



Bihar Water Quality Testing and Supply

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Sector Wide Approach to Strengthening Health (SWASTH) in Bihar, Government of Bihar Initiative
Supported by Department for International Development (DFID), UK

Bihar Technical Assistance Support Team (BTAST)

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ABOUT THIS PROGRAMME REPORT

This programme report has been developed to describe the water quality testing systems of the Public Health and Engineering Department, particularly with regard to the initiative taken up by the Bihar Technical Assistance Support Team under the SWASTH programme, aiming to ensure safe and sustained water supply in each and every household. It draws from secondary sources as well as information gathered through discussions with community members and other stakeholders involved in the initiative. Field level information was gathered from two districts of Bihar - Gaya and Arwal.

SECTOR WIDE APPROACH TO STRENGTHENING HEALTH (SWASTH)

Government of Bihar Initiative Supported by DFID, UK

The SWASTH programme aims to improve the health and nutritional status of people of Bihar by increasing access to better quality health, nutrition, and water and sanitation services, particularly for the underserved groups. The focus of this programme is to strengthen the systems through better planning, organizational strengthening & human resource management, decentralization and convergence among key departments. The programme also uses community level processes to manage, demand and monitor services.



SUMMARY

Bihar is the 12th largest state in the country and is abundant in natural resources, rivers and fertile land. However, water in most habitations is contaminated by chemicals like arsenic, fluoride, iron and nitrate. This contamination has resulted in water borne problems like arsenic poisoning, melanosis and fluorosis, which make it necessary for the Government of Bihar to provide safe drinking water to its people. While hand pumps are the main source of water for a majority of the rural population in Bihar, some also depend on mini piped-water supply schemes. To monitor the quality of water supplied to the habitations via hand pumps, piped schemes and other sources, the Public Health Engineering Department (PHED) of the Bihar Government has been operating water testing laboratories at the State and district levels and adopting various mitigation strategies in areas where water is contaminated.

The document 'Bihar Water Quality Testing and Supply' focuses on the technical assistance provided by the Bihar Technical Assistance and Support Team (BTAST) with the support of the Department for International Development (DFID-UK) under the Sector Wide Approach to Strengthening Health (SWASTH) programme. As part of this assistance, in 2013, BTAST provided infrastructural support to the state laboratory and all 38 district laboratories in Bihar by giving them with updated equipment and power back-up. BTAST also deployed personnel in 13 districts of Bihar. An innovative aspect of this initiative includes four mobile water testing laboratories that were introduced for the first time in Bihar, to conduct spot analysis of water samples from different water sources in remote areas. The success of these mobile laboratories has encouraged the State Government to plan for five more such laboratories to achieve effective examination of water quality in Bihar.

INTRODUCTION

India is the second most populous country in the world with the majority of its population, about 68% in 2013, residing in rural areas of the country, according to the World Bank. There is a wide rural – urban disparity in many of the basic socio-economic indicators of development. The last six decades have witnessed extraordinary development of water resources and drinking water infrastructure, as well as development of energy and industrial sectors in urban areas at the cost of groundwater depletion, water logging, water quality degradation and pollution. This poses challenges to the provision of sustainable supply of safe drinking water to the disadvantaged sections of the population.

The problem of water is not only about availability and supply, but it is also about the quality of available water. Several water sources are found to be either chemically contaminated or infected with bacteria, and it results in diseases and infections. The risk of water contamination is the greatest where water supply is insufficient, people defecate in the open, human and animal waste are not disposed properly, and awareness about safe sanitation and hygiene practices is low.

Bihar is well endowed with both ground water and surface water resources, but the quality and availability of water varies between districts and blocks. For instance, according to the Department of Drinking Water and Sanitation (DDWS), the ground water level is as low as 5m in the north-eastern part of the State and as high as 20m in the southern districts. Further, contamination by chemical compounds and harmful bacteria makes water in several areas unfit for human consumption. Most habitations in Bihar were dependent on surface water till 1970. However, to combat the health problems caused by the consumption of surface water contaminated by chemicals, bacteria and viruses, the United Nations Children's Fund (UNICEF) started promoting the use of ground water for consumption. UNICEF and the

World Bank set-up bore wells in several parts of Bihar, and government organisations such as PHED carried this work further by installing hand pumps in the State. According to DDWS, about 80% of habitations are covered by hand pumps/ bore wells, 4% by piped water schemes and 16% by other schemes.

