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Nālandā UNIVERSITY

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Addressing the issue of Arsenic in Drinking Water: A study of institutional gaps and challenges in Bihar

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Executive Summary:

Arsenic is a persistent issue in many of the Ganga Brahmaputra Meghnad basin in India. However, even though mitigating the issue has gained momentum in many other states in India, Bihar remains largely grappled by faults in the institutional mechanism because of which millions continue to suffer silently in the state of Bihar. Still, the state of Bihar is experiencing technological intervention in mitigating arsenic as compared to the national mandates of following a socio-economic and demand driven approach of mitigation. This demand driven approach of water quality management seems to have been a failure in Bihar the result being lack of participatory approach towards problem solving in the state. The implementation agency continue to provide target based service and the villagers being unaware of the menace of Arsenic are not bothered to take up the responsibility of operating and maintenance of the mitigation technologies.

The ongoing researches in several affected districts reveal the lack of awareness which is primarily due to lack of a strengthened institution at the village level and also lack of primary health care centers to diagnose the effects of cancer. The researchers have several case studies from various affected districts that show the increased mortality rate among the villagers affected by arsenic. There have been cases reported in the Mahavir Cancer Sansthan (MCS) in Patna, Bihar, where a man was brought who had been suffering from arsenicosis from the past 25 years. The family saw 7 deaths and all of the subjects had the symptoms of arsenicosis. There have been several such cases reported in MCS which shows the continued misery that people are subjected to.

The study included interaction with various stakeholders to understand their roles in water quality management and also their respective roles in mitigating the issue of arsenic. Convergence has been identified by several background researches as a major reason for the failure of water quality management issues. Identifying the roles of each institution would help in enhancing the understanding on the possibility of convergence among various stakeholders.

1. Introduction:

a) An overview of the study:

Access to safe drinking water is gaining rampant acknowledgement worldwide owing to the serious interrelated threats that follows the consumption of unsafe water. From the year 1970 to the year 2006, the percentage of population with access to safe drinking water has increased from 45 per cent to 85 per cent. However, the rate in which the access to safe drinking water is increasing is already in decline.[1] Nevertheless, water being a basic right acknowledged by United Nations General Assembly and United Nations Human Rights Commission, a joint monitoring programme conducted by WHO/UNICEF in the year 2010, came out with the data that nearly 738 million people continue to use unimproved source of drinking water. Fodgon (2009), in his report highlighted the severity in access to safe water for the developed and developing countries. According to his study the average percentage of population with access to safe drinking would be lesser in the developing countries as compared to the developed countries.

India as a country faces acute issues of water quality with nearly 195813 of its habitations being affected by poor water quality. The major water pollutants in the country include arsenic, fluoride and iron apart from bacterial contamination. Groundwater is the major source of drinking water in India. It is studied that nearly 66 million people are at risk of fluoride contamination and 10 million due to excess of arsenic in groundwater[2]. The presence of arsenic has been observed in many states of India primarily in the Ganga- Brahmaputra- Meghnad basin *viz* Bihar, West Bengal and Jharkhand. Some other affected states include parts of Chattisgarh, Assam and North - East states like Arunachal Pradesh, Assam, Nagaland, Tripura and Manipur[3].

The government of India has been striving to provide access to safe drinking water. The Article 47 of the Constitution of India confers the duty of providing safe drinking water and public health to the state. Moreover, the country has a ministry at the centre to look after drinking water and sanitation apart from various other government institutions working at different levels. The

[1] Fogdon 2009," Access to safe drinking water and its impact on Global economic growth,' *A Study for HaloSource Inc*.http://faculty.washington.edu/categ/healthanddevgbf/wordpress/wp-content/uploads/2010/03/Access-to-Safe-Drinking-Water.pdf

[2] WaterAid,' Drinking Water Quality in Rural India,' A Back Ground Report

[3] Shanmugapriya et.al (2015),' Arsenic Pollution in India: An overview,' *Journal of Chemical and Pharmaceutical Research* 7(10S):174-177

government has enacted various policies and programmes to ensure access to quality drinking water. Nevertheless, these policies and programmes have undergone transition from technological measures to mitigate the water quality issues to a more socio technological mitigation measures that focuses on community participation[4]. The National Rural Drinking Water Monitoring and Surveillance programme (2006), envisages the institutionalization of community participation for monitoring and surveillance at grassroot level through the strengthening of Gram Panchayats and Village Water and Sanitation Committee (VWSC)[5].

The state of Bihar which has been selected for the present study is grappled with multiple issues of water quality, the chief chemical contaminants being Arsenic, Fluoride, and Iron. There are around 13 districts in Bihar that has been affected by Arsenic well beyond the permissible limits of 1 ppb and 50 ppb as cited by the organizations like World Health Organizations (WHO) and Bureau of India Standards (BIS) respectively. The number of Districts affected by Fluoride and Iron are 11 and 9 respectively[6]. However, the data that has been provided by the government line department on the affected districts is not in consensus with the reports published by other researchers who claim that a minimum of 18 districts have been affected by Arsenic[7][8]. This shows information asymmetry in the entire system.

As a part of the study several interviews were conducted with various stakeholders who are either directly or indirectly working on the issue of Water Quality. The results of the structured interview highlighted a huge gap in the institutional mechanism in water quality management system with the implementation agency of the state being blamed for its inefficiency which is majorly because in the state of Bihar, the line department of the Government is acting as the service deliverer for various implanting various mitigation technologies at the grassroot level[9]. The approach of the department is still target based and the whole process of service delivery is

[4] WaterAid,' Drinking Water Quality in Rural India,' A Back Ground Report
[5] Ministry of Drinking Water and Sanitation (2013) ,'National Rural Drinking Water Programme: Framework for Implementation
[6] http://phed.bih.nic.in/ accessed on 7/08/2016
[7] Brouns et al. (2013),' Dealing with Arsenic in Bihar, Evaluating the success and failure of the mitigation projects and providing a long term mitigating strategy.'
[8] The data on the number of districts affected was also derived from the respondents response and from the workshop presentation attended as a part of the study.
[9] Based on respondents response.

supply driven which is quite contradictory to the type of intervention mentioned in the Sector Reform Project (Swajaldhara)[10].

However, according to the officials working in the Public Health and Engineering Department (PHED) the Swajaldhara programme failed drastically in the state of Bihar as the Gram Panchayat took no initiative in the whole service delivery process.

The menace of water contaminants is still persistent in the state of Bihar with millions suffering from various health adversities that are direct repercussion of the contaminants. It was in the year 2002 that Arsenic was detected in the Bhojpur district of Bihar for the first time. Since then several other districts have been tested positive for various contaminants. However, the technological interventions for mitigating the effects of contaminants have failed drastically.

There has been a complete lack of follow up which has been highlighted time again in the interactions with the various stakeholders. There is a huge gap in the institutional framework which has resulted in the failure of interventions by various stakeholders. Also, in a report by WaterAid, the major reason for the failure in intervention is due to lack of coordination among various sectors or stakeholders at various levels within the system. [11]

Thus the present study tries to identify these gaps and the scope of filling the gaps.

b) Importance of Institutions and Institutional Mapping:

The word institution has no single meaning. Several scholars have come up with different arguments in defining institutions. However, Ostrom has defined institutions as both organization and also the rules within these organizations that frame the interaction of various entities within and across the organization[12].

According to Hodgson, "Institutions enable ordered thought, expectation, and action by imposing form and consistency on human activities"[13]. The importance of institution can be

[10] Ministry of Rural Development, Drinking Water Supply (2003),' Swajaldhara Guidelines.
[11] WaterAid,' Drinking Water Quality in Rural India,' A Back Ground Report
[12] Ostrom Elinor,' Institutional analysis and Development: Elements of the framework in historical perspective.' *Historical Development and Theoretical approaches in Sociology(II)*
[13] Hodgson M Geoffrey (2006),' What are Institutions? *Journal of Economic Issues*

identified by the definition given by Hodgson. The interaction and the framing of behavior are the two components that make institutions so important.

Ostrom in her studies has highlighted the need for a framework to study complex systems. The framework would help to identify the key entities involved and the relationship between them. Institutional mapping also comes under the frameworks for policy analysis[14]. A study done by Green (2007), highlights the importance of institutional mapping. The study says that institutional mapping help in understanding the power distribution within the system (inter and intra organizational) and also helps to identify the key stakeholder who has the power to influence and change the rules of the game.

