FINAL REPORT

ASSESSMENT OF RURAL DRINKING WATER SUPPLY SERVICES FOR THE RURAL WATER SUPPLY AND SANITATION PROGRAM IN BIHAR

CHANDRAGUPT INSTITUTE OF MANAGEMENT PATNA

Phaneeshwarnath Renu Hindi Bhavan, Chajjubagh
Patna–800 001, BIHAR

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ASSESSMENT OF RURAL DRINKING WATER SUPPLY SERVICES FOR THE RURAL WATER SUPPLY AND SANITATION PROGRAMME FOR BIHAR

TEAM MEMBERS

V. Mukunda Das
Shireesh
B. L. Mishra
Vijaya Bandyopadhyaya
Debabrata Samanta

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CHANDRAGUPT INSTITUTE OF MANAGEMENT PATNA

EXECUTIVE SUMMARY

This report aims to provide a sector assessment of drinking water services in rural Bihar, now. The assessment covers six different dimensions of drinking water services. Technical & Service Delivery, Sector Policy & Programs, Institutional, Economic & Sector Finances, Social and Environmental. The findings of the study and recommendations made are expected to provide inputs in the design and implementation of future rural drinking water supply programs in the state.

The Ministry of Drinking Water Supply & Sanitation (MDWS), Government of India (GoI) and the World Bank are currently engaged in preparing and implementing a Rural Water Supply and Sanitation Program for Low Income States (RWSS-LIS), with Phase I Program with an out lay of USD 1 Billion (USD 500 Million IDA and USD 500 Million GoI counterpart funding). The main objective of the proposed program is to improve pipe water coverage, integrated with sanitation services, through decentralized service delivery systems. This program would be implemented through a special window of assistance under the National Rural Drinking Water Program (NRDWP). The understanding of the existing of rural drinking water supply scenario is critical for overall designing of the program for the low income states. This report attempts to present the existing status and gaps in drinking water supply along with suggestions for improved and efficient supply of drinking water in rural Bihar.

While trying to throw light on the overall picture of drinking water services in rural Bihar the report attempts to provide valuable insights on key service delivery issues like geographical distribution, coverage, accessibility and per capita access, quantity, duration and quality of water supply, emergency water supply etc. It presents a comprehensive analysis of performance of various water supply schemes and technologies in operation design & implementation issues and operation & maintenance issues in the state. It also covers an assessment of water resource availability (surface and ground water) in the state. The report examines the sector policy, programs, plans and strategies related to drinking water operating at the state level. It also presents the major initiatives and schemes undertaken in the last 10 years in the state. Further, it provides an overview of current service standards & norms of implementation, subsidies,

incentives and cost sharing structure, research & development initiatives, legal and regulatory framework, demand and supply side capacities and emerging issues in the sector.

The report also examines the current delivery mechanism, roles and responsibilities of different institutions, and requirements in staffing and skills, to plan, design and manage drinking water programs. In addition it also covers the status of decentralization and monitoring & evaluation mechanisms. The report provides valuable insights into levels of self-supply and investment from various stakeholders, cost of various schemes and per capita costs, water tariff policy and its implementation, accountability and audit arrangements in the state. The report also examines the adequacy and current level of participatory practices and ownership in rural drinking water supply services and issues that may limit inclusion and equity. Information on pollution of water sources as well as various water quality related problems in the state, are also covered in the report.

The study was conducted in four sample districts viz. Nalanda, Begusarai, Purnea and West Champaran. Bhojpur district was also visited to assess the only operational surface water scheme supplying water to multiple villages in multiple Gram Panchayats (GPs). The sample consisted of Gram Panchayats (20), schemes in operation (24), village level institutions (22) and households (458) in 40 villages. Focus group discussions were conducted at the scheme level. Consultation meetings involving various stakeholders discussed key issues. Data was also collected from secondary sources and analyzed to gain deeper insights into the existing situation.

Technical & Service Delivery Aspects

In Bihar, a fast-developing state with one of the lowest incomes, drinking water supply services in rural areas consist of hand-pumps and pipe water schemes (tube-well based or canal based) provided by the Govt. In villages other sources of water for daily uses are traditional wells, ponds, tanks etc. As per census data only 1.4% of the households used to get tap water in 2001 in rural areas which increased to 2.5% in 2011. Hand pumps remain the major source of drinking water in rural areas supplying water to 91.4% households (Census 2011). However, during the household survey this figure was reported to be even higher (94.9%) in the sample districts. Trend analysis of the sources of drinking water for the last 10 years shows that wells which used to constitute nearly 23% of the primary drinking water sources have now become obsolete. Only

less than 1% households depend on wells for their drinking water needs. Similarly, the dependence on ponds, river and streams has declined during the last 10 years from 10.7% to 3.06%. Most households have shifted to hand pumps for the sake of better quality of water throughout the year. Hand pumps and tube wells are the primary sources of drinking water even among the marginalized communities in rural areas of Bihar.

All the districts north of Patna and 6 other districts viz. Arwal, Bhojpur, Buxar, Rohtas, Aurangabad and Jehanabad have strong dependence (more than 90%) on Hand Pumps / Tube Wells as primary sources of drinking water.

Significant improvement in rural areas are observed in availability of primary source of drinking water inside or near premises. This might be due to Govt. efforts in installing hand pumps in all habitations during the last 10 years.

The Public Health Engineering Department (referred to as PHED hereafter), Govt. of Bihar, had covered 100% habitations in Bihar in 2004-05. The Govt. concentrated more on hand pumps for full coverage and to ensure equity within available budget. But 18.81% of habitations have now slipped back into partially covered category. Major reasons for this slip-back, as per information gathered in field offices and during focus group discussions are:

- Increase in population leading to emergence of new habitations
- Some schemes became old and wear out
- Water sources go dry
- Water supply schemes became defunct
- Water sources became quality affected
- Systems operate below capacity due to poor maintenance

The state is estimated to have 6,67,163 working hand pumps in use. Most of these hand pumps are installed in public places as per Govt. policy. Assuming that each hand pump services at least 200 population, it implies full coverage of more than 13 crores of population. This clearly spells out sufficiency of hand pumps in rural Bihar.

66.78 % of the existing 906 pipe water schemes are functional in the state. Remaining 33.22 % schemes are non-functional. Major reasons for the inappropriate functioning of the schemes are

non-availability of electricity, theft of wires and transformer, mechanical and civil fault, etc. Same schemes suffer due to the problems due to irregular power supply, no electricity connection, burning of transformers and theft of wires. Major issues like leakage in the distribution system, damage of standposts, leakage in sluice valve, leakage in OHT and OHT not being connected to pump, are other constructions related reasons.

Majority of the households (67.69%) reported that the primary drinking water source became non-functional 1-2 times in the last one year. Nearly 60% households reported that people themselves repair non-functional water equipments whereas in 25% cases Govt. repairs them. Self repair cases may be larger due to incidence of personal hand pumps in use. Since so many households invest personal resources in drinking water sources, with proper capacity building and awareness generation regarding use and upkeep of pipe water sources, people may contribute in operation and maintenance of such water sources.

84.93 % of population in Bihar have access to minimum daily requirement of 40 Litres of drinking water. 15.07% of the population is getting less than 40 Litres Per Capita per Day (Hereafter, referred to as LPCD) of drinking water. Among the four sample districts, Purnea reports the highest levels of service delivery (97.3%) whereas W. Champaran reports the lowest level of service delivery (62.71%). However, water availability goes down during summer season. From the Focus Group Discussions (hereafter, referred to as FGDs) in the sample GPs, it came out that 52 LPCD of drinking water is required for daily needs. Nearly 46% households don't have any fixed water source as a backup during emergency. More than 32% households depend on hand pumps located at a distance in the village if their primary water source goes defunct.

75% households of the sample households, perceived quality of drinking water as good. Sample water testing initiative is in place in all the sample districts and water testing is being carried out and is reported by nearly 9% of the sample households. Awareness regarding purification of drinking water is very low and only 14.19 % households take traditional measures like boiling and filtering through sedimentation to purify water. Majority of the respondents pointed out that no arrangement is made for disinfection of water sources.

28.6% of households report high level of satisfaction with drinking water services now. Nearly 29% of households report moderate level of satisfaction whereas 21.4% household report average level of satisfaction with drinking water services.

The project cycle for water supply schemes is 3-3.5 years (Single village WSS) to 4-4.5 years (Multi village WSS). Design of schemes considered the standard norms for various structures and was found to be reasonable. • Design has been done for 40 LPCD for the projected population for 15 years; the mechanical and electrical equipments have been designed for projected population for 15 years and the distribution network, OHT and other structures have been designed for projected population of 30 years. Land was not a major issue in sample schemes as they are built on Govt. land or on land donated by people. However, discussion with PHED officials revealed that availability of land is a limiting factor in undertaking new schemes. During FGDs, people were found willing to make land available with adequate compensation provided regular and timely supply of drinking water is ensured.

Exploitation of ground water in the state is 43% at present indicating sufficient stock of water resources. All blocks in the state are categorized as safe, except 4 blocks which are categorized as semi-critical. As compared to 2004 estimate, there are marginal changes in the recharge and draft in 2009 in the State. The annual replenishable water resources marginally decreased while annual ground water draft has slightly increased in 2009 as compared to 2004, suggesting the need for water conservation measures and better water management practices. This gives clear indication that availability of ground water is abundant but there are limitations such as contamination problems in certain areas, low yield of tube wells in some pockets of districts like Saran, Gaya & Madhubani and presence of rocky layer beneath the soil making drilling difficult by the available drilling machines.

There are many perennial and seasonal rivers flowing throughout the state ensuring abundant surface water resources. There are 28 dams and other water bodies in the state. Although the availability of water in the summer season is limited, some drinking water schemes can be developed from the available water by according priority to water utilization for drinking purposes over irrigation / other uses.

Various issues which limit improved service levels as identified during visit to schemes and during focus group discussions are:

- Leakage in the distribution system
- Distribution system does not cover entire village
- Damage of Hand Pumps / Water supply schemes
- Damage of standposts,
- Water logging near standposts due to absence of cemented platforms and proper drainage,
- Leakage in sluice valves,
- Leakage in OHT
- OHT not connected with the water source
- Water quality not being tested regularly
- Water treatment is insufficient due to lack of supply of liquid chlorine
- Operator has not been posted in some water supply schemes
- Irregular monitoring of water supply schemes
- Irregular supply of electricity restricting duration of water supply
- Limited household connection
- Solar plant does not work in fog and cloudy weather and no alternative arrangements
- No provision of drinking water for animals in current service delivery standard of 40 LPCD prescribed by NRDWP
- Delay in completion of pipe water supply schemes

Based on the above observations and findings, the following measures are recommended to improve service delivery:

- Since the Govt. has already achieved water security to the existing population mainly through hand pumps, the thrust of Govt. should be on the following issues:
    - Proper repair and maintenance of existing hand pumps
    - Installation of new hand pumps only in slipped back habitations
    - Increasing the coverage of pipe water supply schemes

    - Ensuring quality through regular water testing and treatment
- There is scope to reduce the project cycle time by at least a year through proper project management and monitoring using project management tools like PERT, CPM etc.
- Develop a Citizens Charter for all activities related to water supply
- Site for construction of the water works should be identified in the beginning of the planning process in consultation with Gram Panchayat / villagers. If Govt. land is not available, cost of acquiring land should be included in project cost.
- Organize capacity building programs for contractors to improve workmanship
- Repair of non-functional hand pumps
- Repair of non-functional water supply schemes
- Distribution system should cover the entire village
- Dedicated line for electric supply
- Timely Supply of water and increased duration of water supply
- Alternative power back up for solar system
- Proper arrangement of drainage from the standpost to avoid microbial contamination
- Considering the need of the people, the design criteria of 40 LPCD may suitably be enhanced in tune with the state water policy (70 LPCD) for pipe water schemes
- Strong monitoring of schemes during implementation, trial run and thereafter may be done to ensure quality and avoid leakage in distribution system
- Awareness creation and organizing camps for giving household connections may help in increasing coverage inside premises through taps
- Condition of standposts may be monitored and the damaged ones should be repaired
- Cemented platforms with proper drainage system may be constructed near the standposts
- Water testing on a regular basis (half-yearly / yearly) may be done and the report may be displayed at the scheme site
- Regular monitoring of water treatment measures like chlorination may be structured

Sector Policy & Programs

PHED, Government of Bihar, has drafted a State Water Policy (draft dated 10th March 2010) available in public domain is yet to be finalized and adopted. Although the Water Policy paper is not finalized as yet, the State Government is acting on almost all the issues mentioned therein.

The norms for coverage are, till date, coverage of habitations rather than coverage of households. It was found that there is high demand for household connections in the sample districts. However, often the beneficiaries are not aware of the procedure and the persons to be contacted for getting connection. The State government has given first priority in water use for drinking purpose. However, it is difficult to ascertain whether drinking water is not being misused for other purposes. Often rural households depend on a single source of potable water.

Although capacity building effort is being made in the state there remains a gap between existing capacity and requirements.

In the cost sharing mechanism between Government and the community, the entire cost of installation of the hand pumps / waterworks is borne by the Government. No incidence of cost sharing by the community is reported. Water pricing policy with at Rs.5 per household per month exists but collection is not done because of the lack of clarity on the use of the corpus formed. It has been observed, during the survey, that people are willing to pay small amount of water charges per month provided they get regular water supply.

During the course of the present study, it was observed that significant R&D efforts in the area of drinking water are yet to be initiated in the state.

Bihar ground water (regulation and control of Development and Management) Act 2006 to regulate and control the development of ground water has already been enacted and notified on 29th January 2007 by the Government of Bihar. Simultaneously, this Act also provides inclusion of rooftop rain water harvesting (RTRWH) in building by law. There is mandatory provision for RTRWH structure in the building plan in an area of 1000 sq. meter or more. Till date, critical review of existing laws regarding drinking water sector has not been attempted in detail. Legal framework and guidelines for VWSC are yet to be available with the District officials.

Regulatory framework for water conservation measures by consumers is yet to be made available.

Since the present level of pipe water coverage is 2.5% in rural Bihar (Census 2011), considering the plan size, infrastructure, departmental setup, State Govt. desires to increase this coverage to 20% by 2022. An investment of 1177 crores per annum would be required for achieving this. The current level of investment is to the tune of Rs.600 crores per annum, including investment on hand pumps. Hence, massive investment is required for the sector in the coming years.

Based on the above observations and findings, we recommend the following measures:

- The State Water Policy paper needs to be finalized and adopted on an urgent basis.
- Since quality of water through pipe water schemes is more reliable and assured, there is an urgent need to shift the thrust now from handpumps to pipe water supply schemes.
- The current 40 LPCD norm may be increased in a phased manner to 50, 60 and 70 LPCD for pipe water schemes in the coming years to make it more realistic, need based and achievable
- Since surface water is available in rivers and dams/ other water bodies, a strategy may be developed to utilize surface water for drinking purposes at least in the areas near the surface water sources and in areas with high levels of ground water contamination
- Over time, the focus of pipe water schemes coverage may be shifted from habitation based coverage to household based coverage through household connections.
- Organization of a users' camp at waterworks after due publicity may help in getting the applications for household connections
- Levying water tariff, even if small amounts, may ensure better accountability by users and prevent misuse of drinking water.
- Stress needs to be given on the use of multiple sources and conjunctive use of various water sources.
- Capacity building programs of the various institutions involved in drinking water on a larger scale is required
- The VWS committees need to be formed in all districts at the earliest

- A strategy needs to be evolved to provide technical inputs and basic revolving fund for maintenance to Gram Panchayats before transferring the schemes to Gram Panchayats/ VWSC.
- A strategy for cost sharing in the maintenance of the schemes need to be implemented through participatory approach in a phased manner
- The water charges need to be revised to make it reasonable. Clear guidelines need to be developed for recovering the collected amount. Also, the person responsible for the collection and the use / treatment of the corpus needs to be made accountable
- Incentive schemes may be designed for encouraging the Gram Panchayats (GPs) to take up the management of the schemes
- Critical water sector issues need to be identified. Later, collaboration with specialists / institutions for conducting Research and Development (R&D) activities may be initiated
- A special cell may also be constituted by the Government to initiate and coordinate the R&D activities.
- Activity mapping delineating roles and responsibilities of various stakeholders needs to be done
- A detailed study of existing laws needs to be made and amendments proposed, if required
- Legal framework and guidelines for VWSC need to be developed
- Water conservation measures need to be made legally binding for consumers
- The principles of Reduce, Recycle and Reuse to ensure water security may be used involving conservation and storage of water by utilizing different sources for different uses
- A quality assurance program needs to be adopted in the State for water supplies to reduce the potential risk of contamination of water supply.
- A lot needs to be done towards realizing the goal of water security for all individuals in rural households. Efforts should be made towards bringing awareness regarding water quality, through IEC, to address issues of ownership of systems, health hazards, hygiene etc.

- In order to safeguard the availability and quality of drinking water, this sector must have effective priority over other uses of water
- Government can plan for externally-aided projects and may also think of Public Private Partnership (PPP). Govt. may also insist Central Govt. to increase the allocation under NRDWP. Govt. may also consider increasing the outlay by availing more funds from rural infrastructure development fund of NABARD.
- There is a need to converge the drinking water components of NRHM, ICDS, SSA and MGNREGS programs being implemented in the State. Operationalizing this integration will require understanding of different dimensions of water security and sanitation.

Institutional

PHED has a well-structured organizational setup in place from the State level to Sub-Divisional Offices. However, there is no structured organization at the lower levels like at Block and GP levels. Mechanical and Civil are two main wings for technical service. Construction is taken up by Civil wing while Mechanical wing looks after getting electricity connection and operation of machines. Some gaps in coordination were observed among the two wings at district and sub-divisional level resulting in delay, thus affecting the functioning of schemes.