Several factors lead to contamination of water by bacteria and virus, such as improper usage and waste disposal, ground water depletion, and siltation. Often, this also results in concentration of certain chemical elements and compounds such as arsenic, fluoride, nitrate, or iron which could cause adverse health problems over time. In Bihar, 14,580 habitations are water quality affected, including 10,877 affected by iron, 2,698 by fluoride, 1,044 by arsenic and 1 by nitrate (DDWS website).

To improve the situation of water quality and availability by detecting contamination, the National Drinking Water Mission (NDWM) made regular water quality

S.No	Compound	Desirable Limit (mg/l)	Health Effects (if range is beyond permissible limit)
1	Arsenic	0.05	Prevalence of Arsenicosis symptoms like hardening of palms, spotty pigmentation of skin, melanosis
2	Fluoride	1.0	Dental fluorosis and skeletal fluorosis
3	Iron	0.30	-
4	Nitrate	45	Blue baby syndrome, metabolic disorder, birth malformations, stomach and gastrointestinal disorder

Source: Indian Standard Specifications for Drinking Water IS: 10500

monitoring and surveillance of the existing sources and new sources mandatory in 1986. To facilitate this, PHED established water quality testing laboratories in Bihar -- one at the State level and 38 at the district level. The main role of developing this integrated system was to provide safe drinking water by testing, reporting and generating awareness about the importance of water quality among the community.

In order to continue to test water quality comprehensively with the use of latest technology, the PHED desired to strengthen existing laboratory facilities in Bihar through the introduction of

modern equipment and trained human resources. This was achieved through technical support from the Bihar Technical Assistance and Support Team (BTAST) and financial support from the Department for International Development (DFID-UK) under the Sector Wide Approach to Strengthening Health (SWASTH) programme. Additionally, with BTAST's support, mobile water testing laboratories were introduced in four zones of the State in 2013 to test water quality in remote habitations.

THE WATER QUALITY TESTING AND SUPPLY SCHEME

This initiative aims to build a sustainable model for testing water quality and assessing its fitness for human consumption by strengthening water quality testing laboratories, thereby enabling corrective action to promote the consumption of safe water by local communities. It employs a decentralised approach by establishing water testing laboratories at the State level as well as in the districts, and also divides the State into zones in order to enhance the reach of its activities and facilitate better monitoring, localising the identification of problems and remedial strategies. The initiative incorporates a Public Private Partnership (PPP) model to draw in relevant technical expertise and infrastructural facilities, particularly with regard to the state water testing laboratories and the mobile water testing laboratories. Additionally, since 2010, a Management Information System (MIS) has been maintained to aid decision-making by providing ready access to up-to-date information on the progress of water testing and related results.

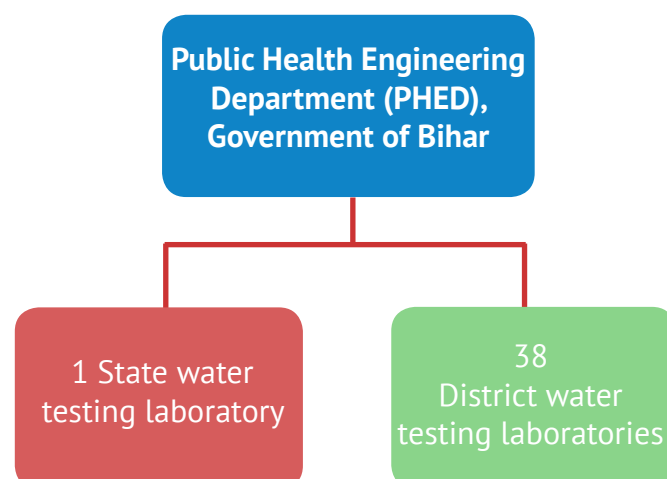
Key stakeholders of this initiative include public, private and civil society entities. PHED is responsible for providing overall direction to this initiative. BTAST provide technical assistance and financial assistance through funds received from DFID. Scientific Research Labs (SRL) has been contracted since 2005 to manage the operation and maintenance of the State and district water testing laboratories. The company has provided trained personnel and upgraded equipment for effective performance of the laboratories. Similarly, PHED has contracted a Kolkata-based private company called Harbauer Private Limited to manage the operation and maintenance and conduct overall supervision of the mobile water testing laboratories for five years. The company is supervising the overall