The present study is designed to understand a similar institutional arrangement in the state of Bihar and more broadly in India on the issue of Water Quality management. There are several institutions in Bihar that aims to work on the aspects of water quality. However, since the issue of Arsenic was observed in Bihar in the year 2002, many interventions were planned and many institutions were set up to tackle the menace of the same. Nevertheless, interactions made as a part of this study has highlighted that people do continue to suffer. Thus, it is of utmost importance to understand the institutional mechanism and to find out the gaps within and among the institutions so that the scope of filling up the same can be understood. Also, since convergence of different organization has been an issue which has resulted in poor management of water quality at the grassroot level, institutional mapping can also help in identifying the areas where convergence is possible as the mapping would help in identifying the interactions.

2. Institutions and Institutional Mapping of Water Quality in India:

a) National Level Institutions:

i) Ministry of Drinking Water and Sanitation:

Ministry of Drinking Water and Sanitation is the nodal agency for the execution and implementation of the projects related to Access to safe drinking water and Sanitation at the center. The ministry has come up with a National Water Policy and National Rural Drinking Water Guidelines and a strategic plan for the ten year that started from 2011 to 2022.

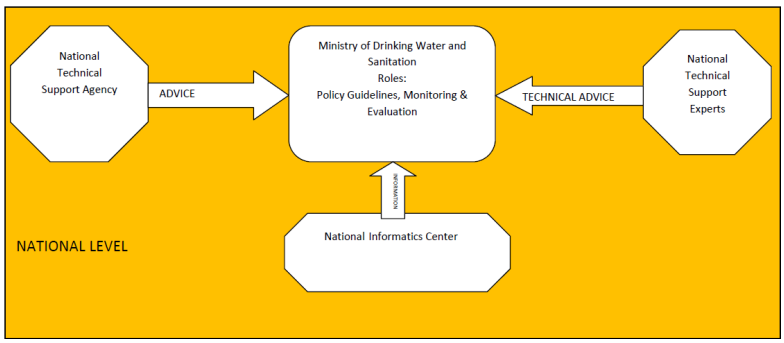
[14] Aligica, P. D. (2006). Institutional and stakeholder mapping: frameworks for policy analysis and institutional change. *Public Organization Review*, *6*(1), 79-90.

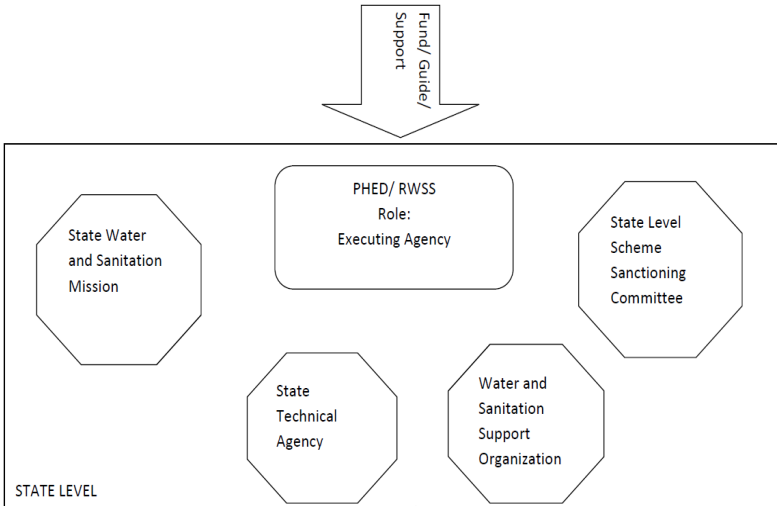
The national water policy is a comprehensive document that portrays the present scenario of water resources in India and the persistent issues in management of water resources in India. The parameters of water quality has been briefly discusses in the National Water policy document wherein emphasis to ensure to access both quality and quantity has been given importance[15]. The policy very specifically talks about sensitization of the community in water related matters and also encourages community based water management. The policy also says that any water resource project planned should consider social, environmental and techno-economical aspects. Before starting the project, consultation with the beneficiary families should be ensured. Concurrent monitoring of the project is given due importance in the policy wherein the projects should be monitored at state and central level to avoid time and cost over-runs. The policy also gives importance to the involvement local governing bodies and Water Users Association in the planning of the projects. The weaker sections of the society would also be given due consideration to ensure equity in accessing the benefits of the project. The action plans should be made by the National Water Board which in turn would be approved by the National Water Resource Council. Moreover, the policy also demands that the state policies should be revised in accordance to the National Water Policy.

The National Rural Drinking Water is has outlined the guiding principle for the implementation and functioning of the rural drinking water projects. The NRDWP is documented to ensure sustainability of water supply and also to ensure that the water is supplied to every household. Care would be taken to maintain equity in water in accessibility to safe drinking water to every household. The programme also lays its emphasis on piped water supply to every household rather than handpumps as the use of the same has over extracted the ground water. The document also talks about envolving the community and local governing bodies. Maintaining of water quality and surveillance is important as per the programme. In the section 12 of the document the institutional set up for delivery mechanism is described.

Institutional Set up and Mapping in India as per NRDWP guidelines

[15] National Water Policy(2012), Ministry of Water Resources, Government of India.


National Technical Support Agency
ADVICE
Ministry of Drinking Water and Sanitation
Roles:
Policy Guidelines, Monitoring & Evaluation
TECHNICAL ADVICE
National Technical Support Experts
INFORMATION
National Informatics Center
NATIONAL LEVEL


Fund/ Guide/ Support
PHED/ RWSS
Role:
Executing Agency
State Water and Sanitation Mission
State Level Scheme Sanctioning Committee
State Technical Agency
Water and Sanitation Support Organization
STATE LEVEL

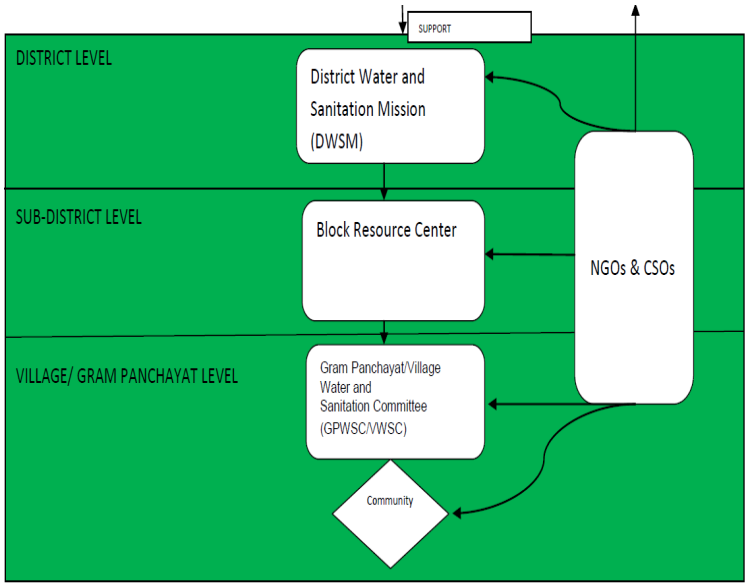

SUPPORT
DISTRICT LEVEL
District Water and Sanitation Mission (DWSM)
SUB-DISTRICT LEVEL
Block Resource Center
NGOs & CSOs
VILLAGE/ GRAM PANCHAYAT LEVEL
Gram Panchayat/Village Water and Sanitation Committee (GPWSC/VWSC)
Community

Figure1: Institutional Mapping and Institutional Setup of Water Quality management in India[16][17]

ii) State level Institutional Set up:

1. State Water and Sanitation Mission (SWSM):

   The SWSM shall be set up at the States/UT level and shall be a registered society. Some of the major functions of SWSM would be to provide policy guidance, convergence of water supply and sanitation activities including special projects, coordination with various state government department and other partners, monitoring and evaluation of physical and financial performance and management of the projects related to water supply and sanitation, integrating communication and capacity development programmes and maintenance of the accounts for funds received for implementing the projects.

2. State Level Scheme Sanctioning Committee (SLSSC)

   This committee is formed in order to avoid administrative bottlenecks in the execution of rural water supply schemes and other related support activities such as WSSO (CCDU), WQM&S, MIS, R&D, M&E etc. The major function of this committee is to prepare an annual action plan that would highlight the guidelines, schemes and activities to be taken up in a year. The source finding committee is also supposed to review the functioning/performance of existing water supply schemes for the availability of safe drinking water.

3. State Technical Agency (STA):

   This is to provide technical support to the PHED and equip them with the current knowledge base. The main function of STA is to plan and design cost effective and feasible rural water supply schemes, help PHED in preparing action plans, to engage technical expers and to give feedback to various other institutions.

