Piped Water Scheme in Barai Vikora

the years. These physical conditions of the community serves a basis for analysis for the community situation but the conditions may not be the same in all areas of the country.

8c.1.2 Attributes of the Community

Attributes of the community help to understand which community traits affect decision-making process at the local level, reasons for less community involvement and interest in PWSs and why sustainability of these systems is a problem. The literacy rate of the union is above average, which implies that most of the residents have the basic understanding of drinking water quality and health risks associated with it. Households have the basic knowledge of arsenic present in their water and the choice of safe-water technology to make to avoid arsenic from their drinking water. Some attributes of national culture reflected in their behaviour are high power distance, high masculinity index and high collectivism(Hofstede, 1991). The high power distance in the society can be seen when there is unwillingness to take ownership of the system, automatically assuming that it is the responsibility of higher authorities. The masculinity is reflected when less women participate in workshops and courtyard meetings. More women participation can lead to better decision making for water-related issues as they deal with water more than men in their daily lives, (involve in activities of cooking, washing etc.) and thus they are the ones most impacted. The high collective thinking is seen when the decision of the group/ neighbour to opt or not for a PWS affects the individual's decision for the same. If a number of households together decide to have a household tap connection for drinking water that attracts other communities / more number of households too. But, if most households in the vicinity have a tubewell, then it is difficult to convince households to move to piped water.

8c.1.3 Rules in Use

Collective-Choice Level Rules

The actors at this level operate under two levels of rules: collective-choice rules and operational rules. Constitutional rules are not applicable at the local level, as they do not directly have any impact on the local governance and day-to-day decision making of organisations. There are some formal rules but the community mostly operates in a semi-formal/informal settings. The formal rules that were observed during the field visit where:-

1. Union level and ward level committees – Arsenic mitigation committees etc. are recruited with the help of the village members, to strengthen local capacity.
2. UP chairman is assigned the power to take all actions related to the villages under his union.
3. Village PWS committees are formed and the tasks of awareness and building community capacity are assigned to them.
4. Monitoring mechanisms are carried out by the local DPHE as and when required.
5. An operator is recruited by the UP to be the caretaker of the PWS.
6. Village level committees are required to be formed according to the policy. But, their selection process is not constitutional. Mostly, village elders become committee members.

Operational Level Rules

The informal operational rules that are self-defined by the communities are the most prominent. They are:-

1. The UP chairman is the most influential man in the village and highly respected.
2. The village elders are respected and listened to over other members of the community.
3. Women participation is low. Women do not participate in local committee meetings, workshops or campaigns due to cultural reasons.
4. The influence of the decision community members is strong on an individual's decision. It is a collective society. For example, a household who may not be interested to pay for a PWS may get interested if his neighbour is paying for it.

5. Village level committees are formed informally by deciding based on preferences who will be part of the committee. They may or may not exist in some community areas. There are no checks and balances placed on their presence.
6. If water tariff is not paid by any household for 3 months, then it's water connection is disconnected
7. Men and Women play different roles in society. The society operates under the influence of high masculinity and gender inequality.

8c.2 Action Arena

The action arena "*Community Adoption of a Piped Water Scheme*" is a complex nested arena. The word community adoption here refers to,

A rural community being able to realise the need for a piped water connection in their household, raise demand for it and sustain it by handling its operation and maintenance (cost wise and technology wise) until its technical maturity time as been reached.

This definition brings back to the research question that this thesis poses, which questions the adoptability and sustainability within communities leading to systems being left abandoned and not becoming popular in rural areas. Section 3.4 describes the issues of adoption and sustainability that PWSs face. Section 6.2, which reports the as-is situation mentions how these two factors are the key reasons for underperformance of these systems. Furthermore, these factors were again highlighted during the field visit and during interviews with field experts (refer to Table C.2 in Appendix C). Thus, this action arena is further subdivided into two action arenas.

- Adoptability of a Piped Water Scheme by a community
- Sustainability of a Piped Water Scheme by a community

Adoptability and Sustainability are subsequent phases within a community. At first, the community adopts a scheme and when adopted it needs to be sustained (well operated and maintained). A well sustained system makes for a successful model and that further leads to more households adopting a piped water connection. These two factors are interconnected connected. Figure 8.12 shows the nestedness of the action arena "*community adoption of a PWS*" into two sub-action arenas in the IAD Framework. At first the contextual factors and stakeholder actions affecting adoptability of a rural PWS are analysed. The outcomes of actions and interactions of actors in the adoption phase impact the stakeholder actions in the sustainability phase.

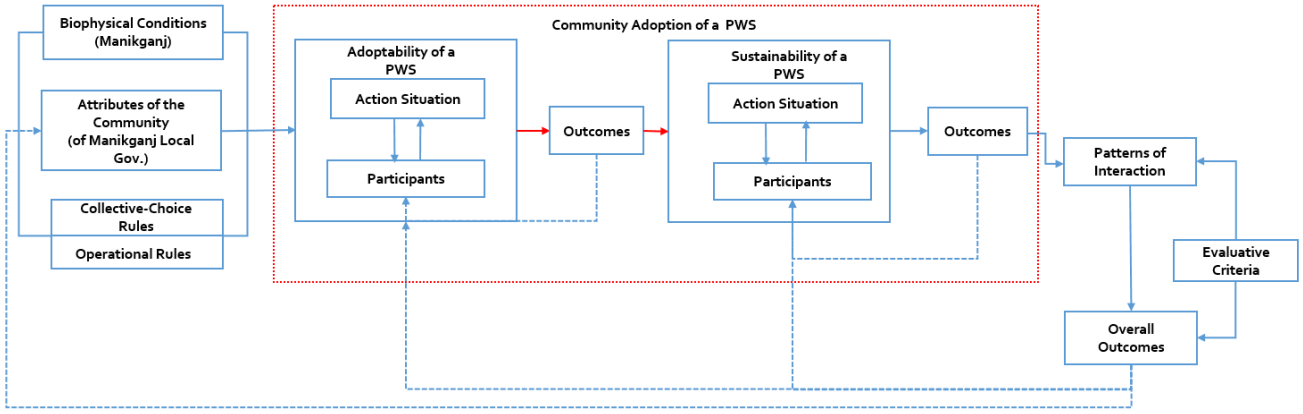


Figure 8. 12 Application of the IAD at the community level

8c.2.1 Rules of the Action Arena

The action situation is governed by a set of working rules that determine who participates in the action arena, the actions they can take, the information they have, the costs involved in actions and the benefits of these actions. The working rules for this action situation are briefly summarized below. These rules are defined based on the definition of these rules set by Ostrom as described in Section 7.3.1.

Rule	Definition of Rule for the Action Arena
Boundary Rules	The participants for this action situation are chosen based on some community level information provided by the local DPHE office and guidance from field experts. The interviews were carried out with the UP chairman at the union office, and community households were visited to gather data about perceptions of people using the system and not using system. Key village personnel, men and women focus groups were selected.
Position Rules	The positions chosen for the participants of this action arena are resource user, seller, motivator and coordinator, caretaker and facilitator. Refer to Appendix-C for the function associated with each position.
Authority Rules	The actions that some participant take to influence the action situation are based on the tasks/instructions given to them by a higher authority (sub-district level government and Local DPHE). The choice of actions of formally governed institutions like the UP and WATSAN committee are based on the role assigned to them in the policy documents and aligned with the goals of SDGs. Participants such as the resource user do not take actions as per any formal rules but are governed by the informal operational rules of the community operates.
Information Rules	Most information available to participants at this level comes from the NGOs. They also have relevant information or instructions from the local DPHE and sub-district level water planning bodies. The participants of this level are more information users than information providers. This includes the field motivators who act based on information provided to them by higher officials. The UPs and WATSAN committees act as a bridge between the local government communities sharing information on either side. Most information sharing happens via informal methods of communication as actors at this level don't operate under any formal rules they are compelled to align to. The social attributes of the community and cultural dimensions affect information interpretation to a great extent.
Aggregation Rules	The control that the UP chairman has on the action situation is determined by the local DPHE's instructions in and in alignment with the policy. NGOs and sellers take actions as per their contractual agreements with the local governments. Other community members, including the members who are given a certain position, have no formal control over their actions. They may choose to perform their tasks or not. There are no sanctions imposed on them for taking certain actions or not.
Scope Rules	They determine the scope of actions that the participants are allowed to take within their organisational framework.
Payoff Rules	The costs involved in carrying out actions in these action situations are borne by higher authorities of the government. Costs of sustaining the system are borne by the community members themselves in the form of tariff rates. The benefits of the actions of participants should come in the form of healthy arsenic free communities with continuous access to good quality water.

Table 8. 5 Rules of the Action Arena at the Community Level

8c.2.2 Participants and Positions

Following the rules, the participants are chosen, and positions are assigned to them as shown in the table below.

Participant	Function	Position
Union Chairman	The Union chairman heads both the *Union Parishad* and the WATSAN Committee at the union level. He has an essential role in almost all the major activities taking place in the villages. The Union Chairman is chosen to represent both the *Union*	Motivator and Coordinator
WATSAN Committee (Union Level)	The WATSAN committee at the union level is formed to take responsibility of coordinating activities of the union with the sub-district level government. It attends to the grievances of unions in regard to WASH sector.	Coordinator and Motivator
Village Level Committees (WATSAN	Various committees are formed at the village level to take charge of community level activities. They communicate between the village and the union. The committee is formed of various elderly and respectable	Coordinator and Motivator

/Arsenic Mitigation/ Piped Water)[5]	village members including women. Each member from each village heads the WATSAN committee of his/her village.	
Local Entrepreneur (LE)	The LE is responsible for handling O&M of the system.	Caretaker
Local NGOs	Help to raise awareness about arsenic, the types of technologies available and create demand for a community-based PWS.	Motivator/Facilitator
Women[6]	Actors are most affected but have least power. Women members can play a major in awareness and adoption of PWSs. Their daily lives are directly affected by issues of water quality and they understand better the problems that come with it.	Resource User
Men	Actors that are affected the resource use and share common property rights on the resource.	Resource User
Village Piped Water Committee Head	The Village PWS head is elected once the system is installed and running to make sure pay tariffs on time, maintain the accounts, handle funds for technical repairs and report to the union if there are any major technical issues that cannot be fixed. He also encourages households to adopt PWSs.	Caretaker, Coordinator and Motivator
Water Tariff Collector	The tariff collector is hired by the LE or the UP chairman to be in charge of collecting monthly tariffs for water. These tariffs are used to pay to hire a system operator and cover other basic operational costs of treatment, cleaning the water etc.	Caretaker
System Operator	The operator is hired to maintain and regularly check the water quality, treat the water and switch on/off the system as per timings.	Caretaker

Table 8. 6 Participants Involved in Action Arena at the Community Level

8c.2.3 Important Community-Level Issues

Before beginning to analyse the action arena, the key issues that affect adoptability and sustainability of PWSs within a community need to be understood. The field interviews with households, women and men, water committee heads and field experts pointed out these main issues at community level. (Refer to Table C.2 in Appendix C)to understand how these 6 major issues were deduced.

1. Awareness
2. Lack of women participation
3. Willingness to Pay
4. O&M issues
5. Willingness to Adopt
6. Trust

These issues of communities will be further elaborated when analysing each of the sub-action arenas.

8c.2.4 Sub-Action Arena: Adoptability of a PWS by a community

The Importance of Awareness in Adoption

The first step towards adopting a PWS in a community is awareness. Communities need to be aware of

a. The presence of arsenic in their drinking water
b. The availability of safe-water options possible to be installed in the village
c. The benefits of having a piped water connection in their household

[5] Most committees formed at the village level – arsenic mitigation, piped water or WATSAN committees play a similar role of encouraging and attending to the communities. The heads appointed for these committees are usually the village elders who have a say in the community. Hence, they are all considered as one actor.

[6] Men and Women are considered separate actors because of the difference in the ways they are affected by water quality issues and the different roles they play in taking decisions of adoptability.

Once communities are aware of arsenic and other contaminants present in their drinking water, and they afford it, they will opt for a safe water source of drinking water. This safe water source can be a deep tubewell (community-shared or private), a dugwell, a PSF filter, RWH or a piped water scheme. In most cases, it is a deep tubewell. Thus, the main competition of PWSs is with deep tubewells. Awareness about the benefits of a PWS would attract more attention towards it and help to increase adoptability of the system.

The Union chairman, WATSAN Committees, NGOs all work together to create awareness. The NGOs are usually the initiators of the awareness campaigns and they bring together other actors to collectively coordinate and run these campaigns. They select the community clusters living in high arsenic prone areas and based on data to decide which communities to approach. Workshops and meetings are organised by the NGO officials with the help of village elders and other influential people from the village. The awareness level of the community is assessed beforehand which defines the goal of the campaigns. Educated and respected village elders are a part of the awareness building process as they have a high influence and major say amongst the village members. They are usually expected to get involved in discussions. These village elders are often given positions in the Village WATSAN committees, Village piped water committees or other such village level committees formed. The UP chairman is the most powerful person in the village with influence and says in major decisions of WASH activities. He is the head of Union WATSAN committee and plays a central role in awareness and motivational activities due to his position. He regularly interacts with the communities during workshops and meetings held by NGOs and the WATSAN committee, to promote WASH activities. He has been actively involved in the piped water projects in *Manikganj* and consults the local DPHE office in case of any issues he faces. He is invited to workshops and meetings conducted by NGOs to attract larger attention. All motivational activities of the WATSAN committees and NGOs are coordinated by the chairman (refer to interview). Resource users here act as information consumers who are made aware of their situation and expected to show interest.

The interviews with village community members highlighted that awareness about arsenic is not a problem in the region. Various awareness campaigns done by the NGOs and the UPs have created enough awareness amongst them that they are aware of the presence of arsenic in their water and of the safe water options available to them which can help them to avoid arsenic. They mostly prefer a privately installed deep tubewell over any other technology option. This may not be the case in all arsenic affected regions of the country, but it was observed such in the villages in *Manikganj*.

Adoption of a PWS is a matter of being aware of the benefits of a PWS than a deep tubewell. As of now, the communities see the more personal benefit in a privately owned deep tubewell than a community-owned PWS. The actions of participants below would explain further on the reasons for this preference.

Actions of Participants

The decision of a household to opt for a piped water connection is dependent on multiple factors and influenced by actions carried out by the participants of the action arena. The motivators such as the local NGOs, the WATSAN committees, the village level committees and the elderly organise workshops courtyard meetings to make resource users realise the benefits of a piped water connection and encourage them to opt for it. But oftentimes, these meetings are held separately for men and women. The high-masculinity index of the society is reflected here, where women often don't interact with other male members of the society and prefer discussions with women communities only. During these meetings, women relate better to the problems that come with not having safe water to drink for their family and realise better the advantages of having a tap connection. Majority of them are the ones dealing with water issues in the village. They must take care of their children's health, walk far off distances to collect water. Thus, they do realise the benefits that a piped water connection can bring to them. However, the decision- making power lies with the male members of the household when it comes to matters of money and agreeing to pay monthly water tariffs for

the tap connection. Men often cannot relate to the problems that women face. As most meetings are held separately for men and women focus groups, it is difficult to convince them to foresee the benefits of paying for a tap water connection and come to a consensus to pay for water. This difference in the male and female interpretation of the problem affects greatly the decision of communities to adopt a PWS.

Women participation in WATSAN/ Arsenic Mitigation/ Piped Water committees is also very less. Although women have 3 seats reserved in a committee of 10, they often don't attend these meetings as they believe their participation is not required or necessary(refer to interview).

The decision to raise the demand for a system is the collective decision of the community. WATSAN committees, Arsenic Mitigation Committees, Piped Water Committees, village elders, local NGO activities can help them in recognising which water options are most suited for certain regions by organizing participatory games and educational campaigns. But, the resource users are the consumers of the technology and the final decision to opt for the kind of technology is in their hands. It may be influenced by the functioning of these organisations. For example, WATSAN committees not being active at the union level does impact adoptability. But, ultimately it is up to them to choose if they want a PWS.

Analysis of Field Interviews

As mentioned before, in *Manikganj*, as well as in most other water-stressed regions of the country, people mostly prefer deep tubewells. The decision to choose a PWS would depend on,

1. Ability to Pay - If the ability to pay for a PWS is very low amongst some households(for example amongst very poor households) then they either opt to choose a cheaper option - safe or not, or they get their water from households that can afford to pay for it. They may also have access to government-subsidized point source water connections. Assessing ability to pay is an institutionally complex issue is left out of the scope of this action situation.
2. Willingness to Pay-Willingness to Pay is a combination of four important factors
    a. Not able to foresee benefits of the system - Costs of the system outweigh benefits. In economic terms, the benefits of tubewells outweigh the benefits of PWSs.
    b. Trust in implementing stakeholders - Familiarity with the local entrepreneur and the village elders who ensure them a well-installed system with good drinking water gives them confidence that their money is in the right hands.
    c. The initial investment required – High initial investment is required from the community to ensure their interest in the system.
    d. Monthly costs required
    e. Social Pressure

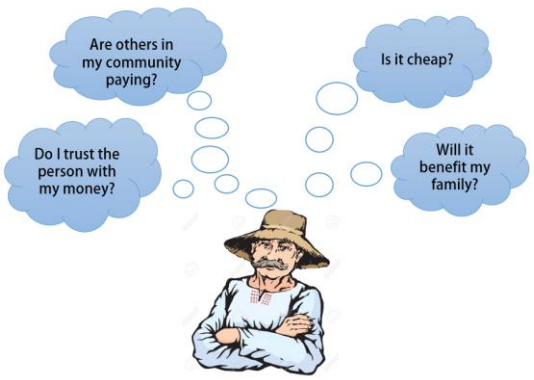


Figure 8. 13 Willingness to Pay Factors

It is difficult to predict which of these factors is most important for communities but a combine of these five identified factors would influence the community's decision to adopt a PWS. If communities opt to install privately owned deep tubewells, it may be because it is not so expensive (requires only an initial investment and no recurring costs), faster to install, water is readily available at all times and not stored for long time and are personal to their household. A community based deep tube well option is usually an option when households can't afford a privately owned tubewell. In either cases, the monthly tariff costs and initial investment is low, there is some level of trust in the implementing stakeholders and they have collectively as a community decided to select deep tubewells. On the other hand, PWSs as of now are

a. Expensive to install - require a high initial investment
b. Charge higher water tariffs than any other systems
c. Take longer time to build and do not provide continuous water supply throughout the day.

Due to these three major reasons, most feasibility studies carried out for PWSs don't give positive results and the adoptability of PWSs in village areas is very low.

Information about Actions

From the perspective of the central government, most resource users have the required amount of information to make decisions about the water issues of their community. According to them, motivators give them enough information for them to be able to raise demands for their own system. However, ground reality reflects otherwise. Although resource users are at the receiving end of information, the channels of communication are varied, haphazard and very informal. The top-down implementation process makes communities reliant on NGOs for information. Multiple NGOs, the *Union Parishad*, the village committees give them different kinds of information based on their bias towards the organisation they work with. It is difficult for resource users to deal with a large amount of unorganised information and be capable enough to take decisions of raising demand all by themselves. The flow of information at community level, as what it looks like from the central perceptive is different from the community perspective. They feel there are too many NGOs working in their villages and all give them different advices on water issues and they are not able to understand which technology is the most suitable for them. Thus, they prefer to rely on tubewells.

The channels of communication between the UP chairman, the NGOs and the WATSAN committee members are informal. There may be some contractual agreements between the NGO and the UP but all workshops and meetings etc are held informally and dates are decided through word of mouth. Information gaps exist between men and women when they don't sit together to discuss water issues and don't tale decisions collectively. Inactive WATSAN committees create a huge barrier between unions and sub-districts. The problems of the community are then unable to reach the *Upazila* WASH committees. Adoption of a PWS is collective decision of the community. Thus these information gaps increase the already existing reasons to not adopt a PWS.

Control over Actions

From the central government perspective, resource users have minimum limitations over their actions. The decision to choose or not a piped water connection is their decision. They have access to all information required to make the decision. However, in reality, the resource users have least control over their actions. Their actions are merely guided by the NGOs or the union chairman in most cases. They are dependent on NGOs to make them aware of the choices they have. They are dependent on the UP for their financial abilities to afford the system. They are they are dependent on the NGOs and union chairman for appropriate site selection. Women are dependent on men for decisions of opting to pay for a scheme or not Hence, the main question raised here is, "*Can these resource users – both men and women, actually be considered decision makers?*" The actions of resource users are bounded by informal and formal institutional constraints. Biases

from NGOs, depending on the technology they want to promote, can greatly affect the choices communities make.

The chairman on the other hand, has full control his actions. He has the power to make choices of the motivators that will participate in awareness campaigns, the developers who will build the system and the coordinators who will interact with the Local DPHE. Thus, the policy gives a lot of room for the union chairman to make decisions about his union and the actions of all other actors in this sub-action arena.

Net Costs and Benefits

Monetary costs of adopting a PWS are the initial down payments required to be paid before implementation begins and the monthly water tariffs required for the O&M of the system. The costs of t organising awareness campaigns and participatory activities such as community mapping should also be considered. The benefits of adopting these systems have been realised in some communities such as the one in the villages of *Barai Vikora* visited where a fairly well-performing system runs and the demand is increasing. In areas which are high in arsenic and deep tubewells are not possible due to low groundwater tables these PWSs are proven to be beneficial and successful to communities and their demand in slowly increasing. As of now, the perceived costs of adopting PWSs in most regions outweigh the benefits received from them. Sustainability of these schemes, discussed in the next section, remains a key factor in shaping such community perceptions. Reasons of trust and social pressure, highlighted above, add to these perceptions.

Interactions

The motivators, coordinators and implementers all interact with resource users to create the demand for a PWS within a community and increase adoptability of PWSs.

Outcomes of Actions

The expected outcomes of all the actions carried out by participants of this action arena is to increase the adoptability of a PWS in a village. Increased adoption can only happen when Willingness to Pay (WTP) increases. WTP can be increased by taking actions to

1. Create awareness about the perceived benefits of PWSs – creating awareness involves time and education about the future value of PWSs that can only be reached with long-term planning and continuous effort.
2. Increase benefits of PWSs over that of tubewells (increase the number of hours of water supply, reduce initial down payment and water tariffs etc.)
3. Build trust amongst community by employing community known and trusted stakeholders for implementation
4. Making the decision to choose PWSs as an inclusive decision – by allowing more number of women participate in decisions of water-related issues, reducing information gaps amongst participants such as the WATSAN committee.

However, currently, the situation is different. Communities do have a choice of opting for a PWS, but there is less awareness about its benefits. The benefits of choosing a tubewell outweigh the benefits of choosing a piped water connection. There is less trust from communities about who to trust with matters of money, will they receive the right water system etc. Fewer women than expected participate in field level decision-making activities and there are wide information gaps between men and women.

8c.2.5 Sub-Action Arena: Sustainability of a PWS by a community

Actions of Participants

Village WATSAN committees, Arsenic Mitigation Committees, Piped Water Committees, village elders etc. play an important in sustaining the system once it is constructed. They encourage households to pay regular water tariffs, listen to the grievances of the communities, report on the technical issues of the system and represent the village at union level for all matters related to the community. Post installation, the village piped water committee elected which usually has the respected village elder as the head, a few women from the village and some other important village members. This committee in the village of *Barai Vikora* is directly placed under the union. This arrangement might differ in different unions. After the construction has been done, the local entrepreneur who builds the system becomes in charge of the system for 12 years. The community members identified well with the local entrepreneur and trusted him to fix any technical problems with the scheme. As per the policy, the O&M is the complete responsibility of the community. This is done to encourage community members to build ownership of their own system. But keeping in view the lessons learnt from the past, the local entrepreneur has been made responsible for O&M of the system for 12-18 years after which it is handed over to the U.P. As explained above in the local level action arena, this model was introduced because the community could not handle O&M by themselves and schemes were left abandoned after construction.

An operator is hired by the UP chairman to take charge of the system's daily operations. He takes actions to supply water to households at particular intervals of time, treats the water, monitors water quality regularly and handles complaints from the community such as issues of broke pipelines. If faced with major technical problems, he reports to the entrepreneur or the council office. The Water Tariff Collector is responsible to collect monthly water tariffs from households. In *Barai Vikora*, the tariff is about 150 BDT/month. According to the tariff collector, most people pay their tariffs. If they are not satisfied with the water timings or there is a broken pipeline that has not been fixed for some time, then they stop paying. If they do not pay for 3 months, then their water connection is disconnected. In the interview session, the tariff collector mentioned that technical problems like broken pipelines which take a long time to fix are the main reasons that discourage people from paying. When very few number of households have interest in the scheme, it hard to keep the scheme running. Most households switch back to using deep tubewells and the scheme is left abandoned.

Together the Water Tariff Collector, System Operator and Village Piped Water Committee Head operate the system. Other community members do not participate in the operations of the system. Major technical failures are to be handled by the developer, it can be the Local DPHE office or the NGOs.

Analysis of Field Interviews

Some key issues related to sustainability highlighted during the interview sessions were:

1. The lack of funds to handle major technical repairs - The funds to handle repair come from water tariffs. When the number of households paying is less, that affects the amount available to be used for repairing the system
2. The inability of community members including the operator to handle major technical problems themselves.
3. Less manpower of the local DPHE to handle repairs such as broken pipelines and leakages.
4. Heavy reliance on one person only - the operator.
5. More damages lead to less motivation to continue using the system and eventually less participation.

Information about Actions

The channels of communication and the working rules remain informal. The main information gaps lie between the community members and the local DPHE. While the local DPHE thinks that they have trained the communities enough to handle the O&M themselves and take ownership, the community members think that it is the responsibility of the higher officials to take care of the system as built it.

Control over Actions

Participants in this action arena do not want to take control of their actions. It seems to be a situation wherein every participant in the action situation thinks someone else has to handle the O&M. While the DPHE and the UP presumes that communities can handle the O&M, the communities think it is not their responsibility. They identify with only three main actors - the operator, the local entrepreneur and the chairman and hold either of them responsible for O&M. The entrepreneur assumes that the operator is trained enough to handle the system. The operator, on the other hand, has to alone deal with the burden of multiple responsibilities and claims not be trained enough to handle major technical difficulties.

Net Costs and Benefits

The costs involved in the O&M are to be borne by the community, in the form of monthly water tariffs. If there is not enough funds collected for the O&M, the system cannot be repaired and is eventually left as it is. In conclusion, the benefits of having a PWS, in the end, are not realised.

Interactions

Interactions in the action arena are not clearly defined in the policy. The policy only mentions that O&M is the responsibility of the community. It doesn't state what positions actors should take to deal with O&M issues, how can they sustain the systems for as long as their technical shelf-life, who is responsible for which aspects of O&M. O&M of a large system such as the PWS is an extensive process which requires multiple people taking charge of different issues – such as pipelines, treatment plant, tank cleaning etc. Current interactions are informal haphazard and mostly undefined. Actors may sometimes come together to handle the maintenance as much as their technical capability or they may leave the scheme as it is, if they cannot deal with technical failures. This poses the main challenge to the sustainability of these systems.

Outcomes of Actions

This action arena results in a situation where no participant wants to take ownership of the system. Central level participants build the system and hand over O&M to communities with the expectation that they build ownership of the community-based system and handle its responsibilities together as a community. However, at community-level interactions amongst the actors end up in *a "It's not my responsibility, it's yours"* situation. Resource users are at times not able to or do not want to take responsibility for the system. They assume handling the system is the responsibility of higher authorities or those who built the system. This results, no system ownership. Any minor technical issues demotivate households to continue paying water tariffs and not enough funds for repair eventually results in un-sustained systems.

8c.3 Patterns of Interaction

Figure 8.15 below briefly summarises the interactions between participants at the community level. It attempts to show a brief overall view of interactions between the actors of this action arena but in reality the interactions amongst actors of this arena are informally rooted and nested in operational and collective-choice rules which are difficult to identify in field visits.

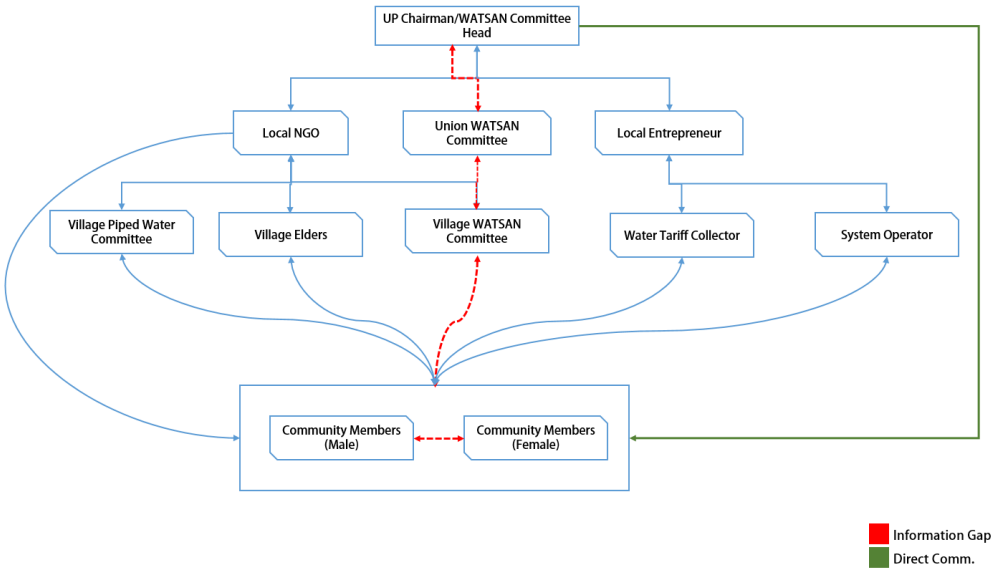


Figure 8. 14 Patterns of Stakeholder Interactions at the community level

8c.4 Current Institutional Outcomes

The outcomes of all the actions that participants carry out results in *"Community Adoption of a Piped Water Scheme"*, if communities can adopt and sustain these systems. Current institutional arrangements indicate that adoptability and sustainability at community level remains a challenge. This will be explained in the outcomes below.

Outcomes that affect the Action Situation Positively

1. The outcomes of running regressive awareness campaigns and the efforts of NGOs and local governments have positively affected the awareness factor. Most of the community members are aware of the water quality. They understand the need for moving towards safe water options in the future, the challenge lies in having the capability to switch to PWSs- financially, technically and institutionally.

Outcomes that affect the Action Situation Negatively

1. Centre's perspective about communities being decision makers themselves needed to be re-thought. From the central government point of view, communities have all the information, resources and power to take actions to request for a PWS. But, considering communities are dependent on other local and community level actors to make the decision for them, assuming they are capable enough to raise demand for a system themselves would be incorrect.
2. The informal operational rule of different meetings held for men and women, influenced by the community attribute high masculinity, hinders women participation in decision making, be it in elected committees or even basic household decisions. The inability to participate in decisions of water issues due to reasons of cultural bias and gender inequality directly affects the community's decision to adopt a PWS. When the people making the decisions about water don't experience the problem first hand, they are unable to understand the need for the system themselves and they may not be the right people to make those decisions. Such decisions turn out to be negatively influencing the adoptability of PWSs. In conclusion, low women participation in the action situation affects the action situation negatively.
3. Community perception of the benefits of PWSs is short-termed. They only understand the costs associated with it when compared to tubewells and are unable to foresee the long-term benefits of

having a PWS, on their health, water quality and overall village economic prosperity. As of now, they view it as a luxury good. The inability to realise the need for the system directly affects WTP for the system and eventually the willingness to pay affects the willingness to adopt the system.

4. The "*I will pay for it if my neighbour will pay for it*" factor, influenced by the community attribute of high collectivism can have either a positive or a negative influence on the WTP factor. It can make all households in the vicinity adopt deep tubewells or it can also make all households switch to a piped water connection.
5. Analysis of the sustainability sub-action arena showed that the main problem in sustaining these systems is that communities are not able to handle O&M and build ownership of the system. The NIMBY principle ("*Not in my backyard*") can explain this action situation most appropriately(Buffoli, Odone, Leask, & Signorelli, 2016). Most participants want the system to be well operated and well maintained but they don't want to be involved in the operations. Every actor points to another actor saying, "*I want it to be sustained. But is not my responsibility*." This has led to the lack of ownership of the system, leading to abandoned systems.
6. Broken pipelines not fixed on time, scepticism about money issues, technical issues of handling O&M, site selection gone wrong have all lead to less trust in the local authorities. Trust in the system comes from the trust of stakeholders involved in building the system. Communities are concerned about who is trustable with their money. Not having enough knowledge of who are the involved people negatively impacts decisions related to adoptability and sustainability both.