process of the intervention. Local residents in the districts of implementation are the target community for this initiative.

THE PROGRAMME COMPONENTS AND ITS IMPLEMENTATION

The initiative under 'Water Quality and Supply in Bihar' was designed to introduce specific changes in the support structures of existing water quality testing laboratories. The following are the structural changes that the initiative sought to bring about:

- Using an outcome oriented approach with greater focus on targets, consequences and time bound delivery of services
- Procurement of equipment for the laboratories
- Financial assistance and deployment of human resources
- Capacity building and skill training
- Awareness generation
- Monitoring at regular intervals against the achieved outcomes



The initiative encompasses two major processes under financial and technical activities. The first involves the strengthening of water testing laboratories at the State and district level and the second process involves the design and operation of mobile testing laboratories/ vans to collect samples from remote areas for testing and to generate awareness.

State Water Testing Laboratory

The State laboratory was under supervision of the Government of Bihar till 2005, after which it was outsourced to SRL. In 2015, this laboratory became the first State laboratory in India to be accredited by the National Accreditation Board for Testing and Calibration Laboratories (NALB).



State Water Testing Laboratory, Patna; Source: OneWorld Foundation India, 2015

The State laboratory acts as a referral unit that undertakes testing, analysis and documentation of water samples, and submits a report to the PHED headquarters. It is under direct supervision of the Chief Engineer, PHED. In addition, as mandated by the Government since 2010, the State laboratory has developed an MIS and has been feeding data into it, constantly updating the current status of tested water sources so that appropriate action can be taken in affected areas.

The targets to be achieved by the State laboratories are as follows:

- To test 2,000 water samples every month with a team of 17 personnel
- To test 10% of the samples received from the districts to cross verify the results with those of districts
- To test 5% of blanket water samples from 16 unaffected districts to cross verify the results

- If need be, the laboratory supports mobile laboratories in conducting bacterial tests

There are two private partners involved in blanket testing being carried out under the financial assistance of BTAST at the district level. These agencies are Spectra (covering 16 unaffected districts), and SRL (covering 22 affected districts).

District Water Testing Laboratories

In Bihar, there are 38 district water testing laboratories functioning across the State. The main purpose of establishing laboratories at the district level was to extend the reach of water testing facilities. Water samples are collected from the habitations, tested in district laboratories, and findings are reported to the headquarters. The monthly target of the district laboratories is to test 300 water samples on 28 parameters set by the DDWS, and submit reports of the analysis. To enable the laboratories to maximise output while ensuring accuracy, the DDWS conducts refresher trainings every year for all district laboratory in-charges and chemists.



District Water Testing Laboratory, Gaya; Source: OneWorld Foundation India, 2015

With the assistance from BTAST, a survey was conducted in 2012 where the requirements of the laboratories were analysed at the State and district levels for better water quality monitoring and surveillance. It was found that the laboratories were facing problems like lack of upgraded equipment, frequent power cuts and lack of human resources, which hindered the achievement of monthly targets.

During the field visit to Gaya district laboratory in 2015, it was found that there are 22,231 public water sources in the district and the majority of the district population is dependent on ground water for consumption. The sources in Gaya district are found to be contaminated by fluoride and nitrate compounds. Therefore, the laboratory chemist randomly selects the habitations with the help of Panchayats and tries to test at least 10 sources from each habitation which helps to assess the status of contamination in a habitation. According to Dr Shailendra Kumar, laboratory in-charge of the Gaya district, there are 24 blocks and 333 Panchayats in the district and the laboratory has covered at least one or two sources from every Panchayat in the district as of August 2015.