4. Water and Sanitation Support Organization (WSSO):

   WSSO is to be set up in all states under the SWSM. The major functions of the WSSO/CCDU is to deal with water quality testing and surveillance, MIS, to take up HRD and IEC activities, to act as a facilitating agency between the community organization and PHED. The WSSO would also help the local governing bodies and PRIs t prepare

[16] The figure depicts the institutional set up from a national level to the village level. The mapping has been done by the author

[17] Based on the extract from the Bihar State Water and Sanitation Mission, SALIENT FEATURES OF WORLD BANK ASSISTED 'RURAL WATER SUPPLY AND SANITATION PROJECT FOR LOW INCOME STATES' (RWSSP-LIS)

water security plan and also plan on the implementation and maintainence of various water supply projects.

iii) District level Institutions:

At the district level, DWSM would be constituted and would function under the guidance of Zila Panchayat/Parishad. The major function of the DWSM shall be to formulate, manage and monitor the water supply and sanitation projects. The functions also include scrutinizing and approving the schemes submitted by the Block Panchayat/ Gram panchayat and to forward them to SLSSC. It is also in charge of entering into an agreement with the NGOs for capacity development, social mobilization, communication, project management and supervision.

At the sub-district level we have the Block Resource Centre (BRC). The function of the BRC as outline by the NRDWP guidelines are: Helping the village committee in the formation of GPWSC/VWSCs, conducting training to the various organization in the village level like the asha workers, SHGs etc to advocate on water and sanitation, preparing annual activities focusing on the IEC and training activities, helping in conducting survey and collecting baseline information.

iv)Gram Panchayat, Gram Sabha and GP/ Village Water & Sanitation Committee:

At the village level we have the GP/GPWSCs. Taking into account the decentralized approach in service delivery that the government aspires to, these committees are mainly responsible for planning, designing and implementing all in- village drinking water and sanitation activities, providing facts and figures to the GPs, ensuring community participation in decision making in all phases of in- village activities, as per swajaldhara scheme organizing community contribution in the form of cash and kind, collecting funds and empowering women for day to day operation and repairs of the water supply and sanitation scheme.

3.Institutional and Stakeholder Setup and Mapping in Bihar:

The institutional setup in Bihar and the functions of the institutions are the same as discussed above and as mentioned in the NRDWP guidelines. In Bihar, the registered

society is the Bihar State Water and Sanitation Mission (BSWSM). This is the main body responsible for implementing the state level water supply and sanitation projects and works under the guidelines outlined by NRDWP and NBA. Under this body they have six missions namely: State Project Management Unit (SPMU), Reform Sector Unit Cell to execute and implement the projects supported by DFID-SWASTH. Some of the planned projects include: Solar Mini Water Supply Scheme, Rural water Supply Scheme, Blanket Testing, Mobile Water Quality Testing Laboratories, District Water Quality lab strnghtening, Smart Water System and IVRS for Department, Project Management Unit (PMU) , CCDU for communication and capacity development, Water Quality and State Training and Research Center each of these looking at specific mandates set by various national plans and programmes.

At the district level there is the District Water and Sanitation committee with roles and responsibilities that has been discussed in the above section. At the block level there are block resource coordinators and at the panchayat level we have Gram Panchayat Water and Sanitation Committee. As per the Bihar Panchayati Raj Act, 2006, the panchayat is responsible for Construction, repair and maintenance of drinking water wells, tanks, ponds, hand pumps, prevention and control of water pollution, and maintenance of rural water supply schemes. However, as per the discussion with the PHED officials, the panchayats do not take any responsibility in the RWS projects.

Since in the present study the stakeholders at the community, GP or village level could not be identified or met, a secondary data analysis was made. A study done by Mott McDonald group discusses some of the issue in the institutions at the village or block level which would be discussed in the latter part of the paper[18].

[18] Mott McDonal (Bihar State Water and Sanitation Mission) (2013),' Bihar Water supply & Sanitation- Study on Social Assessment, including Capacity Building and Communication Strategy

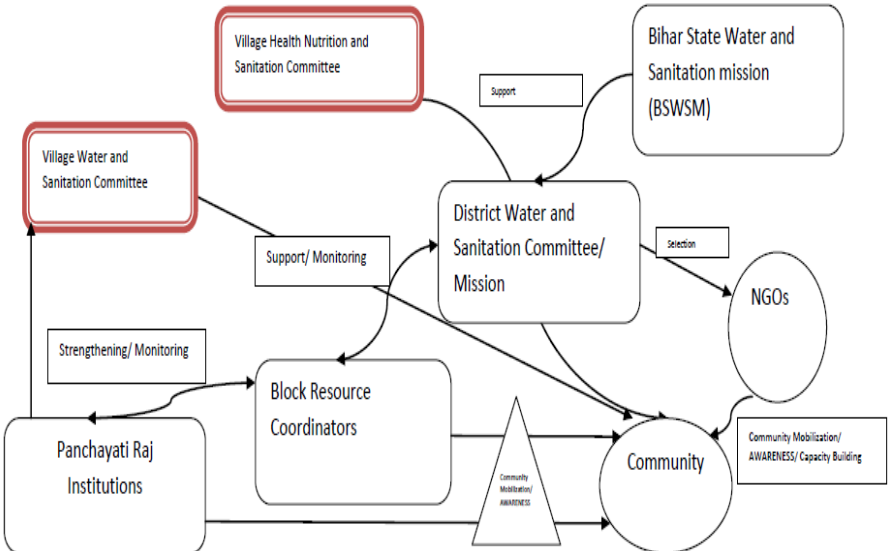


Figure2: A simplistic map of the institutions in Bihar [19]

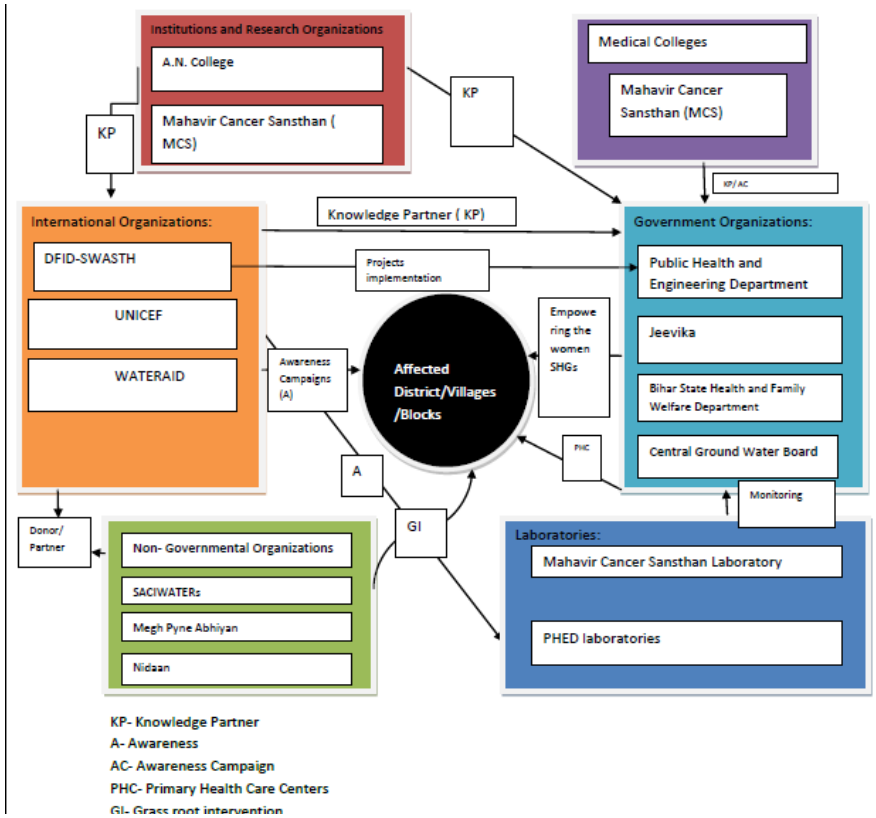


Figure3: Stakeholder Mapping for Water Quality in Bihar[20]

[19] Compiled from various sources: field interaction and respondents response.

4.Elaboration of Various Stakeholders in Bihar:

1. Public Health And Engineering Department

The public health and engineering department, Government of Bihar is an apex organization that fosters the supply of drinking water and sanitation services in the districts of Bihar. The major functions of the PHED as listed by them involves the following: Ensuring access to safe water, supply of drinking water to rural areas and development of sanitation facilities, Constant monitoring of quality of drinking water supply, ensuring participation of the communities in schemes involving drinking water supply and sanitation and reforming water supply and sanitation sector.