Acute shortage of manpower was observed at the level of Assistant Engineers, Junior Engineers, Pipe Inspectors, Khalasi, Plumber, Mistry and Operators affecting project formulation, implementation, monitoring and repair work of schemes. At lower levels Capability of staff to tackle the emerging challenges including coping up with new technology is low.

The present delegation of authority at the level of Executive Engineer and Superintending Engineer is not adequate. Most of the pipe water supply schemes were beyond the delegated authority of the Executive Engineer and Superintending Engineer. It was observed that delay occurs in according technical sanction and acceptance of tender due to inadequate delegation of powers.

DWS Mission & DWS Committee have been constituted in each district and are reviewing the implementation of schemes. Transfer of schemes to GPs is relatively less mostly due to unwillingness, lack of skills, knowledge and capabilities on the part of GPs.

Also, level of involvement of GPs in Planning, Implementation, Operation & Maintenance is low due to their lack of awareness, knowledge and capabilities. GPs which have taken charge are not equipped with requisite resources and capabilities to handle O & M of schemes. VWSCs are yet to be formed in most villages in all the sample districts.

Web-based Integrated Management Information System (MIS) has been developed for monitoring of schemes. But monitoring of schemes is not structured. Due to poor monitoring, quality gets a setback. Many handpumps and stand posts were damaged. There were leakages in the distribution system. No third party evaluation studies have been conducted on the functioning of schemes.

Based on the above analysis and findings, we recommend the following measures:

- Creation of additional posts and filling-up of vacant posts through campus recruitments to take up the load of proposed projects. Since the state desires to cover 20% rural population through pipe water schemes by 2022, strengthening of PHED in terms of additional staff and requisite infrastructure in phased manner should be attempted to cope with the increased work load.
- Massive capacity building of field staff through appropriate training in areas like motivation, team building, new technology and participatory management
- Outsourcing of operation & maintenance
- Better coordination between civil and mechanical wings at district level and below be planned
- Adequate sanctioning authority be given at EE and SE levels.
- Awareness campaigns to educate villagers on proper use of drinking water and sanitation
- Massive capacity building effort is needed to prepare VWSC / GP for handling operation & maintenance
- Mobilization at village level should be initiated for participatory management
- Involvement of the GPs / VWSCs from the beginning i.e. from planning, site selection etc. should be ensured
- Transferring the schemes in phased manner with funds for maintenance, in the beginning itself, under the supervision of PHED
- Dedicated staff and vehicles for monitoring be deployed

- Broadband connectivity with adequate hardware and software support should be provided at district and sub-divisional office
- Monitoring of schemes should be structured and strengthened to ensure quality and timely repair of damaged sources
- Third-party evaluation study may regularly be conducted

Economic & Sector Finances

The Eighth Five-Year Plan in India (1992-97) introduced the concept of water as a commodity that should be supplied based on effective demand, the cost recovery principle and managed by private or local organizations. The approach shifted from supply driven to demand driven for (a) more efficient supply by providing the beneficiary the decision making power to make the project more realistic and need based (b) cost recovery for more sustainable use and expansion.

In last five years, the State Government had earmarked Rs. 1195.48 crores for drinking water supply, out of which Rs. 881.33 crores have been utilized. Large variation in expenditure on drinking water across the sample districts was found. Household level data suggests that for 47.6% of sample households the main source of drinking water is either their own hand pump or some other private sources. 49.3% sample households depend upon public supply of water through hand pumps or pipe water.

Opportunity cost of drinking water from hand pump works out to be around Rs. 550 – 750 per month per household.

More than 80% people are found to be ready to share the capital costs as well as pay monthly usage fees for pipe water, provided they get household connection. People are found ready to pay Rs. 50 to Rs. 2000 to share capital costs and Rs. 25, on an average, as monthly usage charges for pipe water.

Share of investments on drinking water by public and private, worked out for the sample district West Champaran show that, more than 40% of investment in drinking water is from private sources.

There is a paradigm shift in water resource management from supply-driven to demand-oriented approaches. Decentralized decision making and participation of stakeholders have been

increasingly recognized as strategies for sustainable and effective service delivery. Government of Bihar, through their draft Water Policy Paper acknowledges drinking water as scarce and economic good and advocates collection of water tariff for recovery of cost of providing drinking water.

The accountability system in PHED is found to be vertical. Though there is a system of financial audit in practice, there is no scope for social audit in implementation.

Based on the above observations and findings, we recommend the following measures:

- At the time of implementation, different types of expenditure like capital, maintenance and expenditure on direct and indirect support should be taken care of
- Government and its agencies should opt for participatory management of pipe drinking water as people are ready to share the capital costs and bear the monthly usage charges
- Adoption of strategies for decentralized decision making in drinking water may be a help in effective implementation
- The water tariff policy needs to be revised to make it more realistic for providing uninterrupted supply of pipe drinking water
- A system of social audit may be introduced to empower people to hold the service provider accountable for effective delivery

Social

Our survey show that there is hardly any social restriction found in accessing drinking water from different sources. People are found to freely access drinking water from other private sources and public sources.

There are two distinct kinds of participatory spaces that exist in rural Bihar. One is *Gram Sabha* which is an invited space of participation and the other one is *Aam Sabha* which is categorized as popular space of participation. This implies that there is an arrangement of participatory process in rural Bihar regarding any decision making process related to local issues. It is found from the discussion with villagers and other GP level functionaries that *Gram Sabha* meetings are irregular as well as level of participation of people in these meetings is low.

People are seldom consulted regarding implementation of hand pumps or pipe water schemes by PHED. It is found from household level survey that only 7% of sample households have been consulted during planning for drinking water schemes. There is no community preference evident in consultations with any community.

The household survey found that 94% of sample households want improved drinking water services. It is also found that people seldom communicate their demand as a large section (44%) of them do not have a clear idea as to whom their demand should be communicated and a section (6%) did not raise it with an assumption that their demand will not be considered.

No significant differences were found among communities in intention to raise demand for water. The intention to raise demand across the communities is similar. This signifies that there is less incidence of 'capture' or oppression in the rural society. People can raise their demand irrespective of their social status.

It is found that in delivering pipe drinking water supply, GPs are rarely involved. Even when the GPs are involved, their roles are limited to selection of sites. In case of GPs, where pipe water supply scheme has been transferred, it was found that GPs are not prepared to undertake operation and maintenance of the schemes.

The formation of Village level Water and Sanitation Committees (VWSC) is yet to be initiated.

Based on the above observations and findings, we recommend the following measures:

- One of the most widely used approach of involving community and incorporating its view is through participatory social and resource mapping, which needs to include all members of community especially women members. The mapping shall be an effective tool to intervene into the community to understand the social dimensions and act accordingly.
- Village level Water and Sanitation Committee needs to be constituted to manage and maintain the water supply schemes in participatory ways
- Orientation and capacity building of VWSC members and GP functionaries be initiated
- Project funding agencies and staff need to place high priority on training and monitoring of water committees

- Professionals may be engaged in capacity building and empowering GP and communities regarding participatory management tools
- A proposed model for community awareness and participatory management presented in this report, may be adopted
- Increasing investment in social mobilization is emerging to be fruitful.

Environment

In Bihar, about 13 districts are affected by Arsenic, 11 by Fluoride and 9 by Iron. Generally, the entire district is not affected by the quality problem. Contamination is observed in patches in certain blocks, villages and habitations.

1590 habitations i.e. 1.48% habitations of the state in 50 blocks are affected by Arsenic contamination. It was reported that higher concentration of Arsenic is confined to the top aquifers occurring up to 100m below ground. It was also reported by the Primary Health Centre located at Begusarai that skin, lung and liver cancer cases are increasing in the Arsenic affected areas. Arsenic safe aquifers were observed at depths beyond 100m-130m below ground level.

4157 habitations i.e. 3.86% habitations of the state, in 98 blocks are affected by Fluoride contamination. It was also reported that the contamination problems are in patches, in the above habitations. Some locations are also free from fluoride in the same habitation. Skeleton disorders as well as disorders in teeth were seen in villages in Nalanda which may be a result of excess concentration of fluoride in drinking water.

18673 habitations i.e. 17.35% habitations of the state, in 101 blocks are affected by Iron contamination. It was found during focus group discussions with the beneficiaries in Purnea and Begusarai districts that color and odour of the water changes after sometime due to presence of iron in water. Primary Health Centres at Begusarai and Purnea also reported that cases of digestive problems were more in the district mainly due to presence of iron in the water. People of both the districts pointed out that discoloration of cloths happen regularly due to presence of iron in water.

Chloride is not a major problem in any of the districts in the state. Similarly, Electrical Conductivity (actually dissolved solid) is not a major issue in any district of Bihar. However, increasing trend of nitrate presence in groundwater may be considered as a future problem in the state.

Surface water can be made suitable for drinking purposes after conventional treatment.

The broken platform in handpumps, non-availability of cemented platforms in stand posts and leakages in distribution system coupled with inadequate pressure and intermittent supply could be possible reasons for microbial contamination of drinking water. Water logging near the source of water is also responsible for microbial contamination, mosquitoes and related problems. Further, water logging also affects village roads and makes them muddy. Similarly, water logging and muddy conditions after receding of flood water near the sources of drinking water also cause microbial contamination.

Based on the above observations and findings, we recommend the following measures:

- Instead of treating arsenic, it is advisable to tap safe water from arsenic free deeper aquifer and to explore other sources of water such as surface water
- Attempts should be made to construct fluoride free water wells by selecting proper sites through exploratory ground water drilling
- Tapping of deep aquifer can be the solution for Iron contamination
- Surface water based water supply scheme should be started in the state, at least in areas affected by Arsenic, Fluoride and Iron

In consultation with the stakeholders, the following strategies have been identified for sustainability of source.

- Restoration of water bodies like Ahar / Pynes / Ponds / Tanks / Irrigation wells to increase infiltration and percolation ultimately leading to recharge of ground water
- Construction of artificial recharge structure in marginal alluvium and piedmont areas of South Ganga Plain
- Rain water harvesting in fields
- Roof top rain water harvesting

- Recycling / reuse of waste water after treatment at least for irrigation purpose
- Development of proper sewerage system

The following strategies may be adopted to address microbial contamination and related issues

- Water must be disinfected before supply without exception
- Repairing damaged platforms of handpumps, faster
- Construction of platforms for stand posts
- Proper drainage system to drain water accumulated near stand posts and hand pumps
- Regular repair in leakage in distribution system
- Facility for microbial contamination testing at district and sub divisional level

Conclusion

The sector assessment of Drinking Water services in rural Bihar presents a mixed picture. Though on the one hand, the low penetration levels of taps and insufficient supply of pipe water in rural households remains a major concern on the other hand, the coverage of entire rural population through hand pumps signifies considerable development. Existing pipe water schemes function at sub-optimal levels due to various reasons like lack of availability of electricity in rural areas, civil and mechanical faults, poor monitoring due to shortage of staff in PHED, among other reasons. Hence, people perceive hand pumps as more reliable sources of drinking water. But, because of the high opportunity costs incurred by households and for the sake of quality, there is a strong demand for improved water supply services in the state.

The draft state water policy lists all necessary provisions related to drinking water service delivery but a strong thrust is required in the areas of Research & Development, developing & implementing Legal & Regulatory frameworks, revising and operationalizing water tariff policy and undertaking capacity building initiatives at all levels to keep pace with the emerging demand. In quality affected areas, surface water can be made suitable for drinking purposes after conventional treatment. Effective strategies need to be formulated and implemented to tackle the problem of microbial contamination in drinking water supply. Massive investment in the sector to the tune of Rs 2676 crores per annum for next 10 years will be required to realize the goal of covering 50% of rural population of Bihar with pipe water.

The institutional mechanism for delivery of drinking water services is centralized at present. Public Health Engineering Dept, Govt. of Bihar is responsible for drinking water supply services in the state. All pipe water schemes are owned and operated by PHED. Acute shortage of staff at lower levels in the field hinders timely repair and maintenance of schemes. The transfer of schemes to Gram Panchayats (GPs) or Village level Water & Sanitation Committees (VWSCs) has not happened. There is scope to reduce the project cycle time for water supply schemes through better project management and monitoring. Staff strength at junior levels in PHED may be augmented to cater to the increasing work load of new schemes. Also, with proper capacity building of GPs and VWSCs, operation and maintenance of schemes can be transferred in a phased manner to them with adequate technical support from PHED.

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ABBREVIATIONS

AE	Assistant Engineer
ARWSP	Accelerated Rural Water Supply Program
BCM	Billion Cubic Meter
BDO	Block Development Officer
BIS	Bureau of Indian Standards
BOQ	Bill of Quantities
BRGF	Backward Regions Grant Fund
BSF	Border Security Force
BSWSM	Bihar State Water and Sanitation Mission
CCDU	Communication and Capacity Development Unit
CE	Chief Engineer
CGWB	Central Ground Water Board
CPM	Critical Path Method
DDC	District Development Commissioner
DDWS	Department of Drinking Water Services
Dept.	Department
DM	District Magistrate
DPR	Detailed Project Report
DPROs	District Public Relations Officer
DRDA	District Rural Development Agency

EDTA	Ethylene Diamine Tetraacetic Acid
EE	Executive Engineer
FGD	Focus Group Discussion
GEN	General
GIS	Geographic Information System
GoI	Government of India
GPs	Gram Panchayats
HP	Hand Pump
HRD	Human Resource Development
ICDS	Integrated Child Development Services
IDA	International Development Association
IEC	Information Education and Communication
JE	Junior Engineer
LPCD	Litres Per Capita Per Day
MDWS	Ministry of Drinking Water Supply & Sanitation
MIS	Management Information System
MNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MoRD	Ministry of Rural Development
NABARD	National Bank for Agriculture and Rural Development
NGO	Non Governmental Organization
NRDWP	National Rural Drinking Water Program

NRHM	National Rural Health Mission
NTU	Nephelometric Turbidity Units
O&M	Operations and Maintenance
OBC	Other Backward Caste
OHT	Overhead Tank
PERT	Program Evaluation and Review Technique
PHC	Primary Health Centre
PHED	Public Health Engineering Department
PRI	Panchayati Raj Institutions
R&D	Research & Development
RAC	Research Advisory Committee
RTRW	Rooftop Rain Water Harvesting
RWS	Rural Water Supply
RWSS- LIS	Rural Water Supply and Sanitation Program for Low Income States
SC	Scheduled Caste
SE	Superintending Engineer
SGWB	State Ground Water Board
SHG	Self Help Group
SPSS	Statistical Product and Service Solutions
SSA	Sarva Shiksha Abhiyan
ST	Scheduled Tribe

TDS	Total Dissolved Solids
ToR	Terms of Reference
TSC	Total Sanitation Campaign
UNICEF	United Nations International Children's Emergency Fund
UTs	Union Territories
VWSC	Village Water & Sanitation Committee
WHO	World Health Organization
WQM&S	Water Quality Monitoring & Surveillance
WSS	Water Supply Scheme
ZP	Zila Panchayat

CONTENTS

CHAPTER 1

INTRODUCTION

Located in the most densely populated part of the "Hindi heartland", Bihar is India's third most populated state with a total population of 10.38 crores with significant proportion of rural population (9.20 crores). Despite remarkable improvement in the last few years resulting in highest GDP growth rate, the State's performance still lags behind national levels, and is a significant contributing factor to the growing income gap among states. Bihar needs to enter the mainstream of national economic growth and prosperity to reduce its performance disparities in the National level.

Provision of clean drinking water, sanitation and a clean environment are vital to improve the health of our people, improve standard of living and well being of local community and to reduce the incidence of diseases. Problems arising from inappropriate services of drinking water and sanitation are more evident in poor and backward communities of developing countries like India. The problems that affect majority of the rural are: 1) supply of inadequate and contaminated water, 2) improper sanitation and 3) untreated liquid and solid waste. These problems have direct impact on two of the millennium development goals, viz. combat child mortality and combat malaria and other diseases as children suffer most due to contaminated water and lack of sanitation facilities. They are more vulnerable to diseases like, diarrhea, cholera and other infectious diseases. In the absence of pure drinking water and proper sanitation facilities, people suffer from different water-borne diseases, leading to high incidence of morbidity and mortality thereby increasing their sufferings. This, in turn, causes loss of working days and loss of income. Various studies have found that people with medium to high income dropped to below poverty line due to chronic sufferings and cost of treatment. Improving environmental health by addressing these problems would be the most cost effective measure to enhance people's health, welfare and safeguard their livelihood.

The subject of 'Rural Drinking Water Supply' (RDWS) is in the State list. It is also included in the Eleventh Schedule of the Constitution among the subjects that may be entrusted to Panchayats by the States. Empowerment of the PRI (Panchayat Raj Institutions) in rural drinking water supply is one the most important areas of focus in the sector.

In Bihar drinking water supply services in rural areas consist of hand-pumps and pipe water schemes (tube-well based or canal based) provided by the Govt. Other sources of water for daily use are traditional wells, ponds, tanks etc. in villages. Major source of water in Bihar is hand pump. As per census data only 1.4% of the households were getting tap water in 2001 in rural areas which increased to 2.3% in 2011. The increase in the ten years was nominal. Moreover 12% households are fetching water from sources located more than 500 meters away. The depth of the private hand pumps within the premises is 30-40 feet. The quality of water from such shallow pumps is likely to be unsuitable for drinking and other purposes specifically in regions having ground water contamination.