Auto Cleave & Distillation Point, District Laboratory; Source: OneWorld Foundation India, 2015

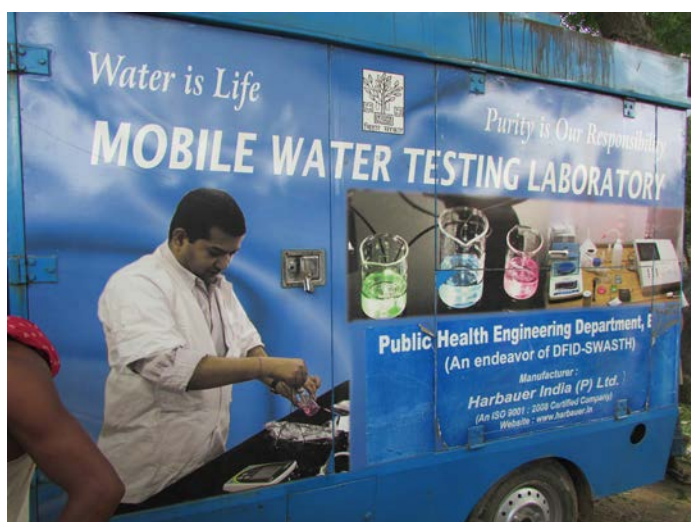
To overcome these challenges, BTAST with the support of DFID, provided infrastructural support to 38 laboratories in 2013 under the laboratory strengthening initiative. This included equipment as per the requirement of the laboratories such as the pH meter, laminar flow, digiterate dispenser, Global Positioning System (GPS) hand set, desiccator, inverters, uninterrupted power supply (UPS), voltage supplier, thermometer, conductivity-cum-total dissolve solvent (TDS) meter, turbidity meter, hot plate, weighing machine, ion meter, spectrophotometer, water bath, refrigerator, got air oven, autoclave and incubator. Also, human resources were deployed to support 16 district laboratories of the State for a period of 18 months.

Mobile Water Testing Laboratories/ Vans

There are 38 district laboratories in Bihar in addition to a State laboratory running in Patna, but reaching remote habitations remains a challenge. Though some of these laboratories have a sample collector among their staff, there are not enough collectors

to bring samples from extremely remote areas for testing. Therefore, to reach habitations in the rural interiors and test water quality, modified vans are used as mobile water testing laboratories. BTAST, supported by DFID and in consultation with PHED, introduced four mobile water testing laboratories in March 2013. The procurement of the vehicles, equipment, chemicals and human resources was done by contracting Harbauer India.

These mobile laboratories were deployed to cover remote habitations located in four different zones - Patna, Muzaffarpur, Purnea and Bhagalpur - of Bihar. Apart from improving coverage of water sources under the initiative and supplementing the work of the State and district laboratories, this component of the initiative was aimed at generating awareness among local communities. The vans are equipped with essential equipment and chemicals to test water samples by 15 parameters, and are given a target of testing samples from 125 water sources every month. In the last two years, 12,000 samples have been tested by the mobile laboratories.



Mobile Water Testing Laboratory; Source: OneWorld Foundation India, 2015

The mobile laboratories in all four zones are directed and supervised by the Superintendent Engineer at the State level. Once the samples are collected and analysed, the reports are submitted to the Executive Engineer at the district level. If any concerns with water quality are reported, required action is taken by the Government to stop consumption of water from that particular source.

the samples tested, whereas primary supervision of district laboratories is the responsibility of the Executive Engineer of each district.