8c.5 Summary

This chapter is intended to carefully analyse the contextual factors that affect the operate and maintain the phase of the process of implementation of rural PWSs. It begins by analysing the exogenous variables that create the environment for local governments act. Then it describes the action arena by sub-dividing it into two sub-action arenas and analysing the field situation. It discusses the communication mechanisms amongst the actors at this level, the costs and benefits of activities they carry out and the amount of control they have over their actions. The patterns of interactions amongst these actors lead to the outcomes of the action situation. These outcomes will be evaluated against Ostrom's evaluative criteria further in Chapter 9. Figure 8.16 summarizes the action arena.

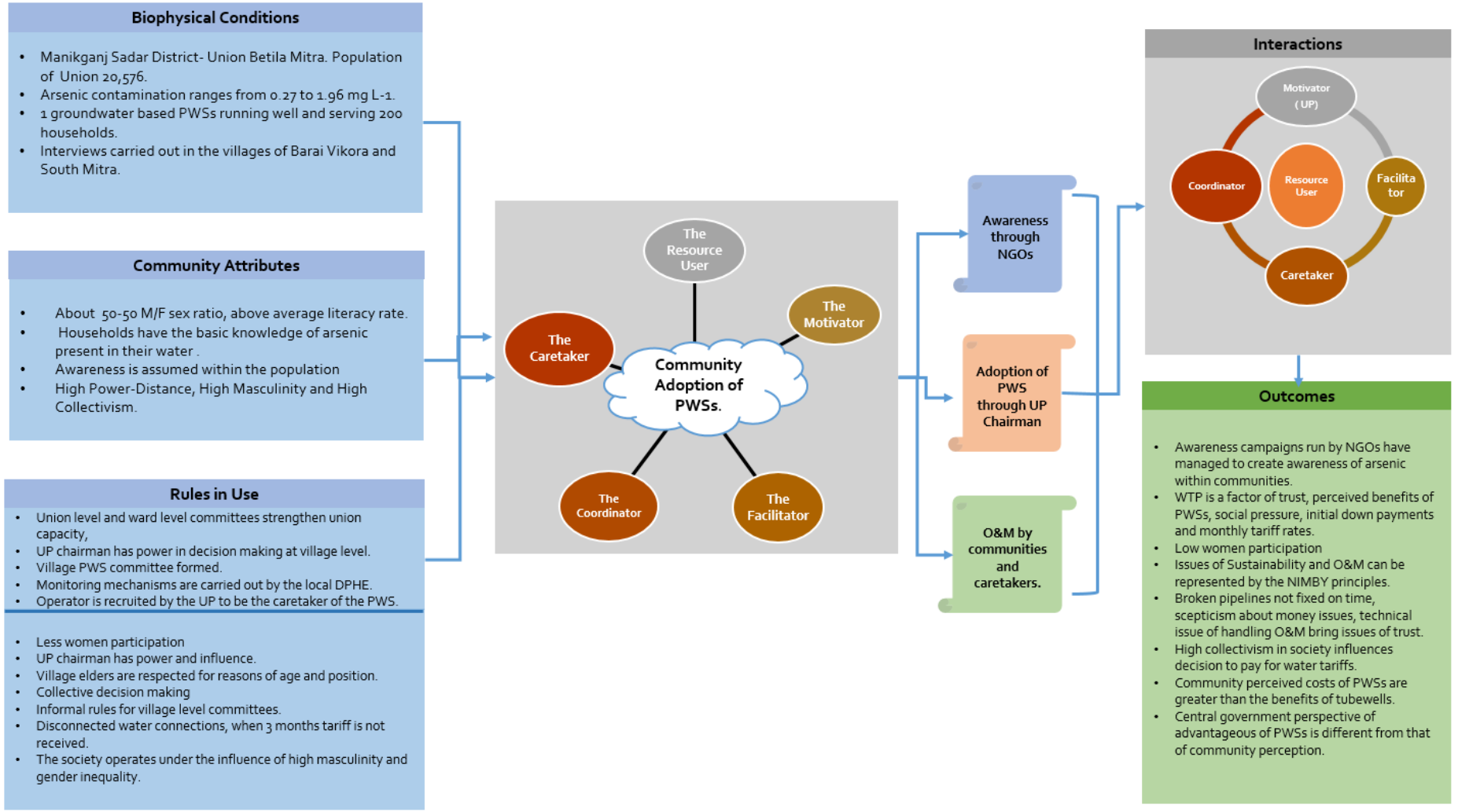


Figure 8. 15 Summary of the Action Arena "Community Adoption of PWSs"

9

Proposed Institutional Arrangements

The IAD has helped to arrive at outcomes. Now, these outcomes need to be re-examined, evaluated against Ostrom's evaluation criteria and then new institutional arrangements are to be proposed. This chapter proposes new institutional arrangements that can allow to bridge the policy gap. The outcomes are avaluated to see which areas need reformation. Then, relevant design principles are identified and applied to support robust new institutional reforms. Validation of these institutional reforms is done by considering staekholder opinion on certain suggested institutional arrangements. These stakeholder concerns are later taken into account when recommending policies. Each section of this chapter is organised in the following manner. Section 9.1 discusses outcomes, evaluation, design principles and new institutional arrangements at the central level action arena. Section 9.2 discusses the same for the local level and Section 9.3 discusses the same for the community level action arena.

Evaluation focuses on valuing the outcomes of the action situations and the relationship between outcomes and the process of achieving those outcomes. The outcomes of each of the three action arenas discussed in Chapter 8 are compared with Ostrom's evaluation criteria to measure their performance. According to Ostrom and Polski, analysing outcomes is about analysing the performance of a policy(Polski & Ostrom, 1999). Re-examining these outcomes to see if they satisfy the criteria of economic efficiency, fiscal equivalence, distributional equity, accountability, conformance to general morality, and adaptability(Polski & Ostrom, 1999), would determine which outcomes are unsatisfactory and which design principles would help to bridge the gap between the current institutional outcomes and desired outcomes and support institutional reforms. Relevant design principles are identified which would support robust new institutional arrangements at each level. Stakeholder concerns about proposed institutions are also taken into consideration. The concerns of the client will be addressed, and policy recommendations discussed in Chapter 10 will be adapted based on the client recommendation.

9.1 Re-visiting the Action Arena at the Central Level

9.1.1 Re-examining Actions and Outcomes

The outcomes of the action arena *"Planning and Designing PWS"* are summarized below.

Outcome 1:- The evaluation studies carried out by JICA and other organisations help to identify abandoned schemes and reasons for un-sustainability. These studies help to learn important lessons from the past and improve future schemes with better planning and designing. Considering the lessons learnt, the local entrepreneur model with a 30-70 partnership has been introduced by the World Bank.

Outcome 2:- Organisations such as RDA are adapting models as per requirements. For example, the PWS constructed for irrigation purposes in Bogra district has now been adapted to provide drinking water as well. More such adaptations in other districts should be promoted. World Bank and NGOs are willing to partner with these organisations the chances of project success are higher.

Outcome 3:- Direct communication with the UP, limiting the number of stakeholders involved in the planning process has proved to be more effective in certain areas of the country.

Outcome 4:- Stakeholders do realise the need for an information sharing system or a data management system for transparency of information circulated and to avoid conflict amongst stakeholder actions.

Outcome 5:- The information gaps discussed in the action arena, amongst actors at the central level and their different planning processes has resulted in multiple plan-implementation models running in parallel to each other. This has created duplication of activities, conflicting actions and inefficient use of resources.

Outcome 6:- The process is evaluated to be participatory only at the central level. The plan is developed outside the boundaries of the community and local governments are not directly involved in the planning process. Actors at the bottom have no choice but to consent to the plans of the centre. There is a lack of information sharing mechanisms and coordination of plans with local governments.

Outcome 7:- The 30-70 model of design construction is a step ahead from the previous model where only a contractor is involved but ensuring private sector's interest in rural development projects with low Return on Investment (ROI) is a challenge.

Outcome 8:- Although the Increasing number of tubewell in the country is a matter of high concern to many stakeholders, no policy or regulation has been initiated to regulate the number of drillings allowed in rural regions.

Outcome 9:- There are a few checks and balances placed on the local government's actions of collection of initial down payments and site selections. The centre doesn't verify if the site is selected by communities together or just some rich persons of the village. They do not check if the site is accessible to all members of the community and where the down-payment is received from. This allows more instances of corruption within the UP chairman and the village well-off people.

9.1.2 Evaluation of Outcomes

These outcomes measured against 6 key evaluation factors of Ostrom are discussed below. The criteria distributional equity and fiscal equivalence are interrelated. Distributional equity refers to individuals paying for receiving benefits and fiscal equivalence refers to paying according to how much you can afford. In the context of rural social goods, they are similar concepts and hence together combines into one, "equity" for the rest of the analysis(E Ostrom et al., 1993).

Accountability

Accountability in this action arena refers to the responsibility of officials to (i) involve themselves in low cost information sharing (ii) evaluate other stakeholder actions with transparency (iii) limit their ability to engage in opportunistic behaviour(A. Smajgl, A. Leitch, 2009)(E Ostrom et al., 1993).

Interactions in the action arena indicate that there is a fair amount of interaction between the government bodies, donor organisations, and private sector involvement in the rural water sector. Stakeholders come together to formulate policies and attend workshops for planning and designing. Outcomes 2 and 4 indicate that there is some information sharing taking place during workshops and published reports and articles. But, the main problem at the central level, indicated in Outcome 5 and 6 is that there are multiple models of implementation running in parallel without interacting with each other. While private organisations and iNGOs each have their own implementation ideas where they deal with local governments directly, some organisations prefer to go through RDA. DPHE's model of implementation attracts most donor attention but may not be the best model. As highlighted in the patterns of interactions, there is huge information gap between the three main models of RDA, DPHE and HYSAWA running parallel to each other with no

knowledge sharing of lessons learnt or data sharing. This has led to many NGOs at the local level carrying out awareness campaigns and feasibility tasks based on the requirement of the organisation. There is an overwhelming amount of information for communities to handle and *Union Parishads* to choose from. The separate programmers from different organisations without any coordination has resulted in a duplication of activities and conflicting strategies that inhibit synergy and optimal use of scarce resources.

Outcomes 9 indicates that stakeholders are not held accountable for some of the actions they take at the local level. There are increased cases of wrongly selected sites or PWSs installed in well-off household regions. Stakeholders do engage in opportunistic behaviour.

Outcomes 5, 6 and 9 conclude that the accountability of the actions of actors at this level is not fully achieved.

Economic Efficiency

Economic efficiency from rural infrastructure projects in developing countries is difficult to expect. The upfront costs associated with PWSs are the research, design, development costs, capital expenditures, and labour and construction costs. The project usually does not run long enough to generate economic returns that would offset these high costs invested by governments. Hence, the need for government intervention. The aim of such projects is to have greater social good. Thus, when conducting a CBA of public infrastructure projects, the greater humanitarian good the project aims to provide is taken into account.

Thus, economic efficiency here refers to *economic sustainability* which as defined as "*the maintenance of an acceptable net flow of benefits from the projects investments after its completion, that is, after the project ceased to receive world bank financial and technical support*", by a World Bank sociologist Micheal Cernea(E Ostrom et al., 1993, p. 15). Economic sustainability is an important factor to consider when planning and designing such systems. However, Michael Cernea, mentions that says that the economic sustainability of rural infrastructure projects in developing countries is difficult to achieve and shouldn't be expected(E Ostrom et al., 1993). One way of having economic returns from community-driven projects is to match the Cost-Benefit Analysis from the Donor perspective with the Cost-Benefit Analysis done from a community perspective to have a fair idea of what to expect before planning the projects(E Ostrom et al., 1993). Encouraging private sector intervention can increase the economic sustainability of these projects in the long run.

Outcome 1 suggests that private sector intervention in rural piped water projects is being encouraged by the World Bank. The SDP 2011- 2015 mentioning "*to ensure DPHE's withdrawal from direct implementation of the WSS projects in the rural areas by 2015, but allow its continued involvement in only technically difficult areas like rural piped-water areas, arsenic-contaminated areas and hard-to-reach areas*(*Bangladesh Government Sector Development Plan (2011-2025)*, 2011)" highlighted *the* central government's interest to withdraw direct involvement and increase private sector participation. Interviews with the World Bank official mentioned how they plan to do it slowly in the coming years. However, Outcome 7 above showed that private sector interest in rural projects is not so high. The low ROI, the high average time taken to get back investment, no added incentives from the government and uncertainties of rural environment discourage them to participate. At the same time, these schemes that are built by consuming large amount of national and international resources and not being able to be well operated and maintained. Thus, cannot be said that the economic sustainability of these projects is achieved.

Distributional Equity or Fiscal Equivalence

Equity here refers to the fact that those who benefit from a service should bear the burden of financing the service and those who derive greater benefits are expected to pay more(E Ostrom et al., 1993). However, PWSs are a public good and expecting equity of public goods can affect social benefits received from that good(Boardman et al., 2010). Stakeholders at the central level do not expect financial equity for these

projects. They, however expect equity in the form of contributing financially towards the maintenance of these systems and building ownership of the system. If communities are able to build ownership of the system and eventually benefit from the water they drink, then the cost of financing can be considered evened out by the social benefits it is providing. This expectation of stakeholders has not been matched yet. It is seen in action arena 3 (community level) that sustainability and ownership of these systems still remains a challenge.

Another way of defining equity in this action arena is by maximizing the number of people reached per PWS in an arsenic-affected area. This would mean that the site selection is appropriately done, the location of construction takes maximum number of households into account, minimal technical difficulties and least possible people excludes from the system due to economic reasons. Outcome 9 shows that this is not always the case, as sometimes the site is selected to benefit the well-off members of the village. Also, households that are unable to pay are secluded from using the system. In conclusion, it cannot be said that equity in these projects is yet achieved.

Adaptability

It refers to how adaptive a plan is, in relation to the area of implementation, and how responsive it is to changing environments(Polski & Ostrom, 1999).

Outcomes 2 and 3 suggest that plans have been adaptive to the local situation to a certain degree. In recent years, some private organisations such as HYSAWA and NGOs are working out design plans which are more appealing to the people of particular regions. However, Outcome 6 suggests that design plans are developed outside of the community and then expected to be successful within communities based on the perception of central stakeholders. These plans do not consider local situations, community attributes and local government capacity issues. Adaptive planning and designing is an effort from both ends, central and local. Overall these plans cannot be considered completely flexible and adaptive. However, how much flexibility of these plans is acceptable without changing the basic implementation procedure is yet to be discussed with stakeholders.

Conformance to General Morality

This evaluation criteria here refers to the presence of rules that keep a check on cheating, favouritism or free riding(E Ostrom et al., 1993).

Outcome 9 explicitly states that there is no such rule and that has encouraged rather than limit local stakeholders to carry out actions of corruption.

Trade-offs amongst criteria

Trade-offs are often necessary when using various performance criteria as a basis for selecting alternative institutional arrangements(E Ostrom et al., 1993). Particularly important is the trade-off in achieving economic efficiency. When infrastructure investments are targeted towards certain segments of society, like the rural poor communities, these facilities still need to be operated regardless of if their costs are not retrievable(E Ostrom et al., 1993). Target groups should be able to receive some benefits regardless of if they can afford them or not. Thus, even though these schemes may not be economically benefiting from the central government or international organisations, they still need to be operated.

The evaluation of outcomes against the criteria concludes that some observed outcomes do match policy expectations while some don't. The gaps between expected outcomes and actual outcomes have been identified. The next step is to bridge this gap by identifying relevant design principles that would help to suggest robust institutional reforms.

9.1.3 Findings and Relevant Design Principles

Some of Ostrom's design principles for enduring institutions were identified as important by stakeholders (participants) to develop new institutions that will be sustained through time and fluctuating environments. The design principles, relevant to the findings of the evaluation done in Section 9.1.2 are:-

Findings	Relevant Design Principles
Less accountability amongst actors about knowledge sharing about various implementation model and information sharing amongst actors.	Clearly Define Boundaries
Low adaptability of plans and low participation of local level actors in the decision of planning and designing.	Collective-Choice Arrangements
Very low economic sustainability of projects due to very little interest of private sector in rural infrastructure projects.	-
Low distributional equity in piped water projects, due to high costs associated with it and less community ownership.	Monitoring Mechanisms
Less number of communities reached due to instances of wrong site selections and favouritism towards wealthy land owners and well-off people in villages. High instances of corruption	Graduated Sanctions

Table 9. 1 Relevant Design Principles for the findings of central-level Outcomes

These design principles as they apply to the action arena *"Planning and Designing of PWSs"* are discussed below: -

Clearly Define Boundaries

Boundaries of the action arena and the individuals participating in the action arena need to be clearly defined(Elinor Ostrom, 1999). Clearly defining boundaries, in this case, would mean pre-identifying the different models of implementation that different organisations are running and the stakeholders that are part of the different models(Elinor Ostrom, 1993). As of now, multiple stakeholders are involved in different stages of implementation, some of them don't interact with the DPHE and the DPHE is not even sometimes aware of the schemes that NGOs are running. Defining boundaries would help to identify the main plan-implementation processes running for PWSs and that will lead to more effective information sharing amongst the central stakeholders. Unfortunately, there is no such method or process in place that will allow stakeholders to come together, discuss and allow them to identify and define the boundaries of model implementation. Hence, there is a need for a system of knowledge sharing of activities of central stakeholders to discuss lessons learnt from each other and improvise their programmes accordingly. This knowledge sharing platform has to create coordination between plans so that activities are not duplicated, or conflicting mechanisms are not implemented to allow communities at the bottom of the pyramid to not be confused and make fair choices.

Collective Choice Arrangements

Collective choice principles specify that a majority of individuals should be able to participate in creating new rules and modifying existing ones(Elinor Ostrom, 1999). To achieve success in PWSs it is important to look at the issue from the community perspective. *What do they prefer to use? Why do they prefer a certain technology? What benefits do they see in tubewells that they don't see in PWSs? How can that perspective be changed? What factors do they value most while agreeing to pay for water?* These are the questions to be asked when designing the implementation plan. Increasing relevance of what matters to the community and allowing local governments to participate in the decision of the plan, either by decentralised planning methods or by centralised planning methods where they have a say in the design of a particular area would make the design plans more adaptive. For example, the RDA adapted their irrigation schemes to supply drinking water at the same time. Similar flexibility and adaptiveness is needed in most PWS design plans. An adaptive design cannot be created only with the help of central stakeholders. Participation of local level stakeholders is necessary for adaptive design.

Monitoring Mechanism

Community ownership can only be increased by increasing monitoring mechanisms at the local level and community level(Elinor Ostrom, 1993). To achieve distributional and financial equity or financial gains in the project, the project has to be well operated and sustained locally. At present, there are no local level mechanisms in place that can improve sustainability. The policy hands over ownership to communities but doesn't define how and who should be responsible for these monitoring mechanisms. Increasing the role of women in the policy can influence ownership positively. When women are given pre-defined roles to handle the system, as more community women are 'stay at-home' women, they can take control of the system and help to build community ownership.

Graduated Sanctions

Graduated sanctions are important to re-enforce rules and reduce corruption(A. Smajgl, A. Leitch, 2009). Those who violate rules must bear the consequences of those(Elinor Ostrom, 1999). As of now, there is no system of checks and balances to ensure that that the UP chairman doesn't involve in opportunistic behaviour of favouritism towards wealthy land-owners. There may not be a national policy level rule to check on the UP level activities but a local government (LGI) regulation to monitor the activities of the chairman can help to avoid problems of cheating, favouritism and free riding.

9.1.4 New Proposed Institutional Reforms for the Central Stakeholders

Keeping these design principles in mind, the new institutional arrangements proposed for actors at the central level are: -

1. A consortium of central level actors- DPHE/JICA/WORLD BANK/RDA/DANIDA/HYSAWA/Relevant NGOS/Donor Foundations at least on a yearly basis that facilitate knowledge sharing between different implementation models. Lessons learnt from different models can be a valuation addition to reach the optimal model that is most suited- obviously keeping in mind that "*one-size doesn't fit all*". It will also avoid information overload at the ground level, contradicting strategies and unnecessary utilization of resources – both human and monetary.
2. To develop adaptive plans the local government has to be actively involved when creating these plans. This would mean giving them more freedom, choice and power constitutionally to choose the structure of the implementation process themselves as per the community attributes. For example, the decision to have a contractor or a local entrepreneur involved in the project should be of the local DPHE. The decision to choose appropriate water tariff rates based on household income should be of the UP or the NGO. Local DPHE and UPs should be able to decide which scale of systems is most appropriate based on demand. When WTP is low, it should be able to create regulations to introduce new rules with its own district or sub-district that would help to increase WTPs by other means. Flexibility in plans such bases on the need of the communities, as using an irrigation-based PWS for drinking water by installing a treatment filter should be the decision of the LGIs and local governments, keeping within the framework of the central DPHE. Adaptive planning and designing is an effort from both ends- central and local.
3. Private sector interventions can be a good option if entrepreneurs are willing to overlook the high time-period for the ROI. To increase economic sustainability of projects of projects, one way is to create local models, whereby the community is self-involved in the construction process. This would reduce government costs, not drastically but in some ways. This institutional arrangement will be further elaborated when discussing institutional reforms at the community level.
4. Giving women defined roles in handling O&M of the system, constitutionally can help to increase system ownership and sustainability. Women would be able to handle the systems more effectively as they depend on water for their basic needs and realise the importance of the system better.

5. There should be a regulation on the number of drillings allowed in the district that will restrict the growing number of tubewells in the area. This regulation should be imposed by the local government office of the district and monitoring of the private tubewells should be tasked to *Union Parishads*. There need not a national level policy to control tubewells installation, but the local government should be given the authority to impose regulations as and when required.

Stakeholder Concern

a) Prohibiting households from installing personal tubewells would receive unacceptance from the people. Also, that would mean the increased dependency on government-provided sources in areas where no other systems are available and increased government control for O&M. Communities want to depend least on the government for water and a regulation on tubewells would mean that continuous water supply from piped water is guaranteed and water is always safe to drink. This may not a possible near future considering local conditions. This concern will be taken into consideration when recommending policies.

9.2 Re-visiting the Action Arena at the Central Level

9.2.1 Re-examining Actions and Outcomes

The outcomes of the action arena *"Implementation of PWS"* are summarized as below.

Outcome 1:- The local-entrepreneur 30-70 model is successful in handling issues of trust and should be encouraged. Private sector intervention is also necessary to increase profitability of these systems.

Outcome 2:- The increased role of NGOs in initiating awareness campaigns and the process of raising a request for a PWS is a fairly consistent and smooth process and affects the action situation positively.

Outcome 3:- Actors at the local level operate with a lot of information gaps. Inactive WATSAN committees, less DPHE capacity and less local government staff for a large population add to this information gap.

Outcome 4:- The less resource capacity of the local DPHE impacts the process of monitoring, creating awareness and indirectly leads to less coordination between the UP and the Local DPHE.

Outcome 5:- The Local DPHE can play the role of a coordinator only, following instructions of the central office. It has been pointed out in the previous action arena that there is no mechanism for information sharing between the local DPHE offices and central DPHE. They don't meet often, and the information gap is large.

Outcome 6:- The overall costs of carrying out the implementation process is higher than the benefits for the actors. The opportunity costs(Boardman et al., 2010) of the tasks of awareness, monitoring, repairing and handling technical failures is more than the benefits that actors receive for it. The low capacity and limited financial resources add to these costs. On the other hand, apart from the minimal government wages, there are not many incentives for actors at the local level to participate in the process. For example, the WASTAN committees have no incentives to remain active.

Outcome 7:- Participation of women in local level meetings of WASH and other activities and awareness campaigns is limited.

Outcome 8:- The increasing number of privately owned tubewells in *Manikganj* pose a problem for the local DPHE to convince communities to adopt PWSs.

9.2.2 Evaluation of Outcomes

These outcomes measured against 6 key evaluation factors of Ostrom, are discussed below.

Accountability

Accountability in this action arena refers to the responsibility of officials to (i) involve themselves in low cost information sharing (ii) evaluate other stakeholder actions with transparency(A. Smajgl, A. Leitch, 2009)

Accountability is the extent to which local stakeholders from the arena involve in information sharing with the central government and within themselves (UPs, WATSAN Committees and other Local DPHEs) to evaluate each other's actions. Outcomes 3, 4and 5 suggest that information gaps exist between the design phase and up until the construction and installation phase. There is some information sharing between local governments – the district DPHE and the UPs about the preferences of households' water supply options. However, this information does not reach central stakeholders to execute customised/ adapted design plans.

Economic Efficiency

Economic efficiency here is a measure of resource allocation (PWSs) and its associated net benefits in the population of the region, to achieve minimum drinking water issues, with minimum possible local expenditures(E Ostrom et al., 1993). If the people of the district are aware of the arsenic presence and they receive a sufficient amount of arsenic-free drinking water without any hassles, economic efficiency is achieved. The Outcomes 1 and 2 suggest that in *Manikganj* some efficiency has been achieved as communities have the basic knowledge of arsenic and they had access to arsenic-free drinking water by some means. Economic efficiency in the case of local level is a matter of motivation of the actors. When local actors carry out tasks of awareness and implementation in the right manner and any sub-districts are not implemented, efficiency is achieved.

Distributional Equity or Fiscal Equivalence

Equity here refers to the fact that those who benefit from a service should bear the burden of financing the service and those who derive greater benefits are expected to pay more(E Ostrom et al., 1993). As PWSs are a public good and expecting equity of public goods can affect social benefits received from that good(E Ostrom et al., 1993). Stakeholders at the local level do not expect financial equity of these projects. They, however, expect equity in the form of compensating their opportunity costs(Boardman et al., 2010) of building awareness, monitoring, repairing and handling technical failures by raising demand for PWSs and sustaining these systems. If communities are able to raise demand for the right kind of system and build ownership of the system and eventually benefit from the water they drink, then the opportunity costs of the local governments can be considered evened out by the social benefits it is providing. Outcome 6 suggests that expectation of stakeholders has not been matched yet. It is seen in action arena 3 (community level) that sustainability and ownership of these systems remains a challenge.

Equity could also mean fairness between individuals to participate in local-level decision making. As explained in Outcome 7, women participation is low due to cultural reasons and hence not all individuals can be considered to be fairly treated.

Adaptability

Adaptability at the local level refers to the local capacity to adapt the design depending on community data and preferences(A. Smajgl, A. Leitch, 2009)(Polski & Ostrom, 1999). Adaptability here can be measured in terms of the flexibility of design and implementation based on feasibility studies.

Interviews and discussions have concluded that these design plans are very straightforward, top-down and instructive in nature. Outcome 8 shows that local governments have not yet managed to overcome the problem of growing number tubewells in the region. Piped water plants set up often don't take tubewell preference into account before they are built. Outcome 4 shows that the local capacity to adapt regulations and plans is very less. In this case, adaptability and flexibility in plans is difficult to achieve.

Conformance to General Morality

This evaluation criteria here refers to the presence of rules that keep a check on cheating, favouritism or free riding(E Ostrom et al., 1993).

It has been highlighted in the central action arena that there are instances of misuse of power from the UP chairman and misuse of funds allocated for awareness campaigns. There is no such rule or law that limits local stakeholders to carry out actions of corruption. The inability of women to participate in local decision making, in some way, can also be considered as favouritism towards male members.

The evaluation of outcomes against the criteria concludes that some observed outcomes do match policy expectations while some don't. The gaps between expected outcomes and actual outcomes have been identified. The next step is to bridge this gap by identifying relevant design principles that would help to suggest robust institutional reforms.

9.2.3 Findings and Relevant Design Principles

Some of Ostrom's design principles for enduring institutions were identified as important by stakeholders (participants) to develop new institutions that will be sustained through time and fluctuating environments. The design principles, relevant to the findings of the evaluation done in Section 9.2.2 are:-

Findings	Relevant Design Principles
Less accountability amongst actors about information sharing and coordination of activities between central and local level and amongst UPs and local DPHE.	Collective-Choice Arrangements Nested Enterprises
Low adaptability of plans and low participation of local level actors in decisions of local governments.	Collective-Choice Arrangements
Fairly good economic efficiency of projects due to NGO and private sector intervention	-
Low equity in piped water projects, due to high opportunity costs associated with implementation but yet the goal of sustainability not achieved. Less women participation and unequal equity in decision making.	Minimal recognition of rights to organise Nested enterprises
Favouritism towards male members of society and high instances of corruption- inactive WATSAN committees etc.	Graduated Sanctions

Table 9. 2 Relevant Design Principles for the findings of local-level Outcomes

These design principles as they apply to the action arena *"Implementation of PWSs"* are discussed below: -

Nested Enterprises

The principles of nested enterprises demand that functions of appropriation, provision, monitoring, enforcement, conflict resolution and governance must exist at the local level(Elinor Ostrom, 1993). As the implementation process nested in the three levels, the principle of nested enterprises is most applicable to make rules for the local level. The key words - *appropriation, provision, monitoring, enforcement, conflict resolution and governance* must be thoroughly considered before proposing any rule for the local level(Elinor Ostrom, 1993).

Collective Choice Arrangements

Collective choice principles specify that majority of individuals should be able to participate in creating new rules and modifying existing ones. The main hindrance to local government participation in modifying rules of the centre is the large information gaps between the centre and the local DPHE. Reducing information gap would mean that the centre has all the right information from the local office to design and implement a system that most certainly will be accepted by communities. Ascertaining success of a system is about knowing well in advance what communities prefer- how much are they willing to pay for water and if not then why not. This is usually done by conducting feasibility studies by NGOs and UPs. These feasibility studies are usually carried out using the *Contingent Valuation Method*(E Ostrom et al., 1993).

The *Contingent Valuation Method* is the most commonly used method used to conduct feasibility studies(E Ostrom et al., 1993). Households are physically approached, from door to door and asked to answer a basic questionnaire which gathers data about how much they are willing to pay for water and which technology they prefer(E Ostrom et al., 1993). This approach is inexpensive to stakeholders and does include community participation, but many times yields biased responses due to different reasons. Sometimes, households just answer based on their neighbour's responses and other times they make overstatements of willingness to pay. A major problem with this method is that local DPHE capacity is low and they are not able to carry out most of these feasibility studies. When the data is not appropriately available to them, they cannot deliver the right information to the centre. Thus, to reduce the information gaps amongst the centre-state and community, a more effective and collective data collection mechanism is required, such that information sharing across all stakeholders is uniform and easily accessible.

A better data collection mechanism would also make plans more adaptive in nature. All the data collected from feasibility studies would allow to study community behaviour. Accordingly, the design plan can be locally adapted to fit the local problems or new regulatory mechanisms can be designed to ensure the success of the execution of the design plan. For example, if feasibility studies highlight that members of a community have a low-income level and are unwilling to pay as unemployment is high in the region the local DPHE can based on this data, decide to involve local communities by paying them to construct and operate the system with the guidance of the local entrepreneur. This will increase help to increase their local manpower and reduce labour costs of construction activities. Making these decisions at the policy level may not be appropriate as the conditions for different areas differ. Adapting a design plan to local conditions could also mean, creating new regulatory mechanisms to regulate the number of tubewells in the region to ensure that PWSs installed are actually used and not left abandoned.

Monitoring and Graduated Sanctioning Mechanisms

Monitoring mechanisms and Graduated sanctions are important to re-enforce rules, reduce corruption and increase active participation. Those who violate rules must bear the consequences of those(Elinor Ostrom, 1993). At present, there are no mechanisms to or checks and balances placed on the actions of the union chairman, actions of WATSAN committees and insufficient women members' involvement. To improve participation, actors should be able to develop monitoring mechanisms that hold other stakeholders accountable for their actions. Making operational rules within specific local arenas in partnership with the district government (LGIs) would allow rules to be context specific. For example, WATSAN committee may be active in some regions, not active at all or may be semi-active in some regions. Incentives to motivate them may be different for different localities. Similarly, the issue of wrong site selection due to favouritism or any other biases from the UP chairman and less women participation need to be overlooked by the local DPHE. However, all of these issues can be very context dependent and having constitutional or formal rules that impose harsh punishments or fines may not work in such scenarios.