The Ministry of Drinking Water Supply & Sanitation (MDWS), Government of India (GoI) and the World Bank are currently engaged in preparing and implementing a Rural Water Supply and Sanitation Program for Low Income States (RWSSP- LIS), with Phase I Program for USD 1 billion (USD 500 million IDA and USD 500 million GoI counterpart funding). The key objective of the proposed program is to improve pipe water coverage integrated with sanitation services through decentralized service delivery systems. This program would be implemented through a special window of assistance under the National Rural Drinking Water Program (NRDWP). An understanding of the existing status of rural drinking water supply is critical for overall designing of the program.

The proposed Rural Water and Sanitation Program would be an effective step to bridge the gaps in supply of drinking water in the State of Bihar. In this context, it is pertinent to assess the status of existing services of drinking water in Bihar. Objectives of the proposed study are as below.

Objectives:

1. Assess specifically the technical and service delivery aspects of the rural drinking water supply coverage in Bihar
2. Examine the existing policy and programs of rural drinking water supply services
3. Assess the performance of existing schemes for rural drinking water supply vis-a-vis planned
4. Assess institutional set-up in terms of roles & responsibilities, delivery mechanisms and sector capacities of rural drinking water services
5. Examine the economic and sector finances for rural drinking water supply delivery

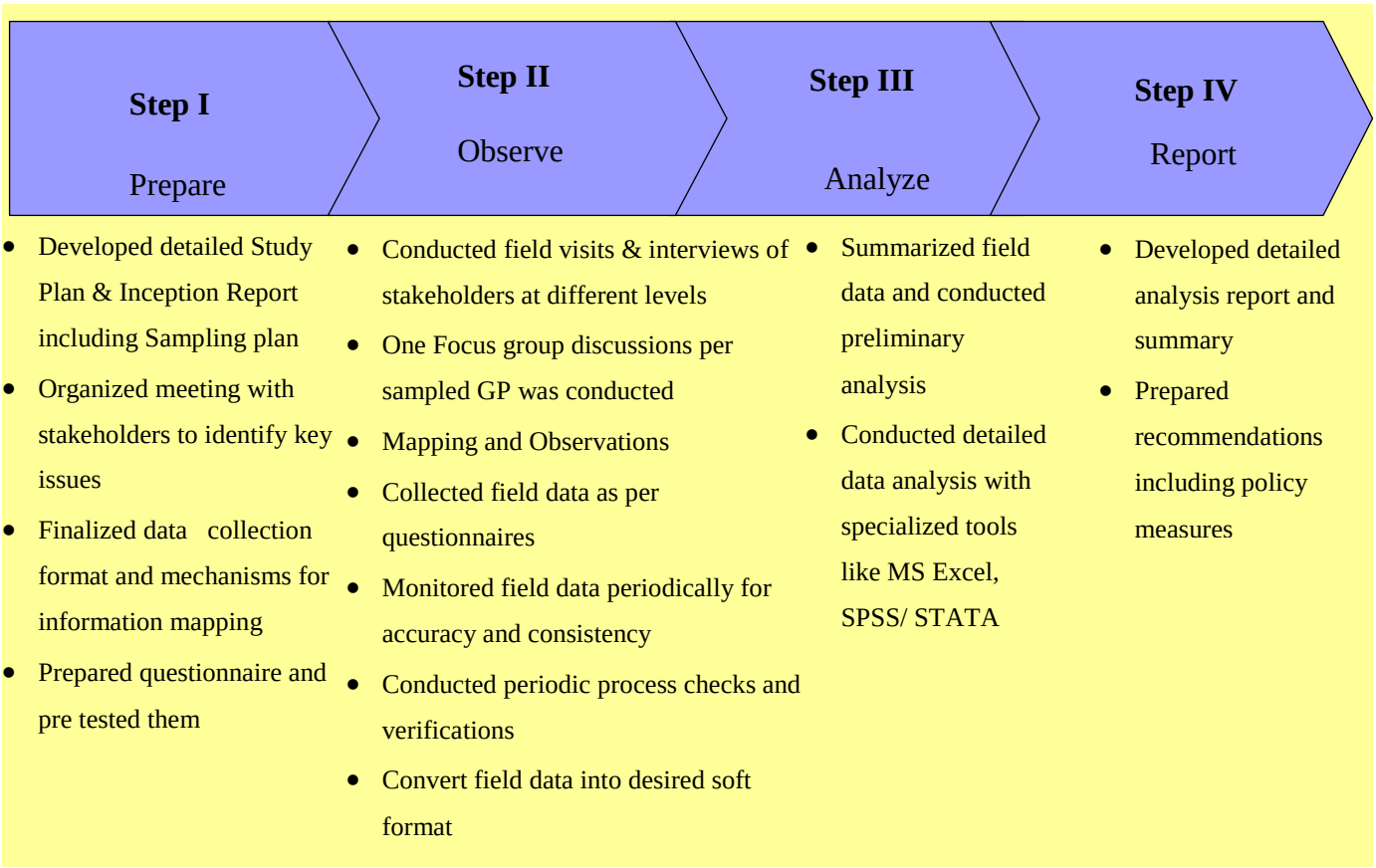
6. Assess the social and environmental aspects of the rural drinking water supply schemes
7. Provide inputs for improvement in the design and implementation of the rural drinking water supply services in future
8. Suggest policy measures for improved and efficient supply of drinking water services

CHAPTER 2

METHODOLOGY

The assessment included both qualitative and quantitative assessment of rural water supply sector and program in Bihar. For this purpose, primary and secondary data was collected.

A four-step methodology was deployed to conduct the study, as shown below.



The highlights of the methodology outlined above are

- The focus of the entire approach was to ensure that the data collection mechanism is precise. Towards this end, a detailed data collection plan was prepared. The plan was executed by a data collection team which underwent focused training for the data collection process. Periodic intermediate validations and consistency/accuracy checks were conducted to ensure that the data is free from error.

- The tools utilized for the study were structured and semi-structured questionnaires, focus group discussions, and personal interview with the stakeholders at various levels.
- Discussions were held with all stakeholders during collection of data to get deeper insights into the existing process/mechanism.
- Advanced and specialized tools like MS Excel, SPSS, STATA have been used for the data analysis, cross-tabulation and gap analysis.

2.1 Sampling Design

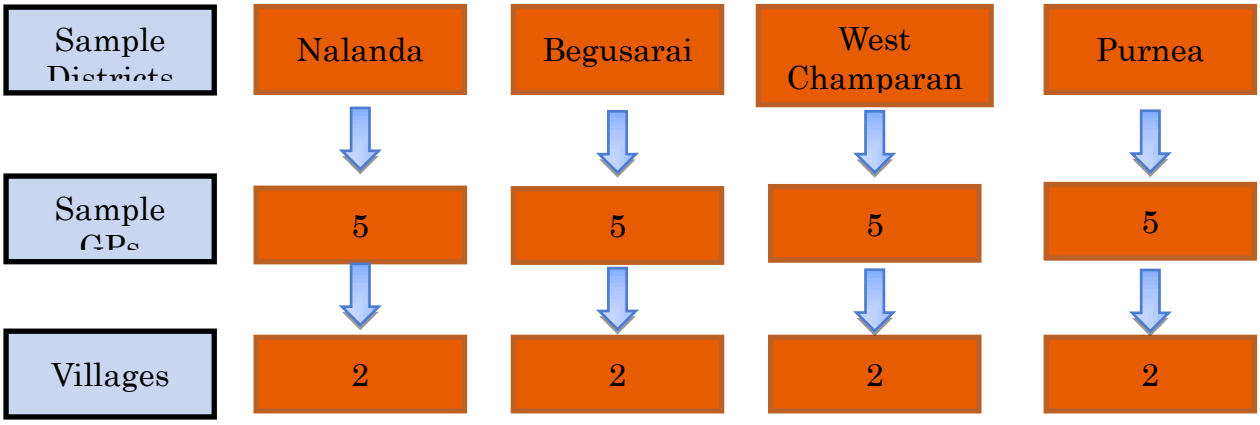


Figure 2.1: Sampling Design

Figure 2.1 depicts the sampling design of our study. Four districts were selected from the State and from each district, five Gram Panchayats (GP) were selected as samples for scheme and GP level survey and focus group discussions. Two villages from each GP were again selected for household level survey. Method of judgmental sampling was used to select the districts, GPs and Schemes while random sampling was done for household selection. Details of sampling plan and justifications for choice are given in the next sub-sections. The only operational Multi-Village in Multi Gram Panchayat (Surface Water) scheme in Bhojpur district was also covered for evaluation.

2.1.1 Selection of Sample Districts

The proposed scheme is to be implemented in 10 districts in Bihar viz. Patna, Nalanda, Begusarai, Nawada, Muzaffarpur, Purnea, Banka, West Champaran, Saran and Munger. Out of the 10 districts where the proposed program is to be implemented, four districts, viz. Nalanda, Begusarai, Purnea and West Champaran were selected as sample districts to assess the status. One district each was selected from the four regions of PHED in the state.

Moreover, the sample districts represent various agriclimatic zones in the state and consist of population of different communities. Representation of various problems of water contamination was taken into account while sampling the districts. There are three main problems of water contamination that affect drinking water quality in the State, viz. Arsenic, Fluoride and Iron. Out of four sample districts, three districts suffer from these problems viz. Begusarai (Iron & Arsenic), Nalanda (Fluoride), and Purnea (Iron). West Champaran was selected to have detailed insight of working of water supply schemes in forest and tribal areas.

2.1.2 Selection of Schemes

The list of schemes in operation in the four sample districts was obtained from concerned Executive Engineers, PHED. It is noteworthy that there are no Multi-Village in Multi-Gram Panchayat schemes currently operational in any of the 10 districts in which this program is to be implemented. Hence, the only operational Multi-Village in Multi-Gram Panchayat pipe water scheme (Surface Water) located in Bhojpur district was selected for evaluation. As per indicative schemes for study provided in the Terms of Reference (ToR), the various schemes sampled for evaluation in consultation with the concerned Executive Engineers are:

Table 2.1.2: Sampled Schemes

Sampled Districts	**Schemes Covered (23)**				
	Hand Pump schemes (6)	Single Village schemes (5)	Mini Water Supply schemes (5)	Quality affected schemes (3)	Multi Village in single GP schemes (4)
Nalanda	Jalalpur [Block - Noor Sarai] (1)	Sawanhua [Block – Harnaut] (1)	Hargawan [Block – Biharsharif] (1)	Khaira Salaru [Block – Rajgir] (Fluoride) (1)	Chandasi [Block – Noorsarai], (1)
Begusarai	Sokhara and Phulwaria [Block – Teghra] (2)		Chandaur, [Block - Bhagwanpur], Sushil Nagar [Block – Begusarai] (2)	Begusarai Mufassil [Block – Begusarai] (Iron) (1)	

Purnea	Jalalgarh [Block – Jalalgarh] (1)	Jalalgarh, Chak [Block – Jalalgarh] (2)	Banbhag [Block - K. Nagar] (1)	Dagarwa [Block – Dagarwa] (Iron) (1)	Dhamdaha, [Block – Dhamdaha] (1)
W. Champaran	Kandolia, Malaitola [Block – Lauriya] (2)	Taulaha WSS [Block – Ramnagar], SiktaWSS [Block – Sikta] (2)	Bhatujala [Block – Gaunaha] (1)		Nautan [Block – Nautan], Lauriya [Block – Lauriya] (2)

Besides, the only operational **Multi-Village in Multi Gram Panchayat (Surface Water)** Muazzampur scheme in Bhojpur district was also covered for evaluation. Hence, a total of 24 schemes were covered across 5 districts for detailed study and evaluation.

2.1.3 Selection of Sample Gram Panchayats (GPs) and Sample Villages

20 Gram Panchayats (GPs), 5 in every sample district where the above sampled schemes are located, were selected for Gram Panchayat (GP) - level data collection. From each GP, two sample villages were selected for survey. One village level institution was sampled from each Gram Panchayat (GP). The various institutions sampled were schools, Anganwadi Kendra, Primary Health Centre (PHC), Border Security Force (BSF Office) etc. Following criteria was taken into account while selecting the villages for data collection:

- Availability of Drinking Water Schemes being evaluated
- Presence of contamination problem
- Mix composition of population with diverse socio-economic group

From each village 11-12 sample households were selected on random basis taking the total number of households surveyed to 458. Sample size for the study is summarized in Table 2.1.3 below:

Table 2.1.3: Sample size for the study

Schemes	**24**
Gram Panchayats (GPs)	20
Villages	40
Village level Institutions	22
Households	458

2.2 Tools designed for the study

The key issues pertaining to all objectives of the study were identified and the survey instruments / tools were designed accordingly. The following tools were designed and pre-tested for carrying out the study:

1. Household Questionnaire
2. Scheme-level Questionnaire
3. Discussion Cues for Focus Group Meetings
4. Gram-Panchayat level Questionnaire
5. Questionnaires for other Institutions
6. Format for collecting data from State / District level Offices

2.3 Collection of Data

Data collection was done both through field visits and other means using the data collection templates customized for each stakeholder group. The template included both quantitative/objective and qualitative/subjective aspects to capture status of drinking water supply in rural Bihar, performance of existing drinking water supply schemes and constraints therein.

Data collection was carried out by the Field Coordinators and Enumerators with the assistance of a support team specially hired for the purpose under direct supervision of the Team Leader.

The data collection team conducted field visits to capture the data points directly from the following:

- Key officials at Public Health Engineering Department, Bihar State Water & Sanitation Mission
- Concerned officials at respective district, GP level.
- District Statistical Office
- Interview with personnel associated with implementation of drinking water schemes
- Focus group discussion and personal interview with primary stakeholders

In the field, data was collected in hard-copy templates. This information was then processed and converted into desired soft-copy format. The data collection methodology is depicted in figure below.

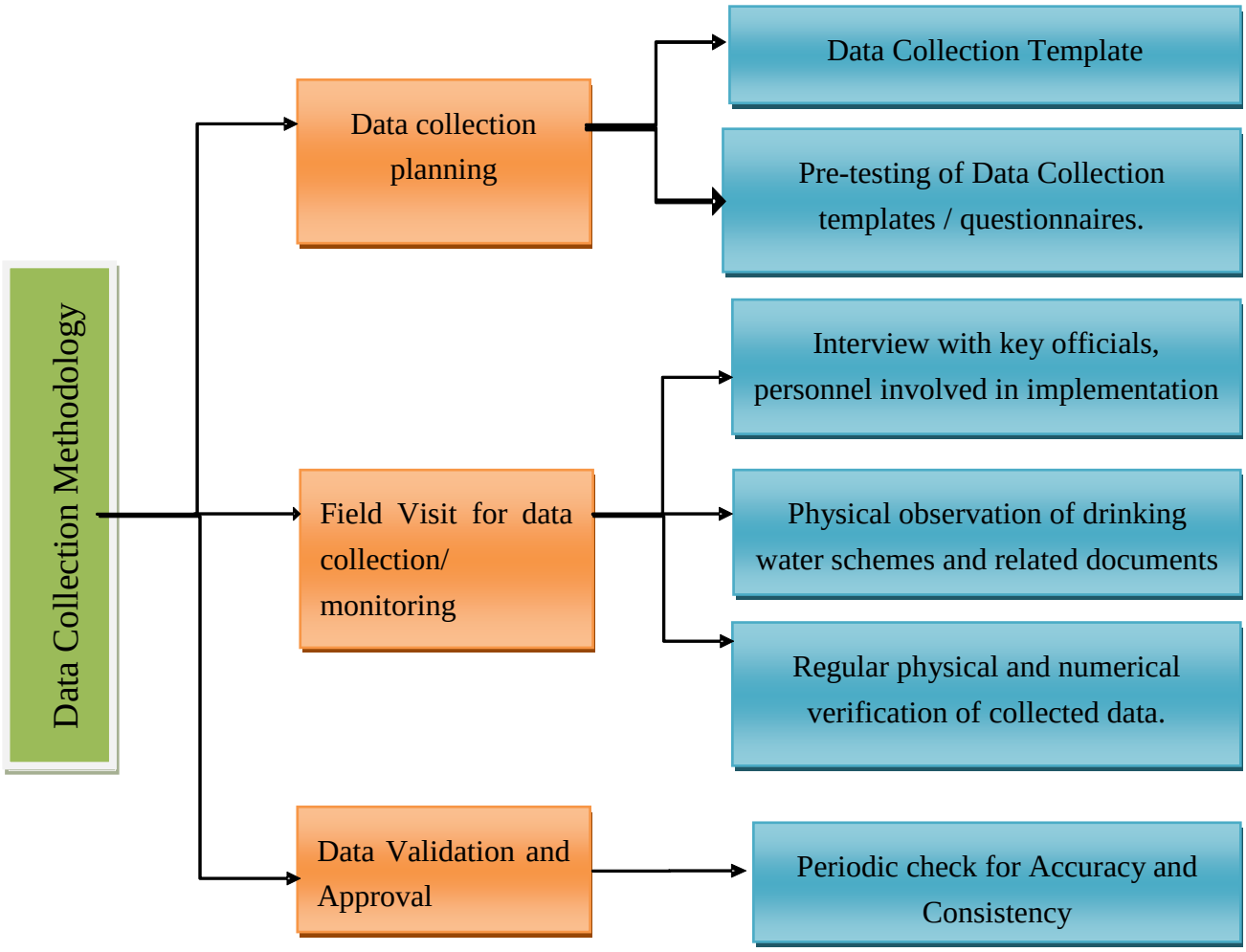


Figure 2.3: Data Collection Methodology

The data collection methodology involved following:

1. Information from 458 households was collected through structured questionnaire and personal interview.
2. Detailed evaluation of 24 Drinking Water schemes across four sample districts was done with structured questionnaire.