The supervision includes random spot checking by technicians and chemists. Samples from hand pumps are checked twice in a year, whereas samples from mini pipe water supply schemes are tested every 15 days. Random checking of tested water samples from the districts is undertaken by the State water quality testing laboratory where 5% of district laboratory samples are tested and cross verified. BTAST is also involved in

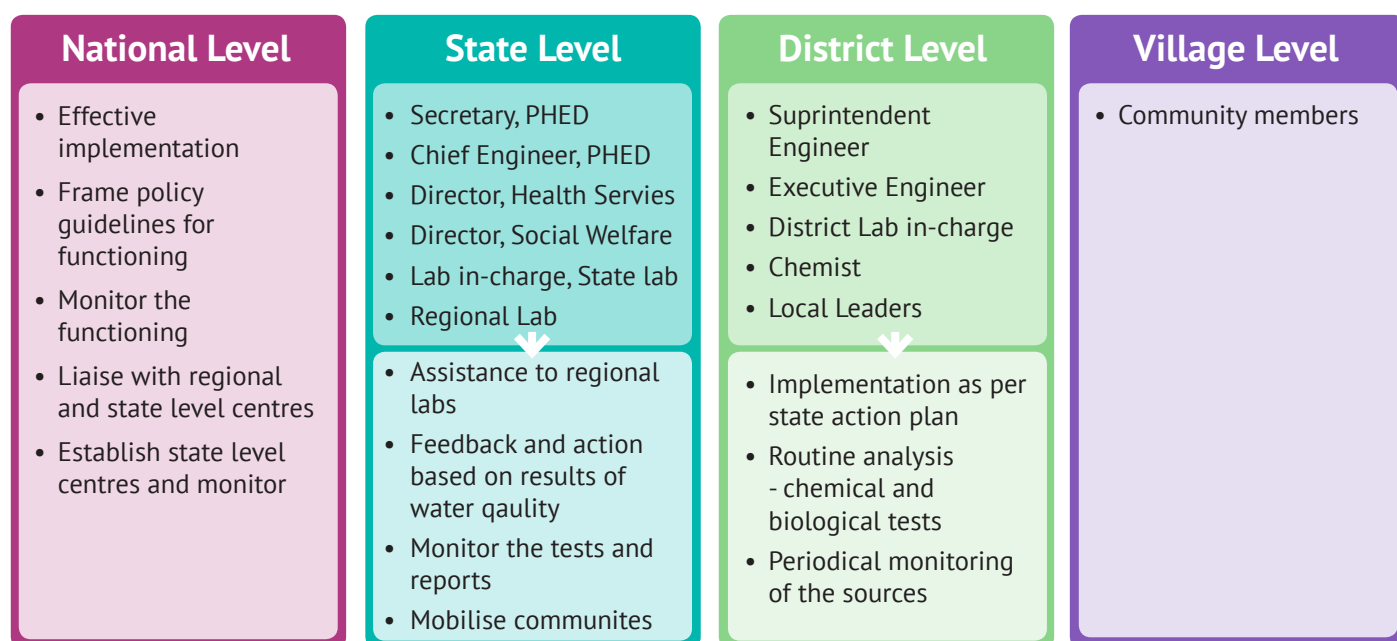


Samples being tested by mobile laboratory chemist, Arwal; Source: OneWorld Foundation India, 2015

Monitoring

The PHED officials follow a process of routine checks to monitor implementation of this initiative. At the State level, a Senior Research Officer at PHED is in charge of overall supervision and monitoring of

In order to observe the process and functioning of mobile water testing laboratories, a visit was made to Arwal district, which was formed in 2001. As per the roster prepared by the headquarters, the mobile laboratory in Arwal was testing water samples from Balidar village, Kaler block. In order to increase the community's awareness, local leaders and officials from the PHED would inform them about the visit and purpose of the mobile laboratories. According to the District Programme Officer of Arwal, the mobile laboratory visited Arwal for the first time in August 2015. The mobile laboratory is expected to generate a raw set of data about the affected and unaffected public and private sources.



Implementation Flow; Source: OneWorld Foundation India, 2015

monitoring the initiative, as monthly reports of each district are compiled by the Regional Manager to track the progress of the initiative. The findings of these monthly reports form the basis for taking decisions on further action to be taken by the team.

EMERGING LESSONS

Awareness generation about water quality: The process of collecting water samples from the community, conducting tests and analysing the results have made the community aware about the importance of water quality. Mobile laboratories further fuel community engagement, as water samples are collected from the sources in the community or houses, and results of the tests conducted are announced at the site. This serves to generate interest and awareness among the community members. Additionally, measures such as stationing mobile laboratories at the site of public functions and festivals to demonstrate the testing of water samples have played a role in building public awareness.