But having, a system wherein actors themselves create monitoring mechanisms and sanctions for other actors can help. To explain the investment in self-monitoring sanctioning activities, the theory of "quasi-voluntary compliance" used by Margaret Levi can be applied(Elinor Ostrom, 1999). This theory has been used to explain the behaviour of taxpayers in regimes where almost everyone pays taxes. Paying taxes is considered voluntary in the sense that individuals are not directly coerced to pay them but choose to comply with paying them timely(Elinor Ostrom, 1999)(Weigel, n.d.). Similarly, if women members of the WATSAN committee check over the participation of other women at village level committees, women participation may increase. Providing incentives to local WATSAN committees, such as "free meals or a free bag of rice" may encourage them to meet up every month to discuss issues. This will encourage village WATSAN committees to become more participative. At the same time, actors who don't follow rules can receive sanctions (depending on the seriousness of the offence) from other users in the same arena and not any higher authority. This method also fits well, with the community attributes of a highly collective country such as Bangladesh.

Minimal Recognition of rights to Organise

This principle suggests that communities should have the right to self-organise themselves by devising their own institutions and not be challenged by the external government authorities.

According to this principle, as long as all acts of the local government are within the framework of the national policy, their choices of plan adaptations, formulating formal rules and regulations within districts and implementing monitoring mechanisms should not be questioned by the centre, but rather their activities overlooked and providing support to these activities.

9.2.4 New Proposed Institutional Reforms for the Local Stakeholders

Keeping these design principles in mind, the new institutional arrangements proposed for actors at the local level are: -

1. Plans can be made adaptive only by allowing local governments to independently act and take decisions appropriation, provision, monitoring, enforcement, conflict resolution and governance. Although the policies emphasize the need for decentralised planning at LGI level, the central government has not made provision for this de-centralisation to take place. Thus, provisions need to be made to facilitate decentralised planning methods. Building a data management system which can allow information sharing across all levels of stakeholders is the first step towards adaptive planning.

2. The *Estimating Econometric Demand* is method of estimating demand using econometric estimations of user behaviour. It is one way to collect data efficiently and allow adaptive decentralised planning(E Ostrom et al., 1993). This method is used to study community behavioural patterns by collecting data about community perceptions, household water uses for different purposes, their time spent in collecting water and other socio-economic characteristics. This method allows would allow to assess better the community's actual intentions, capacity and willingness to have and maintain a PWS. If data can be collected using this method and shared across stakeholders, it can help to solve the problems of adaptability, accountability, transparency and increase trust of communities in local governments. Using information technology to implement this data collection method can also solve the problems of low DPHE capacity.

   A shift from the traditional *Contingent Valuation Method* (simple data collection method in the form of surveys) to the *Econometric Demand Method* is required. Demand is calculated by studying data patterns. With the rapidly growing information technology in the country, this technique is easy to

implement by using applications. Since most users use mobile phones and social media, data mining can be done to understand their choices. An investment in this kind of a data collection mechanism can benefit the entire WASH sector. The net benefits of having this system outweigh the investment required to create such a system.

Stakeholder Concern

a) Collecting user data via social media and mobile applications can pose the issue of most mobile phone users in villages being men. As men hold different perceptions about water, women concerns might be left out. This concern will be taken into consideration when recommending policies.

3. To increase women participation, women only committees can be formed at the local level. An arrangement to allow the formation of separate women's only committees, assisted closely by women NGOs and headed by woman leaders can be a way to adapt policy to the society's cultural attributes.

9.3 Re-visiting the Action Arena at the Community Level

9.3.1 Re-examining Actions and Outcomes

The outcomes of the action arena *"Community Adoption of a PWS"* are summarized as below.

Outcome 1:- Due to increased actions of NGOs in the district, communities, in general, are aware of arsenic contamination and its consequences to health. Awareness of arsenic has been successfully tackled over the years by mass advertising, NGO campaigns and local government activities.

Outcome 2:- Centre's perceptions about abilities of communities to raise demand and their ability to pay are different from actual reality. The plan-implementation process from the central government perspective is different than from the community perspective. Communities are not fully capable enough to raise demand for the system themselves without support from other community level stakeholders.

Outcome 3:- Women participation, in village and union level communities, in workshops and meetings organised is very less due to cultural reasons.

Outcome 4:- Communities don't see the benefit of having a PWS over deep tubewells. The community perceived cost of having a piped connection and maintaining it over time is more taxing than the benefits achieved from it. A cost-benefit analysis from the community perspective has not been carried out.

Outcome 5:- Willingness to Pay is dependent on (i) perceived costs and benefits (ii) trust in the local government and the stakeholders of implementation (iii) social pressures from other community members (iv) initial investment required and monthly tariff rates.

Outcome 6:- The inability to sustain systems by communities due to technical difficulties, lack of funds, and heavy reliance on the LE or the operator leads to low motivation to maintain the system. The responsibility given by the policy to communities to handle O&M themselves with later involvement of the entrepreneur and the NGOs to help them to maintain the system is represented by the NIMBY ("*Not in my backyard*") principle(Buffoli et al., 2016).

9.3.2 Evaluation of Outcomes

These outcomes measured against 6 key evaluation factors of Ostrom, are discussed below.

Accountability

Accountability in this action arena refers to the responsibility of officials to (i) involve themselves in low cost information sharing(Polski & Ostrom, 1999).

Interactions show that is there enough information/data about citizen awareness with stakeholders. Outcome 1 suggested that there is a fairly good amount of information sharing amongst participants in terms of awareness building, sharing data in the form of feasibility studies. However, there are major information gap between the women (who are household water managers) and men (who are decision makers of money). Outcome 3 specifies that there is a difference in the way men and women perceive information and come to a consensus about adopting a piped water connection. Thus, it can be said that accountability of has partially been achieved but not completely.

Economic Efficiency

The overall economic efficiency here refers to the relationship between the costs and associated benefits of adopting and sustaining a piped water scheme by a community in a village(E Ostrom et al., 1993).

This economic efficiency can be measured by carrying out a CBA analysis of PWSs in comparison to a deep tube well (or other technologies)(E Ostrom et al., 1993). A CBA for rural infrastructure projects is usually carried out by the central government and the World Bank from their perspective. The results of CBA often show that in the long-run the net benefits of having a PWS are more as compared to deep tubewells (considering the rate of deterioration of deep tubewells and concerns of futurere groundwater depletion). However a CBA from the community perspective would show that, the net costs of having a PWS in the village (monetary costs of water tariffs and costs operating and maintaining the system, costs of regular inputs, on-going labour, construction delays etc.)(E Ostrom et al., 1993) would exceed the net benefits of having them. Economic efficiency of PWSs from the community perspective is very low as of now. Outcome 4 suggests that the economic efficiency of these projects has not yet been achieved. Outcome 5 mentions that one of the factors affecting WTP is the perceived costs and benefits and its key to achieving success in rural PWSs. To achieve economic efficiency of PWSs, a CBA from the community perspective would give appropriate results. Economic efficiency of PWSs should be measured in terms of:-

[Community Perceived NPV of Benefits of PWSs - Community Perceived NPV of Costs of PWS]

Distributional Equity or Fiscal Equivalence

Distributional equity and fiscal equivalence specify both refer to the notion that those who benefit from the system should bear the costs of financing it and contributions should consider different abilities to pay(E Ostrom et al., 1993).

As explained above, it is not expected that communities bear the total cost of building the system. However, it is expected that communities are able to handle O&M costs by themselves. The outcomes of the action situation suggest that most issues of unsustainability are caused by the inability to pay water tariffs regularly. There might be an initial WTP for the system but the motivation to maintain the system is often seen to die out due to technical difficulties in handling the system. When some households might have the ability to pay factors such a trust, benefit and social pressure play a role in demotivating communities to pay. Income inequality also affects WTP. The current water tariff rates don't take into account abilities of households to pay, suggesting that distributional equity and fiscal equivalence is not completely achieved.

Adaptability

Adaptability refers to the ability of individuals to learn from experience and adapt to new changes by maintaining system performance or by shifting to a new domain(A. Smajgl, A. Leitch, 2009).

Adaptability is reflected in the number of abandoned systems as opposed to the number of sustained systems. When communities are not able to adapt to changing environments, they abandon the system. Outcome 6 identifies the issue of adaptability well. When the issues of lack of funds, inability to handle technical difficulties, reliance on the operator, lack of training and less manpower cannot be handled by the communities, actors begin to throw responsibilities on other actors. When there is a broken pipeline, households blame the operator. When the operator cannot deal with the issue, he relies on the entrepreneur. This situation is represented by the *NIMBY* principle(Buffoli et al., 2016). Communities are not able to adapt to such uncertainties and systems are left abandoned.

Conformance to General Morality

This evaluation criteria here refers to the presence of rules that keep a check on cheating, favouritism or free riding.

At the community level, there are no monitoring or sanctioning rules to check on the roles and responsibilities of households in operating and maintaining the system. The lack of ownership towards the system leads to free rider problems with a community.

9.3.3 Findings and Relevant Design Principles

Some of Ostrom's design principles for enduring institutions were identified as important by stakeholders (participants) to develop new institutions that will be sustained through time and fluctuating environments. The design principles relevant to the findings of the evaluation done in Section 9.3.2 are:-

Findings	Relevant Design Principles
Less accountability amongst men and women about information sharing and taking decisions based on mutual consent and for their benefit.	Collective-Choice Arrangements Nested Enterprises
Low adaptability to changing stakeholders and fluctuating stakeholders.	Monitoring Graduated Sanctions Conflict-Resolution Mechanisms
The very low economic efficiency of PWSs as compared to deep tubewells.	Clearly Define Boundaries Collective-Choice Arrangements
Low distributional equity in piped water projects, due to high costs associated with it and less community interest. Ability to Pay and WTP are low from the community.	Congruence between Appropriation and Provision Rules and Local Conditions
No rules of monitoring and sanctioning for not taking assigned roles or jobs seriously.	Graduated Sanctions

Table 9. 3 Relevant Design Principles for the findings of community-level Outcomes

Clearly Define Boundaries

Defining boundaries of a resource is fundamental to sustainability(Elinor Ostrom, 1993). Currently, the CPR boundaries are not clearly defined, and boundaries change based on user flexibility. Defining the boundaries of PWSs would mean to define at the pre-implementation phase, the communities (geographically) authorised to use the systems and the capacity of system required to cater to the communities. This would set the foundation of collective action. If the boundaries of which communities have rights over these systems is unclear, it is also difficult to define who will be responsible for managing these systems. Defining roles to community members for O&M would also help improve community attitude towards ownership. An effective way to define boundaries could be on the dynamics of the area they live in or on the basic of the income levels of these communities - fairly high-income communities, the middle -income communities and low-income

communities. This would make assessing household WTP easier. A given range of their ability to pay for water can be derived. This would help to increase adaptability, economic efficiency and distributional equity of plans.

Collective-Choice Arrangements

Collective choice arrangements would allow local governments to make their own rules and allow communities to participate in decision making and implementation of PWSs as well(Elinor Ostrom, 1993). In order to increase economic efficiency of PWSs, communities need to realise the benefits of PWSs over tubewells. This would mean making the value of

[Community Perceived Net Present Value of Benefits of PWSs - Community Perceived NPV of Costs of PWS]

positive. To change community perception, the first step would be to set water tariffs based on WTP and household income level. Clearly defined boundaries would help local governments to achieve this. Having a tapped connection can only be beneficial to them, if apart from giving them the comfort of not having to walk long distances for water is at the same time affordable. Increasing benefits could also mean they are able to get more than just water from the system. In rural infrastructure projects, if users feel they are being asked to contribute monetarily to a resource they think is not required, they are less willing to pay. If money can be replaced with other contributions such labour in the form of construction and system maintenance, then benefits are easier to realise. Costs of construction can be reduced, which can also lower capital costs for governments and at the same time users contribute much more than just money. It helps to build ownership and in areas of low employment, it can provide employment to communities (specifically women members of communities) and increase community participation. Involving communities in construction activities have proven to be a successful policy in many communities studied by Ostrom(E Ostrom et al., 1993). A similar successful institutional arrangement of community employment in village of PWSs in Malawi, Africa (E Ostrom et al., 1993, p.99) has been seen(Refer to Appendix D). But operating such a system would mean that plans are made adaptive by local governments and efficient data collection mechanisms, as mentioned above exist. The functioning of such a system would require communities to assess WTP and ability to pay beforehand. This leads to solving the issues of fiscal equivalence and distributional equity.

Congruence between Appropriation and Provision Rules and Local Conditions

This rule re-enforces the principle of income distribution(Elinor Ostrom, 1999). It states that those who receive a higher proportion of benefit should also pay an equal amount of money(Elinor Ostrom, 1999). At the moment, WTP is only assessed using traditional feasibility study approaches (refer to interview with local DPHE). Water tariffs have remained the same across regions regardless of household income levels. All households who receive the water tap connection should pay for water, but the amount they should pay should be defined by their ability to pay. The principle of clearly defining boundaries can help to divide households based on their income levels. A normalised income distribution can be used to determine water tariffs(E Ostrom et al., 1993). Water tariff rates would reduce proportionally, increases willingness to pay and at the same time increase benefits for communities.

Monitoring and Graduated Sanctions

Defining rules of system monitoring, imposing sanctions for not following rules and pre-defining rules for conflict resolution are necessary at community level(Elinor Ostrom, 1993). To improve community behaviour in changing situations of O&M (technical difficulties, no funds, no operator etc.) rules for ownership should be pre-defined. To share the responsibilities of O&M, the principle of collective action would allow communities to themselves choose what they would like to take responsibility of. In most rural infrastructure projects, getting the community involved in taking responsibility for the system is the most challenging task as communities don't identify with these systems as their own systems. They consider being a government

responsibility(E Ostrom et al., 1993). However, involving community members, not just in the decision making but also in the construction would change their attitude from, *"I paid for this system"* to *"I made this system"*. This would increase community involvement and these projects compliant through generations.

Once the system is owned by them, they would themselves formulate operational rules to set responsibilities for their system, based on their strengths and weaknesses. For example, if women are mostly at home while men go to work, they can take care of the treatment of water. Then sanction mechanisms to check on each other's behaviour need to be developed to avoid free rider problems and favouritism (as in the case of women). Following the theory of "quasi-voluntary compliance", in a highly collective society such as Bangladesh, such a mechanism could work in an advantageous way. Communities may begin to develop the attitude of *"I should pay my tariff because my neighbour is paying them"* or *"I should handle operations today otherwise other community members would be upset."* Self-monitoring mechanisms have been identified as the key to long enduring systems, be it the system of tax payment or the system of paying regular water bills. They help to increase ownership of systems or make individuals more responsible.

Conflict-Resolution Mechanisms

Effective conflict resolution mechanisms enable participants to easily identify inappropriate behaviour and inexpensively resolve conflicts(Elinor Ostrom, 1999). Once certain monitoring mechanisms become institutionalized within the community, some rules are required to let individuals continue following those rules without breaking them. To allow communities to continue taking responsibilities and to avoid the free-rider problem, they themselves have to design rules to resolve issues of non-compliance from the rule. For example, if a woman given the responsibility of treating the water, forgets to do it on time, other women in the community should decide the consequences she has to face for not complying with her responsibilities. It is best to let communities decide these conflict resolution mechanisms themselves without interference from higher authorities to avoid resentment towards higher authority.

Nested Enterprises

The principles of nested enterprises demand that functions of appropriation, provision, monitoring, enforcement, conflict resolution and governance must exist at the community level. At the community adoption stage principles of *monitoring, enforcement, conflict resolution and governance* must be thoroughly considered before proposing any institutional reform(Elinor Ostrom, 1999)(A. Smajgl, A. Leitch, 2009).

Currently, the opposite is true. Users are attempting to monitor governance at the collective-choice level with incomplete information. Decisions of conflict resolution and governance are all taken by the *Union Parishad* and not the village communities themselves.

9.3.4 New Proposed Institutional Reforms for Communities

Keeping these design principles in mind, the new institutional arrangements proposed for actors at the local level are: -

1. At the pre-implementation phase, divide households and determine the communities authorized to use the system. Division of households can be geographical, based on region, the area occupied by the community and the number of households within a community and then household income levels and then pre-determine system capacity and scale (small-medium or large scaled) based on demand. The system capacity shouldn't be such that it cannot serve the required population and also not such that it cannot be sustained due to less funds (less number of households involved).

Stakeholder Concern

a) Dividing communities can be a challenge in areas where matters of religion come into play within communities. Hindus and Muslims have different perceptions about water and they may want to

use different water sources for certain reasons. Grouping these households together can be a problem. Issues such as quarrelling with neighbours/possession of land (water users can damage pipelines passing through their own land to stop the water supply to other households) are also prominently present.

b) Determining the capacity of the system is difficult. When water is coming through tap, people do not use it for cooking and drinking only. It is very convenient to use it for bathing and cleaning purposes. Many piped systems intended for drinking purposes have been encountered to be used for bathing and cleaning also. These activities consume more water. More often than not, most PWSs are claimed to be delivering less than what is required because households are using it for purposes other than drinking. Thus, it often reported that demand is higher than what is required but feasibility reports show otherwise.

These concerns will be taken into consideration when recommending policies.

2. To increase WTP, determine water tariffs based on normal distribution of income levels of households within a community. Tariffs may or may not remain the same across households based on the households' ability to pay. Those earn more, pay more. Thus, wealthy landowners may pay more that poorer households.

Stakeholder Concern

a) Convincing economically well-off households to pay more than the poorer households for the same service would be a challenge This concern will be taken into consideration when recommending policies.

3. To increase women participation within the community, formulate a policy arrangement or local level regulation to allow the formation of a separate women's only community. These communities, guided by women NGOs and headed by woman leaders, would help to build awareness and ownership amongst them. To reach consensus between men and female members of the society, village elders- women and men can help to coordinate. Similar to the WATSAN committee, a Women Water Committee/ Women WASH committees that report directly to the UP chairman. Such methods have proven to be successful in India, where women only Self-Help Groups (SHGs) are formed within rural communities and they self-operate(Pandey & Roberts, 2012).

4. Forming SHGs is a way to run a micro-credit facility where women members make small regular savings contributions over a few months until there is enough money to begin lending(Pandey & Roberts, 2012). These funds are then lent back to the members as and when required. In India, many SHGs are linked to banks for the delivery of micro-credit. Such schemes are also becoming popular in Bangladesh with the help of the *Grameen Bank*, which is a community development bank(Barai & Adhikary, 2015). Money lending to poor families to pay water tariffs can be encouraged.

5. The local DPHE should create an arrangement of involving communities in construction activities of the PWS. This can be done by having efficient data collection mechanisms that identify community problems. If unemployment is an issue, adaptive design plans can be made that involve communities in labour work and allow them to compensate labour for money. Such design plans help to solves issues of trust, ability to pay, build ownership, reduce unemployment and increase income levels positively affecting willingness to pay. Households who are unable to contribute monetarily contribute by labour and handling O&M. When water tariffs are collected, labour contributed is considered reducing water tariff costs. This method also helps to reduce some amount of capital costs

for developers by reducing construction costs. Such design plans have proven to be effective in sustainability running village piped water schemes in Malawi and Philippines(E Ostrom et al., 1993, p.87,p.99). Refer to Appendix D for more details on the case study.

6. Allow village elders, community members and village level committees to formulate their own mechanisms to handle O&M based on what they prefer. If women prefer to handle treatment and men prefer to handle pipeline leakages, the arrangement should be established by the members themselves with guidance from village elders and piped water committee heads. If there are problems of free riding, cheating or favouritism, conflicts should be resolved with the help of village elders.

Stakeholder Concern

a) It has often been noticed that the operator is not respectable or trusted and communities begin to not trust the system. In such scenarios, it is difficult to choose or elect the operator for the system. This concern will be taken into consideration with recommending policies.

IV

CONCLUSIONS AND REFLECTIONS

10

Discussions and Recommendations

After having proposed new institutions, it is important to discuss them by bringing back the sub-research questions and the main research question. This chapter concludes the research by answering the main research question and recommending strategies to increase community participation in socio-technical systems such as these ones. Before answering the main research question, an overall summarization of the thesis is done by answering each of the main sub-questions in Section 10.1. Answers to each of the sub-questions lead to answering the main research question in Section 10.2. Followed by that, the research objective and the scientific research objective of this thesis are attended to in Section 10.3 and Section 10.4 respectively.

This thesis begins with explaining the grand-challenge of arsenic contamination of groundwater in Bangladesh. Although piped water systems in arsenic affected areas have been identified as a well-suited technology, the rural areas of the country face the issue of shifting to piped water connections in households. The development of the piped water supply sector has undergone multiple changes over the years which is reflected in the regulatory framework of policies implemented to promote it. These regulations placed, to increase community adoptability and sustainability of the systems have different effects than those expected by the central ministries and the international organisations. Different arrangements instigate different responses from the stakeholders involved. Current policy outcomes do not match stakeholder expectations and rural communities struggle with the challenge of community adoption and maintenance of this community-based common-pool (shared) resource. Thus, this thesis poses the question of,

Which strategies can be implemented to increase community adoption and sustainability of Piped Water Supply systems in the rural areas of Bangladesh to ensure arsenic-safe water in every household-tap?

10.1 Answering the Sub- Research Questions

To answer this research question, 5 sub-questions were used. The answers to each of the sub-questions are discussed below,

Sub RQ 1- What are the roles and responsibilities of the stakeholders involved in supplying drinking water to arsenic affected regions of Bangladesh?

The literature review helped to lay down the foundations to answer this question. At first, the stakeholder groups involved in the WASH sector were identified. Then the relevant stakeholders that play a major role in the rural piped water supply sector were chosen from the pool. The literature review and advice from the field expert helped to identify the stakeholders and their roles. To understand their responsibilities in the rural piped water sector, the chosen stakeholders were considered for field interviews in Bangladesh. These stakeholders were: DPHE (central and local), the Union Council, WATSAN committees, International Development Organisations, Donor organisations, Private Sector Partners and International NGOs. Community interviews were carried out in a high arsenic affected area district –*Manikganj* (close to Dhaka city). The field visit helped to identify key stakeholders and their responsibilities as explained in Section 5.1

of Chapter 5. These identified roles helped to draw out the Power/Interest grid and the Formal Network map in Section 5.2 and 5.3 of Chapter 5. The formal network map formed the formed the basis of the institutional analysis carried out in this thesis.

Sub RQ 2- What are the regulations and processes of development and implementation of rural Piped Water Supply Schemes in Bangladesh?

The major regulations in place for arsenic mitigation were identified during the literature review process. The 3 main policies and 2 implementation plans,

1. National Policy for Safe Water Supply & Sanitation – 1998
2. National Policy for Arsenic Mitigation (NPAM 2004)
3. Implementation Plan for Arsenic Mitigation (IPAM 2004)
4. 7th Sector Development Plan (SDP 2011-2025)
5. National Water Supply & Sanitation Strategies (2014)

helped to gather information about government expectations for rural piped water and identify if policy expectations are matched with actual reality. The plan-implementation process gave and overview of the institutions currently in place for the development of rural PWSs. A comparison between the policy expectations and the field visit scenario done in Section 6.1 of Chapter 6 helped to identify the policy gap between policy expectations and actual policy outcomes. The strengths and challenges identified from the as-is situation in Section 6.2 of Chapter 6, showed that current policy outcomes did not match government expectations. The actual policy outcomes stated that there was a need for an institutional analysis and institutional reform. The methods chosen for the analysis and to suggest institutional reforms were from Ostrom's theories of institutional economics. This step led to identifying and formalizing the conceptual framework used to address the next question.

Sub RQ 3- How can Ostrom's theories of institutional economics be used to understand which current institutional arrangements of the rural water sector affect community adoption and sustainability of Piped Water Supply Schemes?

To understand institutional arrangements nested in the plan-implementation process of rural PWSs, the Institutional Analysis and Development Framework (IAD) was chosen. According to Ostrom, the framework well-suited to analyse already established policy situations where policies have not been able to achieve what they set out to achieve(Polski & Ostrom, 1999). The IAD was intended to clearly identify strengths and flaws of current institutional arrangements. Ostrom's theory of design principles was chosen to support robust new institutional reforms. The design principles were used to bridge the gap between actual policy outcomes and desired policy outcomes. A combination of the two theories was used to form the conceptual framework shown below,

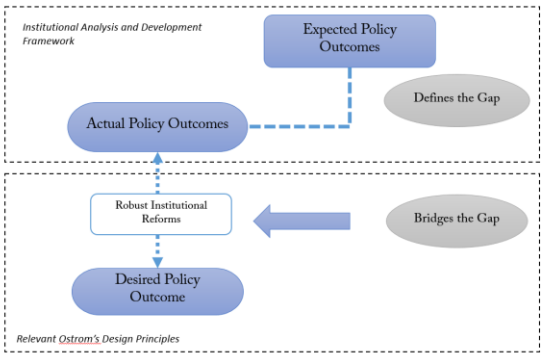


Figure 9. 1 Conceptual Framework

RQs 1 and 2, provided the input that was needed to apply this framework. The IAD framework was applied to analyse the design process (design-finance-construct-operate & maintain) of a PWS, in a sequential manner (central-local and community level). The breakdown of IAD into three major action arenas (planning and designing – implementation and community adoption) allowed to understand the physical conditions, the attributes of the community, the rules in use and the action situations of participants that influence the policy outcomes at each level of governance. The IAD was applied as described in Section 8.1 of Chapter 8. The outcomes of each action arena identified current institutional arrangements the centre-local and community level that affect (both positively and negatively) community adoption and sustainability of these systems. The findings from the IAD application concluded that:-

1. The conditions for decision making and community attributes at the central level set the conditions for decision making at the central DPHE. The central level operates under the influence of the sustainable development goals and the framework of national policies set by the ministries.
2. Actors in the central action arena- the financer, developer, executor, steering committee and advisor interact via workshops and national forums to decide on regulations for the design and plan of the PWS.
3. The national policies developed by the LGD conduct the institutional arrangements for the decision making. The technical guidelines for the design plan is provided by advisors and the financers set the financial models for the sustainability of these PWSs.
4. There are often more than one developers at the central level, leading to multiple models running in parallel. This leads to duplication of activities at the community level and inefficient use of resources. The design plan is developed by interactions with the central level participants only. Local and community level participants are excluded from the decisions of planning.
5. The local level actors work to coordinate the implementation of the design plan within the community. They act a link between the centre and the community.
6. The biophysical conditions of high arsenic contamination set the conditions for the construction of a PWS. The community at the local level is influenced by attributes of national culture- high power distance and high masculinity. These community attributes affect the rules in which local actors operate. The local DPHE and the *Union Parishad* have the power and the position to take complete charge of implementation and monitoring. The chairman of the UP has influence and respect within communities and selects the site for construction. The contractor/ entrepreneur is chosen by the local DPHE.
7. Actors in the local action arena – implementers, coordinators, motivators and sellers interact to implement the given design plan.
8. The monitoring guidelines provided by the central DPHE ensure the design is successfully implemented. The contractual agreements between the local DPHE/UP and the contractor/entrepreneur set the rules for constructing and operating the system. The water tariffs ensure O&M costs are able to be handled.
9. NGOs play an important role in awareness building.
10. The local level operates with large information gaps due to inactive WATSAN committees and women members.
11. The costs of implementation of the piped water systems exceed the benefits obtained from them.
12. The community level actors are the resource users or receiver of the service. They are responsible for operating and maintaining the systems post-implementation.
13. The community operates mostly informally under the influence of community attributes- high power distance, high masculinity and high collectivism.
14. The caretakers, motivators, facilitators and coordinators interact with the resource users to help them to sustain their common-pool resource –PWS.

15. Communities are in general aware of water quality issues. Adoptability is challenge due to low WTP.
16. WTP is a factor of realising costs and benefits of the system, trust, social pressure from neighbours, and high costs associated with having and maintaining the PWS.
17. Adoptability would remain a challenge unless the benefits of having a PWS outweigh the benefits of tubewells, which is currently the most popular technology amongst rural communities.
18. The unsustainability of the PWS is a result of lack of funds and abilities to handle technicalities and un-interestedness to build ownership for the system.

All these findings answered the third research question and set the basis for answering the next research question,

Sub RQ 4- Which new institutional reforms can increase community participation in the implementation of rural Piped Water Supply Schemes and how?

After current institutional arrangements were identified, they were evaluated against Ostrom's 6 criteria for successful policy performance (economic efficiency, fiscal equivalence, distributional equity, accountability, conformance to general morality, and adaptability) to see if current outcomes match these criteria. Evaluation of outcomes suggested which of the outcomes were positive to successful policy performance and which outcomes affected the action situation negatively. Once this was determined, it was clear which of the current institutional outcomes required a reform. The evaluation of these outcomes concluded that: -

1. Adaptability, efficiency and equity of actions and outcomes at the central level are not satisfactory enough to deliver policy success. Accountability fairly exists due to the constitutional rules but needs to be improved. Conformance to general morality is not much of a problem amongst actors at this level, but it is an issue for the local and community level.
2. Outcomes at the local level are evaluated to be less accountable and adaptable. Economic efficiency of outcomes is reasonably achieved but the equity of these outcomes can be improved. Conformance to general morality of actors at this level is unsatisfactory.
3. At the community level all the evaluation criteria at unmatched with reality.

The findings from this evaluation led way into the application of Ostrom's design principles. Relevant design principles were identified which helped to support institutional reforms and make sure that reforms are robust in nature and last through time and fluctuations. The three most relevant design principles which were applicable to each level for this case study were: -

a) Collective-Choice Arrangements
b) Graduated Sanctions
c) Nested Enterprises

New institutional reforms to increase community adoptability and sustainability of PWSs were proposed with the help of these design principles in Chapter 9. These arrangements were then validated by the client assess their feasibility in the real-life context. Most validation only took place with the reply of 'yes 'or 'no' from the client. Stakeholder concerns were expressed wherever necessary. Policy recommendations made, to answer the main research question, taking into account the stakeholder concerns. Answering this research question lead way to developing policy recommendations which helped to answer the main research question in the next section.

10.2 Answering the Main Research Questions

Based on the institutional analysis and proposed new robust institutional reforms, taking client validation into account, the strategies that can be implemented which increase community adoption and sustainability of PWSs in arsenic-affected rural areas of Bangladesh are: -

At the Central Level

I. Sector Development Plan 2011-2015 draws attention to a large number of stakeholder groups running multiple implementation models requiring coordination. The statement can be used as a basis for formulating a committee for knowledge sharing amongst actors. A platform/consortium of central level actors is required where major organisations who design schemes ae invited to discuss positives and negatives of their design process, share information about the different lessons learnt from their models of implementation and suggest key elements of successful implementation to others. This can allow organisations to learn from each other and replication successfully implemented local/ international models.

II. Decentralize the power to local DPHEs, constitutionally (as per policy) to change and adapt plans according to needs of the community. Local governments can decide on the contractor, entrepreneur, and also place a regulation on the number of privately owned tubewells in rural areas. This regulation should be implemented based on local conditions and not as per policy. If the local conditions demand that PWSs are sufficient to meet the demand of communities, then tubewell construction should be regulated with a licensing agreement. Only a certain number of tubewells should be allowed in a geographical region. The implementation of this policy, effective immediately, is needed to control the falling water tables in certain regions such as *Manikganj*.

III. Private sector interventions can be increased by incentivizing and subsidizing local companies to take up construction of PWSs. It may also encourage small and medium scaled companies in the local districts to participate in government projects. Construction of pipelines and building material can be outsourced to community members themselves.

IV. Define specific roles for women in the policy to enforce women participation in decision-making. Policies as of now encourage women participation but do not make it compulsory for them to participate in O&M. Giving women the responsibility of O&M would increase ownership of systems on a large scale. Formation of women only Self-Help-Groups (SHGs) /Committees at the local level could encourage women to abide by the policy and be responsible for O&M. A clearly defined role of women in policies can also increase the functionality and scope of NGOs and allow easier access to communities(Pandey & Roberts, 2012).

At the Local Level

XI. Formulate an efficient data collection mechanism to collect household data from communities at the pre-implementation phase. A shift from the traditional *Contingent Valuation Method* (data collection in the form of surveys) to the *Econometric Demand Method* (demand is calculated by studying community behavioural patterns, the water options they use and the ones they prefer most, the time spent collecting water and other social attributes) is required. With the rapidly growing information technology in the country, this technique is easy to implement by using mobile applications. To solve the problem of only men mobile users in the villages, such data collection can be done in schools and workshop meetings held for women users. Women NGOs can assist in gathering data from women

members of the community. Estimating demand using data analysis and by studying user behavioural patterns has proven to be an efficient method in recent years. '
A combination of both the methods in triangulation can give good results. This method of using social media and mobile applications to collect unintentional data from communities should be encouraged as they increase data quality and accessibility to all stakeholders involved.