3. In every GP, status for drinking water facilities was assessed in one grass root level institution viz. Schools, Primary Health Centres, or Anganwadi Kendra.
4. In each GP one focus group discussion was conducted with the following stakeholders (i) Villagers, (ii) GP Representatives and functionaries, (iii) Members from NGOs/SHGs/Farmers' Club/Mahila Samakhya working under the GP. (iv) School Teachers (v) Health personnel
5. Planning, implementation, Financing, operation and Monitoring, Quality assurance etc. of existing drinking water projects in a GP was assessed through GP level questionnaire.
6. Delivery mechanism, organization structure and gaps therein, problems associated with planning, finance, implementation, monitoring and evaluation etc was assessed through structured questionnaire / personal interview with State and District level officials
7. Consultation meetings with the following officials / Depts. were done and their websites were consulted to collect secondary data and have an overview of the existing situation:
    a. PHED, Govt. of Bihar (Principal Secretary, Chief Engineer, Superintending Engineers, Water Quality Division, MIS & Monitoring Division, District Executive Engineers, Assistant Engineers & Junior Engineers in the Sub-Division, Testing Lab Assistants)
    b. Bihar Rajya Jal Parishad
    c. Central Ground Water Board
    d. State Ground Water Board
    e. State Pollution Control Board
    f. Dept. of Minor Irrigation, Govt. of Bihar
    g. Dept. of Water Resources, Govt. of Bihar
    h. Dept. of Rural Development, Govt. of Bihar
    i. Directorate of Panchayti Raj, Govt. of Bihar
    j. Indian Meteorological Dept.
    k. UNICEF

2.4 ACTIVITY LIST

To achieve all the objectives of the study, the following activities were undertaken:

Activity 1	**Review of Literature**
Activity 2	Collection of Secondary data from various offices like PHED, CGWB, SGWB, Minor Irrigation Dept, Water Resources Dept, Bihar Rajya Jal Parishad, Rural Development Dept, Panchayti Raj Dept.
Activity 3	Collection of data from various websites like MWDS, PHED, Census, etc.
Activity 4	Brainstorming with experts and Engineers from PHED
Activity 5	Development of Questionnaire and other instruments for primary data collection
Activity 6	Pre-testing of Questionnaire
Activity 7	Training of members and enumerators for carrying out field survey
Activity 8	Primary data collection in the field from Households, Gram Panchayat, PHED Dept. offices etc.
Activity 9	Focus Group Discussion at Gram Panchayat level
Activity 10	Tabulation of Data
Activity 11	Analysis of Data
Activity 12	Preparation of Draft Report
Activity 13	Discussion of Draft Report with Key Stakeholders
Activity 14	Submission of Final Report

2.5 Overall Work Plan for the Project Duration

Following is a pictorial representation of the activity plan for executing the study in 8 weeks:

WORK PLAN TIME SCHEDULE								
Task	Week							
	1st	2nd	3rd	4th	5th	6th	7th	8th
Orientation Meeting and Debriefing of Objectives								
Review of Existing Literature								
Development of Questionnaire and Team Training for Survey								
Collection of Secondary Data								
Interaction with key stakeholders and Collection of Primary data from field								
Tabulation of Data								
Data Analysis and Report writing								

2.6 FIELD WORK PLAN

2.6.1 Team Training Program for Survey

After development of questionnaire, the field coordinators conducted a comprehensive training program for field enumerators. The training focused on the overall concept of the study and covered in detail the background, objectives, methodology and various tools designed for data collection viz. Household questionnaire, Scheme-level questionnaire, Gram Panchayat-level questionnaire, Discussion cues for conducting Focus group meetings.

Each questionnaire and data-capture format was discussed in detail and all doubts of enumerators were sorted out before teams left for field visit. Mock-sessions for data collection were conducted to simulate actual situation in the field and anticipate doubts. Difficulties faced in the mock sessions were discussed and practical solutions were devised to tackle any such obstacles during data collection in the field.

All field coordinators were based in the field throughout the period of data collection to supervise and guide the team of enumerators.

2.6.2 Field Work Plan

One field coordinator and three field investigators were deployed in each district from 16 to 28 January, 2013. Data collection work started simultaneously in all the four districts. The water specialists also visited the districts for 2-3 days. The field work plan for the 4 districts is given below.

FIELD VISIT WORK PLAN

Name of District	Team members	Duration of field visit	Work to be done						
			Household survey 110 per district	Scheme level study 5 to 6 per district	Panchayat level questionnaire 5 per district	Other institution questionnaire	Focus Group Discussions 5 per District	Collection of data and information from districts	Supervision / Guidance / Quality check of HH / Panchayat / Other questionnaires
1. Nalanda	Prof. Vijaya Bandyopadhyaya (Field Co-ordinator)	16-28 January 2013					✓	✓	✓
	Field investigator: I	16-28 January 2013	✓						
	Field investigator: II	16-28 January 2013		✓	✓	✓			
	Field investigator: III	16-28 January 2013	✓						
2. Begusarai	Prof. Shireesh (Field Co-ordinator	16-28 January 2013					✓	✓	✓
	Field investigator: I	16-28 January 2013	✓						
	Field investigator: II	16-28 January 2013		✓	✓	✓			
	Field	16-28	✓						

	investigator: III	January 2013							
3. West Champaran	Mr. B.L. Mishra (Field Co-ordinator)	16-28 January 2013					✓	✓	✓
	Field investigator: I	16-28 January 2013	✓						
	Field investigator: II	16-28 January 2013		✓	✓	✓			
	Field investigator: III	16-28 January 2013	✓						
4. Purnea	Prof. Debabrata Samanta (Field Co-ordinator)	16-28 January 2013				`	✓	✓	✓
	Field investigator: I	16-28 January 2013	✓						
	Field investigator: II	16-28 January 2013		✓	✓	✓			
	Field investigator: III	16-28 January 2013	✓						

2.6.3 Quality Check Plan

Periodic checks for Accuracy and Consistency were performed. Our field coordinators were in the field during the data collection exercise to monitor and facilitate the data collection process. Data collected by field investigators was scrutinized daily and random checks were carried out in the field to ensure accuracy and consistency. Any aberrations in the collected data were verified and corrected.

2.7 TABULATION AND ANALYSIS PLAN

The data collected from the sample was collated and tabulated to facilitate easier sharing, referencing and analyses. The profile of the sample households is enclosed in Annexure 1.

A range of tests and checks were conducted to ensure that the analysis is holistic, accurate and detailed.

2.7.1 Software:

We deployed MS Excel for storing and submitting the basic/raw data collected during the study. However, the required data analysis was carried out through specialized programs like STATA/SPSS as it has powerful data handling and analysis capabilities. Due to ease of sharing and universal acceptability, we, however, deployed MS excel for presentation purposes wherever possible.

2.8 STAKEHOLDER CONSULTATIONS

We presented the preliminary observations and findings of the study in a workshop in Patna on 29th January, 2013 and discussed the issues with key staff in the World Bank, officials of PHED, representatives of local communities, PRIs, other Govt. Dept. officials. Stakeholders' comments and viewpoints expressed have been incorporated in this report.

2.9 OUTLINE OF THE DRAFT REPORT

Executive Summary

Chapter 1: Introduction

Chapter 2: Methodology

Chapter 3: Technical and Service Delivery aspects

Chapter 4: Drinking Water Sector Policy and Programs

Chapter 5: Institutional aspects of Delivery of Drinking Water services

Chapter 6: Economic and Sector Finances

Chapter 7: Social aspects of Drinking Water services

Chapter 8: Environmental aspects of Drinking Water services

Chapter 9: Major Findings & Recommendations

Appendix

CHAPTER 3

TECHNICAL & SERVICE DELIVERY ASPECTS

Technical & Service Delivery aspects comprise coverage, geographic distribution, sources of drinking water, standards of service delivery like per capita access, hours of supply, quality, quantity, household access and public stand posts, emergency supply, availability, accessibility, quality, range of schemes and technologies in use, functioning of different schemes, design and implementation issues, operation and maintenance issues and status of defunct schemes and reasons thereof. We have examined the above aspects of drinking water services in rural Bihar through secondary data and primary data collected through household survey and focus group discussions in the sample districts.

3.1 Coverage

3.1.1 Overall Drinking Water Coverage in Bihar

The overall coverage of drinking water through tap water sources in Bihar is 4.4% of households. In rural areas, only 2.5% of households get water from taps. The overall situation is summarized in the table below:

Table 3.1.1: Percentage Overall Coverage of Drinking Water in Bihar

Particulars	Total (%)	Rural (%)
Percentage of households using Hand pump/ Tube well as source of drinking water	89.6	91.4
Percentage of households using Tap water as source of drinking water	4.4	2.5
Percentage of households getting tap water from treated source	3.07	1.6
Percentage of households having source of water within the premises	50.1	47.1
Percentage of households getting water from a source located within 500 meters	37.9	39.6
Percentage of households fetching drinking water from a source located more than 500 m away	12.0	12.6

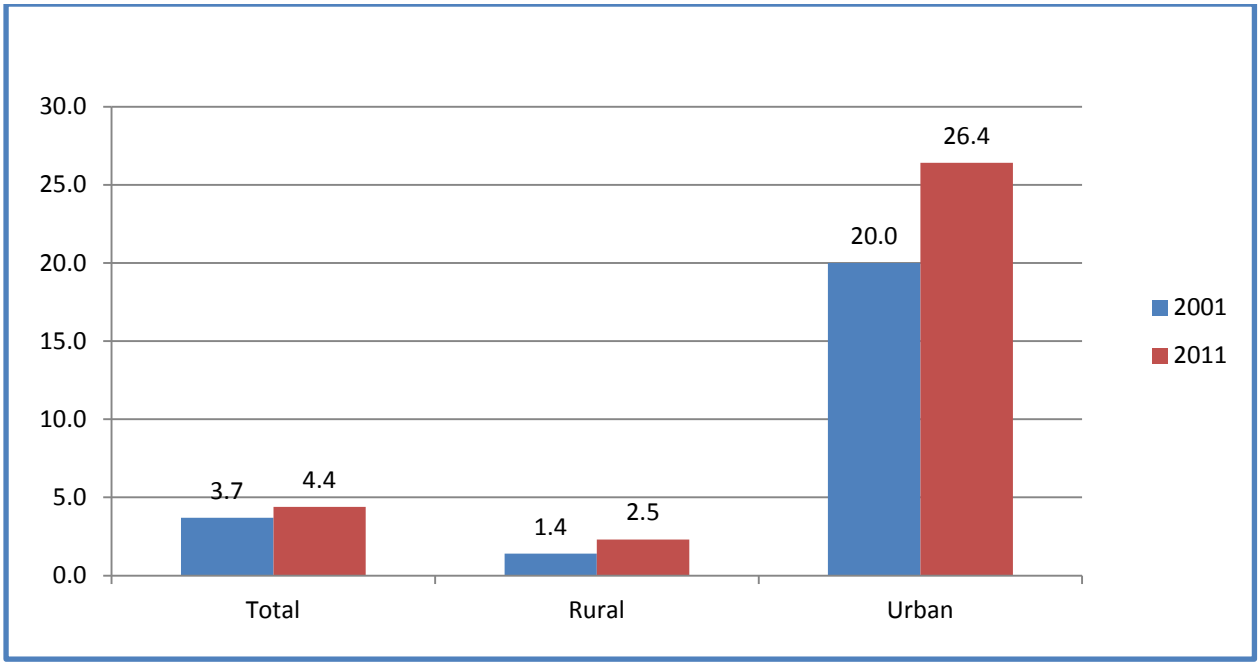


Figure 3.1.1: Tap Water penetration in Bihar

It can be inferred from the above graph that there has been only a marginal improvement from 1.4% to 2.5 % of households in rural areas getting water through taps during the last 10 years.

The coverage of tap water in Bihar is lowest in India which can be seen in Annexure 2.

3.1.2 Coverage by Sources of Drinking Water

The coverage by main source of drinking water in Bihar is presented in the table below:

Table 3.1.2: Percentage Coverage by Sources of Drinking Water (2011 census)

Sources	Number of Households (in lakh)	Total (%)	Rural (%)
1. Hand pump	164.0	86.60	91.4
2. Tap:	8.34	4.40	2.5
(a) From treated sources	5.82	3.07	1.6
(b) From un-treated sources	2.52	1.33	0.9
3. Well	8.20	4.34	4.4

(a) Covered well	1.26	0.66	0.6
(b) Un-covered well	6.96	3.68	3.8
4. Tube well / Borehole	5.67	2.99	-
5.All others	3.15	1.66	1.7

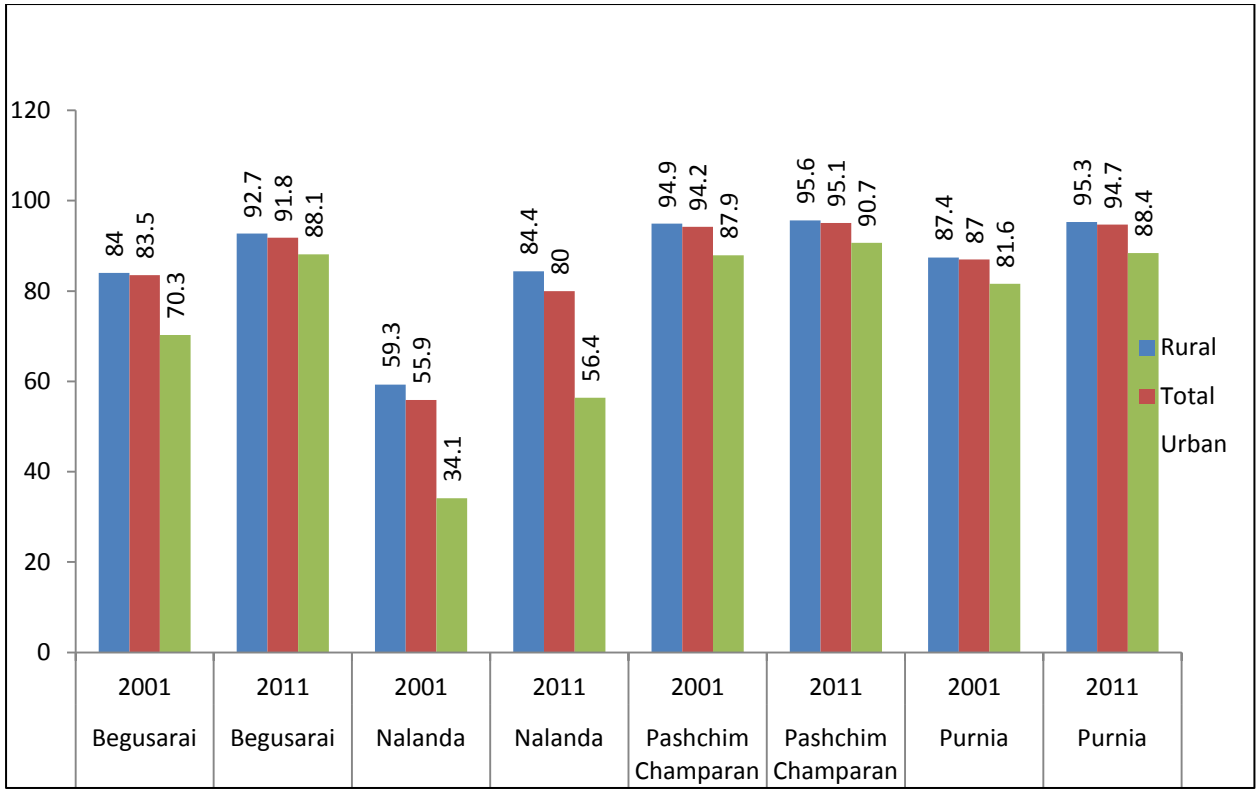
As apparent from the above table, Hand Pumps remain the major source of drinking water in rural areas, supplying water to 91.4% of households. Availability of pipe water is very low in rural areas in Bihar. Only 1.6% of households in rural Bihar get treated tap water and 0.9 % of households get untreated tap water mostly because of the Govt. thrust on hand pumps to ensure water security and equity with the available budget. Wells are becoming obsolete and people are switching to hand pumps and tap water for the sake of quality. The district-wise coverage by various sources of drinking water for 2001 and 2011 is given in Annexure 3.

3.1.3 Coverage of Drinking Water in Sample Districts

The coverage of drinking water by hand pumps / tube wells in the sample districts is presented in the table below:

Table 3.1.3: Percentage Coverage by Hand pumps / Tubewells in sample districts

		Percentage of household using drinking water from Hand pump / Tubewell		
District	Census Year	Rural (%)	Total (%)	Urban (%)
Begusarai	2001	84	83.50	70.30
	2011	92.70	91.80	88.10
Nalanda	2001	59.30	55.90	34.10
	2011	84.40	80	56.40
Pashchim Champaran	2001	94.90	94.20	87.90
	2011	95.60	95.10	90.70
Purnea	2001	87.40	87	81.60
	2011	95.30	94.70	88.40



(Source: Census Info 2011)

Figure 3.1.3 Households using Hand Pump / Tube Well as main source of Drinking Water in Sample Districts

As apparent from the above table & graph, Hand Pumps / Tube Wells remain the major sources of drinking water in rural areas in all the four sample districts. It is interesting to note that for 3 of the sample districts (all except Paschim Champaran), the percentage of households using hand pumps as primary source of drinking water has increased in the last 10 years, with Nalanda reporting a significant increase from 59.3 % to 84.4 %.