The PHED is involved in conducting many water quality tests in the districts of Bihar. The department owns many laboratories which is equipped with instruments that can monitor water quality. It was from the year 2002 to 2003 that this department was involved in conducting various tests for the contaminants present in the government water supplies. The tests brought remarkable results with many parts of the state being contaminated with fluoride and iron. However, it was in the year 2002 that the first test on arsenic was done and a village named Simariya Ojhapatti village of Bhojpur district, was noticed to be contaminated with arsenic in its groundwater. Successively, ten kilometer stretch on the nearby Ganga basin was tested for arsenic contamination and it was found that nearly 13 districts are contaminated with arsenic[21]. However, this remains quite contradictory to the studies done by Brouns et.al, in which the authors concluded, as a result of their field investigation that nearly 21 districts were affected by the issue of arsenic.

The PHED department has also come up with GIS maps showing the severity of the issue of arsenic in Bihar. Moreover, this is a premier organization which has also been involved in the technology implementation to solve water quality issues in Bihar. Some of the technologies adapted includes: Hand pump attachment treatment unit, Sanitary dug well with IM3 hand pump and with solar based pump and Rainwater harvesting systems. These are the short term mitigation options adopted (PHED, 2016). The department is also trying to invoke community

[20] Compiled from various sources: field interaction and respondents response.
[21] http://phed.bih.nic.in/ accessed on 1/07/2016

participation in accessing safe water and is involved in the development of several IEC tools for social mobilization. The department also boast about the operation and maintenance that it looks after which was contradicted by the studies of Brouns et.al in which the field investigation brought into light several technologies implemented, which is now dysfunctional[22].

Therefore, it is necessary to carry out an institutional analysis with the department to find out the work done on water quality issues till date and also to find out the gaps in the institutions which has proven to be an obstacle in the working of the department.

2. **UNICEF:**

The United Nations Children's Emergency Fund is a United Nation's Programme which provides long term humanitarian and developmental assistance to children and mothers in developing countries. In India, UNICEF strives to work on various child development issues and helps in providing hygiene, nutrition, education, protection and social development of children. This is guided by various country level programs that the organization envisions the current one being the Country Programme Action Plan 2013-17. Going through the history of UNICEF, in the early 1970's this institution was primarily involved as a partner with the government of India in the world's largest rural water supply programme. The organization was involved in the making of India Mark 2, which helps in digging boreholes in the hardrock. In Bihar, UNICEF was involved in constructing sanitary wells and rain water harvesting system. However, studies done by Brouns et al. observed during their field visits that most of the technological interventions made by UNICEF is at present dysfunctional and also that when contacted the UNICEF authorities do not respond. The studies also concluded that UNICEF has been the knowledge partner to PHED, so it is important to understand the intervention of UNICEF at both community level as well as organizational level on mitigating water quality issues.

3. **Water Aid:**

Water Aid is an international organization working on policy framing and advocacy of Water, health and Sanitation. "We work with local partners and communities to improve access to

[22] Brouns et al. (2013),' Dealing with Arsenic in Bihar, Evaluating the success and failure of the mitigation projects and providing a long term mitigating strategy.'

water and sanitation and promote good hygiene. We campaign and engage decision-makers to bring about a world where everyone, everywhere has these essentials by 2030" [23].

In Bihar, Water Aid works with the government as its knowledge partner and also works with the civil societies working at the grass root level on the issues of water quality and sanitation. The organization mainly provides fund to the Non- Governmental Organization in carrying out grass root level projects in Bihar on Water Quality and Sanitation.

4. **Medical Colleges and Hospitals:**

Medical colleges and hospitals play an important role in diagnosing the effects of heavy metal contamination on human body. In the study done by Brouns.et.al it was observed that various districts of Bihar, it was found that there was lack of competent health care institutes and medical colleges that could identify arsenicosis[24].

From the field interactions with various stakeholders it was quite clear that there was need of more rigid institutions in the health sector. The ill impacts of arsenic have still not been acknowledged by the Primary Health care (PHC) centers and many government hospitals in Bihar.

In the present study, Mahavir Cancer Sansthan (MCS) was identified as a premier institution in identifying patients who have been affected by arsenic. Many research works are being conducted by the competent researchers in MCS to identify and treat the patient sufferings from various forms of cancer[25]. A detailed questionnaire followed by a survey would help in understanding the current health care facilities in Bihar in the context of Water Quality.

5. **Jeevika:**

Bihar Rural Livelihood Project (BRLP), widely known as Jeevika is an initiative by the Government of Bihar to reduce poverty. This project is funded by the World Bank. The project is currently operational in 6 districts and 102 blocks across Bihar. The main strategy of BRLP program is to build vibrant and bankable women's community institutions which would be in the

[23] http://www.wateraid.org/policy-practice-and-advocacy accessed on 12/07/2016
[24] Brouns et al. (2013),' Dealing with Arsenic in Bihar, Evaluating the success and failure of the mitigation projects and providing a long term mitigating strategy.'
[25] Based on respondents response

form of Self Help Groups (SHGs).These SHGs through member saving, internal loaning and regular repayment would stand as a self sustaining organization. The major project intervention is given in the diagrammatic representation shown below.

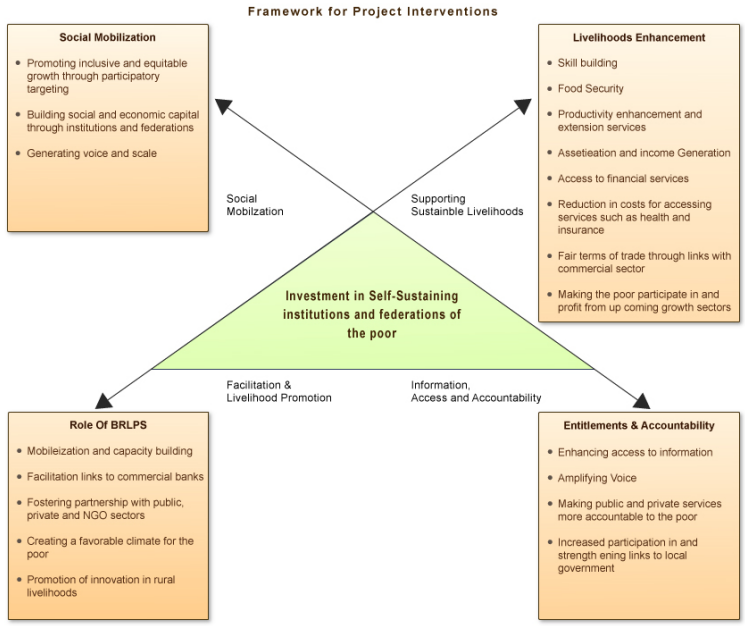


Figure4: Framework for Project Intervention. Source: Jeevika website. http://www.brlp.in/web/brlp/design-principles accessed on 11/07/2016

Therefore, this project of Jeevika is based on the above represented strategy of building a multi-tired, self sustaining, model of community based institutions that can be empowered to self manage their own development. Details of the field findings are attached in the Annexure 1.

6. DFID-SWASTH:

SWAST programme was designed to bring together different service delivery departments of Department of Health and Family Welfare, PHED and Social Welfare Department. The DFID-SWASTH is working very closely with the PHED department on the issue of water quality in an integrated manner. The projects under the RSU cell have been mentioned in the previous section. The organization was involved in the strengthening of district laboratories and also introduced the mobile water quality testing laboratories[26].

[26] SWASTH PROGRAMME REPORT (2016),'Bihar Water Quality Testing and Supply.'

7. **Researchers:**

There are eminent researchers like Prof. Ashok Ghosh who have immensely contributed in understanding and bringing the issue of arsenic to the forefront. Prof. Ghosh has a team of researchers working on the issue of arsenic and has also conducted many field visits to the affected regions in Bihar.

Also, Dr. Arun Kumar of MCS has been an active researcher in finding out the effects of the dosage of arsenic on human body. Dr. Kumar has several cancer patients coming from the various arsenic affected districts to the MCS hospital. The patients when tested for arsenic were found positive. It was found that the concentration of arsenic in the skin, nail, hair and blood samples of the patients tested were beyond the permissible limits of 50 ppb[27].

The finding of the field study and outputs from the interactions are discussed in detail in the Annexure 1.

8. **Non- Governmental Organizations:**

Some of the Non- Governmental Organizations directly or indirectly involved in mitigating the water quality issues are: Megh Pyne Abhiyan, Nidaan and SaciWaters.

The Megh Pyne Abhiyan or MPA as its popularly known is a campaign working with the grassroots organizations and professionals in five flood prone districts (Supaul, Saharsa, Khagaria, Madhubani, and Paschim Champaran) of North Bihar[28]. The institution is working to revive the traditional mitigation strategies practiced by the communities. The dug wells have been found to be a source of clean drinking water in flood prone areas of North Bihar[29]. The authorities, politicians and the communities have always thought of hand pumps to be a source of clean water , however since most of the hand pumps are shallow, it has become a source of

[27] Based on respondents response.
[28] MPA report,' Dug well solution to clean drinking water in North Bihar.'
[29] Ibid:pp 8

arsenic in drinking water. Thus, the MPA came up with the initiative of constructing more dug wells that can be a source of arsenic free drinking water.