XII. Local governments should take actions to involve communities in the construction, maintenance and operations of the piped water systems. Substituting initial down payments for labour promising way to increase community interest in the system and build ownership.

XIII. The willingness to pay an initial down payment costs should be determined using the normal distribution method, where households are required to pay based on their income levels. At the pre-implementation phase diving households based on income level can reduce corruption, increase the efficiency of data collection and help to gauge the interest of communities in PWSs better.

XIV. To increase women participation at the local and community level, women only committees and SHGs should be formed with assistance from the *Union Parishad*. This arrangement to form women water committees and SHGs assisted closely by women NGOs and headed by woman leaders has proven to be successful in parts of India, a country with a similar cultural background. It also helps to make women financially independent. It is a way to adapt rules to the society's cultural attributes.

At the Community Level

XV. *Union Parishads* should allow community members to decide who can handle which aspects of the O&M. They should be allowed to choose tasks as per their strengths and choices. Communities should choose their operator rather than the UP chairperson. Regulating mechanisms to handle unacceptable behaviour should be set up by the village elderly members as they have the power and respect within communities. Higher authorities should avoid intervening.

XVI. A village level micro-credit system for borrowing money to pay for the initial down payment required for PWSs or to handle technical O&M issues has proven to be successful in India. Such schemes can be tested in Bangladesh. Making women in charge of this micro-credit system, with the help of SHGs can also increase women participation. The micro-credit system by Grameen Bank could be researched and encouraged further, especially in areas of high-arsenic.

10.3 Attending to the Research Objective: Serving the Purpose of the Client

Multiple institutional analysis and strategic planning approaches have been used to study the WASH sector in Bangladesh. The work of Gomes et al in extending community operational research in peri-urban areas of Bangladesh(Gomes, Hermans, & Thissen, 2018) and Chan et al in evaluating water governance in Bangladesh(Chan, Roy, & C.Chaffin, 2016) provide institutional insights on the current water supply planning and delivery processes. But a detailed institutional analysis research of rural piped water systems in relation to community participation has not been done before, until now. This research provides new insights into the design process of rural PWSs from the planning stage to the service delivery stage and also studies user reaction when receiving the service. It concludes with proposing institutional reforms that are:-

a. Institutionally possible within the current framework of water governance.
b. Feasible in accordance with stakeholder roles and behaviour

c. Well tested in similar communities across the world, and
d. Sensitive to cultural attributes

The results for this research were presented to Dr Bilqis and has been recognised as valuable to EPRC and DELTAP, with the main argumentation that it provides refreshing insights to deal with community behaviour towards safe water options such as PWSs. Besides these, the policy recommendations made are useful to DPHE and JICA officials interviewed as well. They are open to and looking forward to the findings from this research to gain perception insights of the different organisations interviewed.

In conclusion, application of IAD in this thesis does identify at each tier of governance, the key existing institutions, that would affect community adoptability and sustainability of these systems. The evaluation of the institutional outcomes obtained from the analysis helps to propose new institutional reforms that are useful and the research objective has been achieved.

10.4 Attending to the Scientific Research Objective: Assessing the applicability of the IAD Framework

The IAD framework was originally developed by Ostrom to study the governance of common pool resources (such as fisheries and irrigation systems) in community-based systems(Polski & Ostrom, 1999). Over the years, it has been developed and refined to find use in multiple academic and practical subjects. The application of the IAD framework to socio-technical systems is also not new. For example, Ghorbani, et al. (Ghorbani & Nikolic, 2010), have demonstrated how the IAD framework can be applied to agent-based models of socio-technical systems to exhibit interactions between participants in the action arena and to analyse the outcome of the action situation. Casella has also applied the theory of IAD in complex socio-technical WASH systems to build ABM models(Casella, Van Tongeren, Nikolic, Fonseca, & Moriarty, 2015). Utilization of the framework to analyse socio-technical settings of the energy sector has also been done(Rayhanna, n.d.). However, in most of these researches, the IAD mostly provided input to models, such as game-theory models and agent-based models. This thesis took a rather qualitative direction. Existing literature on the use of IAD to analyse Bangladesh's WASH sector activities was limited as well. Thus, it was interesting to study how relevant and useful the IAD was to the setting *of "rural piped water supply systems governance in arsenic affected regions of Bangladesh"*.

IAD did prove to be a well-suited tool to identify actors and their interactions in an institutional setting. At first, there was abundant literature available to understand the concept of the framework. As mentioned by Ostrom, the framework was appropriate to identify the elements that are needed for an institutional analysis. The framework was well equipped to handle the multi-level nature of the design process. It could be applied to the multi-tiered complex governance problem with overlapping action arenas. It also served its purpose of analysing well-established policy situations by allowing to discuss current stakeholder actions, interactions, their information sharing mechanisms and costs associated with the policy scenario. Of particular importance were the elements – *Information, Control and Net Cost-Benefits.* They allowed to open discussions about information gaps in present institutional arrangements and the limitations of functionalities that actors have. Specific costs associated with these expensive rural systems, not only monetary but also the opportunity costs, were also pointed out. The evaluation criteria helped to analyse concerns of economic efficiency both from the perspective of the central government and the community. Discussions about the community perceived CBA, accountability of actions of actors in the local and community arena, the adaptability of plans, community perceived benefits of tubewells over PWSs are of intrinsic value that contributes to making these institutional reforms. All of these main elements could only be analysed through the IAD lens. Thus, the framework has been proved to be useful in researching this particular topic.

Some adjustments were required. For example, the element '*biophysical conditions'* was not of particular relevance, especially at the central level, where the biophysical conditions the country do not matter in any way to planning and designing of these systems. The diagnosis of some phenomenon required the use of more than one theories or concepts. For example, community attributes could not be studied without using the theories of Hofstede. Economic efficiency and Distributional equity in the case of PWSs could not be explained without using concepts from Cost-Benefit Analysis. However, Ostrom makes it clear that to analyse some action situations, one or more theories are always required(Elinor Ostrom, 1990)(Polski & Ostrom, 1999). The fact that these theories could be incorporated easily, highlights the flexibility of the framework.

11

Limitations and Reflections

It is always wise to look back and reflect on the process of research. This chapter provides a retrospective critique on the research work done . Section 11.1 lists down the limitations of data, scope and methodologies used in this research and suggests improvements to be made. Recommendations for future research are made based on ideas that were considered important to extent the research further or to improve current policy recommendations made. Section 11.2 provides a critique on the numerous aspects that were come across during the last 7 months. The critique here presents my personal reflections on the insights that I gained during the research process.

11.1 Limitations and Future Work

Despite an attempt made to contribute to the research goals of the client, no research can be considered void of assumptions and limitations. Highlighting the limitations sets the premise for future research work to be done in this direction. The limitations are categorised into three types.

Limitations of Data

As discussed in the beginning of the thesis, due to the limited time duration available in Bangladesh (3 weeks) only a portion of the stakeholders from the entire WASH sector have been chosen to be interviewed. These interviewees were selected based on recommendation. Field interviews were carried out in *Manikganj* area only. Thus, the limited sample size and number of observed systems may have led to

1. A generalization of perception and behaviour of all stakeholders, based on the interviews with certain stakeholders. There may be other stakeholders at the central, local and community level with different roles, responsibilities and perceptions. But the actions of actors at each level have been assumed to be of a similar kind, keeping in view the roles and responsibilities of the stakeholders interviewed.
2. A generalization of the field situation based on a visit to 3 village areas only. The field scenario analysis and the results of community level action arenas are based on community interviews carried out only in a specific union. The community level situation may be different in regions, geographically, politically and financially. Communities with other water quality issues such as salinity, in different water-stressed areas may face other kinds of problem situations. Thus, although the basic problem areas may remain the same, not the same rules can be applicable to all rural communities.
3. The research question addressed in this thesis is intended to suggest strategies for all rural regions in Bangladesh. Hence, the institutional reforms suggested are such that they can be applicable for all rural arsenic affected regions in the country. A generalisation of the district and local level community functionalities has been made, keeping in mind the basic general scenario in all villages. However, it may not all apply to all areas, as one size does not fit all. Thus, the IAD application for analysing all local and community level situations on the basis of findings of one region only may have missed out some deeper, intrinsic community aspects.
4. Some stakeholders have been considered in the action arena even though they were not interviewed, due to the importance of their functionality in the action arena. An assumption of their roles in the

action arena is based on information obtained from other stakeholders about their functionalities (second-hand information). These assumptions may have led to information distortion. The roles of these stakeholders can be different when interviewed personally.

Methodological Limitations

Methodological limitations refer to the capacity of methodologies chosen in this research to conduct the research.

Limitations in stakeholder mapping

4. While accounting for the stakeholder positions, the internal hierarchies within ministries and internal departments within the DPHE were not considered. Most positions of actors are based on understanding from semi-structured and unstructured interviews. The stakeholder map is subjective and may introduce the bias of the analyst.

Limitations in the interviewing process

1. Interviews are used as the main data collection method to understand stakeholder decisions and their interactions in the action arena. Although the interviews were designed to take all perceptions and situations into account, there may be the bias in the analysis due to differences in understanding stakeholder functions in depth. For instance, there limited knowledge of the role of NGOs in the different phases of implementation. The perceived role in the action situation, the operational issues of working at community and local level have not been taken into account. The understanding of their power and position in the institutional setup may give them more role in the institutional reform suggested. It may be interesting to see the detailed role of NGOs in the rural piped water sector.

   Future work: - Further research into the active and detailed role of NGOs in the plan-implementation process, by interviewing multiple NGOs (International and Local), can help to contribute to more de-centralised/ community adaptive institutional reforms.

Limitations in the Institutional Analysis

2. IAD is one of the many theories of institutional economics used to conduct institutional analysis. It can be done using other options of frameworks, But IAD is chosen due to its appropriateness in providing the universal building blocks (physical and community conditions, rules in use, interactions) to conduct the analysis. The use of this framework is not intended to steer the analysis into using a particular framework or theory. It may be interesting to conduct institutional analysis using other frameworks and compare results from both methods.

3. The institutional reforms suggested follows an essential top-down implementation approach. Policies and regulations are expected to be reformed by higher authorities. This was done because the decision-making the authority is required to create the environment for other stakeholders to operate. Reforms can be made more de-centralised (community-based) without higher authority intervention which would make the process more participatory in nature. However, enough the sample size of field interviews was not enough to understand community operation and behaviour to an extent where a complete bottom-up participatory approach could be proposed.

   Future Work: - A detailed study of the different arsenic affected communities studying behavioural patterns and choice patterns (using data analytic techniques) can show interesting results. It can

make the process more bottom-up and encourage decentralised planning by NGOs with central government intervention.

4. The concept of benefits and costs of PWSs over other technologies (especially tubewells) has been briefly mentioned when discussing outcomes and evaluation of the community-level action arena. But, the cost-benefit analysis of arsenic mitigation technologies in Bangladesh can be an extensive research of its own. Similar researches have been carried out in Bangladesh (Boerschke & Stewart, 2001) and India(Singh, 2017). Input from such CBAs can into the IAD framework can give different results and may interesting to consider for the central government.

   Future Work: - CBA input of PWSs vs tubewells included in the IAD analysis can be interesting to study for the client.

5. Case studies of well-functioning village piped water systems in regions across the world have been used to support institutional reforms proposed in this thesis. Examples of real-life, already implemented and well tested and verified systems often provide enthusiasm and background knowledge to follow similar approaches. But a multi-country study of already existing successful WASH adaptive planning methods was lacking. The case study method could be further improved by studying general successful institutional reforms of the WASH sector from neighbouring countries such as India and Nepal. Sharing this knowledge from other countries could contribute to further sights for the client. This requires an intensive investigation into the different WASH institutional setups in other parts of the world and could not be improved due to limited time duration.

   Future Work: - It may be interesting to do a multi-country comparative study of WASH approaches with the methodology used in this thesis and share results with the client.

6. The institutional reforms proposed in this research assume high motivation and abilities of actors to implement these reforms. However, realistic scenarios may not be all in favour of actors. Actors' motivation and ability to adopt new changes given perceived conditions and available resources, may fluctuate from the planning phase to the adoption phase. These motivations and abilities of actors should be considered when making policy recommendations. An attempt to include the factors of motivations, technical, financial and institutional abilities was made in the research process of this thesis. But, it was chosen to be kept out of the scope of this thesis as that can This can affect the quality and exhaustiveness of the concepts discussed in this thesis.

   Future Work: - The MOTA Framework developed by Phi et al(Phi, Hermans, Douven, Halsema, & Khan, 2015) can be used to further study the feasibility of the institutional reforms taking actor motivation and abilities into consideration.

7. Qualitative methods used to recommend WASH policies often ignore community behavioural patterns, ability to adapt to change and their complex social interactions. Having the knowledge of how communities interact with each other pre-planning and pre-implementation can drastically improve WASH sector management. Using quantitative modelling tools to understand and imporve service delivery on ground based on behavioural and perception data can be and interesting addition to this research.

   Future Work: - Using the Agent Based Modelling (ABM) tool to study complex social interactions at the community level can help to provide suggestions for policy reform at lower institutional levels in the rural water supply sector. The work of Casella on complex adaptive rural WASH systems(Casella

et al., 2015) , Knipschild (Knipschild, 2016) and Leung(Yeung, Leung, & Ecology, 2018) on using agent-based models to improve service delivery in complex WASH systems can serve as a starting point for future work. A similar ABM model can be developed in the case of piped water supply in Bangladesh as well. Carrying out a research of this type would mean the data collected has to be quantitative in nature.

8. In regard to the applicability of the IAD in analysing socio-technical systems, the use of the framework depends on the way its elements are interpreted and the information available for analysis. Suppose that the framework is used by another person to analyse the same situation, or the stakeholders in the action arena change, or the contextual factors that one is exposed to change, the results of the analysis will also change. Thus, the framework does not guarantee generalizability in all situations due to its very qualitative nature. This can be advantage in many cases but can also prove to be a limitation, if subject to discussion with a technical analyst or an engineer.

Limitations of Scope

1. Considering other technological options for arsenic mitigation such dugwells, Pond Sand Filters etc. in the picture, may differ the institutional analysis (comparison between two technologies adds the complexity of choice) and give different results for institutional reform. Other technology options are left out of the scope of this research to avoid complexity.

2. Not all of the 8 design principles are applied to the results of the evaluated outcomes. Only the ones identified relevant to the situation by the author were chosen from the 8 design principles and applied. Applying of the 8 design principles, one-by-one, to each finding could result in different or more refined results. Their detailed application is left out of the scope of this research to limit the scope of analysis.

11.2 Reflections

In this section, I provide my critique on some of the key aspects that I came across during the last 7 months. I begin with reflecting on some elements I came across during my interview sessions. Then, I present my personal reflections on the methodological choices and the learnings and take-away from the thesis process.

Private Sector Intervention : A Thought for the DPHE-World Bank to consider

The intervention of large private sector activities in WASH activities should be well considered by the government. Private sector interventions to a certain extent may increase economic benefits for the government, but it may have opposite effects on the community, where prices increase to generate profit for private sector, leaving out marginalized communities and increasing economic inequality even further. Even Ostrom's studies say that completely market driven models do more harm than good. They cannot be sustainable in the long run as they are subject to issues like corruption, enforcement and holdout problems. Multiple experiences from the past have shown that in the long run privatization of natural resources has often led to its commercialization and exploitation for economic gains.

Multiple foreign NGO/ Donor Organisation Intervention: My Observation during stakeholder interviews

Bangladesh has been receiving huge amounts of aid from international organisations and NGOs across the globe. Multiple international NGOs , bilateral and multilateral donor agencies (European and American) operate in the country, all pursuing different roles in poverty alleviation, social welfare and the development of society. Foreign Aid has been contracted for almost all kinds of development projects, supplementing national budget, debt relief, achieving SGDs etc. This inflow of foreign aid has no doubt, had a positive

influence on economic development. But, it has heavily increased national government reliance on donor organisations.

The interviews gave an impression of an increased 'rent-seeking' attitude amongst local organisations and ministries. People were often of the mind-set that aid will always be available. Having this in mind, not much effort is taken by local organisations in self-capacity building. This phenomenon can be s with the 'Dutch-Disease'('Investopedia', n.d.), where foreign aid can be considered, similar to a natural resource. For instance, there has been a huge improvement in the development of the WASH sector but it has come at the cost of locals not having control over their own resources and not able to improve their own capabilities. In the long-run it may harm the capacity of the state to perform and deliver eventually having negative effects on the country's economy and regional growth. The rise of the NGOs and private organisations as the agents of development can come at the cost of legitimacy of the state. The government should consider reducing dependency on foreign aid, rather than increasing and focus on developing its own capacity.

Many international NGOs, apart from bringing in foreign aid, also bring in a patronising nature to problem solving. A new technology or method is introduced in local environments by developed countries, with the expectation that it will give similar results. But, these new methods often face implementation failures and are rather a bane in developing countries. Desired results cannot be achieved simply by creating attractive technologies when these entities lack local capacities and enhanced public management systems.

Methodological Choice

The choice of using the IAD methodology was not a consciously pre-decided choice. The initial methodology I decided to use for the problem analysis was Agent-Based Modelling. I was highly ambitious when I started out with the thesis project and I wanted to use a mixed-approach method (Qualitative and Quantitative Approach) and apply it to a real-life case scenario. However, realizing the limitations of time in gathering data, field work and building a model all together, I made a conscious choice of doing a qualitative research. This was my first ever individual attempt in a qualitative study and I found myself lost. I was fixed on my problem statement, but I wasn't sure which qualitative methodology would suit best to analyse such a problem. When presenting my thesis proposal, I identified MOTA to be something suitable for such an analysis.It covered the details of actor perceptions in policy planning and implementations, which seemed to be well suited for such a problem. However, a meeting with Sharlene Gomes, a PhD researcher at TBM, some examples from previous researches and then the field visit changed my mind and I switched to the IAD framework in combination with MOTA. From the field visit, it was more evident that the IAD would apply best. MOTA was later excluded from the research due to the limitations in the type of data needed for a MOTA analysis. Although the IAD framework in combination with design principles was good choice for such a problem analysis, a mixed-method approach, with the availability of time, would be a better suited choice. It would, in my opinion, provide more detailed visualization of community behavior and more depth to the community-level institutional reforms proposed. If given a choice again, I would use the IAD results from the current research in combination with an ABM model, to be able to generate more precise and concrete policy recommendations.

A researcher is always influenced by his/her perception of the problem. It is important to acknowledge my limited rationality in capturing all the ideas and information in the framework of IAD and limited understanding of the technological system. I have made my best attempt to assemble all information possible and represent it correctly in the institutional analysis. However, there may be a possibility that a certain member role or power relation has been misrepresented as most relations are presented as interpreted by me and it is difficult to apprehend the entire implementation process in its real-life sense.

Stakeholder Identification and Interview Process

The process of identifying the stakeholder roles beforehand was quite challenging. It is always advisable to have a pre-defined stakeholder map before going to the field. But, it was difficult for me to visualize the water governance structure of Bangladesh, just with the help of Desk research. I was unable to understand the complexity in the different roles of all the actors apart of DPHE's before going to the field. Thus, although I was guided by Dr. Bilqis, in helping me to choose the appropriate interviewees, I initially did not understand the implementation process clearly. That affected the quality of my interviewees for the first few interview sessions, until I had interviewed 3 different stakeholder types- DPHE- Max Foundation and HYSAWA. This gave me vague mental map of the implementation process. My questions became more focused and refined after a few interview sessions warranting better responses from interviewees. At many instances during my interview transcribing session, I realized that the interview questions could be improved to get clearer and better responses. Having designed more stakeholder specific interview questions beforehand could have helped. I would have acted differently here.

Lost Information Due to Translation

All community-based interviews were possible to be done only in Bengali (the local language) with the help of a translator. I have attempted my best to get most information from the translator. There may be some distortion of information from community interviews in *Manikganj* due to loss in translation. It was important to mention this due to the importance of community-level information placed in this thesis.

The Research Process

This research process has been an extremely adventurous experience for me. I took up this project with the intention to contribute to a real-life actual problem situation and create an impact on lives. It was my first qualitative research. Most of my previous experiences have been with quantitative assignments and I somehow feel that results without numbers are not appropriate results. This explains the large amount of text I have written and my initial decision to include MOTA into my thesis. Diedre Casella, Sharlene Gomes and Dorien Korbee's work in the rural water service delivery in Bangladesh helped me provide starting points to look at this problem from an EPA perspective.

This project was also my first field experience in a village, where I had to interview people, discuss their problems and interpret all of their problems in academic style. it was a valuable addition to my EPA experience. The field visit came with many unexpected challenges such as changing the location of my field visit from *Rajshahi* to *Manikganj* due to security reasons, slightly changing my research topic from small-scaled piped water systems to all sized piped water systems and personal issues of losing my wallet. However, the quality of data I collected was not compromised. I was able to interview most key personnel I intended to interview with the support of Dr Bilqis. The interactions I had with the DPHE, World Bank, JICA, ADB Bank and Max Foundation officials were most relevant to my research and valuable to my professional experience. Dr.Bilqis's frequent input and feedback on local situations was most important to my findings. Given more time, I would have visited a few more affected communities and atleast 2 more PWSs (both working and not).

Going through the entire research process, each step was a new learning curve, from deciding my research topic, to finalising my methodology, understanding and using the IAD, and then comprehending the implementation process into three IAD stages. Interview transcribing was the most painful experience.

Given a chance, things I would do differently are, plan a better field visit, choose my methodology well in advance, reduce the scope of my analysis beforehand, and not transcribe interviews but summarise them. However, I have experienced a whole new dimension in the field of academic literature and research, learnt new political concepts and applied my EPA knowledge as a policy analyst to a technical scenario. This gives me the most accomplished experience of my 2 year EPA journey and makes me proud. In the end, I would conclude with the quote,

"Unless you try to do something beyond what you have already mastered, you will never grow…. Ronald E. Osborn"

V

APPENDICES

A

Stakeholder Interviews

This section discusses the interview protocol adopted during the scheduled interviews, questionnaire for the interview session and then the list of interviewees that provided the information discussed in this document and their respective designations. Further sections discuss each of the interview conversations in detail. Interviews at the local level are summarized and not transcribed mouth-to-word as they were available in English translations of the original version.

A.1 Interview Protocol

Interview began with a brief introduction of myself and my objective of carrying out this research. A questionnaire was briefly followed but, most interviews were open interviews and there was room for cross-questioning and amending questions based on responses. These interviews were recorded for listening later. A translator was present during the field interviews with communities due to language barriers. Each interview began with me first clarifying if it was okay for me to record the interview for further reference. The purpose of the interview was stated. Main things noted at the beginning of each interview

Name of Interviewee:
Position:
Role in Organisation:
Function:
Office Type/Location:
Date:

At the end of the interview it was asked if it was okay to make these interview conversations public. The interviewee was thanked for his time and effort.

A.2 Interview Questions

1. What is your main role/function in the organisation? How many years have you been with the organisation? What are your specific tasks?
2. What is the organisation's work in the arsenic mitigation from drinking water issue in BD?
3. What is the progress in regard to piped water systems in BD? How much of the community based water supply systems are piped water based? Why it is not so popular? How can we make it popular?
4. How do you choose the areas where to choose to install and work, is it based on data of most affected regions?
5. Is piped water mainly installed in peri-urban or rural areas?
6. Can you explain the functioning of the DPHE, from national level to the field DPHE to the union level, complete from top to bottom? (in case of DPHE)

7. What are your criteria for partnering with NGOS, international organisations and private companies? How do you partner? Who approaches who? Explain a little bit the picture?(this is for all community based water supply systems, i want to know)
8. How much work/progress has been done in piped water supply systems? How do you the technology: piped water/deep tube wells, who decides which best suited technology is?
9. The national water policy for arsenic mitigation of 2004 says that there should be more use of surface water than groundwater, why still maximum groundwater is used and not so much surface water is used? surface water can be used in rainy seasons at least, groundwater is depleting
10. How does funding work? Is it initiated from international organisation? Explain the hierarchal implementation process
11. Why are the operations and maintenance of the piped water system costs dependent on the community? Cannot NGO handle the operation and maintenance costs?
12. If WATSAN would be more active, what major role do you think it can play from the piped water perspective?
13. Do you participate in community awareness and motivation activities - capacity building?
14. What according to you is the level of trust, awareness and engagement in the system?
15. Main factors that are responsible for the adoptability of the system at community level.(how do you think a behavioural change can happen at community level?)
16. How do you plan to scale up piped water systems?
17. Do you get always the support from the NGO, in terms of funding?
18. How do you perceive a system of 10-20 households per supply system(in case of piped water or community based common tap)
19. What are your goals/performance indicators for every project you do? Who takes care of the monitoring of water quality every year?
20. What happens to very poor people who cannot pay?
21. Motivation:
22. Ability
    a) Technical
    b) Financial
    c) Institutional
23. What are your two main threats and opportunity?
24. What are the 3 key factors for adoptability of technology?
25. 3 way towards improvement and increase of popularity of piped water system
26. Is there anything important that I did not ask that you would like To share with me?

<u>Specifically for JICA and DPHE</u>

27. Is surface water based piped water systems acceptable?
28. How can those be scaled up?
29. Do you think the PSF if connected to pipe, can it be successful and can it be scaled up?
30. It is best expandable at what level: district or sub district?
31. Why groundwater based piped water system did not become so popular what was the main drawback? How can they be made popular?

A.3 List of Interviewees

	Organisation Type	Organisation	Name of Interviewee	Affiliation
1	Local Research Partner/Client	EPRC	Dr Bilqis Aimn Hoque	President and Director of Research. Environment and Population Research Centre, Bangladesh
2	Governmental Organisation	Department of Public Health Engineering(DPHE) Dhaka – Head Office	Md. Saifur Rahman (Interviewee 1)	Superintending Engineer Groundwater Circle
3	Governmental Organisation	Department of Public Health Engineering(DPHE) Dhaka – Head Office	Engr. Eheteshamul Russel Khan (Interviewee 2)	Project Director WASH
4	Governmental Organisation	Department of Public Health Engineering(DPHE) Dhaka – Head Office	Engr. Mir Abdus Shahid (Interviewee 3)	Project Director BRWSSP(Gob-World Bank)
5	Governmental Organisation	Local Government Division Policy Support Branch	S.M Moniruzzaman	National Consultant(Sector Coordination)
6	Governmental Organisation	Local DPHE Office *Manikganj Sadar* Office	Mohsinuzzaman Khan	Assistant Engineer
7	Governmental Organisation	*Union Parishad Mitra Betila* Office	PR Ali	Secretary *Union Parishad*
8	International Developmental Organisation	UNICEF	Nargis Akter	WASH Project Officer
9	International Developmental Organisation	World Bank	Arif Ahamed	Senior WSS Specialist Water Global Practice
10	International Developmental Organisation	Embassy of the Netherland, Dhaka	Md. Reaz Uddin Khan	Senior Policy Adviser Water Management
11	International Donor Organisation	Embassy of the Netherlands, Dhaka	Peter de Vries	First Secretary/thematic Expert Water
12	International Developmental Partners	Asian Development Bank	Nazmun Nahar	Project Officer, Energy Bangladesh Resident Mission
13	International Developmental Partners	Asian Development Bank	Mohammed Sayeedul Haque	Associate Portfolio Management Officer Bangladesh Resident Mission
14	International NGO	MAX Foundation	A.K.M Waliul Islam	Team Leader MWSSS Project
15	International NGO	Care Bangladesh	A/N.M Kaiser Zillany	Team Leader Tipping Point Project Ex WASH officer
16	International NGO	Practical Action	Engr. Dipok Chandra Roy	Programme Manager Energy and Urban Services
17	Private Organisation (Funded by International Donors)	HYSAWA	Md. Nurul Osman	Acting Managing Director
18	International Developmental Partners	JICA	Ithishamul Huq	Senior Consultant Arsenic Mitigation Involved in the policy

				making of National Arsenic Mitigation Policy 2004
19	Private Organisation (Contractor)	SIDKO Limited	Enamul Haque	Executive Director
20	Local Developmental Partners/Research Institute	Environmental and Population Research Centre (EPRC)	Mohammed Abu Jahid Shipon	Assistant Engineer EPRC Field Expert
21	End Users	Village Community *Barai Vikora*	Operator of the Village Piped Water System	Saiful
22	End Users	Village Community *Barai Vikora*	Head of Village Piped Water Committee	Jafar Alam
23	End Users	Village Community *Barai Vikora*	Water Tariff Collector	Offa
24	End Users	Village Community *Barai Vikora*	Women Focus Groups	Shilu, Ranu, Jeenu, Alia, Ruma, Meenu, Mazma
25	End Users	Village Community *Barai Vikora*	Men Focus Groups	Rizwan, Arif, Amin, Mohammed,Ali, Shamin
26	End Users	Village Community *South Mitra*	Mixed Focus Groups	Haseena, Lucky, Rohima,Ooshi, Sumon
27	End Users	Village Community *South Mitra*	Secretary Village Piped Water Committee	Raizul Islam Khan

Table A. 1 List of Interviewees

A.4 Organisational Interviews

A.4.1 Organisation: Care Bangladesh

1. How many years have you been with Care BD?
   - 18 years with Care BD – 4 years he was involved in WASH Sector
2. Does Care work in the Drinking Water Supply Sector?
   - Mainly in in rural areas
   - Since 1998 they have been working in water sector
   - WATSAN was the first project
   - CLTS – Community Lead Total Sanitation
3. Have you worked with the DPHE?
   - DPHE was the main stakeholder in the project, from the side of the government
   - They work directly with field DPHE Staff
   - Care and other NGOs are the implementation partners
4. How do you interact with DPHE? How do you tie up with DPHE?
   - UNICEF plays the role of bringing DPHE together with other NGOs
   - The project was designed in a way that, DPHE is the main partner and NGOS-Plan International, Care and implementation partners
5. How do you choose your area of work?
   - Care had the opportunity to develop the proposal from their side, based on national level information they choose the area.
   - They identified poor sanitation prone areas – the northern parts of the country, the coastal regions, some areas of Khulna
   - They are chosen based on national level data – in terms of sanitation, water supply and the facilities in the community schools.
   - They propose to UNICEF – they decide which areas to go with
6. How is the business model structured?
   - They play just a facilitative role
   - They do a number of participatory exercises

- It is owned by the community, that is the intention to make it sustainable
- They have a monitoring team, that checks if the community is still practicing those methods to maintain the system.

7. How do you test the participation of the community?
   - The community has to contribute financially to some extent
   - Depends on the project
8. What is the level of awareness in the community?
   - There is a level of awareness in the community
9. What is the level of trust in the system?
   - The way the message is delivered in important, if you focus on the positives, focus on the benefits then the level of trust in the system increases.
10. When do you know that the project is successful?
    - Field Monitoring is done, one in a month visits to the sites.
11. How do you think a behavioural change can happen overtime?
    - The community has to take the ownership of the project.
    - Success of a project is easier in a country like BD when you partner with governmental organisations- such as DPHE
12. Biggest Threat and Opportunity in the CLTS project
    - Threat – In flood Affected Areas, the sanitation projects are broken due to floods. It is important to rebuild those projects. That is a challenge for the community people in terms of the finances. Each year they have to rebuild and construct it. So that is a very big challenge.
    - Opportunity – They have to understand the benefits of this, that it reduces costs and increases benefits.
13. Identify 3 main factors that are responsible for community adoption of clean drinking water supply systems.
    - Group Mentality

A.4.2 Organisation: SIDKO

1. What is your role in the organisation – SIDKO?
   - I am the executive director and I am heading the team who are working in the arsenic mitigation area. We work with iron and arsenic mitigation from groundwater to get drinking and cooking water. The water can only be used for drinking and cooking.
2. How do they work?
   - They have 512 plants all over the country, so far successfully installed. Majority is with UNICEF.
   - UNICEF is the Donor Organisation – who is responsible for funding the project.
   - DPHE is the implementation Partners- receiver of the job.
   - SIDKO is the technology provider. Their Main role is to install, position the plant and handover the plant to the community.
3. What is your source of the water that you are treating?
   - They use water from all kinds of sources – deep/shallow tube-wells/surface water as well.
4. How do you choose the area where you have to operate?
   - In certain areas, especially in the coastal belt, you cannot go very deep. So, in those areas they have to use only shallow tube-wells- 70 feet deep. Mainly in the areas where they is a lot of salinity underground. In the south-western part of the country. Majority of their plants are there (200-300), that is the main arsenic belt of the country. The main arsenic regions are there hence they operate there. Their main focus is to eliminate the arsenic from the groundwater.
5. How do they operate community based?
   - They do only community-based filtration systems, of minimum 100 households up to 500

- They are the only licensee of the government of Bangladesh to do community based arsenic filtration systems.
- Focus is only arsenic removal, and simultaneously iron.