The coverage of drinking water by taps in the sample districts is presented in the table below:

Table 3.1.4: Coverage by Tap Water in sample districts (in Percentage)

Area Name	Census Year	Rural	Total	Urban
Begusarai	2001	3.10	3.80	21.40
Begusarai	2011	2.60	3.60	8.20
Nalanda	2001	1.80	6.70	38.80
Nalanda	2011	3.90	7.90	29.70
Pashchim Champaran	2001	1.50	2.30	9.80
Pashchim Champaran	2011	2.30	2.80	6.80
Purnea	2001	0.80	1	3.60
Purnea	2011	1.20	1.90	8.70

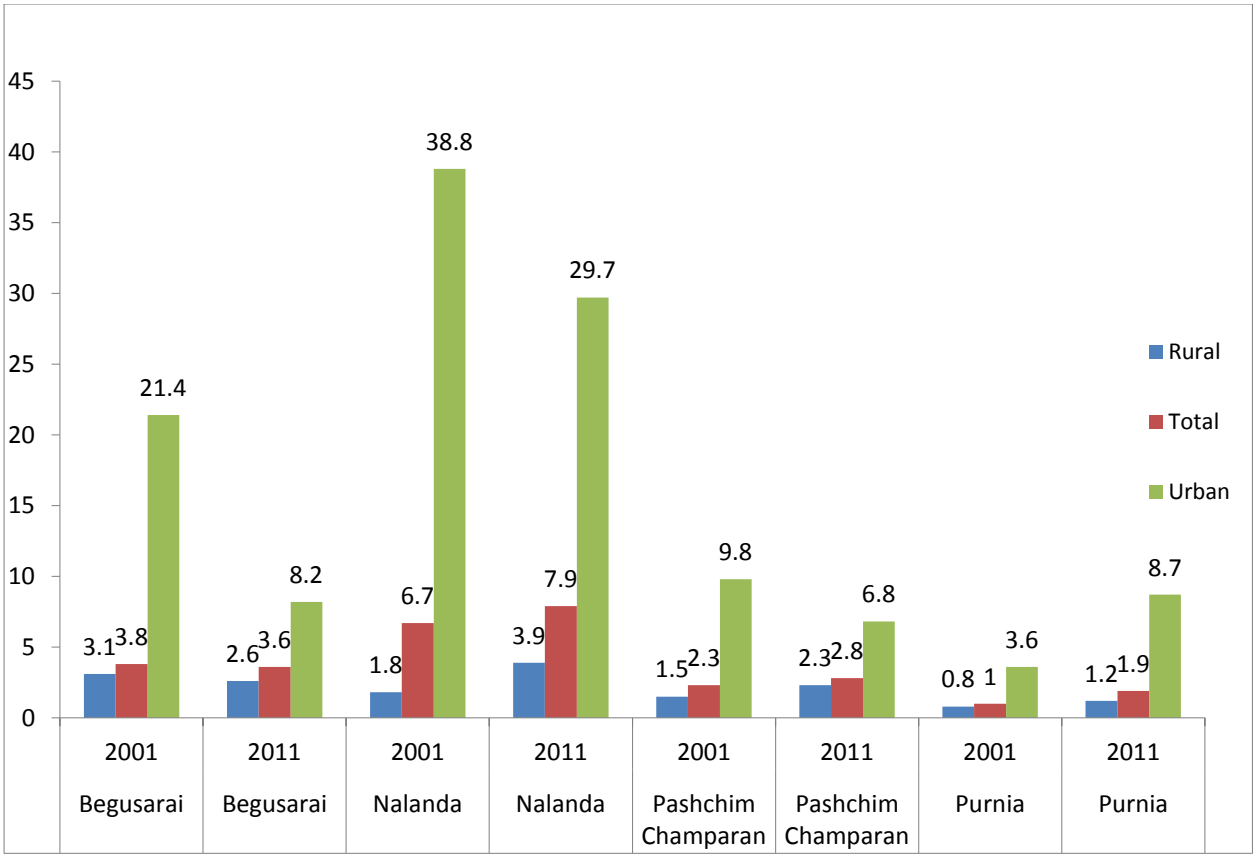


Figure 3.1.4: Percentage of households using tap water in sample districts

As apparent from the above table & graph, tap water coverage in rural areas of three sample districts increased between 2001 & 2011, whereas a decrease was noticed in Begusarai. The decrease might be due to schemes becoming defunct, increase in population and limited new schemes.

From the household survey in the four sample districts, the different primary sources of drinking water with their proportionate use are furnished in the table below:

Table 3.1.5: Primary source of drinking water in sample households (Present Situation)

Source	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Privately owned Handpump	69.30%	26.09%	63.06%	15.25%	43.01%
Private Shared Handpump	8.77%	1.74%	5.41%	0.00%	3.93%
Govt. / Public Handpump	21.05%	67.82%	29.73%	72.03%	48.03%
Pipe Water	0.00%	0.00%	0.00%	5.08%	1.31%
Self Well	0.00%	1.74%	0.90%	0.00%	0.66%
Others	0.88%	2.61%	0.90%	7.63%	3.06%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

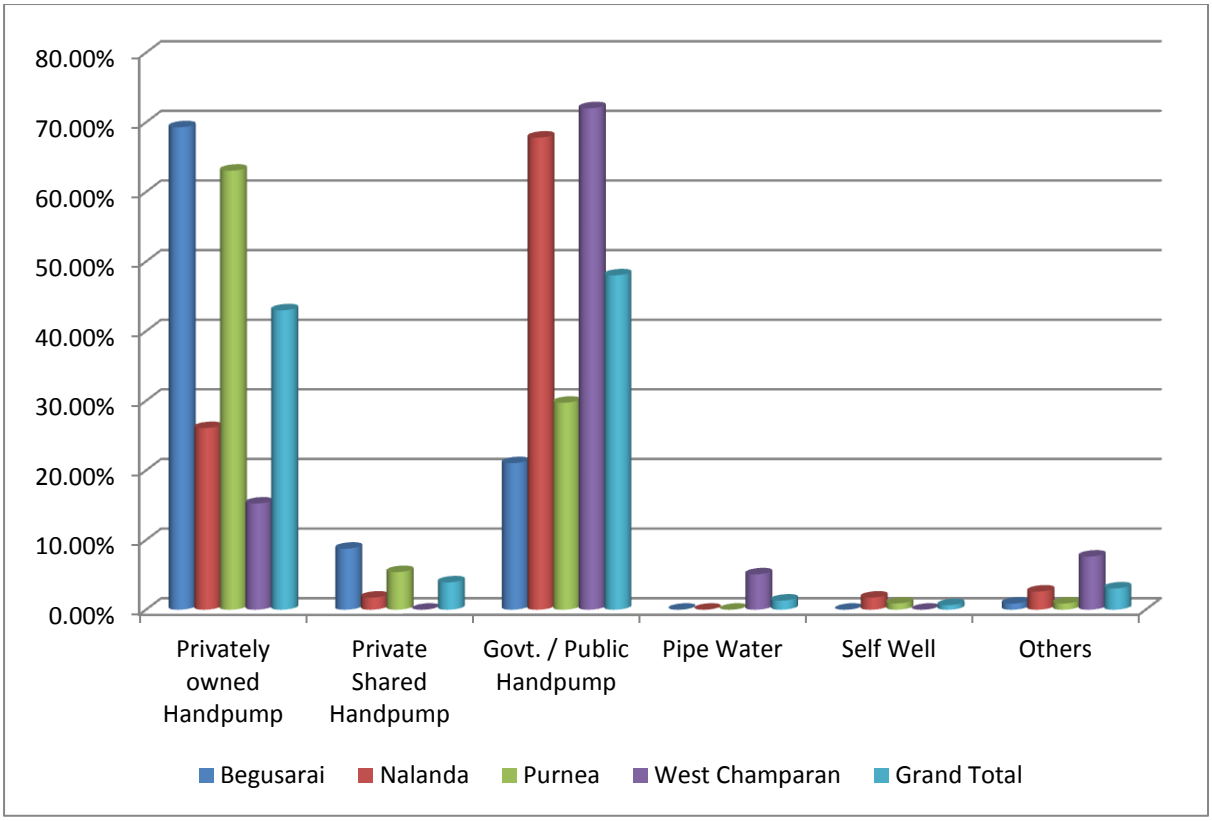


Figure 3.1.5: Primary source of drinking water in sample households (Present Situation) – January 2013

It is apparent from the above table and graph that 94.9% (435 out of 458) households have hand pumps as their primary source of drinking water.

Also, the same primary sources of drinking water are being used for a long time as is captured in the table below:

Table 3.1.6: Duration (in years) for which the same source is being used in sample households

Years	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Last 10 years	59.65%	34.78%	58.56%	14.41%	41.48%
5-10 years	28.07%	29.57%	16.22%	0.85%	18.56%
2-5 years	7.02%	20.00%	8.11%	7.63%	10.70%
1-2 years	3.51%	7.83%	14.41%	40.68%	16.81%
Less than one year	1.75%	7.83%	2.70%	36.44%	12.45%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

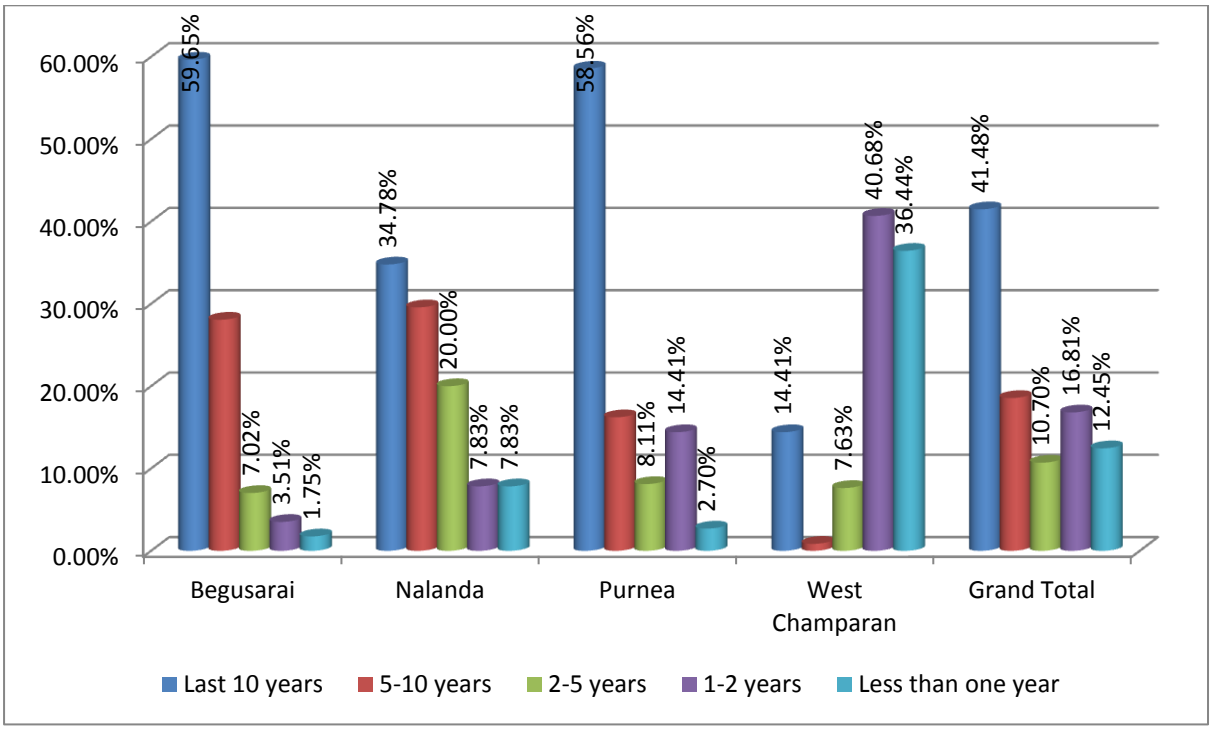


Figure 3.1.6: Duration (in years) for which the same source is being used in sample households

From the household survey in the four sample districts, the different primary sources of drinking water 10 years back are furnished in the table below:

Table 3.1.7: Primary source of drinking water in sample households (10 years back)

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Privately Owned Hand pump	45.61%	9.57%	54.95%	37.29%	36.68%
Private Shared Hand Pump	11.40%	1.74%	5.41%	4.24%	5.68%
Govt. Hand Pump	9.65%	30.43%	20.72%	33.05%	23.58%
Pipe Water Stand Post	0.00%	0.00%	0.00%	0.85%	0.22%
Own Well	1.75%	5.22%	6.31%	0.85%	3.49%
Private Well	8.77%	9.57%	12.61%	3.39%	8.52%
Pond/River/Stream	21.05%	0.87%	0.00%	20.34%	10.70%
Govt. Well	1.75%	42.61%	0.00%	0.00%	11.14%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

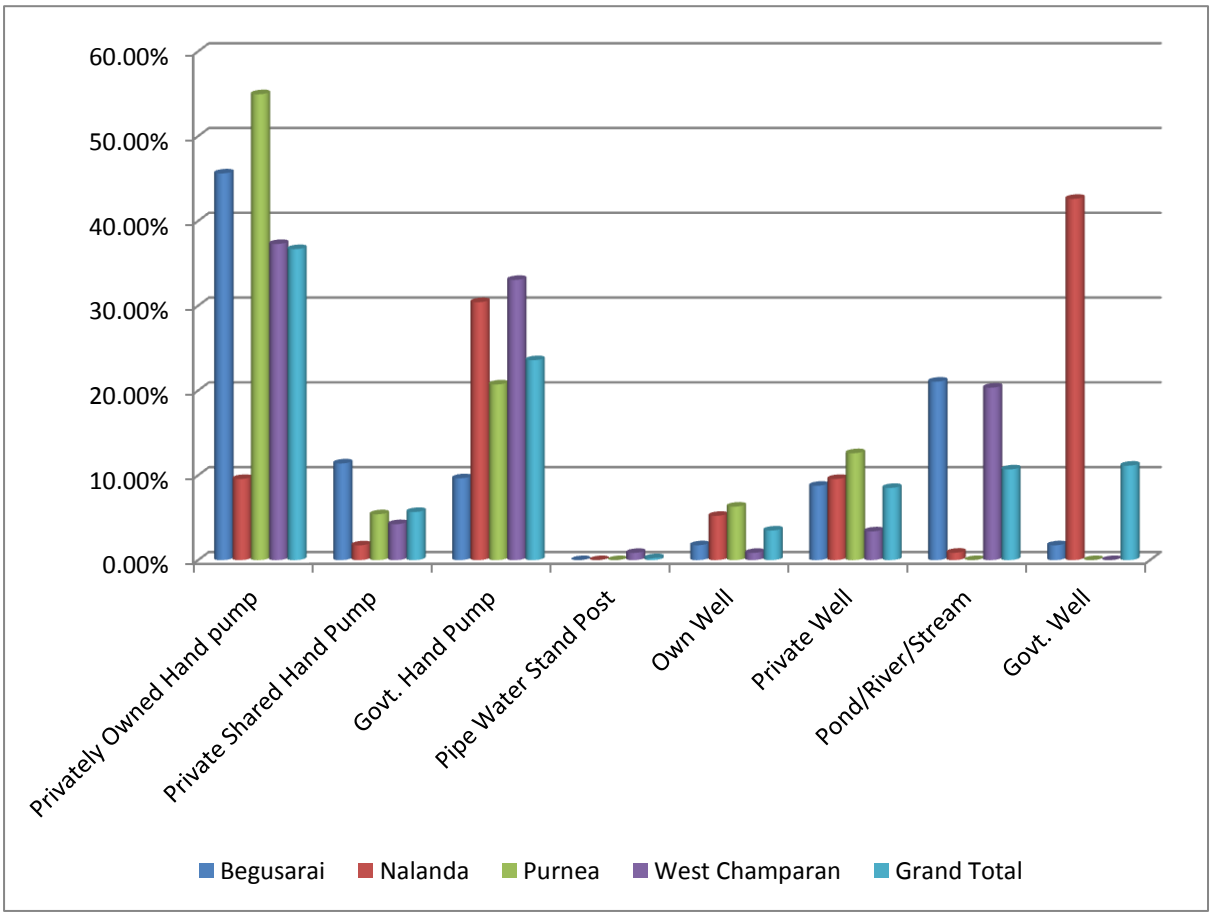


Figure 3.1.7: Primary source of drinking water in sample households (10 years back)

Trend analysis of the source of drinking water for the last 10 years shows that Wells which used to constitute nearly 23% of the primary drinking water sources have now become obsolete and now less than 1% households depend on them for their drinking water needs. Similarly the dependence on ponds, river and streams has declined during the last 10 years from 10.7% to 3.06%. The entire households have shifted to hand pumps for the sake of better quality of water throughout the year.