Nidaan has been a partner with the WaterAid and works on various social issues amongst which is water quality. The role of Nidaan on water quality has been limited to the work that it carries out with WaterAid.

SaciWater is an NGO based in Hyderabad. As a part of its Arsenic Knowledge and Action Network it is trying to form a network in Bihar by starting a pilot in two of the arsenic affected districts. As an early initiative it is trying to bring in the active stakeholders and affected communities on a common platform to discuss the interventions needed.

5.Analysis of the field findings:

The response of the respondents is attached in the Annexure 1.

	TK	LA	LHC	NSP	LF	DDL	LE	CN	NSM	LAD
PHED	✓	X	✓	X	X	X	✓	✓	X	✓
Jeevika	X	X	X	X	✓	X	X	X	✓	✓
UNICEF	✓	✓	✓	✓	X	✓	X	✓	X	X
WaterAid	X	✓	X	✓	X	✓	X	X	✓	X
DFID-SWASTH										
Medical Colleges	✓	✓	✓	✓	X	✓	X	✓	X	X
Researchers	✓	✓	✓	✓	X	✓	X	✓	X	X

NGOs	✓	✓	✓	✓	**X**	✓	**X**	**X**	✓ **X**	**X**

Table 1: Matrix of the major issues highlighted during the field interactions

Abbreviations:

NSP- Negligence of service provider

LHC- Lack of Health Care

LA- Lack of accountability

LF- Lack of follow up

CN- Community Negligence

LAD- Lack of Authenticated Data

DDL- Dysfunctional district labs

TK –value of traditional knowledge

LE – Lack of employees

FP- Failed projects

NSM – No specific mandate

The interaction with various stakeholders brought forth some key connected, inter and intra departmental institutional issues. The PHED department in Bihar is the nodal agency for implementation of any technology related to water quality. However, they face the challenge of operation and maintenance which is one major reason why most of the technologies adopted are now dysfunctional. The operation and maintenance is given to the contractors whose major concern is to make profit.

Justifying the non involvement of community in the technologies implemented, the PHED cites the failure of Swajaldhara an initiative take by the Government of India to scale up the sector reforms in the Rural Drinking Water Supply. The initiative conceptualized the participation of the community by giving them ownership of the water supply assets. Thus, the community as per Swajaldhara had a decision making role in the choice of the drinking water scheme, planning, design, implementation, control of finances and management arrangements. However, this initiative drastically failed as the GP took no initiative in the projects and also the community being unaware of the ill impacts of contaminated groundwater, showed no interest in the cost recovery of operation and maintenance. The PHED has well equipped district laboratories to test the contaminants in water. There has been an intervention with the DFID-SWASTH for

strengthening the district laboratories by funding for lab equipments and chemicals. However, this work is still on progress. Nevertheless, field interactions with many stakeholders have led to the conclusion that these laboratories lack in human capital and also lack in equipments to detect the contaminants in water supply systems. The international organizations are however trying to intervene by assessing the laboratories for parameters like human skills, equipments and testing done. One of the researchers mentioned that the labs lack in human skills and equipments and thus remains dysfunctional. Since, the employees in the labs have to take 300 recording per month and also since the most of the lab instruments are not functional, they tend to note the concentration of contaminants by visual assumption and that too in parts per billion, the analysis of which is impossible without sophisticated instruments like Atomic Absorption Spectrometer (AAS).

Further, as of now the PHED has only conducted tests in the government implemented water supply sources. The major intervention that organizations like UNICEF is wanting to undertake is to empower the PHED to conduct testing of the water supply sources in those 40 per cent of the household who known the supply sources. Even though the ones with their own supply systems are the capable ones, they have equal chances of getting exposed to various forms of groundwater poisoning.

The international organizations like UNICEF AND WaterAid are handicapped as they are merely the knowledge partner to PHED. The ground level implementation is carried out by the PHED department.

The Health department of Bihar has become a discussion among all the stakeholders. Health department in Bihar lacks experts who can work on water quality issues. The PHC in many villages in Bihar have doctors who are not aware of the health impacts caused by arsenic, fluoride and iron. One of the researchers from MCS who was interrogated mentioned about the duty time of these doctors working in the PHC and the lack in competence and interest that they show in treating patients. As a part of the study efforts were made to meet and interrogate the doctors of the Health Department but the efforts were not answered. Even the officials of PHED mentioned that they have been trying to liaison with the Health Department but the efforts have had similar response.

Nutrition and Sanitation is one major sector in which the Bihar Rural Livelihood Project or Jeevika is working on. Though, Jeevika is focusing on the maternal and early childhood

development, it seems that issues of the health adversities caused by groundwater contaminants is their tertiary concern. However, after the successful completion of the projects that they have at present, they would definitely like to work on water quality issues. Studies by several researchers have shown the concentration of contaminants in mother's milk[30]. Due to this there are chances that the newborn child has concentration of arsenic in its body. The UNICEF has also got no reports or statistics on the number of children or pregnant mothers who have shown symptoms of arsenic poisoning or have been tested positive with arsenicosis.

One of the important finding is that the mandate of any organization shifts with the mandate of the political party at power either at the center or the state. For instance, the PHED official did mention that the interests of international organization and NGO's are now more focused on sanitation. This can be due to programmes such as Swacch Bharath Abhiyan and Nirmal Bharat Abhiyan proposed at the center and state respectively.

6.Gaps in the institutional framework:

The basic issue noticed is that the system lacks in proper accountability. The PHED feels that its task is to merely set up treatment units which is quite against the guidelines of the NRDWP, according to which the state should act as facilitator rather than just service provider.

The system lacks in transparency. During the field visit, on asking a PHED official regarding the non involvement of community in decision making, he exclaimed that the department had transferred all its assets to the GP but the efforts were in vein. However, this is quite contradictory to the report published on the PHED website. As per the study done by Mott McDonald group, the PHED had not transferred any fund for O&M to the GP accounts as they feel the GP representatives are incapable of handling such work. Moreover, after the failure of Swajaldhara, the task of operation and maintenance is given to the profit minded contractors.

Even after having a dedicated mission within the BSWSM on communication and capacity development, the institution has failed in creating awareness. This was quite evident in the field interaction with the other development partners to PHED and the researchers.

The data from the MCS research department proves that there are still many arsenic poisoned patients visiting the hospital and many more who abstain from medical treatment due to expenses and suffer silently. Access to clean drinking water and sanitation has its effect on the health of the citizens. However, in the institutional framework of the PHED, focus on the health

[30] Add a suitable reference

component lacks substantially. The PHED is solely involved in technological intervention. The health system in Bihar with respect to diagnosing the water quality affected patients is so dysfunctional that there are no guidelines in the Bihar Health department with respect to water quality and treating patients affected by groundwater contaminants. In the field interaction as well this issue was being constantly put up by the other stakeholders. As a part of the study a patients was introduced. This patient was suffering from arsenicosis and was suffering from renal cell carcinoma. On asking the patient regarding the duration since when he has been developing the symptoms of arsnicosis, the patient remarked that it has been twenty five years since the patient suffered. He has been travelling and consulting doctors everywhere in Bihar but his efforts were not answered. In Patna, he consulted dermatologists in Patna Medical College and Hospital but the doctors could not diagnose him. His whole body had persistent symptoms of arsenicosis. This clearly proves that the medical professionals have not been trained or rather are not aware of the symptoms of arsenic which in turn indicates a complete lack of institutions in the health sector regarding diagnosis of patients affected by groundwater contamination. Morever, on interrogating it was observed that the patient lacked awareness regarding the IEC materials and awareness campaigns. This is further backed by a study done by the Mott McDonald group and which is published on the PHED website. As per their report their was lack of structured organization at the block/GP level as well as the DWSM consultant was not placed in the DWSC because of which the IEC activities were not being carried out properly.

Unanimity in decision making is extensively lacking in the water quality management in Bihar. Each of the stakeholder or the associated organizations and its institution is solely concerned about its individual roles. This in turn has isolated the different institutions which renders them to be active in a particular domain. The study by the Mott McDonald[31], highlights similar problem wherein lack in coordination among different stakeholders has resulted in delay of project delivery. In the introduction section as well, the study made by Water Aid has clearly indicated that lack of convergence has remained an issue which has resulted in poor water quality management.