6. Are you directly involved with DPHE, or a third party is involved?
   - They are dealing directly with DPHE and UNICEF. UNICEF contacts them and then DPHE is involved. Nowadays, UNICEF is not very interested in drinking water sector anymore. As of now, they are not spending now on drinking water sector.
7. If UNICEF is not funding now, which organisations are then funding you.
   - Save the Children
   - World Vision Bangladesh

   They know about SIDKO and they know about SIDKO, they are an enlisted company, licensed by the government itself. So, they directly approach SIDKO, as they are only involved in arsenic mitigation.
   - There is an Arsenic Mitigation Committee in Bangladesh that involves DPHE, BUET and Dhaka University. They decide, whose technology should be approved.
   - In the committee, there is an organisation – BCSIR (Bangladesh Council of Scientific and Industrial Research), they with the help of their Canadian assistance (Oceta) evaluate the technology for 3-6 months doing field test and then approve that yes, the SIDKO plant can go for commercial supply.
8. How do you do the site selection?
   - The selection is done by the buyer- UNICEF/NGO, but they visit the site to do the water test and see the water quality before they proceed to instalment.
   - Mostly, the organisations approach them to work in intensive arsenic affected areas, where the content of arsenic very high (up to 500 ppp arsenic content)
   - The monitoring is done by the beneficiary (which is the member committee of the village – who monitor the plant)
9. What happens if the community cannot pay?
   - Most people pay for the water.
   - Sometimes, NGOs are selling this water as well and making a profit, in regions where this water cannot be reached.
10. Who is responsible for motivating the community?
    - The NGOs are responsible for motivating the committee people, using participatory tools and activities.
    - Sometimes, if there is alternate option available, for example if DPHE installs a hand-pump/Tara pump or a deep tube-well, where the water looks the same (may contain high content arsenic, but people are not aware) then they will prefer the option which is free. Then they will not use the SIDKO treated water.
    - Awareness is important about the content of arsenic. But, if there is an alternate option available, then they will prefer the water from the free source of water.
11. When will you know that the project is successful?
    - It has to be successful for my business to be running. So, only if it successfully installed from my end that I will get more business.
    - They get the project through a tender where they bid based on the technology they have. If they win the tender, then the get a contract issued to them by the funder. Initial investment is theirs. They put in the money and then UNICEF/NGO reimburses the money to them. So, if they do not do a good job then, they will not get the money. Once the installation process is complete, then BUET does the testing of the plant and once the testing is clear then they get the payment.

12. How do you choose how deep to dig for the groundwater?
    - It is area dependent. If it is a saline region, they will not dig deep, they would use shallow water with high arsenic content and filter it out.

- The plant will not work in saline water. They only remain on the arsenic level, not go to the deep saline level.

13. Why do not they use surface water and depend on groundwater only?
    - The treatment of the surface water is extremely expensive. The surface is not in a condition to be used at all. In order to reduce groundwater usage, rainwater harvesting is a solution, during monsoon months but storing of this water is a problem.
14. The National Water Policy of 2004, says that use surface water wherever possible and groundwater as least as possible.
    - The cost of processing the surface water will be more and more resources, like electricity will be required.
    - Rainwater harvesting a solution but still it is not actively pursued by the government.

Community Related

15. Do think that there is trust and awareness about the system in the community?
    - People are much aware about the system than 10-15 years back. Mainly because they have seen deaths in their villages.
    - They trust the system as well.
    - They main issue is the ability/willingness to pay. They are very reserved to spend money.
    - If there is a free source, even if they are awareness about arsenic free water they will still use the water from the free source. Also, because they cannot see the arsenic. Iron they can see, they find it dirty and cannot drink it, but arsenic they cannot see, so they don't think so much. To them, seeing is believing.
16. Do you think that behavioural change has happened in the community over the last 10-15 years?
    - Definitely, due to education
    - They have changed their ways
    - The number of people paying for water is also gradually increasing, in some areas, they are even willing to pay up to 100 BDT/month for water.
17. How do you think you can get more people to pay?
    - In some areas, DPHE subsides for the areas which are very poor and unable to pay.
    - If not DPHE, then the NGOs reach out to the people who cannot pay and subsidize water for them.
    - Sometimes, the NGO motivates the community and they encourage people to sell the water from the treatment plant in areas where there is no treatment plant.
18. What happens to extremely poor families who cannot pay?
    - They will get water, from DPHE or from deep tube-wells but it may not arsenic safe as they cannot pay.
    - The DPHE's awareness campaign included marking the arsenic affected tube-wells red in colour to create awareness amongst the people.
19. Do you think that DPHE and NGOs give you full support?
    - Yes, as and when required they get full support from them.
20. Why are you not working with piped water technology?
    - DPHE is doing piped water systems.
    - SIDKO is not doing and they will not do as well, because
        1. The water is costly, and the possibility of wastage in a household piped water system is higher according to him.
        2. It is only for cooking and drinking and not for another household uses.
        3. Piped water technology will become costlier.
    - They will stick to point source-based system only where people must come and collect it from the delivery point.
    - They will not do household connection, he believes that will create more wastage
    - For his plant type, piped water will be very expensive and more wastage, of the water that is filtered with expensive technology.

21. Do you think that with 50 households, will that kind of system be more successful?
    - That can work, but it will be hard to make it sustainable financially. Recovering the cost will be difficult as the material (media used) in the treatment plant is expensive and cannot be made cheaper (imported from Germany) hence, recovering the cost would be the main challenge in a 50 household or less system.
    - They need a minimum of at least 50 or more.
22. Do you think that you can make any improvements in your technology or way of working?
    - If the material can be locally produced, local production of the material can make the cost cheaper.
    - If cost becomes cheaper than they can install more plants in more areas and reduce cost for the community.

A.4.3 Organisation: Department of Public Health Engineering – Interview 1

1. What is DPHE's role in the drinking water circle of Bangladesh?
    - That is dependent on the project itself
    - Support of the NGO- for motivational activities – Software
    - Sometimes they undertaken investment activities as well, like construction
2. How many projects have been implemented for arsenic mitigation throughout the country?
    - Since 1993 we have implemented many projects- research projects, investment projects many.
    - All together 20 Projects.
3. What is DPHE's work in the arsenic mitigation issue mainly in piped water systems?
    - Initially, from 1993 the projects where mainly related to studying the magnitude, scale of the problem and the affected areas.
    - A study was conducted where it was found that people mainly prefer groundwater over surface water.
    - We found that groundwater can be directly pumped without treatment in many areas, where there were deep aquifers present. There we have constructed deep tube-wells.
    - But, in many arsenic affected areas where there is salinity, in those areas drilling is not feasible, and mainly in those areas piped water systems are constructed.
    - By policy, the government has instructed us to reduce the number of drillings and to comply with that policy implementing piped water supply is the fit solution, as you can drill minimum number of times and supply to a large amount of people.
4. Do you think that piped water systems have gained the popularity, as groundwater is depleting slowly and you have to make the switch to an alternate source soon?
    - Where we cannot have surface water we have to use groundwater. If we use surface water, we must go through a treatment process, there is no other alternative.
    - In some cases, but without treatment we can use groundwater.
    - Our policy is to implement the system, establish the project and then hand it over to the user group for operation and maintenance but maintaining a treatment unit for the community group living in rural areas is usually a challenge. That is why we try to avoid treatment units.
    - That is why by installing 2/3 tube-wells, we started to supply piped water. Even then, operation and maintenance, especially the running of the piped water system, electricity is the main cost, is very high. In many places, the user groups were not able to provide the electricity connection fee, in those areas, the O&M has become a problem.
    - It is not a technical issue, but a management issue for not being able to select groundwater as a source of water supply.
    - The main reason is that people should have less O&M cost, that was also the main target, hence they did not focus on using surface water.

- More than 50% of the systems are running successfully because of the demand from the community.
- The demand from the community is more for groundwater. Even after DPHE installs the tube-well, they still use install their own hand-pump, that way they become less dependent on the government system.
- Sometimes, when they know that there is a successful tubewell installed, they know that it is a freshwater source and they install their own hand-pump.
- Without depending on the community-based system, they have started to use their own water point.
- But, wherever there is no other option of drilling for groundwater or surface water, in those areas people are still depending on piped water systems. – main reason for success of rural piped water supply system.
- According me more than 50% people are using piped water systems.

5. Do you think that that piped water should be expanded, considering the challenges it is facing?
   - Yes of course, if you drill in close by areas multiple times, then it is not sustainable.
   - In our system, minimum of 200 households should be there to maintain the system. Piped water can reach many households at the same time.
   - If there are 1000 households, which is about 5000 people in the system, then when one household pays 100 BDT/month, it becomes 50,000-BDT contribution from the community and with that contribution, that is ideal to maintain the system properly.
   - But collection efficiency is not so good, sometimes they pay, while sometimes they don't. That is an issue.
   - Many times, people have other alternative options that is when they will not pay, due to these reasons many piped water schemes were abandoned.
6. How do you choose the area where you will set up? What is the criteria for choosing?
   - Minimum criteria are that it should be arsenic prone area
   - Based on a feasibility study which determines, who are willing to contribute and pay.
   - The number of people that can be served from one system.
   - Availability of land, who is willing to contribute land for the construction
   - Initial down payment is required from the community (Around 10000 BDT/system)
   - Whenever in the account, the *Union Parishad* chairman says that, they have accumulated 10000 BDT minimum, then they know that there is a Willingness to Pay. Then they take that area into consideration.
   - Initial down payment from the community is 10000 BDT, that confirms their willingness to pay and then they are also required to pay a monthly cost for Operation and Maintenance.
   - The UP chairman has the main reach and say at the local DPHE office, that this particular village in the UP should have the piped water system.
7. What happens to communities, who cannot afford the 10000-BDT minimum down payment?
   - The down payment is based total from the community and is not per family. So, if one person contributes more than the others, it doesn't matter to them. That is an internal village matter. In the end, they should be able to show 10000 BDT, in the bank account.
   - It can come from 1 person, 5 persons or the whole community.
8. Do you participate in motivating the community?
   - DPHE involves the Community Based Organisations, CBA or NGOs who are tasked with these kinds of jobs.
   - NGOs do these tasks
9. What is the model of working for you?

- The demand must come from the community. They submit the application to the Local DPHE office. Based on that we understand that this is the demand, and then we do a study and then accordingly install the system
- All the water options provided by us, the demand has to come from the community.
- We then provide the system based on the site which has been selected by the local representative
- Before the system is handed over to them, we form a user community, hire an operator, give trainings, instructions and guidelines.
- About 50-55% of the projects running are solely supported by the DPHE with no donor support. In these systems, part of the money must come from the community for construction.

<u>30-70 Model of Working</u>

- But, in donor funded projects, there is a model where in a local entrepreneur is involved. In this model, 30% is put but the local entrepreneur and the 70% is put by the World Bank(Donor). In this case, DPHE acts like a design consultant.
- The initial model was this: The local entrepreneur they propose, and design the system select the site and the DPHE checks if everything is okay. The scheme is proposed by the entrepreneur and approved by the DPHE.
- But based on the lessons learnt, this model was changed and DPHE took the responsibility to design the system for the rural communities and then ask the LE to take over.
- Usually, people rely on the government only when there is a crisis of quality and quantity. Otherwise, on other areas they prefer not to rely on the government.
- Where there is iron, there is arsenic mostly, iron has the aesthetic quality to differentiate but arsenic does not.

10. How do you measure your success?
    - Proper site selection can tell us the success rate of project.
    - They make their own arrangements about the land, how much is each person's share on that land, and then they come to us with the land. As DPHE we make a contract with the UP chairman.
    - Many times, site selection is not in our hands.
    - The WATSAN Committee at the *Union Parishad* level, decides the site. So, sometimes, if due to corruption, they can say that we need the piped water system in this area that may not be an affected area. It can be that the population in that part of the village is not much. Still that site is selected.
    - So, the plan is ready, and the scheme is ready but, the site selection is not in their hands. Hence, the plant is set up in places where there is not so much crisis. If the site is wrongly selected, the system fails in 2 years.
    - Hence, the community has to be more participative, come to a consensus together.
11. Is the WATSAN Committee active? If active would it play a role?
    - The WATSAN committee is not at all active. If they are more active they would play a major role. It is mostly influenced by the chairman rather than every committee member having a major saying in the decision-making process.
    - Mostly, no one questions the chairman's choice at the meetings. The working paper is approved without much discussion.
12. Do you participate at all in motivation building, community capacity building?
    - The Local DPHE offices do it.
13. Do you think the issue is –willingness to pay or ability to pay?
    - The trust is the main issue.
    - They want to see the full system and then see the benefit from the system, if they think that yes, it is beneficial after it has been built, then would like to start paying.

- The entrepreneur has to wait for many years (12-18 years) to get back the money, they have to obtain the trust of the communities.
- More number of house connections for the entrepreneur, the more his profit. But he usually has to wait 12-18 years to get back the money that he has invested. It is therefore sometimes hard to motivate local entrepreneurs.
- The 30-70 Model is so far the most successful model we have seen. After 18 years, the entrepreneur hands over the system to the community.
- There are point sources available to collect water for people who are unable to pay for the water.

14. What do you consider as the flaws in the system?
    - From the community, there is no trust in the system
    - The criteria for site selection is often wrong
    - Nowadays, DPHE has been demanding for their own site selection.
    - There are still places in the country where the arsenic content is high, but the site is still not selected.
    - Sometimes, the contracts intentionally avoid drilling in difficult areas. As DPHE has a guideline that if the drilling is not done right, then the contractor will not be paid.
15. Do you think that the community has the awareness about the water quality?
    - The community does have the awareness. They may not know the details, but they are aware of which water is good to drink and which one is bad.
    - The suggestion would be to find a community leader. Especially, the UP chairman plays a very important role, so he should be elected carefully.
16. What are the KPIs for the success of the project?
    - Technically sound system – 1st priority
    - Adoption from the community – 2nd priority
17. What are the major challenges that you face?
    - The main challenge is to convince an entire community to pay for the water supply.
    - Some people find alternatives and build their own individual systems and want to avoid subscriptions. In order for rural piped water supply systems to become a reality, it is important that as a community people should come forward.
    - It is difficult to be successful in piped water due to scattered rural living, site selection
    - Another drawback, deep tubewell is successful because of being fresh water, temperature and taste as well.
    - Piped water gets hot stored in the pipeline.
18. Is resources a problem for DPHE?
    - Resources is not a problem for the DPHE. It takes 6-8 months to get the funding approved once a request is approved.
    - Three kinds of funding: Government, UNICEF, WHO, World Bank
    - Technicality is not an issue, management is the problem
19. Can it be possible to install surface water based piped water systems, as the Policy says use surface water as much as possible and groundwater is depleting slowly.
    - They are extremely expensive. Surface water is much polluted and treatment of that requires technology we cannot afford.
    - It is a futuristic vision.
    - I do not think that there is any harm in using groundwater for drinking purposes, as only 3% of the groundwater is being used for drinking. Most of the groundwater is used for irrigation sources and industrial sources that has to be reduced but not for drinking.

A.4.4 Organisation: Department of Public Health Engineering – Interview 2

1. What role were you associated with at the district level and what tasks are you involved in in your current position?
   - DPHE is a government organisation under the local government ministry. DPHE is mandated to provide WASH facilities all over the country except, Dhaka, Chittagong, Rajshahi and Khulna. These cities are under the WASA.
   - At district level, we implement WASH facilities in that district under the annual water development programme.
   - DPHE is mostly involved in the rural areas. After the development, in the rural areas, the infrastructure is handed over to the community.
   - But in the urban areas, the infrastructure is handed over to the municipal authority. They maintain and operate the infrastructure. The O&M is not the responsibility of the DPHE. It is either the municipal authorities in the urban areas that handle it or the community in the rural areas that handle it.
2. What do you think is the progress regarding piped water systems?
   - It is a vital issue, in the context of our country. In Bangladesh, rural water supply system is mainly point source based. Only very few piped water systems have been established. 500 villages, maximum not more than that. Out of 90,000 villages only 500 villages have been covered uptil now.
   - Recently, a project has been implemented under the World Bank, the 30%-70% model, where entrepreneur provides 30% of the contribution and the government or the World Bank provides the 70% of the contribution. The O&M is done by the entrepreneur for 18 years and then handed over to the community. Under this model, a test project is going on, under this project – 37 projects have been installed.
3. What is the main reason why piped water is not popular?
   - The physical appear of groundwater is good. Groundwater is abundantly available. Shallow aquifers provide fresh groundwater. Piped water is expensive and does not appeal in appearance.
   - In the rural areas the housing is scattered. Technically it is difficult to provide piped water in all areas. It is not a collective area. That is a major hurdle to construction. Accessibility for communities also reduces. Most areas are wet lands. There are saline areas.
   - It is a challenge to provide water to each household.
   - It requires a large investment.
   - Willingness to for water is low. People are not habituated to pay for water. In their perceptions, water should be free.
   - Deep tubewells are not community based and are point source based. They can be personal. Communities prefer deep tubewells.
4. Do you think that piped water should be expanded, or it is not a good option?
   - We have to move to piped water today or tomorrow. It is the future of modern housing. It is definitely the future of water in Bangladesh and the government is working towards it.
   - Point source systems and private water supply is not monitored for quality issues. Piped water systems can be more centralized, and it is easy to monitor the water quality. The monitoring system is better. Point source water supplies require huge man power from the government's side to keep monitoring the water quality one by one.
   - In Bangladesh, there are about 1.5 million water points that are government owned. Privately, there is no exact data available. But there are about 10 million-point sources. It is impossible to monitor the water quality of such a large amount of systems. So, eventually the most viable solution is to move to piped water systems.
5. What is the best way to scale up the system? What is the vision to scale it up?

- When the private sector gets involved, then it a good way to scale up. The technology is there. But budget is a constraint. To expand to 90,000 villages, the financial capability is less, and O&M is a problem. Man-power is a problem. If the private sector is involved, then the situation will change. That is the road to scale up.
- Acceptance will then come slowly in the community. When the familiarity increases, when they realize the benefits, then acceptance increases.

6. Which factors can increase the adoptability?
   - Increasing awareness
   - Currently 29% of the tubewells are arsenic contaminated. They are demarcated with red color to make it recognizable to communities. So, people are aware that water from these tubewells is not drinkable. But still, if they are drinking from there that means that there is no alternate option available in their village.
   - So, to increase adoptability, you have to increase alternate options and awareness at the same time.
7. How do you choose the area where to install?
   - DPHE is the implementer and provides technical support to NGO and local DPHE. It provides all R&D support to the contractor to work in the field. It plays more of a technical supervisor role, also providing the technology to work with.
   - DPHE has no role in choosing the area. That is the responsibility of the Union and *Upazila* Level WATSAN committee. They choose the area.
   - The WATSAN committee gives the list to the local DPHE office. The local DPHE checks for the feasibility of the project based on social aspects, region, technicality, affordability, and willingness to pay and reachability to the poorest.
   - Then the request comes to the central DPHE office. They approve the request and sanction the project. The number of water points-household connections is determined based on the capacity of the tank and the number of people in the community and then the project is carried forward.
8. Which areas have more piped water – rural or peri-urban?
   - Piped water is mainly peri-urban as of now. The peri-urban areas are not distinctly defined. So, mostly it is in urban areas under the municipal corporations.
9. What is the main reason for not using surface water based piped water systems?
   - Piped water systems in itself are very less in number. Surface water is contaminated. After treatment it would become very costly to afford. It is very complicated technically. The treatment of surface water also requires more electricity. That would mean more costs to the consumer. I would say surface water-based water systems are not so viable in the near future.
10. Is the WATSAN committee active?
    - At each tier of government there is the WATSAN committee. WATSAN committee is not so active many a times. In the month of October, which is celebrated as the Sanitation month, that month they do become active in meetings. Unless they have been asked to carry out activities from the central level, the WATSAN committee usually remains inactive. There is no extra incentive for them to focus on WASH activities.
    - Their main function is social mobilization.
11. Do you think that if they are more active, they will play a major role in motivating the people?
    - WATSAN cannot really play a major role, unless the piped water committee with a community leader can be the right person to carry out the awareness campaigns in the villages.
    - They are just members of the UP, but they do not directly interact with the communities.
12. Do you think that the community is aware? What is the level of awareness amongst the people?

- Awareness isn't much of an issue. Most people are aware of the water they drink. They would only prefer contaminated water when there is no other alternative or the alternative is too expensive.
- The awareness of communities is mostly limited to – safe water or unsafe water. Whether it is bacterial or arsenic contaminated that they do not understand.
- DPHE has a program Water Safety Plan. It is an awareness campaign. In some areas we introduced the Water Safety Plan, to give the message to the stakeholders.

13. You have worked at the district level. Now you are the head office? Do you see a gap between the district and the head office? Is the district level performing as per the mark?
    - The gap between the district and the head office of DPHE is very vast. The policies and strategy plans set cannot be followed has per document. The field situation is very different, and they have to be adapted depending on situation. In some cases, the political situation is different. At central level most of activities are as per strategy and documents, and they expect the same from the local DPHE offices. But it doesn't always work out.
    - The demand at the field level is huge for piped water, but that demand calling does not reach the central office. Harmonization is required from both ends.
14. Do you always get the support from the NGO that you need?
    - The community awareness should take place from the NGO. Without the NGOs at grassroots levels, this system would fail to perform. NGOs are performing well in general.
15. How do you test the willingness to pay for the communities?
    - Currently, there are only 37 projects installed country-wide under this model. The areas chosen were based on the willingness to pay, in areas where people are not scattered living, well concentrated areas, people are a bit on the higher income level and where the chances of it being successful are high. But, there are areas which are worst affected with arsenic but have no piped water because they might fail there.
16. Do communities have trust in the system?
    - There needs to be trust in the system. Trust comes from providing continuously good quality of water. If we maintain our standards then there will trust in the system, the issue of trust can only be fixed from our end. We have to build their trust in us.
17. What are the three main factors that affect the adoptability of piped water systems in rural Bangladesh?
    - Build Ownership
    - Willingness to pay
    - Water should be continuously and always available.
    - Continuous support is available to the technology. Not disrupted.
18. How do you perceive a system with 20-30 households?
    - Economically it is not viable. Installation costs are very high.
    - More than 1000 households participate then only it will work. Water tariff is very low. It will not be able to run with 10-50 households. 10 BDT/month.
19. What is the future of piped water systems in Bangladesh?
    - Piped water systems is certainly the future. It will be increased in the near future.
20. PSF connected to pipe, can it work and be successful?
    - Very less yield. Only 10-20 families can use PSF. It is not expandable.

A.4.5 Organisation: Department of Public Health Engineering – Interview 3

1. What are your specific tasks and roles in DPHE?
    - DPHE is responsible for WASH activities IN urban and rural areas, except areas where WASA is present.

- I am heading the Rural Water Supply and Sanitation Project under DPHE.
- Under this project, we have installed 20475 water options, 37 piped water supply schemes, rehabilitation schemes, 55,000 latrines.

2. What is your option about PWSs in rural areas?
   - In urban areas, it is very easy to manage because after construction we hand it over to the municipality for O&M. They are involved from the beginning in the project.
   - But in case of rural water supply, it is very difficult to manage sustainability of the project, handing over to the communities is not sustainable.
   - So, in collaboration with the World Bank, we introduced the 30-70 model whereby 70% is contributed by the World Bank and 30% is contributed by the sponsor/entrepreneur.
   - After construction, the Entrepreneur will handle the O&M and collect water tariffs for 12 years. After the end of 12 years, the project will be handed over to the *Union Parishad*. Then the UP is the owner of the project.
3. Does the UP has the knowledge to handle the project?
   - Yes, before starting the project, the UP is engaged, and all other local allies are engaged at every stage. So, they are well informed about the project. So, they can take over after 12 years.
   - A tri party contract is done, between the UP chairman - owner, DPHE Executive Engineer - employers, Entrepreneur- service provider in the beginning of the project itself.
4. When did the focus shift to piped water supply schemes?
   - From 2004
   - In 2004, the government constructed 90-99 piped water supply schemes. Those were mini projects with less number of households. Those were in collaboration with UNICEF, World Bank and DANIDA and other NGOs. In total at that time, there were 120 schemes.
   - The evaluation was done by JICA and there is a publication available about the lessons learnt.
   - After that many other schemes were introduced with different models- some are direct UP managed, others are community managed models some are sponsor managed models
   - The government introduced in the 5-Year Plan, where they decided to place a person-incharge for every piped water scheme in arsenic affected areas.
   - DPHE is handling all areas, whether arsenic affected, saline, iron affected, for water supply projects. We are handling only arsenic affected areas. About 42 districts in total. Where there is arsenic, the technology is different.
5. How do you select the site?
   - The JICA has the data from surveys. Based on the suggestion from JICA, the DPHE selects some areas. If the arsenic is above 60% and the water coverage is below 40%, those areas are chosen.
6. How do you see the community's reaction to this project that has recently been implemented?
   - The communities are very satisfied. Because these areas were heavily affected areas, so this technology has brought them much advantage.
   - They had to walk far off distances to get water which they can now, now get directly from the tap. And the water is arsenic and saline free.
   - In problem areas, usually people are willing to adopt piped water systems. But in areas where they can easily get water from the tubewells, there adoption is difficult.
   - So, for the success of piped water supply, the most important thing is the selection of the village.
7. Do people have trust in the system and are they willing to pay? What happens to families who are very poor and cannot pay?
   - They are very little in number. Maximum 2-3 families in a village. In the villages, everyone can afford a mobile phone but don't want to pay for water. The tariff is not so much maximum 100 BDT/month.

- In this project, we decided to engage a motivator to motivate communities to pay for water. During construction, the motivator motivated the communities to pay for good quality fresh water. It was a maximum of 200 BDT/month or average. They can get up to 10,000 litres of water per month in that cost. That cost is not a lot.
- 2/3 families that are very poor, they can get community-based point source system and they can pay less – around 100 BDT/month and still get the same quality of water.

8. Who was the motivator in this project, is it the NGO?
   - We hired a community development promoter for the duration of this project -18 months as a component of the project. It is not the case in all DPHE projects. He was hired on a project basis.
9. Is the WATSAN community active in helping to play the role of a motivator?
   - The UP chairman plays a very important role. He is the main contact person. The head of the WATSAN committee is the UP chairman and the members of the UP and also the WATSAN committee members. During the construction, the UP members were the main contact partners. In addition, we made a Water User Committee for every scheme. It has 11 members.
   - The Ward members were made the CDP chairman. The ward members are also WATSAN committee members. And female members were also included.
   - We created the committee such that, the ward chairman is the CDP chairman, the School teacher, female member is the vice chairman, a school teacher, the sponsor, the land donor all are included in the committee. So, we created another committee similar to the WATSAN committee.
10. When did this project start?
    - October 2012. We have worked in 383 unions. It ended in 31st December 2017.
    - World Bank is doing their evaluation. They will evaluation and give us the results.
    - We have visited all the sites. We think it will do well. Each site, 650-700 connections are there. Every month they are giving tariff for the water.
11. What do you think about surface water based piped water systems?
    - In urban areas it is possible. In rural areas, it will be difficult to manage.
    - Technology is available, but management will be a big challenge.
    - Less manpower, high costs, high tariff.
    - They cannot pay such high costs in rural areas.
    - For urban areas, it is being implemented, as it is technically feasible and manageable as well. But for rural areas, until now there is no such plan.
12. How do you see the future of piped water systems? Is it going to expand?
    - The future is piped water systems. It has to expand. Today or tomorrow we have to move to piped water.
    - The question is what the best model is. Each model has to be area specific and in line with the local politics. There is no one model for all places. One size does not fit all.
    - Different models for different areas.
13. What are your KPIs for project success? How do you measure the success of your project?
    - People are getting quality water
    - People are paying tariffs regularly
14. How do you plan to scale up from this project?
    - That is a question we have yet to answer. We have to see from the success of this project.
15. Do you think that communities lack awareness?
    - NO. They very well know what their water quality is.
    - The UPs also spread awareness.
    - They have the knowledge about it. The contaminated water is demarcated.
16. What are the 3 key factors that influence the adoption of PWSs in rural areas?

- Convenience - convenience over health
- The # of people it reaches.
- Water quality monitoring is easy. Easy O&M.
- Willingness to pay – easy access to other sources like tubewells reduces willingness to pay

A.4.6 Organisation: JICA

1. What do you think is the current progress in Piped Water Systems in Bangladesh?
   - Piped water system in Bangladesh is growing up. In every area, water is easily available from underground. People can easily get water from tubewells.
   - Mostly piped water is available in urban areas. We call it Paurasabha piped water supply Most of these are planned and implemented by the DPHE or any other government agency and then it is handed over to the Paurasabha- municipal corporation.
   - Because of urbanization of areas and increase in construction, the need for piped water supply is increasing but the investment is not coming up at the same rate. The expansion is not so rapid.
   - The government has the sector development plan and SDG. According to the SDP and the SDG, there is a target that 100% coverage of urban towns with piped water supply. So, the future is good but huge investment is required.
2. Where is this investment expected to come from?
   - All investment comes from the public sector- government.
   - Private investment we have not seen, but slowly-slowly public/private partnership is coming up in small scale in rural areas.
   - But majority of the investment is from the public sector.
   - If it is very big project loan is taken from the International Banks.
   - The reason it hasn't expanded rapidly, because each house has his/her own water supply system. It is very easy to install a tubewell to a low-cost pump and water is available at each household. Once they build up their own system, interest for PWS or any network from the city municipality becomes very low.
   - In every case, we have realized that the revenue collected is very low than the O&M costs. That is why in most cases, sustainability becomes a question and problem, and very few exceptions are there.
   - Subsidy is provided to the consumers, even in towns and cities and the cost is lowered to encourage the use. All the 4 WASAs, have been subsidizing water.
3. Are the people trying to make the shift from deep tubewells to piped water?
   - People are less interested. Even though piped water has benefits, but cost is involved. Every month you have to pay. The cost is high. Consumers cannot always rely on piped water for drinking water. The water may not be treated well. They have their own tubewells which give drinking water. That is why piped water is not being popularized.
   - But in some areas, because of the water quality issues, salinity issues, arsenic problems, iron problem, treatment of water is required. In those areas, if a piped water system which treated water is provided, it will be accepted. But, then cost becomes an issue. It requires investment.
4. Government has many plans in their national development program. But, the priority is not given to water. Anyway, people are managing their own water. So, water is not a priority. PWS is considered to be a modern facility and doesn't come across as a major issue in the development programs. If groundwater is easily accessible to people, they don't see it as a major problem.
5. In rural areas, how much progress has been done in PWSs? Is the community willing to adopt these systems in rural areas?
   - In the rural context, PWSs are more favourable in rural areas. Rural areas are more favourable for individual piped water connections. The installation and piping cost is very low.

- Piped water systems are just coming up. SDG has targeted the promotion of piped water systems in rural areas. So, very recently, some PWS has been implemented in rural areas with the DPHE and World Bank partnerships. They are functioning well, and the demand is also high. But sometimes there are water quality issues. If the water quality issues were not addressed during the time of construction, but later the water proved to be contaminated due to high iron and bacterial content.
- Many are functioning well, some are not.
- In the rural context, community adoption is the main problem. In Bangladesh, bringing together community on one platform is very difficult. Initially, everyone agrees to pay. But, when the piped water system is installed, they do not wish to pay. They have their own system.
- But in arsenic affected areas, it is easier to monitor a few deep tubewells with piped network system for them than to monitor multiple deep tubewells that are privately installed. That is why there is much focus on deep tubewells with piped network system. That is coming up.
- In every DPHE project, in rural areas, provision for piped water system is a component of the project, recently. The government is giving importance to increase piped water systems particularly in problem areas – arsenic, iron salinity and low groundwater table areas. To solve these issues.