3.2. Geographical Distribution of Drinking Water Services

The geographical distribution (district-wise) of households in Bihar using Hand Pumps / Tube Wells as main source of drinking water is depicted in the figure below:

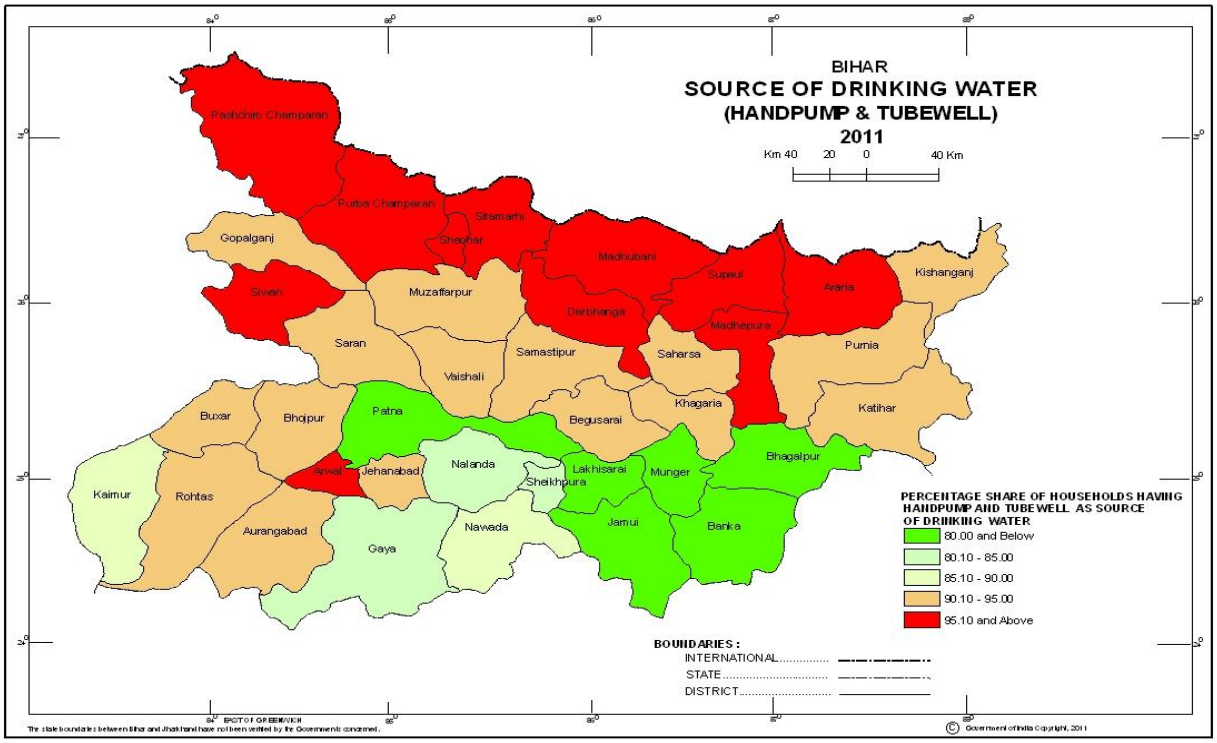


Figure 3.2: Geographical distribution of rural households using Hand Pumps as main source

It is apparent from the above figure that all the districts north of Patna and 6 other districts viz. Arwal, Bhojpur, Buxar, Rohtas, Aurangabad and Jehanabad are largely dependent (more than 90%) on Hand Pumps / Tube Wells as primary sources of drinking water. Districts like Patna, Lakhisarai, Munger, Jamui, Banka and Bhagalpur have least dependence on Hand pumps (less than 80%) as primary source of drinking water. Other districts depend on hand pumps for drinking water needs in the range between 80-90%

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The geographical distribution (district-wise) of households in Bihar using Taps as main source of drinking water is depicted in the figure below:

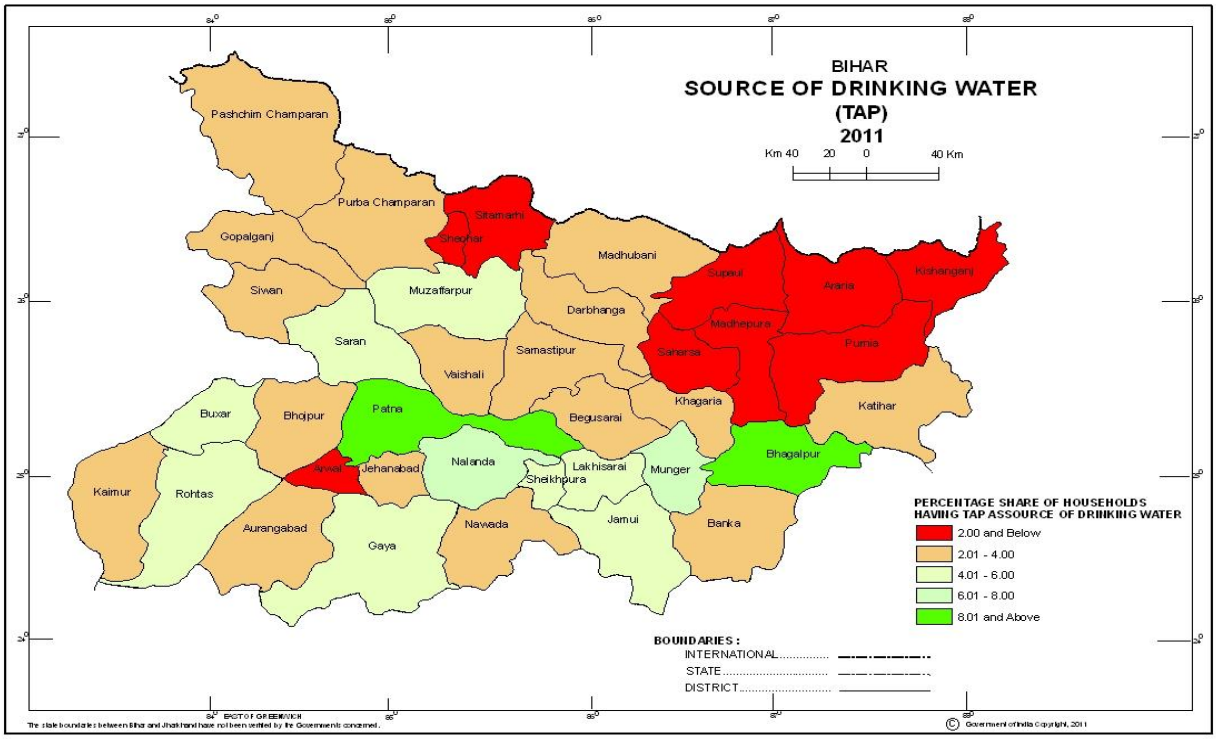


Figure 3.2.A: Geographical distribution of rural households using Taps as main source

It is apparent from the above figure that all the districts north of Patna and some districts viz. Arwal, Jehanabad, Bhojpur, Kaimur, Aurangabad, Nawada and Banka have very low penetration (less than 4%) of tap water as primary source of drinking water. Only Patna and Bhagalpur report more than 8% penetration levels of tap water as primary drinking water source. Other districts using taps for drinking water needs range between 4-8% of households.

3.2.1 Coverage of Drinking Water among Marginalized Communities

The coverage of drinking water among marginalized communities as in 2011 is presented in the table below:

Table 3.2.1: Percentage Total Households among marginalized population using various drinking water sources

	Tap Water	Hand Pump	Covered well	Tube well / Borehole
Total	4.40	86.60	0.66	2.29
SC	4.21	86.27	0.73	1.93
ST	2.97	77.77	0.96	3.51

The table above suggests similar dependence on hand pumps for majority of households among SC population. However Hand pumps (77.77%) and tap water (2.97%) coverage is slightly less among ST households.

Table 3.2.2: Percentage Rural Households among marginalized population using various drinking water sources

Category	Hand pump / Tube well / Bore well		Tap water		Well		Other source	
	2001	2011	2001	2011	2001	2011	2001	2011
Total	84.7	91.4	1.4	2.5	13.1	4.4	0.7	1.70
SC		89.50		3		5.60		1.60
ST		82.40		4.20		10.10		2.10

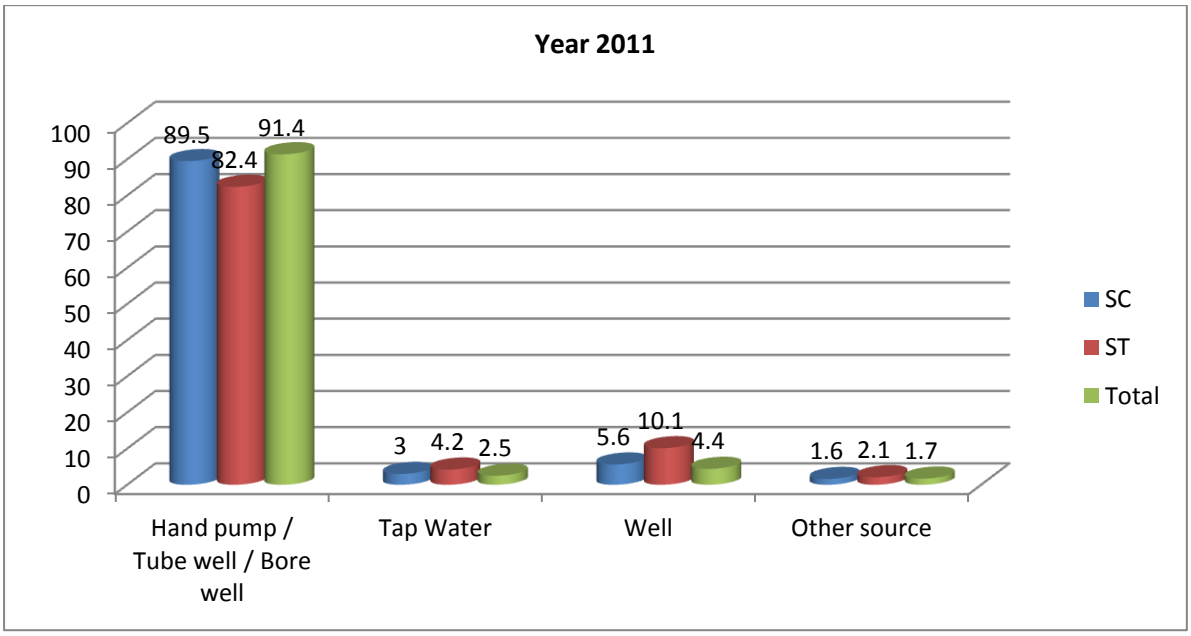


Figure 3.2.2: Rural Households among marginalized population using various drinking water sources

It is apparent from the above table and graph that hand pumps and tube wells are the primary sources of drinking water even among the marginalized communities in rural areas of Bihar. The distribution pattern of households by primary source of drinking water is similar to the overall picture in rural Bihar except for a higher percentage of ST households (10.1%) that depend on wells for their drinking water needs. It is also noteworthy that only 82.4% of ST households have access to hand pumps / tube wells as their primary source of drinking water.

Table 3.2.3: Coverage by Hand pumps / Tube Wells for Marginalized population in sample districts

		Percentage of households using drinking water from Hand Pump / Tube Well		
Area Name	Census Year	SC	ST	Total
Begusarai	2001			83.50
	2011	91.30	82.20	91.80
Nalanda	2001			55.90
	2011	80.40	69.40	80
Pashchim Champaran	2001			94.20
	2011	95	87.80	95.10
Purnea	2001			87
	2011	94.40	93.50	94.70

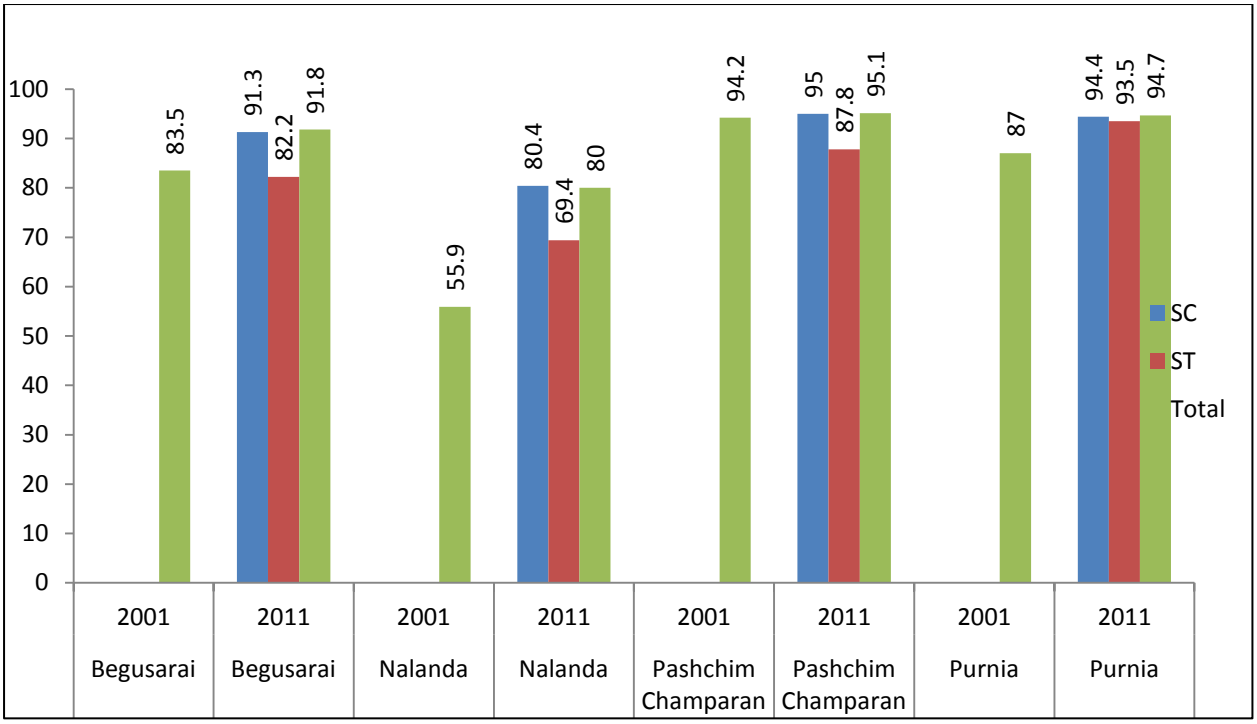


Figure 3.2.3: Percentage of households using Hand pumps / Tube Wells among Marginalized population in sample districts

It is apparent from the above table and graph that hand pumps and tube wells are the primary sources of drinking water among the marginalized communities in all the sample districts. The distribution pattern of marginalized households by primary source of drinking water is similar to the overall picture of all households in rural Bihar. Even in the sample districts, a lesser percentage of ST households have access to hand pumps / tube wells for their drinking water needs.

Table 3.2.4: Coverage by Taps for Marginalized population in sample districts

	Tap water supply			Tap water from treated source		
District	SC	ST	Total	SC	ST	Total
Begusarai	3.50	10.90	3.60	2.30	7.40	2.50
Nalanda	5.60	15.20	7.90	3.30	7	5.40
Pashchim Champaran	3.10	2.90	2.80	2.20	1.70	1.90
Purnea	1.90	2.20	1.90	1.30	1.60	1.30

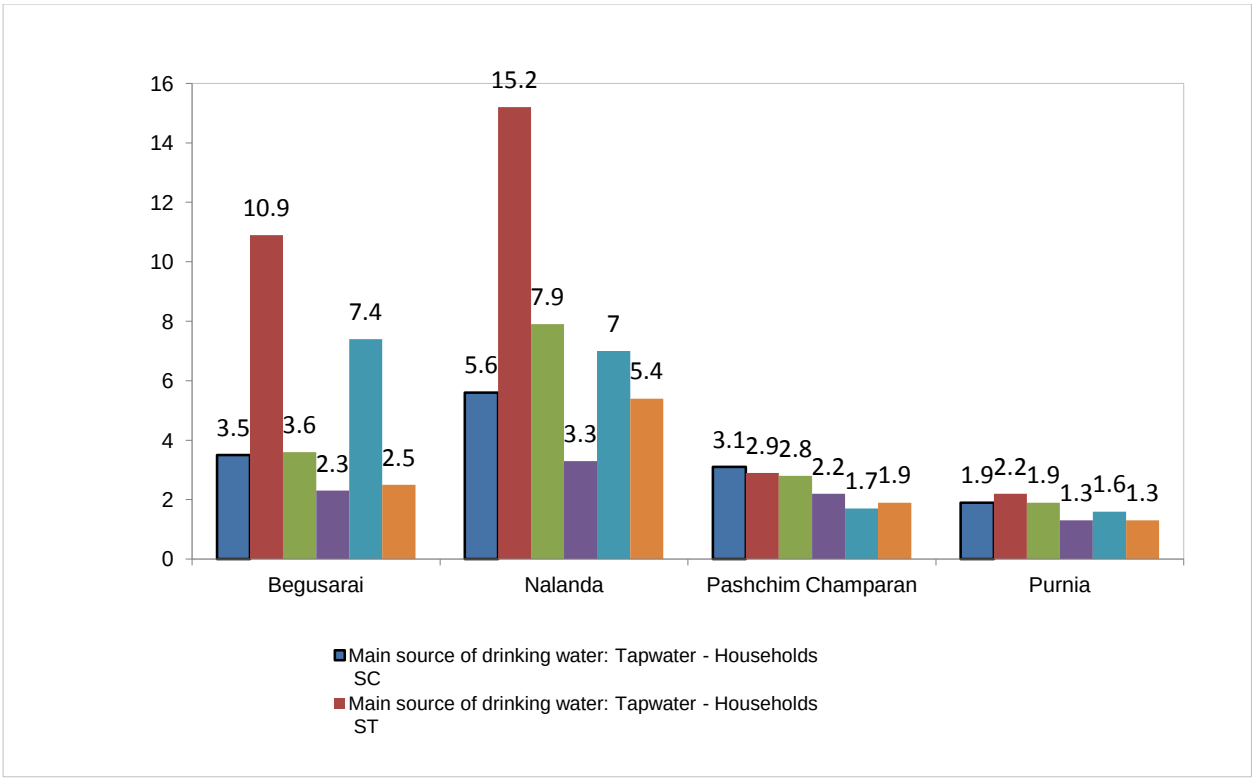


Figure 3.2.4: Marginalized Households using Taps as main source of Drinking Water in Sample Districts

As apparent from the above table & graph, the penetration of Tap Water for drinking remains a major concern in all the four sample districts. Except for Nalanda which leads the pack with 7.9%, all the other sample districts report current penetration levels of less than 4% of households. The coverage through treated tap water is even lower (less than 2.5%) in all the sample districts except Nalanda which reports 5.4% coverage.