Another issue within the institutions working on the Water Quality aspect which was highlighted during the field study was lack in the number of employees. The officials of PHED as well as other organizations blame for the delay in projects due to the lack in number of employees. Also,

[31] Mott McDonal (Bihar State Water and Sanitation Mission) (2013),' Bihar Water supply & Sanitation- Study on Social Assessment, including Capacity Building and Communication Strategy

it was noticed that the PHED website has recruitment notice cancelled and a fresh recruitment notice was never again posted for the same posts in their website.

The access to data and information asymmetry is one of the reasons for this failed market of service delivery. Most of the data in the BSWSM website including the information regarding their missions and the annual reports remains under construction, thus inaccessible.

Scope of filling up the Gap in the institutional framework:

As per the field interaction with the experts, some of the recommendations for filling up the gap in the institutional framework are the following:

1. Maintaining accountability within the government departments and also with the other stakeholders.
2. Strengthening the health departments by frequently conducting trainings for the doctors to diagnose patients suffering from ground water contamination.
3. A study made by Ongley (1999), discussed the major institutional issues faced by many developing countries in water quality management. One of the reasons for the failure in institutions as quoted by him is because of," Unwillingness to accept low technology solutions even when these are more sustainable and suited to local skills, etc.[32]" In the context of Bihar, this is also one of the problems that the people as well as the authorities are not aware of the low cost solutions which are sustainable and which can be maintained by the community itself. Though it is true that the efficiency of these household technologies would be lesser than the sophisticated technologies used, nevertheless, the easy of construction and maintenance would make these local solutions more sustainable. An example to this can be the matka filters used for iron removal.

[32] Ongley, E.D. Water quality management: design, financing and sustainability considerations. *In* Proceedings of the African Water Resources Policy Conference, Nairobi, May 26-28, 1999. The World Bank (in press).

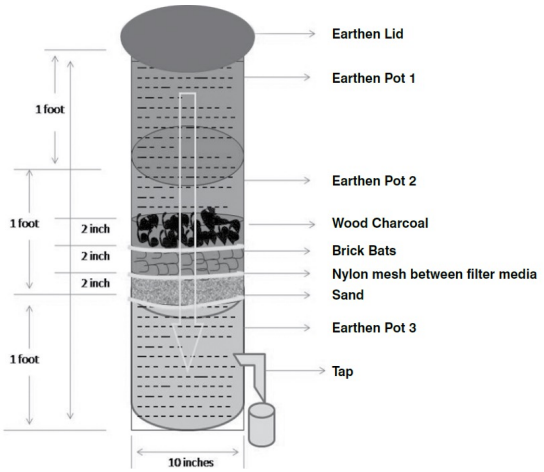


Figure: Components of a Matka Filter; Source: Technical document on MATKA (EARTHEN) FILTER designed and implemented by Megh Pyne Abhiyan in five districts of North Bihar[33].

4. The priority of the community needs to be understood. As per the field interactions with the officials of PHED, it was quite clear that neither the community wants to take the initiative for the operation and maintenance of the technology installed by the government nor does it want to invest anything on the technologies. One indication of this can be that the priority of the community especially in rural Bihar might not be to mitigate the issue of arsenic, rather they might have some other issues in their priority list in which they consider themselves responsible. Therefore, it is of utmost importance to understand the priority of the community[34]. The policy and reforms to be made at the state or central level should also consider the priority and interest of the community.
5. The interaction with the experts in Jeevika, PHED and the international organizations threw light on the issue of 'follow up'. Many plans and policies are introduced by the government and other organizations. However, the plans and polices remain active for a certain period after which 'follow up' of the same becomes difficult. This has also led to the failure of institutions as reported by Ongley[12]. There needs to be a continuous monitoring on the follow up of the implementation agencies.

[33] https://meghpyneabhiyan.files.wordpress.com/2011/12/matka-filter-local-earthen-filter2.pdf accessed on 22/07/2016

[34] Ongley, E.D. Water quality management: design, financing and sustainability considerations. *In* Proceedings of the African Water Resources Policy Conference, Nairobi, May 26-28, 1999. The World Bank (in press).

6. Regular recruitment as per the specification given under the NRDWP guidelines should be implemented in the various institutions working on water quality[35].
7. Improvement in accessibility to government data. Enhancing the user interactive aspect for easy access of data and to overcome information asymmetry.

Annexure 1:

(a). Questionnaire to the various stakeholders:

1. Key intervention on water quality issues.
2. Details of the recent water quality survey taken. Explain the key findings.
3. Technologies adopted. Failure in technology implemented, if yes, reasons
4. What are the steps taken to make sure that the technologies that are adapted do not fail in the future?
5. Number of time operation and maintenance is carried out on the technologies implemented.
6. How far do you take into account the acceptance of the technologies adopted by the community?

[35] National Rural Drinking Water Programme Guidelines, 2013

7. Throw light on some on the reasons that led to non acceptance of the technologies by the community.
8. Discuss about the choice of technologies finalized by the department
9. What are the most important dimensions that you look after while finalizing the technologies adopted?
10. Do you take care of the traditional knowledge of the people in mitigating arsenic. How has this affected the choice of your technology?
11. List down some of the major failures on technologies that you have faced till date.
12. Give a list of the primary stakeholders involved in water quality in the state.
13. Give a list of the primary organization on the water quality in the state
14. Talking about community consultation that was mentioned on your site, how far is it achievable?
15. What are the major guiding policies for the operation of this organization?
16. List some of the state / central policies with regard to water quality.
17. Discuss about the IEC materials used. Who prepares them? How effective is it according to you ? Throw light on the acceptance of these by the community.
18. Discuss some of the major success that you have achieved till date on water quality.
19. Throw some light on the health issues associated with heavy metal contaminants. Focus on the issue of arsenic.
20. As this department relates engineering and health dimensions, discuss about the incidences and affects of arsenic on human body and give the details of all the hospitals and health care facility centers that take care of the patients suffering from arsenic contaminants.
21. Where can I find more details on the organization that deals with individuals affected by heavy metal contaminants?
22. Give details on some of the loopholes that you perceive in the organization. What steps do you think that the organization should take on combating these?
23. How much important do you feel is the need to bring together different stakeholders/institutions/organizations on a common platform to discuss about the water quality issues and its mitigation? What can be the positive outcome of this?
24. What are your major funding agencies?

25. In what ways do you think the international organizations help you in implementing the technologies proposed?
26. What are the programs in which the international organizations supported you? Why were you in need of their support?
27. How effective has the international organizations been in acting as a knowledge partner for PHED?
28. Do you find any loopholes in working with international organizations, NGO's ? If yes, why?

2.Questions to the UNICEF:

1. What were the WASH related programs implemented in the state of Bihar.
2. Amongst these what are the most successful programs that has been implemented in Bihar.
3. How do you gauge the severity of water quality issues in Bihar?
4. Discuss some of the programs planned by the organization in Bihar related to water quality issues that have not been successful. Why do you think these programs, policies failed?
5. In what ways has the organization been able to intervene in the mitigation of water quality issues in Bihar?
6. How has the organization helped PHED by being its knowledge partner?
7. Would you like to list some of the active stakeholders/institutions who deal with water quality issued in Bihar?
8. In your current vision 2013-17 do you have any special provision on implementing programs related to water quality and more specifically related to arsenic?
9. In a scale of 1-10, how much will you rate the severity of the issue of arsenic in Bihar?
10. Are there any current working programs that directly/ indirectly deal with the issue of arsenic?
11. Do you have any record of the number of children and pregnant mothers who have been affected by heavy metal contamination in Bihar?

12. What sort of problems (if any) do you face when you deal with Government departments? And, What were the difficulties you faced (if any) when you work as the knowledge partner with the PHED?
13. Throw some light on the attitude of PHED in terms of acceptance when you discuss with them the key interventions that can be made on mitigating water quality issues.

14. How much beneficial do you think it would be to bring all the active stakeholders/institutions working on water quality issues on a common platform, do discuss on the key intervention?
15. How many hospitals according to you are currently active in Bihar in diagnosing patients with arsenicosis? With this regard where do you think intervention is needed?
16. Some comments on the health sector/ health departments working on diagnosing the effects of heavy metal contaminants in Bihar. List few of such hospitals.
17. How much fund till date has been allocated for mitigating water quality issues?
18. Do you think the funds given to organizations like PHED is being properly utilized? If no, Why?
19. In one of the articles referred in this study, the authors talk about some technological interventions like Rain water harvesting systems and handpumps that the organization implemented in various districts in Bihar, but which is dysfunctional now. Would you like to justify on why the technologies have become dysfunctional?
20. What is the role of community in your WASH programs?
21. Does the community readily accepts the technological or any other form of intervention implemented by you?
22. How much value do you give to the empowerment of community members in solving water related issues?
23. The traditional mitigating strategies adopted by various affected communities, how effective do you think these are?