6. The National Arsenic Mitigation Policy of 2004 mentions the use of surface water based piped water systems, why isn't surface water systems promoted?
   - I was involved in the making of the policy. In the rainy seasons only, surface water is available. Dry seasons, good quality surface water is not available. In the rainy seasons, rainwater can be used. In the dry season, hand-pump water can be used, with passive sedimentation. In this way, the problem can be solved. But the government has still emphasized on surface water use.
   - Currently, DPHE has an ongoing project under JICA assistance, where JICA is preparing a map of potential safe surface water sources. So, that DPHE can follow that map to use those surface water sources.
   - In rural context, pond water treatment is easier than river water. River water treatment will be very costly. River water treatment is cost ineffective.
7. Should this policy then be revised?
   - We have to focus on surface water sources, because everywhere groundwater is depleting. Most of the groundwater is used in irrigation. So, groundwater is going down. So surface water has to be promoted.
   - Where good quality surface water is available, they try to use surface water. But where it isn't they have to use groundwater.
8. What role do you think WATSAN committee can play, if they are more active? Specially in regard to increasing community participation?
   - WATSAN committee played an important role in the past. They did a good job. But their performance has gone down over the years.
   - There are some reasons for that: in order to organise a WATSAN committee every month, they need extra costs and that is not available. It is not part of the budget. The WATSAN meeting at *Upazila* level is conducted together with another meeting.
   - WATSAN committee can provide guidance to the communities. A separate committee is made at the Union Level, which is for piped water systems. The guidance from the *Union Parishad* and local DPHE is coming directly for piped water systems. So, I don't think the WATSAN committee at the *Upazila* Level has any major role to play.
   - WATSAN committee can oversee the implementation process. But the main role is to be played by the *Union Parishad*. Because UPs are the owners.

- Wherever rural piped water systems are implemented, the UPs are involved. They select the area, conduct the feasibility study. Without their involvement it wouldn't be possible. Land is provided by them. They are very important Stakeholders.

9. Do you think that the UPs should then be made responsible for community awareness or NGOs are doing that job better?
   - The issue is that UPs have small man power, and they cannot handle large communities. They cannot create awareness. All they can do is make some advocacy through ward members. But there must be some NGOs for intensive awareness building.
   - They are not capable of handling awareness campaigns on their own.
10. How do you measure willingness to pay?
   - Before project implementation there are two steps carried out:
     1. Pre-feasibility test – the willingness to pay is accessed.
     2. Feasibility study and detailed design – the tariff rate is determined; O&M costs and the community contribution is determined.
   - If they are not willing to pay, or the success of the project is dicey, then there will be no project.
11. But then, in that sense even if it is a highly arsenic prone area, it will be left out if the willingness to pay is low in that area?
   - Then we have to go for alternate approach. After a huge investment, if the system is abandoned then it is not worth the time and effort. So, there are other approaches to handle the system.
   - PSF filters is an option. Treated water from dug well, deep tubewell or ponds can be used.
12. Do you think PSF based piped water systems would be feasible with maximum of 20 households?
   - With Pond water, with multiple communities involved, the pond water will dry over.
   - We have tried a similar approach with river water and it is called RSF. River water based piped water systems, but it wasn't very much popularized.
   - It involved a lot of wastage.
   - Pond water is no feasible for piped water systems, but we do have some small lakes called Oxbo lakes, from those lakes piped water systems have been constructed.
   - Piped water systems can be successful but more attention in this area is required to scale up.
   - They haven't scaled up, because the investment is huge in this direction or area.
13. What are according to you the 3 main factors responsible for adoption of piped water systems at community level?
   1. They should handle the O&M costs. That is key to sustainability. Even if it is given free of cost, our experience shows that until there is participation from the community in terms of money there is no sustainable. When they participate in costs, then they realise it is their property and then that affects the sustainability.
   2. Build ownership: by ways of participation in capital costs
   3. Trust in the system: User friendly access. Easy access to a government system is most important. Because If I have my own system, what would motivate me to make the change. So, a gov. system should be easily accessible.
   - Awareness is there amongst people. Reluctance to pay is the main reason for no sustainability.
   - If they can operate a system by themselves investing their own money, then government systems usually fail. You can see an example in Sabar, where a piped water supply was build. But it failed. Every house had their own system so that government system failed.
14. When did you start working in piped water systems? And how do see the progress as of 2018?
   - Since 2002 I have been involved in Rural PWSs. around 200 piped water systems have been introduced in this 15-16 years. Not all are running well. It wasn't very successful.
15. Is the government then still interested in taking PWSs forward or not, looking at the failures?

- They have plans to make it successful. PWSs are the future. Main reason being, it is getting impossible to monitor more than 12 million tubewells for water quality.

16. What efforts are the main international organisations taking and DPHE taking?
    - The new approach towards PWSs is in the planning stage. Some implementation was done as a test model with the World Bank project under the 30-70 model. The lessons from that model are yet to be learnt.
17. What is JICA's role in this picture?
    - Building the DPHE capacity in water management.
    - Preparing long-term/mid-term action plan.
    - Finding and mapping problem areas.
    - Monitoring water quality and other surveillance activity
    - In Urban sector-providing piped water system in the Chittagong and Khulna WASAs
18. What is the main threat to DPHE and main opportunity in regard to PWSs?
    - For sustaining PWSs, DPHE has no role to play. That is handled by the Paurasabha. Whether they are sustained or not, DPHE doesn't know. Although they are the ones implementing. So that is an issue from DPHE's side.
    - DPHE should be involved in the sustainability of systems role.
    - Opportunity – DPHE has manpower, technical experience they can support Paurasabha but that is not in the policy, so they cannot do it.
    - Strengths- technical knowledge, equipment, experience
19. What happens to the very poor families who cannot afford to pay in the 30-70 model?
    - Those cannot provide tariff, they must get water. That is compensated by the well-off people. That is the condition of the piped water supply system. So, the rich pay for the water for the poor.
20. Do you always get the support from the NGO?
    - Sometimes, NGOs don't communicate with the central DPHE. They have their own capacity in water supply sector.
    - They communicate with Local DPHE after the implementation of their project. Small scale NGOs do communicate as they need the support from DPHE but iNGOs do their own thing.
21. Is there a gap between central and local DPHE?
    - Yes, there is a gap. The information flow is not functioning. At this moment, JICA is trying to build information gap. Local DPHE, *Upazila* and *Union Parishad*, they meet monthly so definitely there the information flow is stronger.

A.4.6 Organisation: Asian Development Bank

- We have been working on piped water systems in the hill track regions of Chittagong. We coordinate with the Chittagong Paurasabha. ADB usually coordinates with the local NGOs
- ADB began this project in hill track areas recently to reach the most problematic areas.
- Currently we are working on 3 *Upazila*s, we have installed 600 paras.
- ADB gives training to the local people to operate and maintain.
- We work in partnership with UNDP
- The demand has to come from the community. The selection spot comes from the community. The community leader selects the spot.
- In most cases it is seen that technology is not a barrier. Accessibility in hard-to-reach areas is a barrier.
- Small-scaled PWSs have been more successful in these areas. Only about 30-40 households are involved. A minimum of 20 households are involved. Most communities are willing to pay, in small groups. Also, in the hilly areas, such an arrangement is better as communities live scattered.
- NGOs are the ones motivating they help to choose the feasibility plans.

- After demand is raised takes between 3-6 months for the intervention to happen.
- Electricity has been a hindrance in many places. For now, 200 of our water pumps operate on solar and we plan to expand that further.
- The needs of every community are different, so it is difficult to operate.
- We operate with the Chittagong WASA. We don't deal with DPHE.
- We usually give O&M trainings (1-day trainings) to the community members and then we hire the caretaker to take care of the operations. The caretaker is selected by both of them.
- Usually It is a 2-year project. They start the project, show them the way and then leave the site.
- After a year we go back to see the progress and report the lessons learnt.
- Our job is only to build it and the show communities the way. They have maintained it themselves. We leave it up to them to operate it.
- ADB is involved in almost processes of the development.
- From the lessons learnt we decide whether or not we should go for another project.
- The UP chairman is always involved, but he has no influence on community or local NGOs.
- The approach is bottom-up.
- We haven't thought about surface water-based systems yet. But rainwater-based work best in hilly areas.
- There are no overlaps in the urban areas as such. The government takes care of that.
- We only work with UNDP as of now.
- 3 key factors that affects adoptability and sustainability of these systems– willingness to Participate, lack of education in WASH sector, freedom of speech of the poor people as rich people have more voice.
- There is trust in the system and demand can created if there is awareness.

A.4.7 Organisation: HYSAWA

- We are a non-profit company initiated by the government. We receive the money and then follow the government rules and we work towards community mobilization.
- In some areas tubewells/handpumps are not feasible. In those areas piped water schemes are installed by us.
- We have installed 37 piped water schemes until now. We work with the RDA model. We don't work with DPHE.
- We prefer to deal directly with the union council. So, we plan and develop the scheme for them and then give it to the union chairman directly. So, we have direct contact with the chairman and we know directly from meetings with him the problems of the community.
- We appoint a local community leader with the help of the chairman and then make him the in charge of O&M.
- The main issue is that with 37 different schemes, there 37 different types of communities and their needs and preferences. So, we cannot have a plan in mind when we approach the community.
- Also, WTP is very low. They would rather walk 0.5 miles instead of paying for the water tariff.
- They do not understand the benefits of the system, in other words they do not care. They will only pay if it is absolutely necessary and there is no option.
- Sometimes the system is installed in a rich land owners place and then it becomes his system.
- Tariff collection is a problem.
- Sometimes, community members don't like the owner.
- Perceptions differ from place to place.
- In my view, motivation works only to a certain extent, it should be customised to their needs.
- Based on ability to pay we can range the tariff collection, that can improve the situation.

- Planning stage these PWSs are good, implementation stage they are not well integrated. Also motivation of various actors differ. Sometimes, it is also cases that chairman is paying the entire amount for the system himself to get popularity during elections.
- Elections affect the council governance to a large extent.
- If there is no water crisis in the area, any community-based system will not work. Scalability is a far-reaching factor. The right spot matters most for sustainability.
- In rural areas-if any one person has a water point all villagers will come and collect it.
- For example, in Satkira: there is no water source, there any system will work, they must buy water anyway.
- Piped water is considered to be a luxury and safety is not a concern. They only want to pay for need and not for luxury.
- Vendors also want to get business out of it, so many factors are there that they are failing.
- We have installed 20 schemes all are successfully running in water crisis area. All were done with the UP directly.
- PWSs have a future. It is more of a perception that is a luxury. It is a need.
- Surface water based PWSs are costly. PSF is also not a good option, it requires a lot of maintenance. We don't deal with DPHE. DPHE is good at technical things but they don't have a good pre-motivation plan. Construction and monitoring activities are weaknesses. Their technical design is good though.
- Lacking –construction, money and good management.
- Local NGOs have good community management systems. Irrigation based PWSs are doing very well. RDA is has a good model of implementation.
- It totally on context where it will work and where it will not.
- 3 factors for adoptability and sustainability: trust, awareness and affordability

A.4.8 Organisation: Embassy of Netherlands

- We mainly work in donating to organizations to support them to build infrastructure. Main organizations we are working with are UNICEF and BRAC.
- Now have shifted to urban drinking water management from the rural side. Earlier we did build and contribute in a few piped water schemes but not anymore.
- DPHE has issues of manpower. I would say there is also lack of leadership. In my opinion, the government should take charge of O&M to some extent. The HYSAWA and Marks model are better than the DPHE model in that sense. They should improve service provision and depend less on communities.

1. What is the scalability of the models likes HYSAWA and Marks model?

- The Indian solution is far more effective in that sense.
- Participation is not a remedy for all solutions.
- Indian model is a scalable model
- Main problem is that partner organisations are not ready for large-scale implementation
- The scale of the problem is huge, and the capacity is limited.
- Coordination is required which is lacking
- Institutionalization of lessons learnt is not so good.
- There is a need for data management, better technology organizations, and focus on leadership rather than participation.
- We have long standing relationships with BRAC and UNICEF 10 years as of now. And we mostly see that policy development, leadership and steering of the gov. is the main issue.
- There has to be lessons learnt from the Indian model.
- As, Netherlands we plan to retire from the drinking water sector in BD as they have little to offer.

A.4.9 Organisation: Practical Action

- We have been working on MAR project with UNICEF, Dhaka U-Research and PWS implementation with DPHE.
- We are mainly a technology-based organisation. We develop technology for different areas and the work with local NGOs to implement.
- Technology is context specific – sometimes RWH sometimes PWSs.
- From source to consumption there are 5 steps- we only care about the source part.

1. How do you create awareness within communities about technology?

- There are various tools, demonstrations and folk songs in local languages and dramas.
- Community meetings
- In most cases we support 80% of the costs. Community only has t bear 20% of the cost.

2. What are the issues you face most?

- Issue of trust. Communities are reluctant to use a new technology. Tubewell is their first choice.
- It has more benefits to them than piped water. Main issues with piped water are – timings on water.
- In urban areas there is a regulation in place for surface water use and tubewell use but in rural areas not yet. 97% of the water in groundwater.
- In Rajshahi 30 schemes of any other water technology have failed. Only tubewell is successful. Gov. should put a restriction on tubewell water.
- DPHE has no manpower – capacity at the bottom is a problem.

3. What areas are you working on mostly?

- Most of our activities are in the urban areas. Only 20% of our activities are with rural areas.
- We mostly work in vulnerable areas where the LGI authority functioning is not so good.
- There is 3-pary arrangement – Municipality+ local NGO+ Practical Action
- Local NGOs are the ones working on the field.

4. Main challenges?

- Limitations in gov. policy
- Operational arrangement
- Municipal authority or union council
- Every election the government changes
- Technology should be context specific
- Affordable to the people
- Easy Operations and Maintenance
- More resources
- Willingness of local authority to participate and be enthusiastic

5. 3 main factors for adoptability and sustainability?

- Demand, awareness and lack of financial resources.

A.4.10 Organisation: Max Foundation

- We have a small project, as foundation as a total scheme, now under implementation under in Bogra (district), and it is supported by Aqua for all in Netherlands– they are the main donors and Ox impulse. They are 2 donors supporting us. Both are Dutch organisations. So, they have some findings and Max foundation also have their own contribution. And this project is being implemented in Bogra district.

6. It is a small-scale pipe water scheme?

- Yes, it is a small-scale pipe water scheme and implementation started in 2016, in fact on documents it was supposed to be started from January 2016 but in actual, it started in June 2016 and first 3-4 months was inception period. Project is implemented in partnership with a local partner NGO, its name is DUSCO and technical partner i.e a corporate organisation, its name is Rural Development Academy (RDA). Siddiqui is the project manager of the project. In fact, I am not a full-time staff of Max Foundation, I am an advisor. I am working with World Bank and working as a freelance consultant with another organisation.

- This is the first introduction of the project. This project actually started built on experience of the world and the DPHG- they have done some experience in pipe water scheme. Currently we have finished, one world, a mega project with DPHG, last December – dual pipe water supply project. They are now launching another project which is for the urban area, in the municipality, they have taken 30 towns, they are going to implement a comprehensive pipe water network in the municipality area. Besides, there are other stakeholders. In fact, the major technological solution, i.e. the Tube well for the drinking water, total coverage for pipe water is not more than 2 percent.

7. But is this data available for?

- They have data on existing pipe water schemes implemented by different stakeholders. These stakeholders are mainly DPHG, UNICEF and from the NGO sector – there is BRAC , GE and some other NGO's, they have just . It is not more than 300-400 all over the country. So, it is a very small quantity. It is not very significant. Mainly Non-pipe options are the main source of drinking water. Non-pipe means Tube well, tube well is a ground water source, both shallow and deep. Surface water, means the ponds and filters, filters are the sand filters. That options are also there but very few. These options are mainly available in the coastal areas where there is saline water. Ground water – there is no layer. Surface water – river water most of it is saline. Few fresh ponds are there, people use those fresh pond water and treat water through PSF and drink it. In some coastal areas, saline affected areas, another option is rain water harvesting. This option is very popular in saline affected coastal areas, there is plenty of rain and people are getting rain water living in their houses, they don't have to walk to get the water, but not round the year, 6 to 7 months they can get rain water in their house. So, it is big source. So, rain water harvesting, PSF, Tube wells, in some cases Hitech RO (reverse osmosis), used sometimes commercially, few private sectors operate this RO but this is also used in saline affected area.

8. This is mainly in urban area?

- No, it is in rural area. There also some RO plants are operating.

9. But that is also point based?

- Yes, correct. Point-based. Sometimes water builders are there, they just transport water to house.

10. What about the idea of surface water being piped. There can be point source but all water can be branched or piped*?*

- Normally ground water can be piped.

11. But why not surface water.

- For surface water, if you see the pond water (PSF) , pond is another problem. Water is available 7-8 months and 3-4months in the dry season, all ponds are dry. People have to collect water from other sources. That is not a pond, sometimes rain water. During rainy season, 4-6 months, usually they collect water from rain water. They don't go for other options except when there is a ground water. Tube well is very popular in Bangladesh, as it is easy source of ground water everywhere except in few parts in the hard to reach area , in coastal area where there is no layer for ground water. So people are compelled to go for other option. Let's say – PSF , rain water harvesting. People don't drink rain water in Dhaka as there is supply water there.

12. So what about the policy of 2004, more focus should be on surface water?

- The policy focuses on use of surface water and not ground water, but reality is different because surface water is not that much abundant. Once upon a time it was, as there was plenty of rivers and canals in the country. There were not many tube wells, tube wells came to Bangladesh after liberation, during 80's or 90's . Before that, people use to drink surface water –mainly pond water, kennel water. And that is why there was many prevalence of diarrheal disease in the country.

13. It happened during the British time, the tube well installation ?

- No, after liberation. During 80's and 90's, first tube well was introduced to Bangladesh. Before that some tube wells were still there, but negligible. Now, even in the rural area, 5-6 households can use a deep tube well and shallow tube wells. Shallow tube wells are very cheap, which means water in available in 5 meters only .In Samaria, Water layer in Bangladesh, suction mode you will get the water. That is why plenty of Shallow tube wells are available.

14. But is that water pure?

- Not pure in all areas. In shallow tubewells, mostly the shallow layers are arsenic affected. But arsenic contamination is not a hotspot, i.e arsenic contamination is mild. And hence people drink shallow water. But mostly the problem in shallow water in some areas is arsenic. Now people are more conscious, they don't drink shallow water once they now that this water is arsenic contaminated. Those tubewells are actually sealed with red mark. So they don't use water from that tubewell for drinking purposes but use it for other domestic purposes. And normally the deep tubewell water, the deep tubewell is from 700-900 feet, doesn't have arsenic contamination. So it is mostly arsenic free. So policy advocated for deep tubewell water. It is recognized as safely managed water source for drinking. It also advocated by HDC, the deep tubewell and not shallow tubewell as in shallow tubewell the problem is arsenic affected and also iron is in high concentration. Also you would also find all kinds of bacterial infection in shallow water, particularly where latrines are close to shallow tubewell. Therefore the policy advocates against use of shallow tubewell. But in all private sector, tubewells are mostly shallow tubewells, because it is cheap. One deep tubewell costs 80-90 thousand while a shallow tubewell is only one-tenth the cost. That's why all people who are poor , purchase a shallow tubewell as it is easily available in the supply chain. They can easily purchase it and dealers are available. So within 2-3 days they can install a shallow tubewell. But deep tubewell is usually given by DPHG, public sector . so they usually give the deep tubewell. It is not usually for a single house. In policy it states that a deep tubewell needs to convert 50 people or 10 houses, whatever is less. Sometime now it happens that even 23 or even 5 houses can purchase a deep tubewell. So , there are the main sources, the shallow and the deep tubewell in non-piped options. It covers 95% of non-piped options.

15. And are those piped options are also groundwater based. Until now nobody is using surface water for piped water ?

- There are some surface water based pipe connections but not in rural areas. It is because surface water pipe systems need water treatment systems. Ground water in maximum cases don't need treatment. And when there is no treatment, the water is less costly, tariff is low and people are able afford easily.

16. so what do you think. Does the govt has a vision for pipe water?

- Yes, the policy encourages the use of surface water and talk about gradually shifting from ground water to surface water. Earlier most of the sources of water was surface water before tubewell was there as ground water was not detected at that time. 90% people who were using surface water started using ground water after tubewell came. Now govt is again encouraging to use surface water are ground water layer is depleting day by day.
- If the industry, domestic and irrigation is all dependent on ground water , then what will happen is a climatic change, a negative impact on the environment. That's because the recharge in the deep layer is not enough. Policy is now strict to move to surface area. In the rural area there is still no restriction on the deep tubewells but in the Paurosabha/municipality area , nobody can introduce any deep tubewell until they get a permission form the municipal authority.it is the right of the municipality to supply the drinking water, either thru pipe water or through the deep tubewell.
- Govt cannot restrict for the drinking water as the coverage is not there. Coverage is there around 90% as people somehow get water from the deep tubewell, the drinking water.

17. But the govt doesn't want to restrict the number of deep tubewells?

- No, Still not because the people have the right to have access to drinking water. Now what happens, the country is being from poor to middle income country. So everyone wants to have their own tubewell. They don't want to share tubewell with other houses.

18. But in urban areas we can have a low against deep tubewells right?

- Yes, in urban areas, there are municipality rules that people cannot put their own tubewell until they get permission from them.it is the duty/mandatory task of municipality to supply drinking water but in rural there is no such authority. That's why the parishad/local govt have given the mandate but local govt doesn't have authority or funds to provide piped drinking water and that's why the private sector is coming, the private houses manage their water sources on their own. That's the problem between urban and rural context. So that is why there is not much restriction.
- But now, even the DPHG is also mandated to provide water supply. Particularly in the rural area. In the urban area the municipality is there, but for the rural are there is no authority. DPHG is taking that responsibility and govt is pressing that DPHG should not go for further tubewell but should shift to piped water. Why, because one deep tubewell is shared by 3-5 houses right now i.e around 30 people. And hence per capita investment is high whereas per capita investment in piped water is less as it reaches more people, more coverage. It can cover rich , and poor equally.
- Yes, it is the vision. The govt wants blanket coverage. That all the people should come under the drinking water coverage in HDC. HDC wants that people in the rural area, particularly the women in the rural area should not walk miles after miles for drinking water. Physically they are in a difficult situation and have to do physical labor and waste their time for drinking water. Therefor HDC is mainly focused on getting people water in their houses, the doorstep supply . Doorstep supply can only be ensured through the piped water.

19. But then the progress is not much.

- Yes, that is because it is a technical problem. Tubewell is not that technical, every house can operate it. Pipe water schemes you have to operate through technical people. Operator and plumber would be there. Some successful entrepreneur or operator is required to run the pipe water schemes. But tubewell it is not required. Tubewell after installation is handed over to the houses. But piped water is not handed over. It is installed in PPP system -public private partnership. Public sector installs and operate for some time and then DPHG signs agreement to construct , invest and operate for decided time until return on investment and then hand over to local govt. DPHG schemes with world bank are big.
- The entrepreneurs are basically contractors. They construct the tubewell, the system and then they go away after settling the bill. But in case of piped water, the arrangement is that you will construct it and maintain it. Most of the private players, the entrepreneurs are majorly contractors, or builders. They handover the schemes to users and they go away.
- But now in PPP arrangement, you have to invest it, construct it and operate it. It is more responsibility given to the private sector.

20. How do you choose these entrepreneurs?

- Choosing is a different mechanism. The selection sometimes is through bidding process. Public procurement rules is followed. Tender documents are prepared by DPHG and go for open bidding. Bids are selected based on their experience, technical knowledge, locality factor and solvency /financials.
- Sometimes what happens is that enlisted DPHG contractors work all over country but doesn't work in piped water schemes as they must stay with the community as they have to work with the community and hence in piped water schemes. So that whether particular entrepreneur is from particular community is also a factor in selection. Also, bidding is that at what tariff can he provide the water to consumer. Example, a bid is like 1000 litres for 12 BDT etc.

21. What about the community, how do they perceive this system? I am not able to get the public perception. Some say that they don't want piped water as they have tubewell already. Some say they haven't been lucky yet to get an option. It's like in the same area there are different views.

- Normally site is selected in areas where there is water crisis.

22. So you would not go to areas where there is no water crisis. Or People won't accept in area where there is no crisis?

- No, People will still come as they have convenience. If you visit, they have dual connections, both tubewell and piped water. On asking why both, Piped water is good quality but piped water supply is

not continuous, due to electricity outage or something then tubewell is there. There are some people who have their own submergible pumps but still when pipe water system is constructed in their places, they also get connection from our systems. Why? Because submersible system is more costly. They have to pay 1500-2000 BDT for electricity bill. But they can easily get water from pipe system with 200-300 BDT. So why they will go for the submersible? That is the reason: it is cheap and it doesn't require any maintenance. Because if the system is their own tubewell, they have to repair on their own. However, in pipe water system it is responsibility of operator to ensure the supply. If supply is stopped for 1-2 hrs, it is big problem. All people rush to operator and he get into an uncomfortable position. So all operators try to give continued service as it is also their business.

- People are now getting more benefits and doorstep water service through pipe water which they cannot get from a point source.
- Govt is not encouraging tubewells as too much drilling may contaminate water table. Unscrupulous and indiscriminate building of tubewells can lead to contamination of ground water.

23. So, there is no plan as of now for surface water based pipeline?

- No plan but policy is there to encourage surface water. But the problem is that , we had many ponds at one point of time but now with urbanization, ponds are also depleting.

24. And also Surface water requires treatment and treatment is expensive. So if treatment is expensive and they raise the cost of pipe water , do u think people will accept it.

- They will accept is, as pipe water in some municipality schemes is based on surfaces water derived from rivers. After treating the river water they supply through pipe systems. Normally this cost is more than the ground water. Because they require treatment plants, they are costly. Treatment plants maintenance is also a concern. Sometimes they get clogged due to sand and mud. They can clear and wash as routine maintenance. But once there is outage due to technical reasons , they cannot repair it.IT requires calling for highly skilled mechanics or technicians.

25. that means it is high maintenance ?

- Yes, it is very high maintenance. That's why normally DPHG and other agencies try to avoid treatment plan along with ground water systems. But ground water in most cases doesn't require treatment plant.
- That's why although it is in the policy, but DPHG s not taking any current plans to do surface water based pipe systems. Because technically there technological challenges and also there are not many surface water sources for that kind of pipe water sources. Ponds are very limited. Most of the rivers are not silted. And in nearby most of the rivers are polluted. At the moment, pond water is being used for non-piped options- for PSF. If you connect a pond to pipe water supply, the pond will dry up within a month. Because pond you cannot get the water recharged quickly. PSF water is only used for drinking and cooking purposes. But piped water is used for all domestic purposes. As per policy a person needs 80 litres per day for domestic needs. But for drinking a person needs only 2-3 litres. Hence normally pond water is not advocated for piped water but for PSF it is ok. One PSF is ok for 40-50 households, around 200 people. This is nearly 500 litres /day which can extract per day from pond which can be recharged.
- River can supply but there is problem of polluted rivers. In whole Dhaka city, more than 90% water source is ground water source. Only 10-12% is supplied from Sahibabad treatment plant which takes water from the river. And now a days river water is very polluted and they need water treatment. And people in areas where surface water is supplied have many complaints of high chlorine does, bad smell etc. They are not happy with that supply. People where ground water is supplied, they are happy as water is clean and water quality is good, much better than surface water. That is the major technical difficulty. Although we are telling that Surface water is good but what is the source?.
  Source is the problem. Water quality, Surface water quality is not good. Pond water even though is not contaminated, but people don't keep it idle. People culture fish and also wash cattle etc. If you ask a pond owner to keep it only for drinking water, they will not agree as to keeping the pond idle. He can use the pond for economic purposes. Hence they don't even have too many PSF for pond

waters. This is the social problem. Although we are promoting policy but reality is different due to geology.

26. Another question is how do you scale or when you plan to scale up pipe water systems what is the best model that you have seen so far? Is it small scale like 100 people are involved in 1 pipe water scheme or I think you have also implemented 400-500 households in one scheme. Big scheme like the one I visited is currently serving 350 household as it has a problem with connect.

- The capacity is large up to 1000-1200 households. 100000 liter overhead tank is there and that tank can supply at least 2 hours for 1000 household. Problem is that they cannot efficiently operate it. There are many complaints about the water supply. Water quality is not that good because there the treatment plant is not working very well. That's why people have complaints about water quality and hence many people who already have any connection have declined to take pipe water connection. They install their own tubewell and have their own water. In urban area people don't have option, but I rural areas they have options. They can take water from pipe or they cannot. They would rather go for tubewell or any other options. As per size, 800-1200 is the current scale which DPGH would install in conjunction with World Bank. But there is also INGO , international NGO , they install medium size schemes which connect 300-600 households.
- The one we are currently implementing in Bogra is medium size. We have 25000-30000 liter overhead tank and we have 20000-50000 in Pausrosha area where cover is high but is called medium scale. Last size schemes which are difficult to implement sometimes based on treatment plant. If there is a treatment plant , it is very difficult. Because the operator needs to backwash, clean it again and again. Chemical agents are needed to clean properly. So it is difficult actually.
- So, it is difficult but without treatment plant it is very simple – just on and off the switch and it flows. So, for big scheme size operation is more difficult but for small size even a non-skilled community/entrepreneur can operate it after getting one day or two day training. They can easily manage it.
- We advocate for smaller size is because it is easily manageable and entrepreneur is available because risk for big size scheme, more participation in investment of private sector is needed and entrepreneur are not that much solvent , they can invest very small amount ,so if you design a big size, then you will not get that many entrepreneur. If it is a private sector (PPP method) – ensuring participation of the private sector in the implementation process, then you have to design the scheme as per the capacity of the community and entrepreneur.

27. So medium and small scale are more successful?

- Medium and small scale are more successful. Medium scale are – many NGO, JIZ, UNICEF schemes , NGO funds are mostly medium sized and mostly they can serve 300 to 600 households. Sometimes they have an overhead tank and sometimes they don't have. Sometimes they have a plastic tank (PVC), they can also operate this kind of tank. This is easily manageable.
- Small sized you will not find plenty, we have to start with max foundation link , Patwakali and Kurigram . The size is very small. The design is 10000 litres water tank and it is not civil structure, it is a PVC tank constructed on a pillar and there is a small borehole there and from the tank water is distributed. Thus, just 50 to 70 households can be connected, 75 is the max connection. This is easily manageable. They don't need highly paid professional operators. The community level any operator can operate it. Another advantage is that, in the rural setting, you will not get 300 to 500 households in one place, they are scattered. That is why more the houses are scattered, more expensive will be the pipeline networking. One of the requirement for us to be successful is – how many households can you connect from a unit length of a distribution pipeline. So it varies. If you can connect so many households from one distribution pipe, then the cost is less. Hence, in urban setting pipe water is economically more feasible than rural area . Economically more feasible. Per Capita cost is less so people can pay more in urban area. In rural area it is very difficult to get 100-150 BDT for billing purposes. People are reluctant to pay for water in rural areas because they are not habituated. They are getting free water from tubewells. But in the urban they don't have any option. And they are rich

and can pay more. Even 300-500 BDT is not a problem for them. So they can easily pay. That's why in the urban context the pipe water system is more feasible.

28. What according to your experience what is the better scalable model in rural context?

- In the rural context , the size should be mini size. Small scale is better. In that you would get those clusters.50-70 houses you would get in many places and hence you would be able to target those clusters. But 500-700 or even 1000, it is very difficult. Very rarely you would get such spots in rural, only in urban or semi-urban you would get such clusters. In rural areas, you would not get more than 20-30 house clusters and hence better to have such small size PVC systems.

29. Are you actively engaged in local community awareness activities, capacity building or your dealing directly?

- For the pipe water, the pre-condition is that you need to create awareness among people, mobilize the demand. Because while you go even in areas of water crisis, people are habituated to have water from either point sources or distant sources. You have to make the people understand the benefit s of the pipe water. You are giving then the good quality safe water. They don't understand what is safe water. They don't understand that tube well water can be poisonous from iron or manganese or arsenic. Salinity is a problem. Could cause diseases like dysentery etc. Sometimes feacal contamination is there. So they cannot understand it. They don't know whether they are drinking safe water or not. So when we go with pipe water scheme, we have to mobilize the people and make them understand that this water is a good quality water. And also give people knowledge about the parameters of a good quality water. So they know what is a good quality water. Once they know, then they deny the contaminated sources and go for the pipe water systems. But then comes the cost. Earlier they were getting free and now they have to pay. If you offer at market price of a 1 litre water bottle at 15BDT per litre they would not be able to afford. We have to provide them water as per their affordability. On what they are able to pay per month for pipe water.