3.3. Accessibility of Drinking Water in Bihar

Accessibility depends on the location of drinking water source. The source may be located inside the premises, near or away. Location of the source is an important factor which determines the time taken to fetch drinking water by households.

Accessibility of drinking water inside the premises, near or away is presented in the table below:

Table 3.3: Accessibility of drinking water inside, near or away for households in Bihar

TRU	Within Premises		Near *		Away @	
	2011	2001	2011	2001	2011	2001
Total	50.1	39.6	37.9	48.2	12.0	12.2
Rural (R)	47.1	36.3	40.4	51.1	12.6	12.6
Urban (U)	75.5	70.5	17.4	20.9	7.0	8.6
R-U Diff	-28.4	-34.2	23.0	30.2	5.6	4.0

*: 'Near'- Within 500 metres in rural areas or within 100 metres in urban areas
@: 'Away'- 500 metres or beyond in rural areas or 100 metres or beyond in urban areas

It is apparent from the above table that there has been significant improvement in rural areas in availability of primary source of drinking water inside premises. More than 10 percentage point jump was observed in households having primary source of water within the premises in rural areas. This has happened at the cost of reduction in the percentage of households who had the sources of drinking water near their houses. But there is still a significant proportion (12.6%) of households where people have to travel for more than 500 meters in rural areas to get drinking water for their daily needs.

The accessibility of drinking water sources in rural areas among various communities is furnished in table below:

Table 3.3.1: Accessibility of drinking water inside, near or away for marginalized population in rural Bihar

Category	Within the premises		Near the premises		Away	
	2001	2011	2001	2011	2001	2011
Total	36.3	47.1	51.1	40.4	12.6	12.6
SC		29.40		50.30		20.20
ST		38.40		43.20		18.50

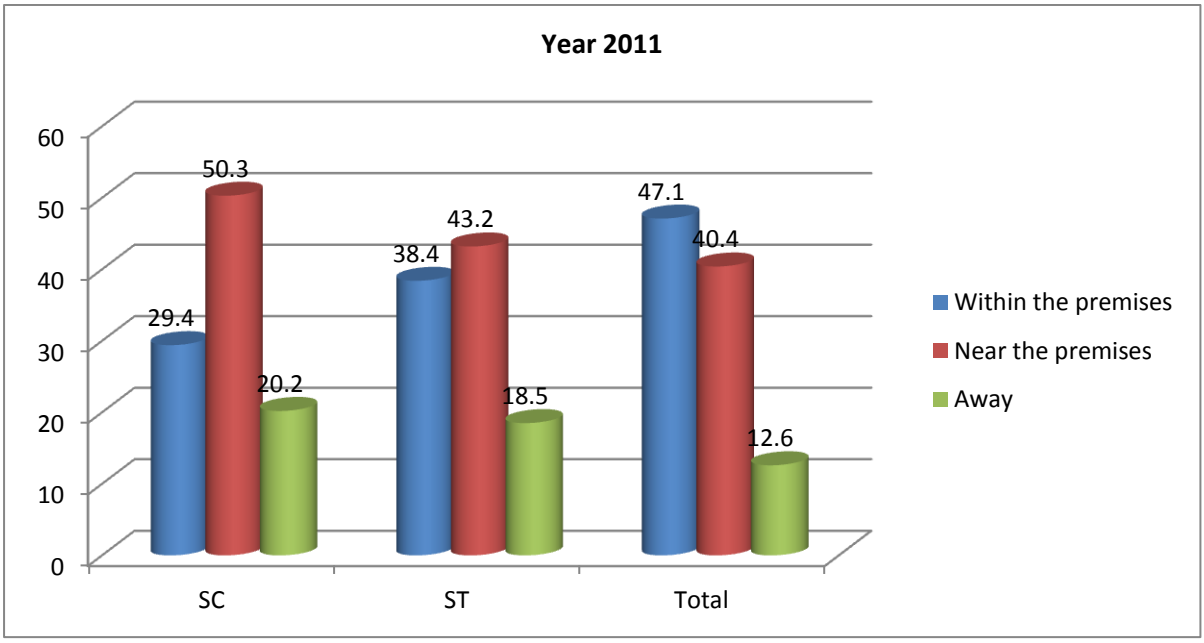


Figure 3.3.1: Accessibility of drinking water inside, near or away for marginalized population in rural Bihar

It is apparent from the above table that availability of primary drinking water source inside the premises is much lower among marginalized households. Around 18-20% SC / ST households in rural Bihar travel more than 500 meters to fetch drinking water for their daily needs whereas the same figure for total rural population is just 12.6% which clearly shows that marginalized households have a disadvantage. Many people in rural areas have got their own shallow hand pumps inside premises. A major portion of marginalized households have to depend on Govt. hand pumps or other sources outside the premises. Because of poor accessibility, they spend considerable time in fetching and hence lose productive work hours.

The accessibility of drinking water sources in the four sample districts is presented in the table below:

Table 3.3.2: Accessibility of drinking water inside, near or away for marginalized population in sample districts

		Within the premises			Near the premises			Away		
District	Census Year	SC	ST	Total	SC	ST	Total	SC	ST	Total
Begusarai	2001			40			48.6			11.3
	2011	34.3	49.5	52.6	48.5	36.7	36.7	17.2	13.8	10.6
Nalanda	2001			34.4			46.5			19.1
	2011	23.1	39.9	45.9	45.6	34.6	33.7	31.4	25.4	20.4
Pashchim Champaran	2001			37			55.1			7.9
	2011	33.7	41.3	52.1	53.3	45.7	39.9	13	13.1	8
Purnea	2001			51.5			42.5			6
	2011	41.2	49.3	49.1	47.3	42.3	42.6	11.5	8.4	8.2

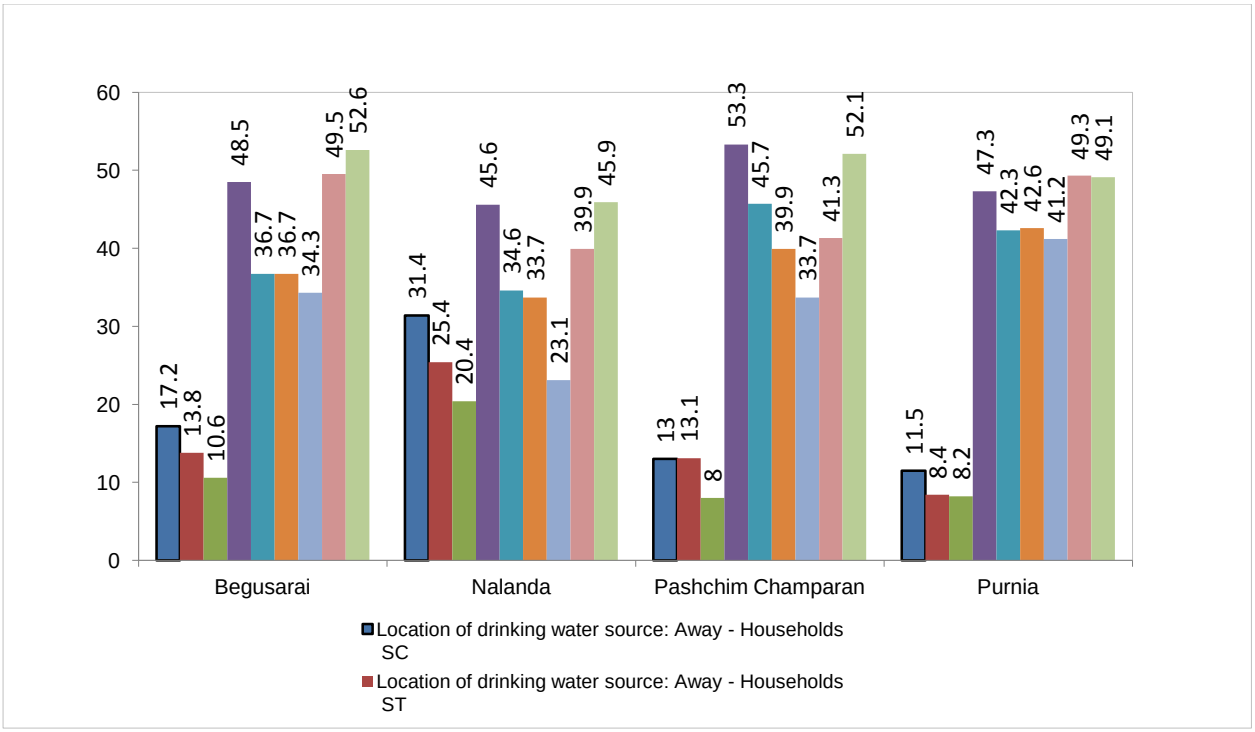


Figure 3.3.2: Accessibility of drinking water inside, near or away for marginalized population in sample districts

It is apparent from the above table and graph that availability of primary drinking water source inside the premises is much lower among marginalized households even in the four sample districts. More SC / ST households in these sample districts travel more than 500 meters to fetch drinking water for their daily needs whereas the same figure for total rural population is lesser which clearly shows that marginalized households have a disadvantage. Even among the marginalized communities, SC households seem to have poorer accessibility (inside and near premises) to drinking water sources as compared to ST households.

The accessibility status for all 38 districts is detailed in Annexure 4.

During Focus Group Discussion in sample GPs, it came out that 50% households have their primary drinking water source located inside the premises. The figure for near sources was reported as 48% and only 2% FGDs reported away sources.

In the household survey also, the accessibility of primary drinking water sources today and the situation 10 years back was assessed and is reported as follows:

Table 3.3.3: Accessibility of primary water source in sample households (Present Situation)

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Inside premises or within 50 meters	88.60%	83.48%	73.87%	61.86%	76.86%
50-500 meters	10.53%	16.52%	26.13%	37.29%	22.71%
more than 500 meters	0.88%	0.00%	0.00%	0.85%	0.44%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

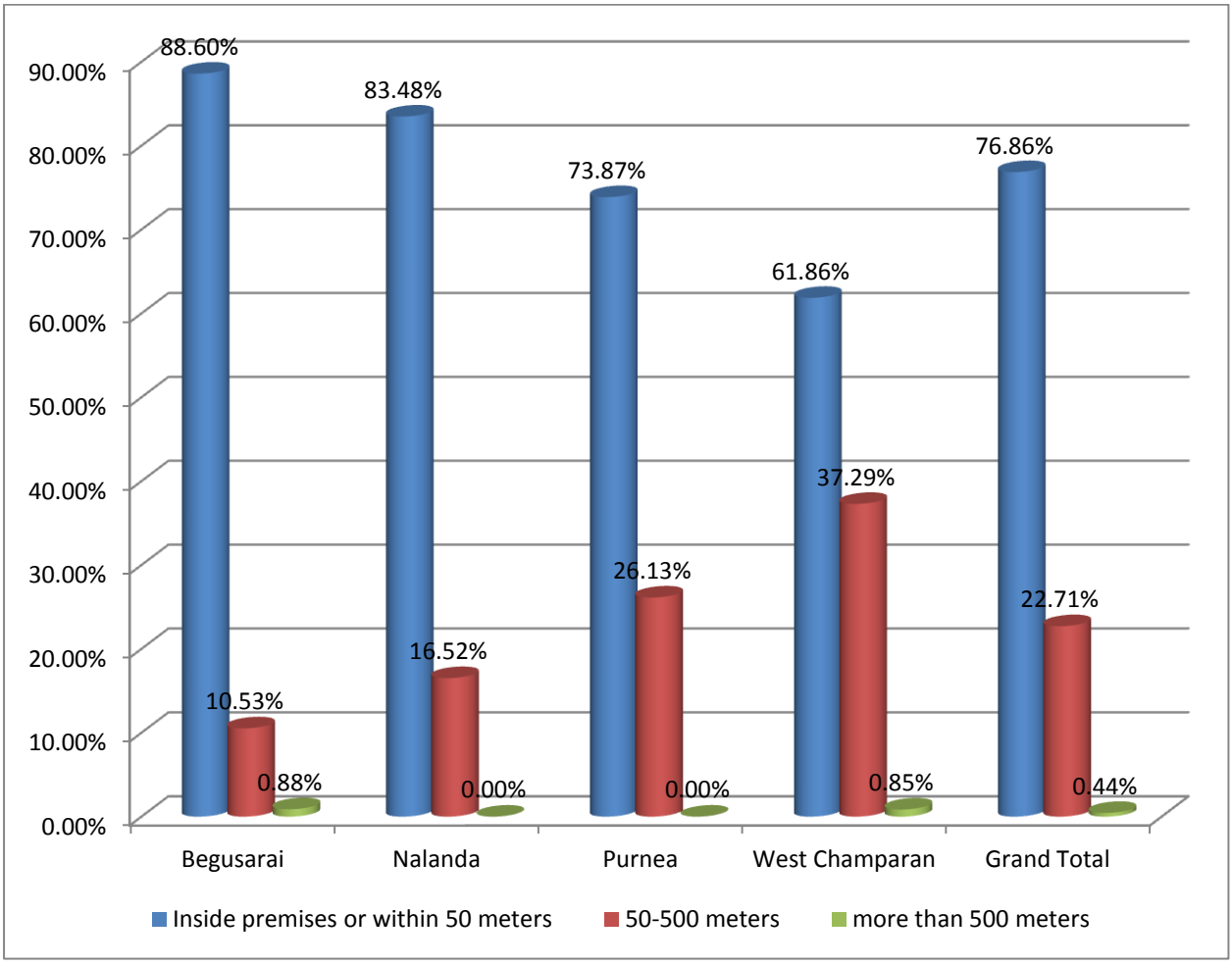


Figure 3.3.3: Accessibility of primary water source in sample households (Present Situation)

Table 3.3.4: Accessibility of primary water source in sample households (10 years back)

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Inside premises or within 50 meters	52.63%	40.87%	55.86%	41.53%	47.60%
50-500 meters	25.44%	50.43%	41.44%	32.20%	37.34%
more than 500 meters	21.93%	8.70%	2.70%	26.27%	15.07%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

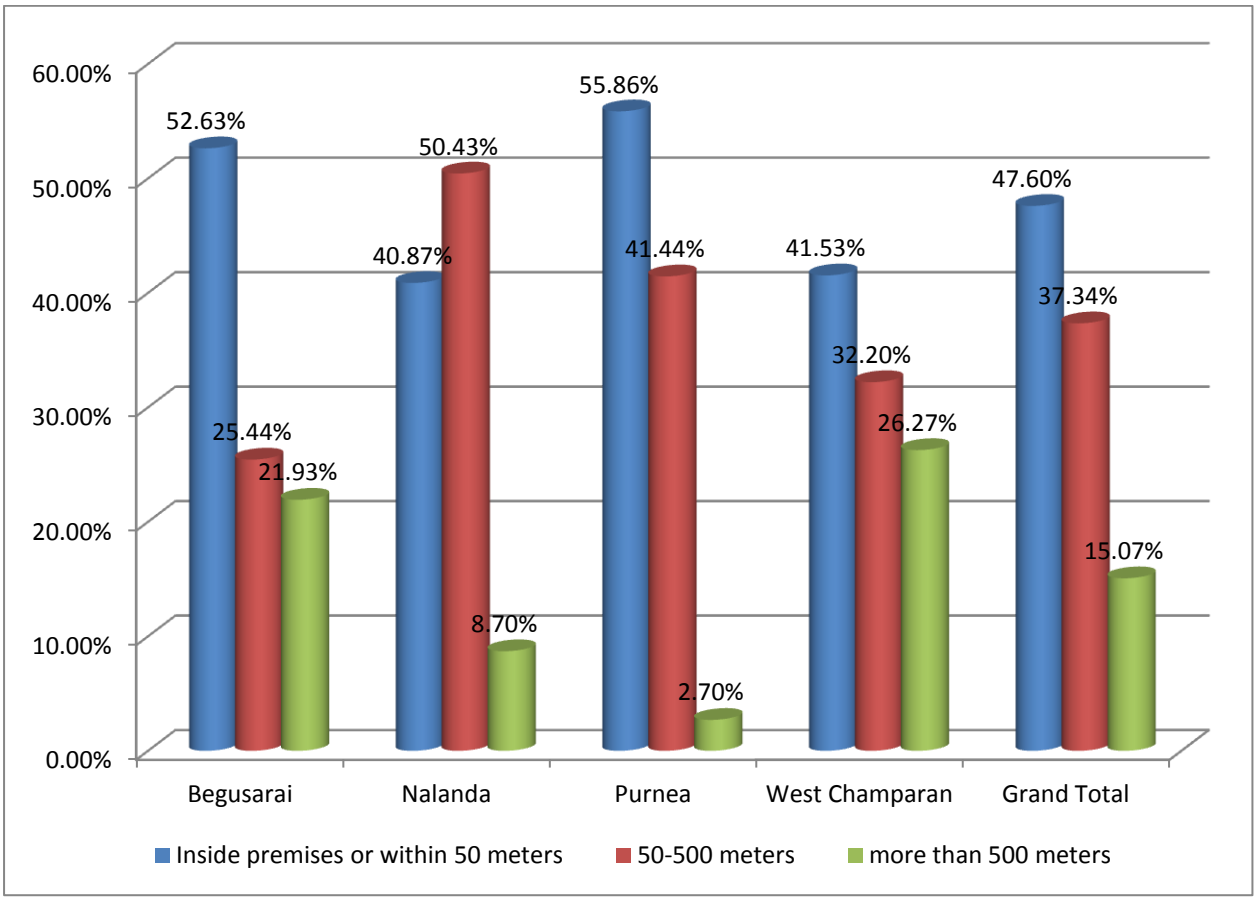


Figure 3.3.4: Accessibility of primary water source in sample households (10 years back)

It is apparent from the above tables and graphs that the proportion for primary drinking water source inside and near the premises has increased considerably in sample rural households over the last 10 years. The proportion of away sources has gone down to less than 1 % from more than 15% ten years back, which might be due to the result of Govt. efforts in installing hand pumps in all habitations during these years.