Increased efficiency: The human and infrastructural support provided to the initiative has enhanced its efficiency tremendously. For instance, due to increased efficiency it was found that by May 2015 itself mobile laboratories had completed testing 82% of the 18,000 water sources that were targeted to be tested by end 2015. Also, at district laboratories, better infrastructure helped increase the number of water samples being tested per month from 125 samples to 300 samples.

Improvement in health of community members: The government's efforts towards awareness generation, prevention of water consumption from



"Strengthening of laboratories at sub divisional level has been the most important impact because the labs were not well equipped with the equipment and human resources. The involvement of BTAST has resulted in better functioning of the district labs with quality result."

Chandreshwar Ram
Executive Engineer, Gaya District

contaminated sources, placement of treatment/removal units to deal with excessive fluoride and arsenic, establishment of mini pipe water supply schemes and hand pumps, etc, have led to a change in the health of the community members.



“Through this van, I was able to sensitize the members about the importance of quality water. At times, it becomes difficult to manage the tests as people get excited and get samples from their households. Community members welcome the mobile van with great enthusiasm.”

Jagat Bhushan, Chemist, Mobile Van

Lack of Human Resources: As per government norms, it is mandatory to perform both the tests - chemical and biological (bacterial/viral) - at least twice in a year. To conduct the chemical tests on 300 samples is a time consuming process, requiring trained human resources. The district laboratory in Gaya, for instance, is facing challenges in meeting its target due to inadequate human resources. A similar situation is observed with the mobile testing laboratories. It has been found that there is a need for at least three functionaries in a mobile laboratory, as it is difficult for the chemist and the driver to complete all the processes of collecting samples, analysing them and documenting results.

Lack of space in vans used as mobile water testing laboratories: The vehicles used as mobile water quality testing laboratories (Tata Ace) are not

large enough to facilitate the performance of necessary tests on all 15 parameters as mandated by the DDWS. Also, the vehicles have no space for a generator or even the necessary equipment to conduct bacterial tests. As a result, the chemist has to take the samples to the district laboratory to conduct the remaining tests, inadvertently increasing the burden on district laboratories.

Lack of precautionary aids in mobile laboratories: There is need to provide some safety measures and equipment in the mobile laboratories. Masks and aprons are needed to perform the tests properly.

Process delay: There are process related delays in providing necessary facilities to district laboratories. For instance, in order to collect samples from the field, the laboratory collection personnel require transport, for which they make requisitions to the concerned approving authority. However, obtaining clearance takes so much time that it sometimes makes it difficult to achieve the targets of the month. Such factors disrupt the activities of the laboratories and hamper their ability to expedite the testing of water samples.



“I am a care taker of the fluoride removal unit set up by PHED. It has been working for the last four years. I personally consume water from the removal unit and have seen positive impacts in comparison to the community members who do not consume.”

Manjula Devi, Care Taker, Churi Village

SUSTAINABILITY AND REPLICABILITY

The relevance of these water quality laboratories is indisputable, and any intensification of efforts to test and address water quality issues in the interest of public health requires strengthening of these laboratories in terms of infrastructure and human resources.

Supported by a realistic action plan, the successes of the district laboratories and mobile testing laboratories have prompted the Government of Bihar to scale up the project in the State. The PHED has planned to launch five more mobile laboratories in the State with an advanced vehicle (TATA 407). Also, there are plans to establish water quality testing

laboratories at the sub-divisional level in order to increase the reach and effectiveness of the initiative. The initiative to strengthen water quality testing laboratories has augmented the capacity of the State, district and mobile laboratories immensely.

The financial and technical assistance provided under this initiative has led not only to increased coverage of public and private water sources in habitations across the State of Bihar, but has also extended the reach of activities in remote areas and helped raise public awareness regarding water quality and safe practices. Overall, it has enabled a more systematic and comprehensive assessment of the quality of water being used by people in the State, thereby providing crucial support to corrective action in the interest of community health.



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