30. How do you test this willingness?

- Yes, we have a survey. Once they have a willingness , then they become motivated to pay. Normal trend is there on how much they are ready to pay for a monthly connection. So we take that views in survey. Example, how much can you pay for water bill. How much can you pay for mobile bill. Can you pay 200-300 BDT . such type of questions. Coordinating the survey and trend the tariff is set.
- Once they know that they are going to get safe and clean water, continuous water. Then they are ready to pay. Then with small commitment pipe water is constructed there and connection is given to them.

31. Do they trust the system?

- Yes, they trust the system as long as the service is good. When you give them commitment to provide good quality water and suddenly after implementation you increase the tariff or you fail to give them a good service, then people will lose their trust on you definitely. This normally happens and even in world bank cases.

32. So the trust is really dependent on water quality and service?

- Yes, and also on how long are you giving them the water- all 24 hours or only during some peak hours. So now people wait for morning , noon and evening peak hours and if they don't get water during those hours or don't get good quality water or go for tariff correction every month, then people lose trust.
- That's why it depends on operator on how much good quality service they can provide to the people. So feasibility of the pipe water depends on the serviceability.

A.4.11 Organisation: Policy Support Branch

1. What is the function of the PSB in DPHE?
    - Ministry of Local Government is the active ministry for water supply and sanitation in the country. Under this ministry there are two divisions: rural development division and local government division. Under the LGD, there are some institutions DPHE, WASA, City Corporation, Rural Development Authority, Paurasabha, *Union Parishad* etc.
    - Policy Support Branch is Branch under the Water Supply Wing of the LGD.

- Any policy, plan or strategy regarding WASH sector that needs to be developed, prepared or revised is the responsibility of the Water Supply Wing. But on behalf of the Water Supply wing, the Policy Support Branch is assigned to carry out these functionalities. This is the main function of the PSB.
- We have 3 main functions:
  1. Develop and review policy and strategy of the sector.
  2. Sector coordination among all stakeholders of WASH sector.
  3. Capacity development of sector stakeholders.
- For example, the SDP was prepared in 2012 in line with the MDG target. But, now the MDG period is over. And the focus has shifted to SDG, especially SGD 6.1 and 6.2. So, now the SDP needs some revision and modification. So, the PSB will be working on that.

2. How do you work on that?
   - At first there is a forum called Local Consultative Group for Water Supply. The additional secretary of the LGD- water supply wing, is the chair of this forum. PSB acts as the member secretary of this forum.
   - The Donor agencies like World Bank, JICA, DANIDA, ADB, UNICEF, SDC and some other NGOs are all part of this forum.
   - LCG meetings are held quarterly share an update of the status of the sector. Updates of policy issues, or other issues raised, like the SDP needs to be reviewed and revised.
   - The process is as such: the ministry forms a committee of 7/8 members, with those who are experts in their field and have the knowledge to contribute to the revision of the document. There will be a chairperson and a co-chairperson, and then many professors from technical universities who are experts. All these experts will sit together and discuss and come to a consensus that these areas should be revised. And these parts should be added.
   - These meetings will be held under the umbrella of the PSB.
   - PSB will coordinate all the meetings and workshops. When a consensus is reached that these are the final recommendations, then these recommendations will be presented. Based on the revision of presented ideas, the changes will be finalized.
   - After that, there is another step: Another forum called national forum for water supply and sanitation. This is chaired by the secretary of the LGD.
   - All these final recommendations will be presented to the National Forum. In this forum, other ministries like health, education will be present. They will approve, and a final approval will be given. Then the PSB will carry out the revision process.
   - We are responsible for bringing together decision makers, stimulating discussions and drafting revisions and writing final documents.
   - The printing, distribution amongst stakeholders is also taken care by us.
   - We also organise workshops with Mayors from different cities to share knowledge about any successful project implementation.
   - We have to organise some workshops at local DPHEs where we explain them how to execute tasks in local languages.
   - The documents are prepared both in English and Bangla and depending on states, some other local languages.
3. Are you also working directly with the WATSAN committee?
   - The head of each level government, UP chairman, Local DPHE chairman are all invited to our workshops. But, as such the WATSAN committee is not invited.
4. Do you invite private organisations and NGOs?

- NGOs we do invite to workshops. Private Organisations not really. But slowly we are encouraging them. They are not directly related to the policy planning and strategy. So they aren't really invited.

5. The initiative of when to revise the policy, who initiates the discussion?
   - Sometimes, the policy makers, development partners sometimes the UNICEF. We frequently meet, and discussions are brought up at AGMs. It is mutual topic of discussion of what to change. If some in-house changes in documents also need to be made, we work in that direction also.
6. Is the local DPHE involved in the policy making?
   - At policy making level no.
   - But, the local DPHE is involved in the workshops.
   - When some strategies or policies is prepared, at first a draft is prepared and shared with the field level, district level, *Upazila* level DPHE to get their feedback. Not to all *Upazilas*, but some *Upazilas* are randomly selected. Usually, opinions are taken for getting field level feedback. If any strategy is suggested, the idea usually comes from the local level to the national level. The UP chairman is involved.
   - The process of policy formulation is bottom up. At each level, the views of the government is considered.
7. What is your vision for PSB, after having separated from DPHE and being a separate entity?
   - PSU was funded by DANIDA, but PSB will be funded by UNICEF.
   - A new project is coming up, called the GOB-UNICEF WASH project and PSB is one of the component of this project.
   - UNICEF and PSB will be organizing workshops to analyse bottlenecks of the WASH sector throughout the country. This will involve major stakeholders from the field, from the local level.
   - These workshops will analyse, what are the bottlenecks of the WASH sector, what measures should be taken to mitigate these bottlenecks and who is responsible for which tasks.
   - Based on the output of these workshops a new plan will be prepared, 2021-2025 development plan.
   - Academicians are actively involved and consulted when these documents are prepared.

A.4.12 Organisation: UNICEF

- From that 1970, UNICEF is promoting water supply technology, which is actually microbiologically safe. At that time there was some chemical testing also and it was found ok. But in mid1980s, nationally arsenic was not actually detected or prioritized so much. But when it was detected very close to India in Bangladesh in 1993. From that time UNICEF is also concerned about arsenic contamination. They started getting involved in testing, technological development, survey and promotion of the technology, so with the major partner DPG and with some national NGO, we started to work on how to deal with this problem. So, we had a large project, we started in 2006 and finished in 2012 and also many projects where we actually try to identify the real scale of the problem and how to mitigate.
- So, this is all how UNICEF is trying to address the problem. We have a policy -The National Arsenic Mitigation Policy and we also have an implementation plan for arsenic mitigation, which is not approved from government yet but is in the process of approval. We call it IPAM.
- So, this is also one of the policy documents that UNICEF is actively involved and try to influence the sector to take or adopt the best practices.
- In arsenic mitigation there are few challenges, why it is still not up to our expectations because the challenge is with the technology. People don't like new technology. They are used to Tubewell technology, they don't want to adopt new technologies. The operational maintenance of new technologies is a big problem. Also, the Technology knowhow is also difficult for them

and hence cannot manage those technologies. Government is giving allocation equally irrespective of arsenic contamination level. The high concentration areas, it is hydrologically difficult and people normally for the age of work, don't want to go over there. So, government and also NGOs, if the go to arsenic prone areas, there is some political influence, there is some bias, and while it travels through the government channels, it funds are allocated to Government and is not allocated fairly to poor people.

- Yes, that is one reason but also the influence of politicians. And, the Government officials allocated these tubewells etc. to their relatives or in case of politicians, sometimes they would allocate to people who would vote for them it is happening in most of the Bangladesh. It is a very political issue. So that's why this arsenic mitigation is not getting full momentum. So, it's always a challenge with so many things.
- So then in the last few years, we tried differently. We realized we did not have a target and we are giving water pump scattered. We still could not even after 20 years say that we yes, we have covered this area and this area is arsenic mitigated.
- They are far and also not in communication with politicians or govt. Poor people don't have reach or communication. The people who are getting tubewell this year, may be after 2-3 years he will get again in allocation. So this is not actually controlled or fully organised that everybody gets it. Then we thought that we need an approach where we can allocate it evenly across everyone even the poor vulnerable and affected people. We will target all the population not just the tubewells but all people. This approach is called Arsenic village approach. We take unit village and we will cover whole village, whole population will be covered with arsenic safe water. We will do arsenic screening in the village. The screening data will come to use, we will identify the need and we will allocate accordingly. This is called DPG UNICEF arsenic mitigation protocol. There is step by step process of selecting the site. Also the criteria for where we will install the tubewell. This will not be on other's recommendation but on criteria. We called allocation based on need as Equity based and not equally.
- Then we go for screening, validate the site, locate the site, allocate and install the tubewell. Work with the sanitation and hygiene. Then we declare the village as arsenic safe.
- We have with this approach worked for last 2 years and 6 *Upazila*.
- We have installed 1000 last year and previous to that 1200. So total 2200. Tubewells and not pipe water. We have installed 6 piped water systems.
- Tubewell or pipe water?
- Both are well accepted. Pipe water is always well accepted as it is closer to their homes.
- Yes, but the problem is the operational maintenance. Because for pipe water they need a system or operational maintenance and there should be a paid caretaker, Electric bill a pump operations. Treatment plant is also required at some places because in Bangladesh you cannot just dig tubewell and pump pipe water out of it due to iron and other contaminants. It there is iron contamination, pipe water will not work. So you have to put the treatment plant. And if you put the treatment plant, then the operation maintenance is critical. There are many pipe water schemes which are abandoned due to lack of operation maintenance.
- Yes, UNICEF is directly not implemented. It is implemented though DPG or NGOs like EPRC. EPRC was our partner. DPG is our technical partner. They implement the technology like tubewell, pipe water etc., but they don't have enough human resource to trigger the community outreach, mobilization, awareness building and operational maintenance training. That's why we hire NGOs because there are good on these issues.
- If it is highly arsenic prone area, we found that people don't care. They say we are having this water from generations and from childhood. We are ok with this water. If water is cursed from god, we are ok with it they are not taking any initiative. They don't know what to do. When we

started community mobilization and our discussion with them, then they are able to understand the effect of arsenic. They have understand but ask on who will help us? If you are able to help us we will provide with whatever we can do. In many cases they are positive, even though they are very reluctant in the beginning. It takes some time to make them understand the problem. Then they ask or demand for help and arsenic safe options. Then there is also a contribution money that they have to contribute. This is a govt rule. This is for their ownership. So that they understand that this is not free, that this is their product and they have to maintain it. Tubewell is fine, they can take care of it as it is closer and a bit easier to maintain with little training and tool. Spare parts are available within their reach. If it is a different technology, it is better in beginning as it give then better water but slowly it needs some operational maintenance, needs some filter changing, changing the medium, washing etc. Then it became a headache for them and they don't want to continue. People always want easy things, so they just want to turn it on and water will come and they don't have to do anything else. So whenever some extra work is required then it slowly becomes defunct. They don't want to do that. Also, if they have to pay monthly, some pay and some don't. For tubewell it is fine but for pipe water it is continuous, they have to pay monthly like caretaker salary and Electricity etc. and they don't want to pay monthly.

- It takes time. In highly contaminated areas there are three pipe water schemes with treatment plants, there they are still running because they don't have any other option. They have to depend on that technology. So they are trying hard to maintain it and keep it running. They have been there for two years. All these two years our partners have worked with them on how to maintain and how to deal with financials and records. Also we try and motivate people with awareness sessions, orientation and some gatherings and rallies etc. In those areas, people are aware and motived to take care. 3 Pipe water schemes are going well. If other NGOs come and give another pipe water schemes then people abandon old systems are they are getting new system for free. If system is not used for 6 months, then it completely abandoned. It is big investment loss. It's also a duplication which is a concern. If there is tubewell provided in such place, then piped water system gets ignored. There is also electricity problem. If electricity is not there they move to tubewells. Even though it is a new tubewell it could be arsenic contaminated. They will use it as they don't know that it might be arsenic contaminated. They didn't test.
- Yes, only if DPG is installing the tubewell and has tested for arsenic contamination. But if tubewell is installed privately they would not test for it. DPG cannot install all. In Bangladesh there are 12 Million tubewells, 10 Million are private and 2 Million are public installed. DPG doesn't have responsibility of private tubewells.
- We have campaigns like, please test your tubewell to check for arsenic contamination. People are aware of doing the test.
- There are two type's tubewell, shallow water and deep water. Usually shallow tubewells are arsenic contaminated, deep tubewells are arsenic safe mostly. If very few areas both shallow and deep are contaminated, but mostly deep (>500 feet) are safe.
- It is in our long term solution. It is our arsenic policy and in our implementation plan. It is provided as short term and long term solution. We are not ready yet for the whole district or for Bangladesh for pipe water scheme. All the state of whole Bangladesh with pipe water scheme to take this huge things still we are not ready and if we go for that it will take time but by this time people are having all this arsenic alternative water so the short term solution is go with tube well, rain water harvesting or other technology if nothing is suitable. But for the long term solution we have to go with pipe waters. So we are slowly moving towards it.
- The Progress is not satisfactory. The Bangladesh government is having huge funding so here actually expecting that from that funding we will get benefit

- Yeah, that is another issue. We always say use surface water, if not always but prioritize surface water. But what happens to surface water is, it is highly polluted. To treat this surface water, we need to treat the surface water first and then pipe water is cleaned. So the pipe water is cleaned, both ways we can go – we can use the ground water and surface. If we use the ground water, then it will take less treatment and easy to use. If we use surface water, it will take huge treatment. Hence, it will double the cost.
- We are not going big scale for pipe water scheme yet, though we have long term plan and our long term solution is pipe water, so we should move to that direction but still we are lack behind. And, another issue is if we go with pipe water how we can go with surface water. Then it will take huge, many things will be dependent on this issue – the way surface water is polluted, it will be very difficult to use that for treatment also. So, we have to reduce the surface water pollution.
- So how is this surface water getting polluted? It's from Industry , faecal sludge management , all of it is coming to our river and surface water ,and it gets mixed with faecal sludge and industrial pollution, altogether and may be if you can see the surface water in the river, the quality of the water, you can see how much pollution.
- No! The rural people, they are poor it will be difficult for them to pay this huge amount, from them we struggle for small amount also. In city area, we are also having like in Dhaka city, we have may be 60-40 percent, and some are surface water based and ground water based. It would be huge cost, for city people also it is ground water mostly. So, everything will be changed. It is possible, I am not saying it is not possible, but we need huge level of political commitment and also long term planning and good planning. We always plan for short term , we have a 5 years planning but it needs to be operational so that people can be accountable for what they are doing like government is doing surface and other agencies ,other NGO's , other donors are going through different ways.
- We work from the beginning – planning, implementation and then monitoring. But, the long term monitoring is missing and also the periodic monitoring. Like what government should do. It cannot be done by project. The project has some targets and end date like 2 years and 3 years and after that project, all the people will leave. So it is the project matter. Government does not work like this, government should remain there and should have some monitoring in place so that they can be accountable and also they can conclude. There is a system, but it is not going well. So, in our next project which we are just starting, we will work on system strengthening, under this - we will work with government to build these data management system, monitoring system, water quality surveillance system, so we will actually work on those issues.
- Our major partner is Government. Like, if we go with NGO's, private firms, this is also under the umbrella of DPHE. It is not that differently we are going with different organisations.
- Yes, so we have NGO's, other organisations so that they can implement on behalf of us and we also have DPP – Dev Project Performa with DPHE. We have agreement which we do as partnership.
- Major Thing is operational maintenance.
- Community can have the responsibility, but when there is money involvement, they have to take care of giving, taking money, operational maintenance, then at the beginning they are happy. They say it is fine, but slowly it doesn't actually work well. When we are there, may be for 6 months, we are monitoring, then project finished, people go and then they are reluctant to maintain those things and if there is some problem happen and it needs some repair / maintenance , it aggravates their willingness also negatively . So this is the situation.
- We have, in our next project we have 12 pipe water projects. Within these next 2 years we have just started. We are in site selection, planning phase actually. Many tube wells also, so it is only pipe water scheme.

- We do the feasibility analysis. We do mapping of those areas and we see the feasibility of pipe water scheme and water quality issues. And, then we select the site. And based on the poor, it should be in front of poor people's house. There is a criteria for - Highly contaminated and highly demanding. Based on these criterias we select.
- DPHE is your technical team. Hence, it is from both sides. We meet each day, sometimes once in a week.
- We hire NGO's. We say partnership as they also contribute in small amounts. Hence, it is partnership. From money wise, it is very insignificant. But, as they are providing their thoughts also, hence we call it partnership. Yes, and that is what we are working on. Years after years, different nature of people in different parts of the country. There is nothing common for all.
- Less awareness. I should not say, there is no awareness. If you ask people, they will say many things, they will understand that they know very pretty well, but whether they are practicing, whether they are believing on that, whether they are acting based on that, that is missing.
- Sometimes there is a trust issue is there, as there are some organisations which could not finally give good water. But it is need to change people's attitude and behaviour. In the beginning they say, when we see water coming, we will start paying the bill. But when the water is coming, most of them start paying bill. But, slowly it becomes less. People get another option like which is giving free. Many organisations just having donor fund, that technology will give you water for free for may be a year or two and then they are gone. So people whenever they see free water, they will go for that.
- Ya sure, because the system cannot be dependent on one person. A team needs to be trained on how to operate; if one person is not there another personal can work on it. But, as we have to pay, one person basically would mean responsible, he will be the care taker. We can train 2-3 persons, but we cannot pay 2-3 persons. So, we need one person to be responsible, but others will think that they will no more be there. This is one of the challenges that we face and that is true, the *Union Parishad*, it is true they will not give priority if something happen. So those issues we will need to work, how to make this system more sustainability. What is the other way? May be there are 3-4 pipe water scheme in a union, we can have 3 technical people can trained , so that people can call and they can come and see what is the problem and fix. We can develop some small entrepreneur or a small body who will control and monitor technically 3-4 or 5-6 systems. Something we need to think of that way.
- If possible, there has to be scaling things. Like we have just pipe water scheme in one union, body will not work on 1 pipe water. If there are 10 schemes, to manage those 10 schemes, there could be group of people like 3 or more sitting at the union level and they can actually monitor and take the responsibility of those 10 water schemes and producing reports and all these monitoring and maintenance things. So, if we go for scaling up then we can do something. But still we are working on it. We are thinking of 2000 people par, so close to 500 households.
- It is not a better solution because as I mentioned, in pipe water scheme we have to go for treatment, initial costing will be high .Hence, it won't be sustainable and not cost effective. Some people just go for well, production well without treatment, but as per me we cannot go without treatment as there is huge problem of iron and manganese.
- The number of people we served and also, maintaining our standards – water quality standards, standards – like if we provide one tubewell to 200 people, standard , water quality we will actually go with Bangladesh standards which is 1550 ppp , we prefer to go with WHO standards but If already installed and we cannot say that we are following WHO standards. We always have to say we are going by Bangladesh standards.
- In that case we have able people who pay for them. We motivate them. So that people who could not pay and people who have ability to pay can actually pay more.

- Whenever we go from beginning that is why we have NGO partners because we cannot expect DPHE partners to engage them. So NGO's will go for all social norms – they start with people, they work with people, they sit with people and discuss what is their problems and what are their solutions, they go with social mapping, they identify the problems, they come up with solutions with the people, It is not NGO's coming up with solutions, it is people coming with the solutions. That way, then they prepare disease tree, what kind of disease they are having, why this disease is happening, with this kind of discussions slowly and slowly solutions come from their end. Then they say, we need safe water, then how can we do that. Then they say apply for *Union Parishad*. I will not apply, you should apply, I will help you with it. Then they apply to *Union Parishad*, and then they get approval and then all material come. Then they take care of material. By location and place, they decide that this place is good for us. NGO or DPHE does not decide. Then we finalize that this area is technically ok. This way they are involved right from the beginning and we get contribution money from them. Tube well installation happens, and they monitor by themselves. Then we ask them, if nobody is there this much deep it should go , this much of pipe water, platform will be like this , cement and sand will be mixed in this ratio – this way they monitor. They are very much involved in the site selection.
- You can ask EPRC as they have 2 pipe water schemes installed in their field. They have technical knowledge on wash sector. They work on many research projects, many technical arsenic mitigation projects, they work with us directly to implement tube well. Last 2 years, they were engaged for sanitization, community mobilization.
- That is what I told, we will work on this – System strengthening. If the government is strengthened enough, then they will control on all these things. People will not scatter and alone and all will be under same umbrella. So similar approach we need to follow. This we need to work on.
- Most of the things we discussed, Arsenic mitigation is really a challenge. It is a multi-type challenge – technology challenge, people behaviour challenge, operation maintenance challenges, area wise challenges, policy challenges- influence: Various challenges that make it more complex.

A.4.13 Organisation: World Bank

- The arsenic was detected in 1996, so that time bank started the project in 1998 – it is called Bangladesh Arsenic mitigation water supply programme –BAMWSP
- That project did not do any pipe water programme. so, they did a blanket survey – so that was a very good asset for the country for the PHE – they covered 270 sub districts – that data is still there with the PHE – that is called the baseline of the arsenic – Later JAYKA did an update on that data – sometime in 2009
- They did one pilot in DUPTARA near Dhaka. one pilot only—so that time bank promoted private sector in Bangladesh – with that idea the second project was conceived within the time of the implementation period of the first project –so these two projects overlapped for some time
- second project had – I would say an ambitious target – so it targeted for 300 schemes – but there was no pilot done – only DUPTARA was there

1. How were the lessons learnt from there?

- At that time there was no market for private sector – even today also – I am coming to that ,so that project had to be restructured – scope was reduced – only 21 schemes was kept and the scope of the project out of these 300 this was massive jump

2. But, is it because resources were limited or the concept was vague or?

- the concept was nascent, very vague & very premature, very new concept- private equity sharing – because you know private sector in Bangladesh is mostly in construction business – all in construction business – if you go for rain water harvesting – contractors will construct, get the bill from DPHE – just construction contracts
- one aspect was operating as an entrepreneurship for twelve years was very new concept and on top that there was requirement of you give some money, the bank will match that money with 70% grant financing – that project was grant financing

3. So, the bank gave 70 % and then did you monitor later –like how is the performance?

- It is bounded by the project period, once the project is over you have to – what we tried to do like in our capacity DPHE you have to look after these schemes – like water quality, service aspects etc.

4. And they continued to monitor?

- They are supposed to monitor these 21 schemes and initially the split was fifty / fifty – bank will provide 50% and private sector will provide 50 %. unfortunately, nobody came – so then it was restructured – it was revised upward to 70 % and 30 % by the private sector – it was like market testing
- Under that second project BAWSPP, idea was that DPHE published a request for expression of interest (EOI) -- If you are a private sector and I am interested to develop a scheme , I would come out with this proposal – like this is the potential village , I would like to develop this – DPP scheme – so there was no competitive bidding
- the technical design was prepared by DPHE – DPHE were having a in house technical firm, the technical design was the responsibility of the sponsors and not DPHE in the second project – so they came up with their own proposal – with their own design

5. And they have the technical knowledge?

- they hired or did dome joint venture with technical engineering firm – prepared a preliminary so project proposal and submitted to DPHE
- DPHE had a list of criteria – like you know the village has to have – for example a minimum threshold no. of households, water quality has to be you know- it has to be arsenic contaminated area something like that – village had to be clustered

6. But, villages are mostly scattered?

- they set up criteria –and interested private parties – they put up proposals and DPHE screened those proposals

7. And how was the response to the second project?

- unfortunately, all those activities took a long time –so the project like you know eaten up three and a half years, so because of the time constraint – there was lot of proposals – I think 120 or something
- DPHE could advance – as I said 21 – so the bank cut down to 21 schemes actually

8. Out of those 21 schemes – how many are now successfully running?

- I think we must admit that business entrepreneurship- so you cannot expect all businesses to thrive – failure is very common thing –I think majority of them are working – I have to check with DPHE – how many out of 21 are still functioning

9. But, you are still financing DPHE, it's not like the partnership is over?

- given the success of 21 schemes – they demonstrated some good operation – so the bank took its third project in 2012—Bangladesh Rural water supply – with 125 schemes ; but one of the lesson is that if you keep the design in private sector, it eats up a lot of time ; if you prepare the design upfront for the project implementation , then you get full cycle of project implementation period –

so that is one of the key learning—this project – the design was included in the project implementation period – so that you hire a consulting firm , they will come and design – unlike the previous one , this project included the design prepared by DPHE – DPHE selected the site , they did the feasibility study and handed over to the selected sponsor --- so , unlike the previous project , there was major shift – that you know competitive bidding was introduced – the sponsors participated in the bidding process

10. And how many – what is the level of participation?

- very few – many of the schemes only one bidder showed up or may be two

11. And you chose the ones who show up?

- if they are qualified – they met the qualification criteria – you have to give the work order

12. Why is it like that – is it because the business is not sustainable for a long period – people won't pay immediately?

- yes and also they are worried about 30 % -- this recouping the 30% investment over a period of 12 years – it is a long time – so either you have to reduce the operation period that they can recoup their 30% investment – in that case the tariff will increase – so you have to keep the tariff in the comfort zone of the rural people also—say if you keep 600 taka, you can bring back your investment in three/ four years' time which is very unrealistic. So that's how we kept it 10 to 12 years – so that 12 years will give time to recover their investment within acceptable tariff plan

13. Because, you cannot ask for more than a limit?

- the biggest challenge is that they have alternative source – hand tubewell – which does not cost anything – you just pump the water –get the water and drink the water – so it is like getting the villagers habituated to drink from the tap and pay tariff – so that is the challenge

14. But, then when you do a survey – do you do a feasibility study of the awareness – are most people aware that the water is arsenic contaminated?

- The only bargain is that you have to educate the villagers – that because, you know arsenic is unseen – iron is visible, so you can say it is red water but it is aesthetic issue only – iron does not harm your body as arsenic does
- Whatever you do –any willingness to pay survey –it gives a false impression because everyone raises their hands – if you ask them whether you will pay 150 taka to avail tap water, they raise their hands, but ultimately we have seen actual takers are less that who showed their interest

15. In reality say out of 300 people who showed interest – how many would pay say 100 or so?

- Half – 50% will become real customers – whatever you do group discussion – social interaction – we did all this – we did down the steam survey – technical firms reached out to house owners --- house to house consultation for customers – but ultimately the households – they want to see real infrastructure coming up , then they start believing that you know something is happening – if you keep any household contribution , that risk is there – because you know that upfront 30% is from the sponsors – that 5 to 10 % within that 30% is factored coming from the house owners

16. And 10% may be coming from the house owners?

- Ideally 10 %, but in reality 5 to7 % from the house owners – rest is from the sponsors- so he has not much to gain. idea is that sponsors will invest t their money, he will feel that I have to recoup that investment

17. Will it be push for the sponsors to recover the money – but it doesn't work – they don't pay

- It depends – the design matters – how you design the scheme – if you design in gold plated scheme operating the scheme – ultimately that 30 % will not become 30 % - you get my point – so may be their investment is only 10% - so like you know this infrastructure for example , I designed it – it cist

100 taka – actually it is available in the market for 80 taka , so if you do 70 – 30 % of 80 taka , your investment comes down

18. What you show is different from actual investment?

- your recommendation can be that the design should be readymade – realistic – not – but if design – they overestimate it

19. But, then they approve it?

- Because you know, water supply schemes –like you know some components you can get away with – foe example – overhead tanks –it is one of the costly item in pie water scheme – but, if you abandon it, you can still supply water by direct pumping. So, these are the things that inflate the scheme cost – but, see Dhaka city –there is no overhead tank – whatever overhead tank you see in Dhaka city, they are not functional, they are idle – what they do, they just do direct pumping – turn on the pump – supply the water – so people get water.

20. Ultimately you will say that scaling up is not a vision or it is a vision? How is that going to work – do organizations want to scale up or they have just given up?

- Not all villages can become pipe water, if you consider financial viability – technical viability – then they have to consider alternative option , hand tubewell – thing is that it has go with hand tubewell option – hand tubewell will remain – you cannot eliminate it.

21. What are your main priorities?

- Fiscal decentralization
- Financial Sustainability of projects
- We are only concerned about these aspects.

22. Which schemes do think are doing good according to you?

- Schemes which are working in coordination with union chairman.
- Operator is from the same area and same district
- Entrepreneur is trustable to the community and is hired by the chairman or local DPHE
- Now we are planning to partner with RDA as their model in good.

23. Do you work with NGOs?

- No, as an organisation we are mandated to work with government ministries only. That is a worldwide mandate. But there is a section that is looking into private partnerships. But that is not priority.
- Now we are planning to work with RDA

24. What are your KPIs for success in PWSs?

- Increase private sector capacity and interest in PWSs
- Local gov. capacity increased
- DPHE capacity increased.

25. Any new upcoming projects?

- We have no plans to roll out any PWSs as of now. We must see how the recent ones build performed first.

A.4.14 Interviewee: Field Expert from EPRC

1. How do you investigate the area and reach out to and area?
    - At first, we investigate the area and check the source of drinking water. Then we discuss with committee people
    - Many people walk far away from their water source, the we investigate and intervene.

- We organise workshops and meetings where the UP chairman is invited. We take the help of Up members and some women NGOs to organise workshops.
- When we go through the council members, then the output of people attending is higher because UP members have a lot of respect in the village.
- Mostly male people come for those workshops though. But they cannot understand the problem better. It is better and easier to convince women as they are affected most by the problem.
- As the decisions are related to money, the power to make decisions lies with the male members usually so women members don't attend meetings.
- Women are easier to influence. They are the key managers of the house. It is usually of their interest to travel less distance for water.
- When we intervene, they are very much willing to participate, but when to comes to paying money they are usually reluctant.
- But when the system is installed everyone comes to talk water from the point source. Also, the monthly water tariffs, some pay while some don't.

2. How to organise a workshop in a village?
   - At first, the UP members are asked for help. They tell them in some community speeches that the water they are using is not good for them.
   - We use flip charts, posters and photos to demonstrate water problems to communities.
   - Mostly communities nowadays are aware of arsenic problem. Awareness is not an issue in most areas.
   - A baseline survey is conducted, and the courtyard meetings are organised. They have 15-20 people usually we try to keep the gender ration equal in mixed groups but is hard to get always.
   - Many times, there are separate meetings for men and women. That is a huge part of the problem.
   - Less children or teenagers in these meetings. There is separate session for school children in schools.
   - Demonstrations about water quality are easier to understand when training communities. We usually do demonstrations during screenings.
   - In some cases, they know some skin diseases can happen, they don't know the exact causes, but they are aware. They don't know about cancer.
   - Motivation is easier when colours are used.
3. How do you test the water and conduct screenings?
   - When we go to test the tubewell in the house we write result cards and give to them to keep. When another NGO comes, they already know about the arsenic level from the information in the card.
   - After some time, the red mark on the tubewell fades away.
   - DPHE+JICA did a nationwide survey. From that source we decide which union to go to.
   - A workshop usually involves 40-50 people – NGO workers, volunteers, union chairman etc.
   - Workshops are held at union level
   - Courtyard meetings the turnout is about 15-20 people at village level.
   - Approximately 3000 people live in a village.
4. Can we discuss the motivation of these villagers to use the system?
   - In the beginning they are very active, but if there is any technical problem the motivation decreases.
   - If the system runs smoothly we have seen demand increases in many villages nearby
   - As of now if there are 3000 people in a village that is about 750 households appox. But only 150-200 households are connection usually. Maximum 350.
   - They all agree to pay at workshops. But when it comes to giving money they have issues of trust. Also, users have increased without paying.

- After installation a committee of women is formed for maintenance, trainings are provided to 3 people from each committee and tap point source committee is formed.

A.5 Field Visit

The field visit was done in *Manikganj Sadar* a sub-district in the district of *Manikganj* close to Dhaka. It has about 1.3 million inhabitants and covers an area of 1379 km². *Manikganj* is one of the arsenic affected regions of the country. Local offices and Community Members were visited in *Manikganj Sadar* sub-district.

Official Information About The Piped Water Connections

Total connections: 376 connections
166 in *Barai Vikora*;
154 connections at Arijabal;
15 connections in Kali Bari;
41 closed connections
335 active connections

Upcoming Plan

- 20-25 new connections
- increase water bill by 50 BDT
- Change the bill receiving system from the 5th to the 15th of every month for customer flexibility.
- To increase initial down payments due to increasing electricity rates and labour costs.