24. While working with the community have you sensed social exclusion and caste discrimination when it comes to access of safe drinking water in Bihar? If yes, where do you think key intervention is needed?

25. Role of Panchayati in providing access to safe drinking water. Discuss few loopholes in panchayati raj system.

3.Questions to researchers/doctors:

1. Have you known of the issues of fluoride/ iron/ arsenic in Bihar? If yes discuss about the severity of the issue and its impact on human health?
2. How many patients have you diagnosed till date who has suffered from problems related to water quality?
3. Do you have testing laboratories that detect heavy metal contamination in human body? If no, list the laboratories which can diagnose heavy metal contamination.
4. Any workshop conducted till date on harmful effects of groundwater contamination?
5. Where do you think key intervention is needed on combating the harmful effects of groundwater contamination?
6. How much important do you feel is the need to bring various stakeholders on a common platform for discussing and working out action plans for dealing with water quality issues?

4.Questions to researchers and academicians:

1. Discuss about your experience in dealing with heavy metal contamination in Bihar.
2. What are the major obstacles that you faced during your study?
3. What are your key findings and where do you think is the key intervention needed?
4. List the stakeholders/institutions/organization that you are aware of that work on water quality issues.
5. Discuss your association with an active stakeholder and how has it been helpful.
6. Discuss the role of government in your research works.
7. How far have you seen the government implement technologies functioning in your area of study?

8. What are the common complaints of the people as you have observed from your field studies?
9. How much importance do you give to the coming together of the various stakeholders in discussing matters related to water quality management and arsenic mitigation?

5.Questions to Jeevika:

1. Does Jeevika know of past efforts (training, campaign etc) made by SHG network on issues of safe drinking water? For instance, Household water treatment systems
2. What is the scope of including safe drinking water as a topic for discussion in SHG weekly meetings?
3. How does quality of water matter to women of SHGs? (not sure how will you pitch this question)
4. How can safe water become a priority for women of SHGs?
5. Possibility of role played by ASHA workers (who are also members of SHGs) for water quality?
6. Any committee under Cluster Level Federation that can include safe drinking water? If so, how?

7. How much value do you give to the empowerment of community members in solving water related issues?

8. The traditional mitigating strategies adopted by various affected communities, how effective do you think these are?

9. Comments on the PHC at the village level. Are these doctors aware of the problem of arsenicosis/ flurosis? Are they able to treat their patients?

10. Are you aware of the work on water quality being done by the Bihar State Health and Family affairs department?

Annexure 2:

Response of the respondents:

1. **Public Health and Engineering Department:**

The interview with one of the employees of Public Engineering and Health Department (PHED), brought forth key findings on the whole role of Public Engineering and Health Department. The key intervention of the department on water quality issues has been in implementing technologies to mitigate groundwater contamination and also in creating awareness among the people by community consultation. According to the PHED, it does regular monitoring and the recent water quality tests were done in the year 2014-2015. However, it claimed that in the year 2010, the department made a groundbreaking find, in which around 1900 habitations were found to be arsenic affected. To ascertain that the technologies implemented are operated and maintained periodically, the PHED department holds workshops for the operators and also the local village people are provided with the mobile numbers of these operators. This insures that there are less operation related problems and even if the problem exists the operators who are the village members are entitled to and are capable of repairing the machine. On asking questions related to acceptance of technologies by the villagers, the department informed that the community has no say on the technologies implemented. The community members lack relevant knowledge on the issue of arsenic so they are not capable of making any comments on the technologies implemented. The issue of non acceptance of the technologies is very rare and is related to the primitive thinking of the villagers who tend to follow the mitigation practices practiced by their forefathers. Also, talking about the consideration of the traditional practices followed by the community, the PHED informed that the traditional practices have helped the department in locating the aquifers that are not contaminated with arsenic. However, this is a rare practice and is adopted only when there is lack of technology to detect arsenic in the aquifers. Further, the choice of technology depends on the principle that the technology should be cost effective and should benefit a large number of people.

Some other officials during a focused group discussion in the Jeevika SPMU office justified the reasons for non involvement of the community. According to them the Swajaldhara institution did have mandate for mobilizing the community and giving the full ownership of drinking water

assets to the panchayati raj. Involvement of the three tier Panchayats, requisite social mobilisation, communication, capacity development processes were considered to be important components of the Swajaldhara .Also, the community or the GP was 100 per cent responsible for the operation and maintenance and partly responsible for the capital cost. Thus, it was a demand driven approach. However, the officials of the PHED informed that the Swajaldhara which was the scaling up of Rural Water Supply sector reforms was an absolute failure. The government has tried and given away all the water supply assets to the GP. However, the GP took no or very minimal initiative. The main issue according to the official was that the community still does not value the commoditization of water. It believes that water is to be given for free. The community is not able to sense the ill impacts of the water quality issue. Therefore, the community or the GP does not show any willingness to pay. This also indicates that they do not value the technologies planned or proposed to be implemented. This justifies that the reason why community has no say on the technologies implemented at the village level.

PHED also gave a list of primary stakeholder or organization in the state working on water quality. Apart from the PHED department some of the primary organizations which are involved in water quality are: UNICEF, WATERAID, Nidaan and Bihar state Ministry of Health and Family welfare. The major role of the international organizations like UNICEF and WATERAID is to act as a knowledge partner and they have also contributed in the preparation of IEC materials. NGO's like Nidaan have contributed in creating awareness and these are directly involved with the people in the ground level. The PHED also remarked that these days the contributions from NGO's and other organizations on water quality mitigation has reduced as they are mainly focusing on issues related to sanitation. The funds to PHED comes directly from the Central or State Government. Also, recently World Bank is funding for some projects on water quality.

However, the PHED department also agrees that there is a lack of health care facilities in the state when it comes to water quality. The doctors are not trained enough in the primary health care centers. The department also felt that there is a necessity for different departments and organizations to come together and work on a common platform. The issue of arsenic or any other metal contamination for that matter is a multi-dimensional problem and efforts in mitigating the issue in isolation is one of the major reasons+ for the failure of many projects.

2. UNICEF:

Two of the UNICEF (Water, Sanitation and Hygiene) WASH officers were interrogated to understand the role played by UNICEF as a stakeholder in Water Quality.

UNICEF has prioritized its intervention in the water quality sector from the early 1970's. It was then that UNICEF was responsible in fixing India Mark II hand pumps in many districts of India. At that time the issue of accessibility was the major problem faced in many parts of Bihar. Slowly, the issue of accessibility reduced as ground water was explored. Talking about Bihar, the state has enough water supplies as it is abundant in groundwater. However, it is now that with the growing research it has been understood that this ground water of Bihar in many of its districts is not potable as it is severely contaminated with contaminants like Fluoride, Iron and Arsenic. Thus, at present UNICEF being aware of such an issue has a WASH section in its Patna office. The major role played by the UNICEF is by being a knowledge partner with the Government of India and also with the PHED department in Bihar. UNICEF has come out with many Information, Education and Communication materials which are being used by PHED for awareness campaigns in the affected districts. The exact quantification of priority is difficult but the active involvement of UNICEF in many water quality related programs is commendable.

The WASH officers mentioned that in the coming years UNICEF has fundamentally four plans and programs related to its intervention in the water quality sector in the state of Bihar.

1. In Bihar 48 percent of the households have their own water supply systems *viz. hand pumps and tube wells.* Now, since these households have their own water supply systems, government does not take the responsibility of testing these wells for its water quality. Nevertheless, though these households seem to be the capable ones, it can never be said whether there water supply system is contaminated or not. Therefore, UNICEF would like to intervene on this and would like to investigate by empowering the government on the water quality of these 48 per cent household systems.
2. The second plan by UNICEF is to create a Water Quality Task force. This water quality task force would be created to empower the implementation agencies.

3. Assessment of the district laboratories. The PHED department of Bihar has established water quality testing laboratories in almost all the districts of Bihar. Unfortunately, at present these labs are dilapidated and dysfunctional. The maintenance of these labs is overlooked by the Government and there is absence of proper instruments to measure water quality. The UNICEF is preparing an assessment report based on the availability of human resource, testing done and Human Resource skills.
4. Another major plan in the list of UNICEF is to evaluate the water treatment technologies deployed by the PHED or any other organization for its suitability, effectiveness and ease of maintenance.

On asking questions related to the partnering of UNICEF with PHED in Bihar, the officers seemed to be quite upset. According to them, the PHED never considered themselves accountable for most of the water quality related issues. The institutional design and mechanism within the PHED system was structured in a way that it has become quite dysfunctional at the implementation level. The PHED merely wants to take up the task of implementation of the technology but for subsequent tasks of analyzing its effectiveness, suitability and maintenance, is something for which they do not want to be accountable. Moreover, the PHED overlooks all the other water supply systems that are not implanted by them. Thus, in a crux the PHED shows multiple levels of irresponsibility and does not want to be accountable to the people. On asking questions related to the involvement of community in the plans related to technological implementation by the PHED, the UNICEF officers exclaimed that the community is never consulted by the PHED, they do not have a say to any of the technologies implemented by the PHED.

On asking questions related to the record that they have on the children affected by arsenic, the UNICEF does not have any record as such. Talking about the awareness of UNICEF on the number of active stakeholders that are working on water quality the officers mentioned that PHED is the major stakeholder, then the international organizations like their team and also in the DFID was also working, Central Ground Water Board in Bihar has also been working on understanding the geochemistry of arsenic and other contaminants, apart from that they are also aware of the efforts being put by eminent researchers like Dr. A.K. Ghosh from A.N. College and Dr. Arun Kumar from Mahavir Cancer Sansthan. The UNICEF team also agrees to this point

that lack of coordination among different stakeholders have resulted in non-unanimous decision being made at the state level and also that there should be a clear understanding on the role played by the different stakeholders in the state of Bihar working on Water Quality issue.

The WASH team, UNICEF also exclaimed that the whole system of health department is not functioning well.

The role of community in the development of their plans plays a central role. The team prioritizes community participation in all their schemes. The issue that they face with the community is the acceptability by the community on the awareness campaigns that they hold. The community members still carry this taboo that the ground water is live water and very fresh for consumption and that the reservoir or supply water is dead water. Moreover, one reason why the PHED fails in operation and maintenance is because they give this task to the profit-minded contractors who are not much concerned about the welfare of the people.

On questions related to the feasibility of the technologies implemented by UNICEF till date, the team said that they are just a knowledge partner to the PHED and that it is the role of PHED to implement technologies. The study done by Brouns et.al mentioned that during the field visits carried out by the team, they saw that most of the hand pumps installed by the UNICEF was dysfunctional. The team justifying this said that the role of UNICEF as mentioned before is just to guide the government and it is not in charge of doing every other process that follows as a result of the first process. The scaling of the technologies is done by the government and UNICEF has not much say on it. Therefore, it's the duty of the PHED for the continuous evaluation of technologies implemented for its suitability and feasibility.

6. **Water Aid:**

A brief telephonic interaction with one of the Water Aid officials focused on the activities carried out by Water Aid in Bihar. According to the official, Water Aid is presently focusing on sanitation. However, they do have plans for intervention on water quality issues. In Bihar, Water Aid was working with a NGO Nidaan that carries out some grass root activities on Water Quality in Bihar. However, the official did comment on the plight of PHED department and the dilapidated condition of the district labs. Also, the lack of skills among the employees of PHED is one major reason because of which many of their interventions have failed drastically. The

major mandate of this organization is to work with those organizations that are directly connected to the people. Thus, the organization works with the government and the grass root level organizations in the ratio of 3:7. Therefore, their major focus is to work with the community.

Another important point that was highlighted by the officer was the shifting of mandates of the organization according to the mandate of the political party at power. This was told to justify their enhanced involvement in mitigating sanitation issues. At present both the central and state government are focused on sanitation. This has in turn motivated the international organizations to frame their mandates and action plans according to the decision made by the government. However, since the conversation was telephonic, brief and also because the organization is primarily a donor partner to other NGO's much focus could not be laid on its contribution towards water quality.

7. **Medical Colleges and Hospitals:**

In the present study, a research scientist in the Mahavir Cancer Sansthan, an institution in Bihar which is specialized in cancer treatment, was interviewed to understand the role of medical institutions in mitigating the issues related to water quality. Arsenic is a carcinogen and leads to many forms of inter related diseases like diabetes, acute weakness, constipation, skin diseases, cardiac issues and gastrointestinal problems. The researcher added that many patients who are diagnosed with cancer visit the institution for their treatment and out of these patients many have also been tested positive for arsenicosis. The patients come from various districts of East and West Champaran, Muzzafarpur and Patna. Concentration of more than 500 ppb was found in the blood, urine, hair and nails samples of the patients. The EPA standards are 10 ppb which is far lower than the concentration of arsenic found in the patients from the above mentioned districts. There have been numerous surveys made by the researcher and his team in two of the most severely affected villages in Bihar namely : Tilak Rai ka Hatta and Simhari. In both of these villagers many have been diagnosed with acute arsenicosis. The effect of arsenic was quite visible in the bodies of these patients as told by the researcher. The researcher also exclaimed that many women are subjected to the arsenic poisoning and they develop various forms of cancer like cervical and breast cancer. Most of the villagers affected by arsenic complain of acute weakness which has been scientifically proved to

be one of the effects of arsenic and it is not with cancer but with acute weakness that most of the patients expire.

Mahavir Cancer Sansthan has a fully fledged laboratory with Atomic Absorption Spectrometer to detect the concentration of arsenic on human body. The researcher also explained that medicinal plants have the property to absorb arsenic and decrease its content in the human body. Medicinal plants like Tulsi (*Ocimum tenuiflorum),* Turmeric (*Curcuma longa*), Rennet (*Withania somnifera)* etc. have properties to absorb arsenic and intake of any of these in its proper dosage can reduce the concentration of arsenic from the body.

The lack of proper health care facilities at the village level was one of the major problems of the villages in Bihar. The researcher during his field visit had observed that many of the specialized doctors had fixed a day for themselves in a week for outdoor patients. Even those doctors who are supposed to stay in the village would never stay in the village. These doctors lack in the knowledge of arsenicosis and arsenic because of which they fail to detect arsenic poisoning in its early stage. The doctors are not trained and it is indeed a matter of surprise as quoted by the researcher that the medicos are taught just one paper on heavy metal poisoning which is included in forensic science.

Thus, there has to be multi-dimensional intervention. The experience of the researcher with PHED department had been controversial. According to him the PHED was not very effective in carrying out the task at the ground level. The laboratories owned by the PHED are also quite dilapidated and dysfunctional. The people are still suffering, no matter how many technologies have been implemented in the villages. The villagers are not much interested in the scholars and other officials coming and making them aware about the issue of arsenic in their respective villages. The poverty in many of the villages has crippled the tendency of these affected people to visit the nearby hospitals to get them treated.

According to the researcher the major role is played by the government departments and also by the international agencies that can directly approach the government departments. There should be periodic training of the doctors on such issues as water quality which has so badly affected many places in Bihar. The researcher also laid emphasis on different stakeholders to come together on a common platform to work on issues related to water quality in Bihar. As the whole

issue is multi-dimensional, only multi-dimensional intervention can help in sustaining the water quality management issues in Bihar.

8. **Jeevika:**

The interaction with one of the officials of Jeevika highlighted the past efforts made by the members of the Self Help Group on Water Quality. The members of the Self Help Groups in some of the blocks were trained to repair the hand pumps whenever it became dysfunctional. However, this model could not be followed in the other districts and the approach was not sustainable enough so at present there are no such groups working on repairs of the dysfunctional technologies implemented. Another, effort that was made was to train the women of the SHG for water quality testing. However, this attempt could not be scaled. The water quality testing mentioned herein is demand driven. When the villagers demand for such tests, the trained members of the SHGs carry out the quality tests. However, this approach could not be sustained as well. The officials are not even aware whether such practices are being carried out and if at all it is being carried out, they are unaware of the districts where these groups are active.

The officials of Jeevika discussed that several such initiatives were framed but it could not be followed up. Discussing on the scope of involving the SHGs on water quality issues, the official told that according to the new project of Jeevika II funded by World Bank, nutrition and sanitation are two of their important interventions. Jeevika is currently focusing on maternal health and post child birth period of around thousand days. It is currently working on sanitation by focusing on behavior change of the people. However, an intervention specifically on water quality training is still on cards. They would first like to successfully complete the intervention of health, nutrition and sanitation that they have planned.

A study done earlier by the Mott Macdonald Group on the stakeholder analysis did give an insight on the possible role of Jeevika and its SHGs on water supply and quality. According to the study made, the institution has huge potential as they work at the grass root level in 8 districts and has community support. The SHG members can be involved for better governance at the

community level. Therefore, the members of SHGs can be utilized to reach the communities to generate awareness amongst them on the issues of water quality[36].

However, in some of their training modules they do have specific topics on the importance of water quality.

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