Summary of Field Interviews

A.5.1 Organisation: Local DPHE

- There are 3 piped water supply systems installed in this Zila.
- We are charging a maximum of 250 BDT/household for each month. If they do not pay for more than 6 months, then the water supply is disconnected from the household.
- Economic Conditions of the people is not good, that is the main reason that they do not pay.
- Most of the people in this area are using piped water. They also have their own personal tube-wells installed. They use both
- Piped water supply systems will be better as it serves many people at a time and multiple households are accessible at the same time.
- We participate in the WATSAN Committee meetings, where the UP chairman is present,and he/she gives the information about the demand and the site selection.
- The Central DPHE has the decision-making power. We assist in ensuring quality and implementation.
- We do not have any fixed schedule for the motivational activities. We rely on the local NGOs for that. We do have days, like the world water day where we organise programs but not on a regular basis.
- We take the information given by the UP chairman as that coming from the entire community.
- The WATSAN Committee is not active, but only becomes active in October, when the meeting is held or during election times.
- In *Manikganj* area there is no NGO operating. We do not have any NGO supporting us.
- There is an open bid, where in a local entrepreneur is selected through the bidding process and he is given the contract for 12 years. He can collect monthly tariff for 12 years.
- We help in providing any technical support.
- Small Scaled Piped Water Systems cannot be successful from the government point of view as 100 households is not sustainable enough for us to carry out O&M regularly.
- The main criteria for success for us is: the water quality is good and more number of people participate in the system
- We at Local DPHE only help to implement and we do not play any major role in the decision-making process.

- My vision for the future is to make *Manikganj* covered with piped water system where each household has access to piped drinking water in their household.
- The main flaw in the system, is that the Donor has this idea wherein he says this is my system and you find the place where it will be most successful
- This system is not participatory at all. This process needs to change.
- We have to cater to the needs of the people, so the system should be designed by them.

A.5.2 Organisation: *Union Parishad*

- We are mainly responsible for the social activities and the welfare of the union.
- There is 1 PWS in this union in *Barai Vikora* village.
- There are just the 2 of us and we handle all of the WASH operations in this union. There are about 40 villages in this union.
- We also deal with any complaints of the PWS.
- We hired the operator as well. We also deal with international NGOs if they want to come and install any system in our village.
- A few years ago WHO came to install some systems. We prefer piped water supply. In some villages it is running successfully but in many villages the pipelines are broken due to construction and then they don't use it anymore.
- They main problem we are facing is that 2 of us have to handle all of the WASH activities. That is a problem.
- I do not know much in detail about piped water, mainly the chairman is handling it and he is not here. I am mainly assisting him.

A.5.3 Interviewee: Operator of the Village Piped Water Supply System

- There are two tanks. Water is generally stored in the underground tank from morning to evening. Water treatment is done in the underground tank. During water treatment no choline is added.The chamber of the underground tank is small. Water is lifted in the overhead tank from where it is supplied to the communities. It is divided into two parts. Every alternate hour water is supplied in different zones.
- I have been operating this system since it was built. This project was built by the World Bank.
- Water is supplied every day from 6am to 5pm. The households are divided into four zones and it is supplied in different zones on an hourly basis.
- For every connection each family is paying 250 taka/month.
- The capacity of the overhead tank is to supply for 200 people but the local's demand is for 400 people only.
- There are more than 20,000 people in this area, in the union but there are only 3 piped water supply schemes. Only 50 people are being served.
- There is no provision for water quality testing.
- This is a government financed project, by the World Bank.
- Water quality testing can be done from the personal funds that is collected from water tariffs.
- People do not want to drink piped water because they think that piped water is full of bacteria, and other contaminants.
- If piped water can be made bacteria free after water quality testing they will drink it.

A.5.4 Interviewee: Head of Village Piped Water Supply Committee

- The Local People chose me as the President of the Village Piped Water Committee
- Most of the tube-wells in this area are dried up and hence I prefer piped water myself.

- Piped water should be the future of the villages
- My job is to speak with people about the problems they are having with water and then pass on the information to the WATSAN committee meeting at the ward level.
- I realise that more and more people are interested in getting water but due to the less capacity of the tank that is not possible.
- I have to move from house to house to see the present conditions of water supply systems. I sit with communities to discuss their problems. I believe that with discussion with the local people the present situation will be observed.
- There is a need to treat the water from bacteria and other contaminants before providing them. There have been so many children dying in the villages due drinking contaminated water.
- Also the water from the piped water has to be fresh and regularly treated.
- Water supply is not regular right now. I trying to make the water supply regular.
- The water bills have to be collected on time. People sometimes do not pay on time.
- There is no funds for repairing the pipelines.
- Usually, the water tariff money collected for the system is used for repairing but when there are less people paying on time, it becomes a problem, as there are less funds for emergency situations then.
- Also, there is a lack of trained personnel for repairing damages and pipelines.
- The pipelines are not well-maintained and there are many leakages.
- I prefer piped water for drinking over tubewell water. Tubewell water in *Manikganj* is drying up and they are mostly out of order.
- People would also prefer piped water over tubewell water if it made cheaper and there is proper responsibility of maintenance from the government.
- People need to be made aware, they have to learn how to control water wastage. They should keep a strict eye on water wastage.
- Eventually all the villages in this area have to move to piped water as tubewells are drying up.

A.5.5 Interviewee: Water Tariff Collector

- Piped Water is more convenient than tubewell water.
- Most people who have the pipeline pay for the water. They may pay late but they pay.
- There was piped water connection from another village but due to construction all of their pipelines are broken down. Now they are not paying anymore for the piped water.
- If some households do not pay for more than 3 months we disconnect their pipeline. But mostly people are paying. The collection fee is 250 BDT/month. The water bill has to be paid from the 1st to the 5th of every month. Usually people pay in the 20th something of every month. They are mostly paying late.
- I also prefer piped water over any other water. People nowadays are also preferring piped. All together in the area there are about 350 connections and more connections are increasing.
- Due to shortage of funds and high initial down payments, it is not possible to give more connections.

A.5.6 Interviewee: Focus Groups Men : Near a System with Broken Pipelines

- Majority of the people in this village are using tubewells in this village.
- Piped Water is a luxury and we don't think that it is a need. We get drinking water from tubewells.
- The tubewells are cleaned and maintained regularly.
- If we need water we can get it from the tubewell.
- Safety is not the first priority of the people, the main concern is the tariff and the money.
- Also, many times, due to construction they break the pipeline and then there is no water.

- So in such scenarios what is the point of paying for piped water.
- We will prefer tubewell because the water is fresh and always available. We don't have to rely on the government to get water.
- Piped water we have to rely on the Operator.
- After the pipelines broke we don't have any option. We do not want to pay for a system without any reason when we are not getting water from it.

Do you think you should make the change from tubewells to piped water like in other villages?

- Yes, but the main problem is that the initial down-payment is very expensive.
- Also piped water is not properly used. People waste water, keep their taps open. As a result, there is high wastage of water.
- We know about arsenic, but if there is tubewell working in the area, we don't think piped water is required. DPHE has tested the tubewell and it is not red. Water from tubewells in this area is drinkable.
- We definitely support tubewells as it is cheaper and more facilities than piped water.
- Also there is no role of chairman involved in tubewells. In tubewell we can get water whenever required.

Do you think there is any Hindu/Muslim problem when it comes to taking water from tubewells?

- No, since 25 years our hindu neighbours have been taking water from the same tubewell has us and there is no problem.
- There is no religious problems here. We don't believe in that.

Have you thought about what will happen when there is no water from tubewell ?

- No, but by then we have to find another solution. As of now it is okay and we see more costs in piped water. When we are happy with tubewells, we do not want to move to piped water.

A.5.7 Interviewee: Focus Groups Women : Near the Water Supply System

- 7 of the group of 10 used piped water.
- They Use Piped Water drinking when available.
- Some people have a deep tubewell with no arsenic in it, it is safe to drink so they do not need the piped water system
- We are aware of the arsenic problem. We know that the tube-wells which are marked red by the government, we should not drink water from them
- If we have any problem they complain to the operator in charge
- We do not know about the DPHE, we know that this system has been constructed by an engineer called Kabul Khan.
- If we have any problem, then we just speak with the operator.
- We are satisfied with the system as we have good water in our homes and we are not paying more than 150 taka/month
- Some villages are lucky as they can use tube-wells and not rely on piped water and do not have to pay
- Main advantage of the tubewell is that water is available at any time. Piped water is controlled with time.
- We are not doing any O&M. The engineer Kabul Khan does this job too. All we do is pay to the money collector.
- We get about 1 hour of water daily with piped water. People who have tubewells are lucky as they can get water whenever they want.

- We want at least 4 hours of water every day.
- At the moment each of us pay 150 taka and that is what we can pay maximum, if more than 200 we will try to get private tubewell.
- We knew about arsenic 1 year ago. Some people from NGOs came to do water quality testing of tubewells and also gave us a chart which tells how much arsenic the tubewell have.
- The UP chairman comes sometimes for workshops and speeches but usually only when there are elections.
- The arsenic tubewells are marked with a red colour.
- We do not operate the system. It is mostly Kabul Khan and the operator. If there is any problem we will ask the operator as he lives close by. So far there has been not much of a problem and we are very satisfied with the piped water. It is also not dirty. The only problem is that we need more hours of water.

A.5.8 Interviewee: Focus Groups Mixed : No Piped Water Connection

1. What water supply do you use?
- Man: We all use tubewell water. There are some NGOs that have come to tell us about piped water but it is too costly for us. Especially, the initial down payment. It is a lot.
2. But what about women? Do they need piped water ?
- Woman: But the men are earning so they have to decide. Also we have tubewells so we can get our water from there.
3. Do you have to walk long distances to get water?
- Sometimes, when there is electricity problem and then there is no water for a long time we have to go far away area to fetch water.
- It is a problem. But we don't have any option. Also, getting piped water is constly. We don't know if the money is being given to the right person. We are not sure who will come and how to maintain such a system.
- Some households are poor and they cannot pay for piped water.
- Also, if know any trustable person we can make him incharge of the system, but we have to hire the operator, It is very complex.
4. How about the chairman? Does he visit here often? Did you tell him about water problems?
- He comes sometimes for workshops and we listen to him. But his office is far from here so we cannot get there easily. We usually speak to the village elder.
- The arsenic tubewells are marked with a red colour.
- We do not operate the system. It is mostly Kabul Khan and the operator. If there is any problem we will ask the operator as he lives close by. So far there has been not much of a problem and we are very satisfied with the piped water. It is also not dirty. The only problem is that we need more hours of water.

B

Actor Network Scan

This section describes the actor network scan that helped to arrive to the P-I Grid and the Formal Network Map drawn in Chapter 5. The actor network scan also proved to be beneficial to identify critical actors and their goals and align the thought process which was beneficial when applying the IADs framework.

Please Note: Care Bangladesh and Asian Development Bank are excluded from the Actor Network Scan as due to their limited role in rural piped water systems. They were interviewed, however, their role was limited in village areas and not found sufficient enough to be discussed in this thesis.

B.1 Actor Identification

Governmental Actors	**Corporate Actor**
i. Central DPHE	i. Local Entrepreneur
ii. Local DPHE	ii. SIDKO
iii. *Union Parishads*	iii. HYSAWA
iv. WATSAN Committees	
Interest and Civil Society Actors	**Intergovernmental Actors**
i. Rural Committees	i. UNICEF
	ii. World Bank
	iii. Embassy of Netherlands, Dhaka
	iv. Max Foundation (iNGO)
	v. Practical Action(iNGO)
	vi. JICA
	vii. EPRC
	viii. Local NGOs

Table B. 1 Division of Actors

B.2 Actor Objectives

Actors	Strategic Objectives	Problem Specific Objectives	Interest in Problem (High/Low)
Central DPHE	i. Water supply and sanitation facilities throughout the country ii. Provide advisory service to GoB in framing policy and action plans for WSS iii. Provide support to the local government institutions (LGIs) in the development and O&M of the water & sanitation facilities.	i. Build rural PWSs in arsenic-affected areas wherever feasible ii. Increase the use of piped water supply outlets for common use like public stand posts. iii. Realize at least the operations and maintenance costs of all piped water supply in the shortest possible time, but not later than five years.	High

District/ Local DPHE	Executing the implementation process and coordinating with the local governments to ensure WASH facilities are available to residences of the district.	i. Hiring Entrepreneur for Construction ii. Monitoring site selection and construction process iii. Increasing Awareness about arsenic iv. Handling major technical failures. v. Deciding Water Tariff Rates	Medium
Union Parishad	Executing and coordinating activities of agricultural, industry and community development within the local limits of the union. Responsible for coordination WASH sector activities at the union level.	i. Choosing the builder to develop the system – DPHE/NGO/Private Organisation- HYSAWA ii. Site Selection iii. Organizing awareness and capacity building campaigns iv. Hiring local operator to maintain the system v. Dealing with minor technical problems of O&M	High
WATSAN Committees	Supervising and coordinating water supply and sanitation activities of the DPHE, the NGOs and other stakeholders.	i. Organizing awareness and capacity building campaigns. ii. Communicating between the communities and the union or between the union and the sub-district office (*Upazila* office)	Low
Local Entrepreneur	i. Building WSS projects in villages and small districts ii. Receives maximum amount of funding from government organisations or NGOs with a 30% own contribution	i. Building PWSs in the villages ii. Investing 30% of own finances and receiving 70% from donor organisation iii. Receiving ROI in the form of monthly water tariffs iv. Operating and maintaining scheme for until 12-18 years after construction.	Medium
SIDKO	Only government approved technology company responsible for setting up community based treatment plants in arsenic affected areas. They are the pioneer in arsenic and iron treatment plant technology and only contractors licensed by the GoB to build community-based arsenic filtration systems.	i. Builds arsenic treatment plants in affected regions system ii. Receives money from UNICEF and DPHE iii. Monitors system for until 2 years after construction	High
HYSAWA	i. Non-profit financing organisation set up by the Local Government Division(LGD) to mobilise resources for supporting capacity development of local governments and communities to empower them to manage decentralized WASH systems. ii. Governed by a board of members comprising representatives from ministries, local governments, and development partners and chaired by the Secretary of the LGD. HYSAWA was designed to be a multi-donor funded private company that would directly support local governments at the union level to build WSS infrastructure.	i. Develop Piped Water Schemes in water-stressed village areas across Bangladesh in collaboration with *Union Parishad*. ii. Decentralize activities and build ownership of systems amongst LGIs. It receives funds from multiple donor organisations such as DANIDA and directly develops a plan to be executed by the *Union Parishad* without having to deal with the DPHE.	High
JICA	i. Achieving sustainable economic growth and poverty alleviation ii. Provide assistance in building infrastructure, educational	i. Collaborate with DPHE to in building DPHE management capacity for rural and urban water supply service.	High

		facilities, health care, rural development, governance and disaster management.	ii. iii. iv. v.	Prepare a technical guideline on water supply in both rural and urban areas. Improve the technical capacity of the DPHE in locating and developing a water source and selecting appropriate technology options for extracting water from that water source. Prepare action plans for the DPHE to direct them aligned with the Sector Development Plans. Establish a monitoring framework for monitoring the operation and the water quality of installed water supply facilities and carrying out surveillance activities to monitor them.	
World Bank	i. ii. iii.	Provide financial resources to carry out economic growth projects. Advise on financial sustainability of projects. Fiscal decentralization and promotes Public-Private Partnership (PPP) to build local capacity.	i. ii.	lending funds to the DPHE. direct the DPHE to choose an appropriate financial model that would ensure that the PWSs can sustain for a long period of time with the tariff rate assigned to the community for the particular project without being abandoned.	High
UNICEF	i. ii. iii. iv. v.	Financing many of DPHE's projects also acts as a major operational advisor concerned with matters related to health for the benefit of women and children. provide healthcare and management of arsenic related conditions. conducts awareness campaigns with the support of NGOs to spread awareness about the issue. developing policies, strategies and guidelines by participating in the Local Consultative Group conducted by PSB.	i. ii. iii. iv. v.	Assisted DPHE in installing deep tubewells across the country to provide drinking water to all. carry out a nationwide survey to map out the high-arsenic zones and tested all the existing tubewells to demarcate the safe ones from the unsafe ones. UNICEF's actions in Bangladesh are mostly concerned with WASH activities. They work in the area of rural water supply and water quality issues piloting new technologies to ensure safe water, collecting data on water point functionalities and water quality parameters of wells. They have developed and implemented the Water Safety Plans in collaboration with DPHE to improve household drinking water quality. They are working with schools, mainly in low income communities and villages, to engage children as change agents in their homes and communities to increase the awareness and demand for safe water. Many of these plans have shown positive results. Shares training tools and strategies with DPHE to improve monitoring. Carry out project monitoring.	High
Embassy of Netherlands	i. ii.	An active donor in the rural WASH sector of Bangladesh mainly focusing on difficult and hard-to-reach areas. Do not involve themselves in the planning and implementation of the project but support projects financially only.	iii. iv.	Financially support UNICEF, WHO and DPHE to build rural PWSs. Plans to retire from the drinking water supply sector of Bangladesh as they believe they have little to offer.	Low
Max Foundation	i.	Improve living conditions and increase economic growth of	i.	Build piped water schemes themselves with support from the local	Medium-High

		rural poor by promoting Max WASH approach. ii. Carry out basic participatory activities to create awareness, build community capacity.	governments of districts and the *Union Parishad*. ii. These PWSs are financed by their own government or some funding agency, they hire a contractor to construct the system and they take the support from LGIs and UPs to run the system. iii. Able to serve hard-to-reach communities in areas where there is an actual demand for the system in as less execution time as possible.	
Practical Action	i.	Improve living conditions and increase economic growth of rural poor by promoting WASH approach. ii. Carry out basic participatory activities to create awareness, build community capacity.	i. Build piped water schemes themselves with support from the local governments of districts and the *Union Parishad*. ii. These PWSs are financed by their own government or some funding agency, they hire a contractor to construct the system and they take the support from LGIs and UPs to run the system. iii. Able to serve hard-to-reach communities in areas where there is an actual demand for the system in as less execution time as possible.	Medium
Local NGOs	1.	Understand the dynamics of the community well and are able to motivate people. They are the main actors creating awareness, demand and also conducting trainings etc. 2. Most international NGOs prefer to partner with local ones for motivational activities with communities.	iv. Motivate communities to become aware of arsenic, adopt PWSs and help them raise demand. v. Help community sustain PWSs by conducting trainings and workshops vi. Conduct trainings and workshops for awareness building.	High
EPRC	i.	Incorporate and implement strategic research, academic and developmental activities for effective and sustainable achievements in targeted goals. ii. Conducti partnership and collaborative projects with governmental departments' non-government organisations and donor agencies from Bangladesh and other countries.	i. Carrying out technologically verified and organised field work in arsenic-affected areas to increase awareness and build capacity. ii. Carry out monitoring activities to check water contamination level after system in built. iii. Collaborating with international partners-NGOs and UNICEF/World Bank to carry out research based field activities. iv. Conduct trainings and workshops for awareness building.	Medium-High
Rural Communities	Actors that are affected the resource use and share common property rights on the resource.		Actors that are affected the resource use and share common property rights on the resource Women specifically, their daily lives are directly affected by issues of water quality and they understand better the problems that come with it.	High

Table B. 2 Goals and Objectives of Actors

B.3 Actor Resources

Actors	Important Resources	Replaceability	Dependency	Critical Actors
Central DPHE	Constitutional Guidelines and Authority Technical Capacity Research Capacity Ability to Contact and Coordinate with donor organisations. Institutional Power Power to receive and utilise funds from donor organisations	Low	High	Yes
District/ Local DPHE	Constitutional Guidelines and Authority Institutional Power Ability to Reach Communities	Low	High	Yes
Union Parishad	Constitutional Guidelines and Authority Institutional Power Ability to Reach Communities.	Low	High	Yes
WATSAN Committees	Constitutional Guidelines and Authority Institutional Ability Ability to Reach Communities.	High	Low	Yes
Local Entrepreneur	Technical Capability	High	Medium	Yes
SIDKO	Technical Capability	High	Medium	Yes
HYSAWA	Technical Capability Development Capacity Ability to Contact and Coordinate with donor organisations. Power to receive and utilise funds from donor organisations.	High	Low	No
JICA	Technical Knowledge International Experience Financial Capability	Low	High	Yes
World Bank	Technical Knowledge International Experience Financial Capability	Low	High	Yes
UNICEF	Technical Knowledge International Experience Financial Capability	Low	High	Yes
Embassy of Netherlands	International Experience Financial Capability	High	Low	No
Max Foundation	International Experience Financial Capability Institutional Capacity Human Resources	High	Low	No
Practical Action	International Experience Financial Capability Institutional Capacity Human Resources	High	Low	No
Local NGOs	Human Resources Ability to Reach Communities.	Low	High	Yes
EPRC	Technical Knowledge Research Ability Field Expertise	High	High	No
Rural Communities	Ability to Raise Demand and Adopt Systems Institutional capability to handle O&M and sustain systems	Low	High	Yes

Table B. 3 Resources of Actors

C

IAD Application

Section C.1 in this section describes the positions that were used in the IADs framework and Section c.2 is a compilation of the important community interview statements that allowed me to draw conclusions of the major community problems, from their perspective.

C.1 Definition of Positions

Position	Function
Legislature	The legislature is the government body responsible for creating laws relating to water supply and management and dedicating organisations to handle tasks related to the water sector. It authorizes the organisations to create and implement policies for the benefit of people in the rural water supply and sanitation sector.
Executor	The executor is the government authorized organisation that is responsible for creating and issuing policy documents, strategies, sector development and implementation plans that authorized respective organisations to develop and plan water supply management systems. It manages all matters relating to water supply and sanitation facilities in both rural and urban areas. It mandates certain organisations to handle WASH activities but also encourages private sectors and NGOs to participate in the betterment of these activities.
Developer	It is the entity responsible for planning, designing and implementing water supply systems in coordination with other stakeholders. It has the technical ability to plan and design a water supply system, regulate the implementation process of the system and verify the construction and technical capacity of the system. It can request for support from financers as and when required to do the implementation process.
Steering Committee	It is the organisation responsible for bringing together stakeholders, organizing meetings and workshops to steer discussions to create, develop and revise policies for WASH sector, devise implementation plans and sector development frameworks to map the implementation process.
Financer	This position is taken by any donor agency with the available resources and interest to participate in the WSS sector. During the development phase, the entity assuming this position is faced with development/resource risk and financing risk.
Advisor	The advisor consults the developer on the best technical plan and managerial strategy to develop a successful system.
Implementer	An implementer is an entity responsible for executing the task of implementation of a PWS in an area. It participates in selection of the site for the scheme, chooses the installation contractor, has the knowledge to verify the technology being used and the ability regulate and monitor the installation process of the PWS in any particular area.
Seller	The business entity who possesses the technology for use in the PWS and is able to carry out the construction work of these PWS. His business involves charging the developer for his services. He can also benefit from the monthly tariffs charged from the community members. He may or may not be responsible for the operations and maintenance of the scheme.
Motivator	The motivator plays the role of motivating the local communities at grass-root level by organizing participatory activities to create awareness about water quality issues, assist in site mapping and in raising demand for a PWS.
Coordinator	The coordinator, as the name suggests helps to coordinate the activities between the central, local and community level. It mostly acts as a bridge between the three levels, communicating relevant information.
Resource User	The resource user is the person using the common pool resource (in this case PWS) and who is most affected(knowingly or unknowingly) by its utilization. The resource user has shared common rights on the resource available and has the authority to avail information and take basic decisions about its use. The resource users in this scenario are the most affects but least powerful actors in the Power-Interest Grid.
Caretaker	The caretaker is the person who is taking care of the daily operations of the scheme, such as collecting tariffs timely, switching on-off the power, treating the water when needed and making

	sure all households connected get water at the right time. He may also handle basic technical issues which require small fixes.
Facilitator	A facilitator is someone who helps communities to realize common objectives by providing trainings and assisting them in technical issues without taking a particular position in the activity itself.

Table C. 1 Definition Positions Used in IADs Framework

C.2 Identification of Key Community Problems

Statement	Type of Issue	Responder Type
There is awareness amongst the people about the issue of arsenic but not of the long-term health impacts. If aesthetically, they do not see any issue, then usually drink that water. Also because, they do not realize the benefits of having piped water.	Awareness	Field Expert
Not all of the community members are affected by water quality issues and hence not all of them have equal interest in engaging in the issue.	Awareness	Field Expert
There is no fund for any major repairing to be done. The funds collected are only enough to treat the water.	Sustainability	Village Piped Water Committee Head
In reality communities are not self-aware and self-capable of raising the demand without the support of an NGO.	Sustainability	U.P Chairman
Women are supposed to be a part of the committee meetings but many times they do not come for the meetings.	Lack of Women Participation	Field Expert
There is no trust in process. Sometimes, people feel they may be exploited, especially when many pipelines are broken down due to road construction or other reasons.	Sustainability	Village Piped Water Committee Head
If I have a personal deep tube-well and it is tested arsenic free I would prefer to use that than piped-water. It is a one-time cost and water is available at any time. - adoption	Adoption	Women Focus Groups
We knew about arsenic problem one year ago when an NGO came to test the water quality in the area. They also did not awareness building activities to tell us that there is arsenic in the tube-wells. They gave us a card for each tube-well in the house.	Awareness	Women Focus Group
We do not know what happens when we drinking that water, but we know that is bad for health and bad things happen.	Awareness	Men Focus Group
We are okay to pay for water if it is upto 200 taka/month but not more than that. We need to discuss with our husbands before we decide if we want the subscription. They are the ones who will pay the money.	Willingness to Pay	Men Focus Group
Many people in the village who can't pay do not get the connection. They use point water from the point source. They have to travel long distances to get that safe water.	Ability to Pay	Women Focus Group
We have no idea about DPHE, but we know that this piped water has been constructed by an engineer called Kabul Khan	Awareness	Women Focus Group
Some people who are lucky have a tube-well in an area which has no arsenic. Otherwise, we have to rely on piped water.	Adoption	Women Focus Group
Piped water is a luxury to us. It is not a requirement. If we can manage with water from tube-well it is fine.	Adoption	Women Focus Group
Tube-well water will get over after decades and by then we may not be alive. So as long as we can get water now we are happy.	Awareness	Women Focus Group
We need to rely on the operator for the piped water, if anything happens and we cannot handle it ourselves. Technical difficulties are hard for us to handle.	Sustainability	Men Focus Group

When workshops are organised, mostly male members show up for the workshops are events. But,it is the women who understand the situation related to water better. Men are not involved in any form of housework so they cannot relate to the problem.	Women Participation	Field Expert
The WATSAN committee is not active, it only organises a few events on World Water Day. It becomes active in the month of October as they need submit the yearly report in October but other months, it is very inactive.	Institutional	UP Chairman
The decision making power lies in the hands of the male members of the family when it comes to money aspects.	Women Participation	Field Expert
When workshops are organised they show willingness to participate but money becomes a matter of negotiation. They are negotiating based on their economic status.	Adoption	Field Expert
When any committee meeting or workshop is organised in partnership with the union council then the number of people that show up is more in the meetings, otherwise it is hard to get the attention of many people	Trust in external parties	
Women are easier to influence as they are the most affected by water quality issues. They show a lot of interest especially women of areas where they have to travel far distances to get water for their family.	Women Participation	Field Expert
The courtyard meetings that are held are mostly held separately for men and women.	Women Participation	Field Expert
When the technical difficulties of the piped water systems becomes difficult to handle then the motivation of people also decreases, but a system is running smoothly for a while then the number of users increase.	Sustainability	Village Piped Water Committee Head

Table C. 2 Community-Problem Analysis

D

Nice to Know

An interesting read for anyone curious to learn from successful institutional arrangements in similar situations.

D.1 Malawi Village Water Supply Systems

The village water systems completed in Malawi from 1968 to 1988 are now famous for the simplicity of the waterworks and for the amount of community labour mobilized to construct and maintain the systems. Water for these gravity-fed systems is diverted from unpolluted rivers originating at high elevations .Each system consists of an uptake pipe, storage tanks, and a network of pipes and valves that feed tap stands. The system design for all the projects, as well as the specialized construction materials were supplied by the government which was supported financially by a variety of public and private donors. Because the technology was entirely new to the villagers, ministry personnel supervised construction and maintenance work. Village residents supplied the remainder of the inputs, principally the labour needed to dig and refill trenches, excavate tank sites, carry pipe from deposit sites, and plant grass over the pipeline.

The support of village leaders, who still exercise great influence in Malawi, was crucial to the success of the projects. These people formed a project committee, which assisted engineers in fitting a design to a particular local area and oversaw the organisation of labour. Separate committees were formed for each section, branch, and tap in each project. Project assistants worked with the committees at these levels to assist in organizing the workers and advising them on technical matters. Villagers were organised into work teams supervised by project, branch, and village committees representing differing communities of interest in the water system. All villagers contributed to the construction of the intake and the trenches needed for the large pipes that carried the water from the intake down the mountain to the point where it was diverted into branches. Each branch of the system was constructed by residents of the villages it served. The system that distributed water to standpipes within a village was constructed by village residents. A project committee and tap committees handle maintenance and repair. The project committee supervise branch repair teams , tap committees, and intake caretakers; raises small sums for repairs and to pay the caretaker; and reports any repair work that cannot be handled by repair teams to the ministry's rural water section. Members of project committees and repair teams contributed about one day per month to complete their tasks; members of tap committees donate about one-half day per month.

These institutional arrangements for construction and maintenance have been important to the success of the project. They have combined good time and place information about the construction site with modern engineering expertise in a productive manner. They also have represented the different communities of interest associated with network type infrastructure facility.

Please Note: This exerpt has been abstracted from Ostrom's Book *"Institutional Incentives and Sustainable Development: Infrastructure Policies in Perspective", Page 99*

D.2 Self –Governing Philippine Irrigation Community

Zanjera farmers are all landless farmers who have entered into a contract with a landlord that permits them to cultivate land as long as they construct and maintain an irrigation system for themselves and the landowner. The term Zanjera is a word of Spanish origin meaning "cooperative irrigation society"; it is also used to refer to the irrigation system managed by such a society. The organisation of these societies and systems probably reflect both Spanish and pre-colonial indigenous cultural influences.

Zanjera Danum (a pseudonym) is a communal societies operating irrigation systems in the Philippine province of Ilocos Norte. It irrigates 1,500 hectares of land, which is divided into 32 named field areas. A fixed number of membership shares was assigned to each area/village when the zanjera was created. There are 564 such shares. Each share has one or more claimants, with some claimants owning more than one share. The claimant holds the right to till the land associated with the share and has responsibilities and privileges that the irrigation association assigns to each share. The right to a portion of the system's water is the main privilege; providing a labour and construction material is the principal responsibility.

The operation and maintenance of the zanjera is governed by the institutional arrangements that represent the three levels of the physical system: the canals serving the areas, the branch, and the zanjera as a whole. One of the tasks of the leaders' at all three levels of the association is to organise and monitor work details of differing sizes. The membership of the entire system is mobilized to repair the diversion structure and to clean the main canal. Each area is required to organise its members into five groups, which are assigned a three –and –one-half-day duty period, in sequence. Thus, on a routine basis, a holder of one share contributes three and one-half days of work every two weeks doing maintenance tasks or helping to rotate and distribute water in the system. Each of the five groups of zanjera is composed of individuals from every area in the system; each area contributes two members to each group for every ten shares in the area. Along with the rule that distributes the fields of an share holder at both the head and the tail ends of the canal, the way of forming work groups ensures that the interests of all the sites are protected in the operation of the system.

Elaborate records of work contributions of each shareholder guarantees that rules concerning labour contributions are enforced. Shareholders who do not show up for work are fined. Conflicts do arise, and appeals up through the three levels of the zanjera are possible.

Unlike most administered systems, the zanjeras make efficient use of water through well-maintained structures of local design. The complex, multilevel organisation of the zanjeras makes it possible to accurately represent the interests of each member in the different portions of the irrigation facility itself. It also facilitates the mobilization of appropriate amounts of labour for reconstruction, maintenance, or operational tasks that differ dramatically in scale. In some parts of region several zanjeras have joined in a federation that permits them to exploit a single, large-scale diversion structure.

Please Note: This exerpt has been abstracted from Ostrom's Book *"Institutional Incentives and Sustainable Development: Infrastructure Policies in Perspective", Page 87*

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