Accessibility of primary drinking water source at any time of the day was assessed in the household survey and is presented in the table below:

Table 3.3.5: Accessibility of primary drinking water source at any time of the day in sample households

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Freely at any time	97.37%	85.22%	87.39%	25.42%	73.36%
Freely but with time restriction	1.75%	12.17%	10.81%	72.03%	24.67%
With permission	0.88%	1.74%	1.80%	0.85%	1.31%
With permission during a fixed time	0.00%	0.87%	0.00%	1.69%	0.66%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

It is apparent from the above table that majority of the sample households get drinking water freely at any time and some of the households have time restrictions in fetching water.

3.4 Coverage of Drinking Water by Habitations

The PHED, Govt. of Bihar had fully covered 100% habitations in Bihar in 2004-05. For full coverage and to ensure equity within available budget, the Govt. concentrated more on hand pumps. However some habitations have slipped back into partially covered category. The status of fully / partially covered habitations for various communities is given the table below:

Table 3.4: Fully / partially covered habitations across communities

Type of Habitations	Total	Fully Covered	Partially Covered due to Slipped Back	Percentage of fully covered (%)	Percentage of partially covered (%)
Total	107,642	87,394	20, 248	81.19	18.81
SC	23,520	21,987	1,533	93.48	6.52
ST	1,952	1,885	67	96.57	3.43
Minority	21,514	20,318	1196	94.44	5.56
LWE	28,784	27,604	1,180	95.9	4.1

It can be observed that 18.81% of habitations have slipped back into partially covered category. Major reasons for slip-back of these habitations as per information gathered in field offices and during focus group discussions are:

- Sources go dry
- Water supply schemes become defunct
- Sources become quality affected
- Systems operate below capacity due to poor maintenance
- Some schemes become old and wear out
- Increase in population leads to emergence of new habitations

3.5 Schemes and Technologies in Operation

There are mainly two types of drinking water schemes viz. Hand pumps and Pipe water supply schemes. Hand pumps being installed in the state by the PHED, Govt. of Bihar are one of four variants viz. Singur, Tara, India Mark II and India Mark III. Pipe water supply schemes in operation in the state are Mini scheme (Solar/Electric), Single Village scheme, Multi Village scheme in Single GP, Multi Village scheme in Multi GP. Any of these schemes can be classified as quality-affected scheme if it has provision to tackle the contamination problem at source by way of filtering and in-built treatment technology.

All these pipe water schemes can be either ground water or surface water based schemes but currently only one scheme (Multi Village scheme in Ara) is using surface water. The

following table captures various types of schemes and technologies in operation in the state along with approximate per capita cost:

Table 3.5: Various types of drinking water schemes in operation

Type of Scheme	Design Population	Remarks
Hand Pump (Singur / India Mark II / India Mark III)	I HP for 250 population	More coverage at lower per capita cost (Rs. 80 – 185)
Mini Water Supply (Solar-based / Electricity-based)	1 scheme for 1,000-1,500 population	Supply of water to a compact area; per capita cost of Rs. 1000 – 1500
Single Village	1 scheme for 5,000 – 15,000 population	Operation & Maintenance is easy; per capita cost of Rs. 1500 - 2000
Multi Village in Single GP	Coverage of more than 1 village in 1 GP (50,000 population)	Operation & Maintenance is easy; per capita cost of Rs. 2000 – 2500
Multi Village in Multi GP	Coverage of more than 1 GP (more than 100,000 population)	Operation & Maintenance is difficult; per capita cost of Rs. 3000 – 5000
Quality-affected	Any of the above schemes to tackle contamination problem	Operation & Maintenance is difficult; per capita cost of Rs. 2500-3500

3.6 Status of Schemes in Operation

In Bihar, PHED has given major thrust on hand pump schemes in the last 10 years. This was done to ensure coverage and equity in available budget. The status of Hand pumps installed by PHED as on 31st March 2012 is summarized in the table below:

Table 3.6: Status of hand pumps in Bihar as on 31st march, 2012

Particulars	Total no.	Defunct Hand Pump	Running Hand Pump	% of Defunct Hand Pump	% of Running Hand Pump
1.Hand operated tube well					
125 mm × 40 mm × 46m / 61m Indian mark with 111 pump	74488	4848	69640	6.51	93.49
Special Hand Pump	123268	34064	89204	27.63	72.37
Ordinary Hand Pump	554430	105816	448614	19.09	80.91
Gravel packed Hand Pump	17140	1198	15942	6.99	93.01
Tara Hand Pump	23850	5040	18810	21.13	78.87
Force and Lift Hand Pump	5	0	5	0.00	100.00
Hand Pump with iron removal machine	9616	7407	2209	77.03	22.97
Total Hand operated tube well	802797	158373	644424	19.73	80.27
2. Drilled Hand Pump					
India Mark II	12983	1909	11074	14.70	85.30
India Mark III	12492	827	11665	6.62	93.38
Total	25475	2736	22739	10.74	89.26
3. Total Hand Pump in State	828272	161109	667163	19.45	80.55

It is apparent from the table that total no. of hand pumps installed is 8,28,272. Out of these, 19.45% hand pumps have become defunct due to mechanical fault and due to scheme becoming old and worn out. 6,67,163 hand pumps are currently in use. As most of these hand pumps are installed in public places as per Govt. policy, we can assume that each hand pump

services at least 200 population which implies the full coverage of more than 13 crores of population.

Since the Govt. has already achieved water security to the existing population mainly through hand pumps, the thrust of Govt. should be on the following issues:

- Proper repair and maintenance of existing hand pumps
- Installation of new hand pumps only in slipped back habitations
- Enlarging the coverage of pipe water supply schemes
- Ensuring quality through water testing and treatment

The status of the pipe water supply schemes in the state is furnished in the table below:

Table 3.6.1: Status of pipe water supply schemes in the state

SI. No.	Particulars	Number	Percent
1.	Total scheme	906	100.00
2.	Running Schemes	605	66.78
3.	Non functional schemes	301	33.22
3.1	Only Mechanical fault	03	1.00
3.2	Only civil fault	26	8.64
3.3	Only problems related to electricity	72	23.92
3.4	Transformer problem	02	0.66
3.5	Civil and Mechanical fault	84	27.91
3.6	Civil and Electricity fault	10	3.32
3.7	Electricity and Mechanical fault	01	0.33
3.8	Civil, Mechanical and Electrical (all three faults)	103	34.22

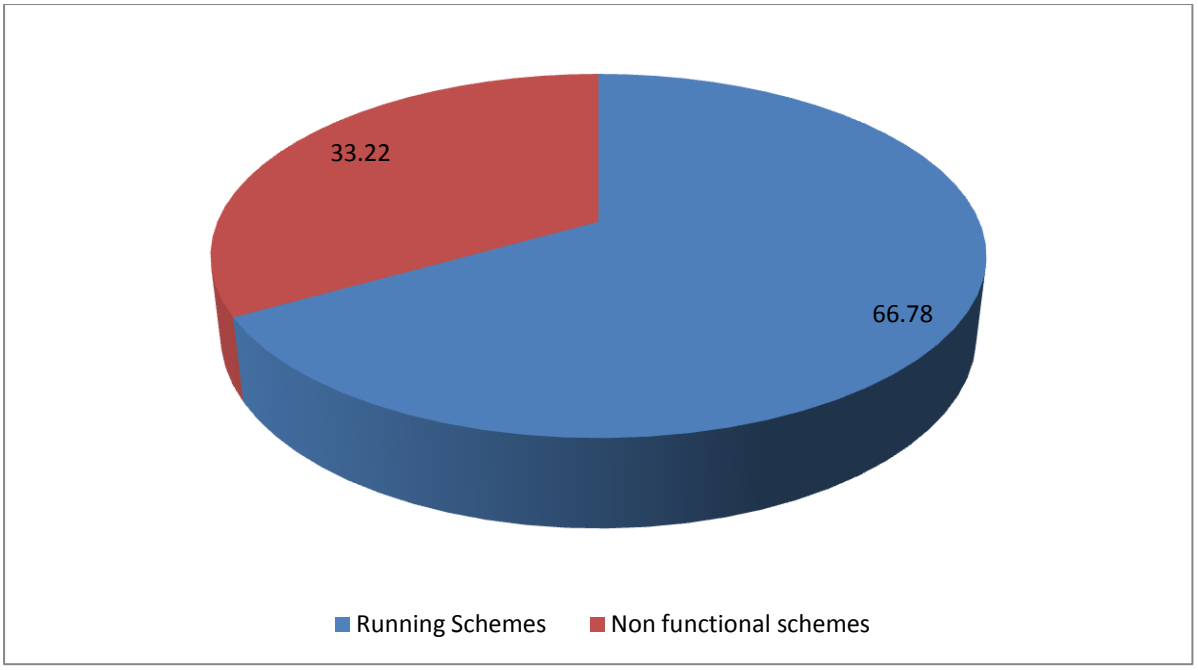


Figure 3.6.1: Functionality of pipe water schemes in Bihar

It is apparent from the above table and graph that 66.78 % of the existing pipe water schemes are currently functional in the state. Remaining 33.22 % schemes are non-functional. Reasons for non-functionality with corresponding contribution is depicted in the graph below:

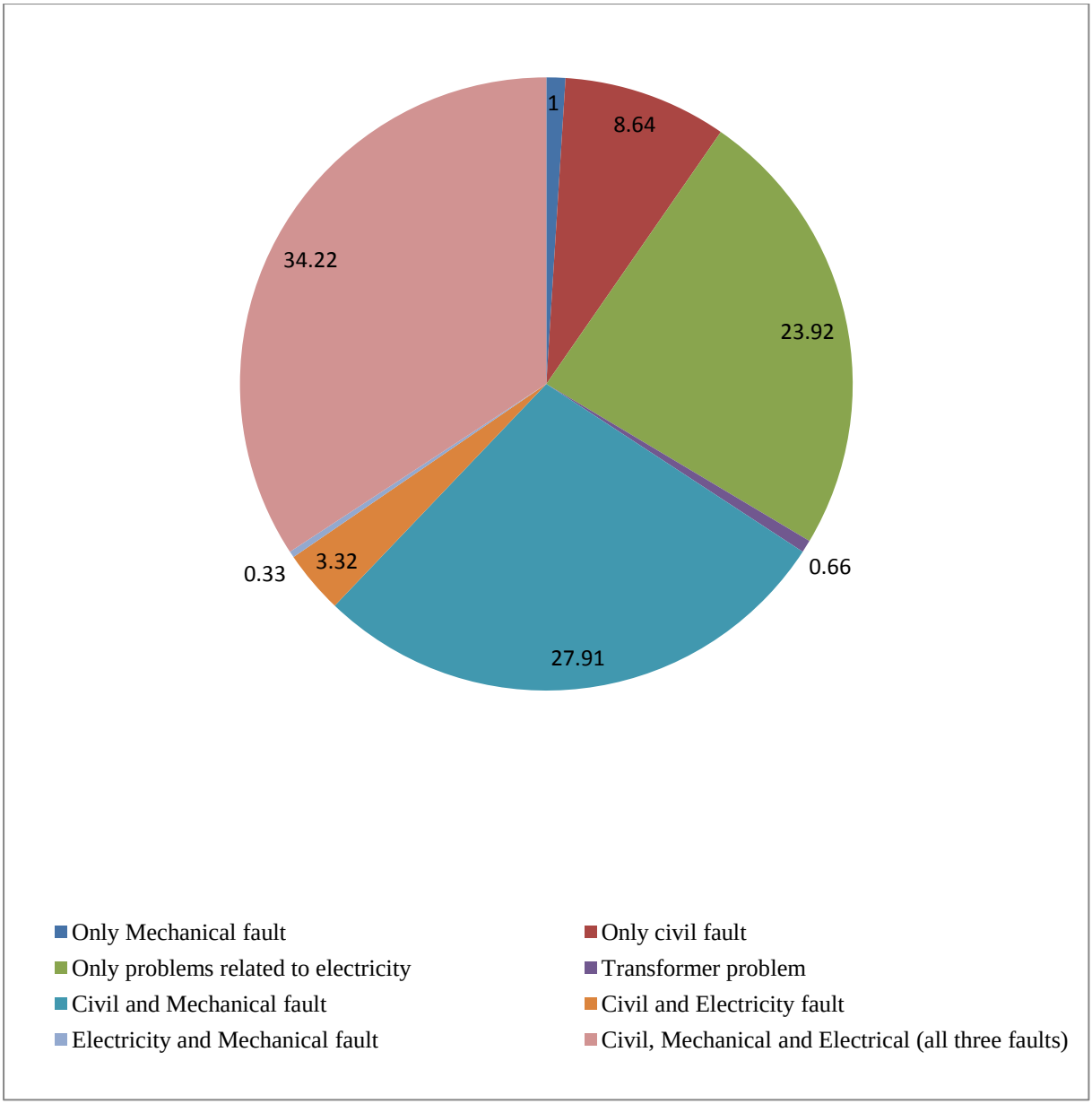


Figure 3.6.1.1: Reasons for Schemes becoming Defunct

It is apparent from the above graph that the reasons for non-functionality of the schemes are mechanical and civil fault, non-availability of electricity, theft of wires and transformer etc. Majority of the non-functional schemes suffer due to the problems related to electricity like irregular power supply, no electricity connection, burning of transformers and theft of wires. In civil fault, major issues are leakage in distribution system, damage of standposts, leakage in sluice valve, leakage in OHT and OHT not connected to pump.

Table 3.6.2: Status of pipe water supply schemes in the four sample districts

Particulars	Begusarai		Purnea		Nalanda		West Champaran	
	No.	%	No.	%	No.	%	No.	%
Total scheme	32	100.00	14	100.00	16	100.00	22	100.00
Running Schemes	24	75.00	8	57.14	11	68.75	11	50.00
Non Functional Schemes	8	25.00	6	42.86	5	31.25	11	50.00
Reason for non functioning of the scheme								
Old schemes under renovation	2	25.00	2	33.33	2	40.00	5	45.46
Failed tube well	1	12.50			1	20.00		
Civil / Mechanical fault	1	12.50	3	50.00	1	20.00	1	9.09
Low voltage	1	12.50			1	20.00	1	9.09
Transformer burning / theft	1	12.50					1	9.09
Lack of transformer and wire both	1	12.50					1	9.09
Scheme closed due to other reason / getting electric connection	1	12.50	1	16.67			2	18.18

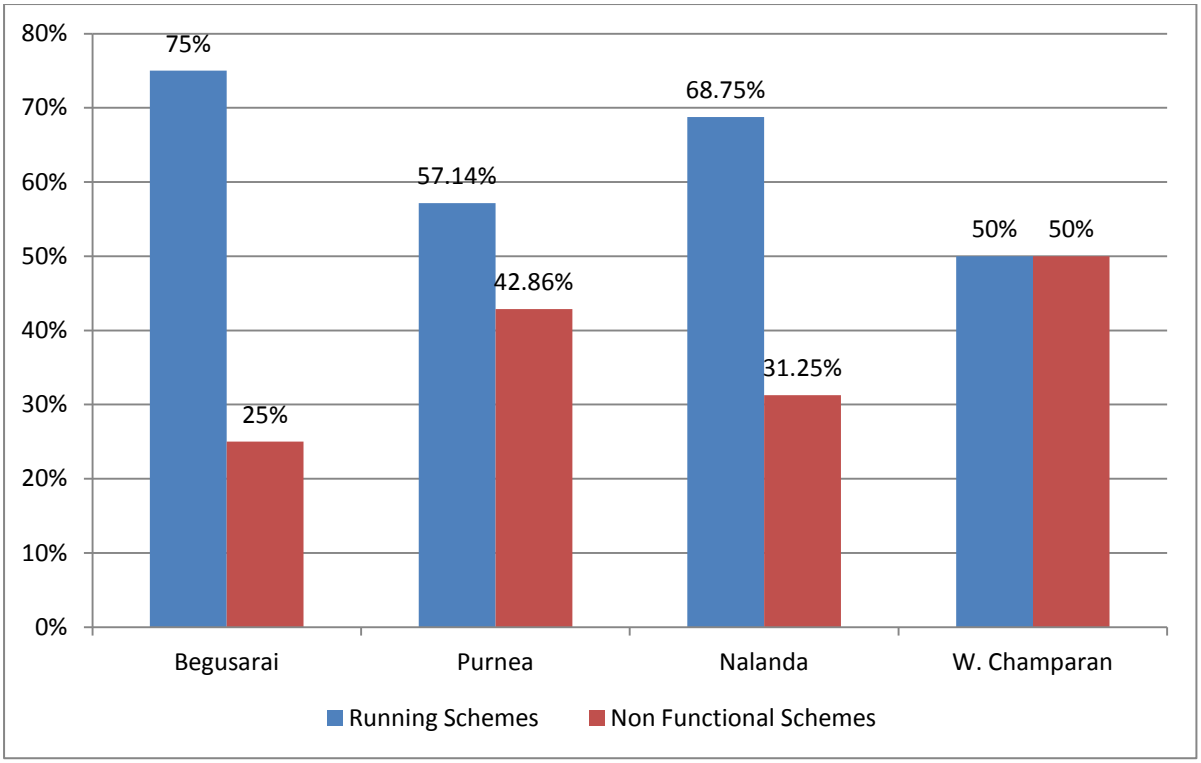


Figure 3.6.2: Functionality of pipe water schemes in sample districts

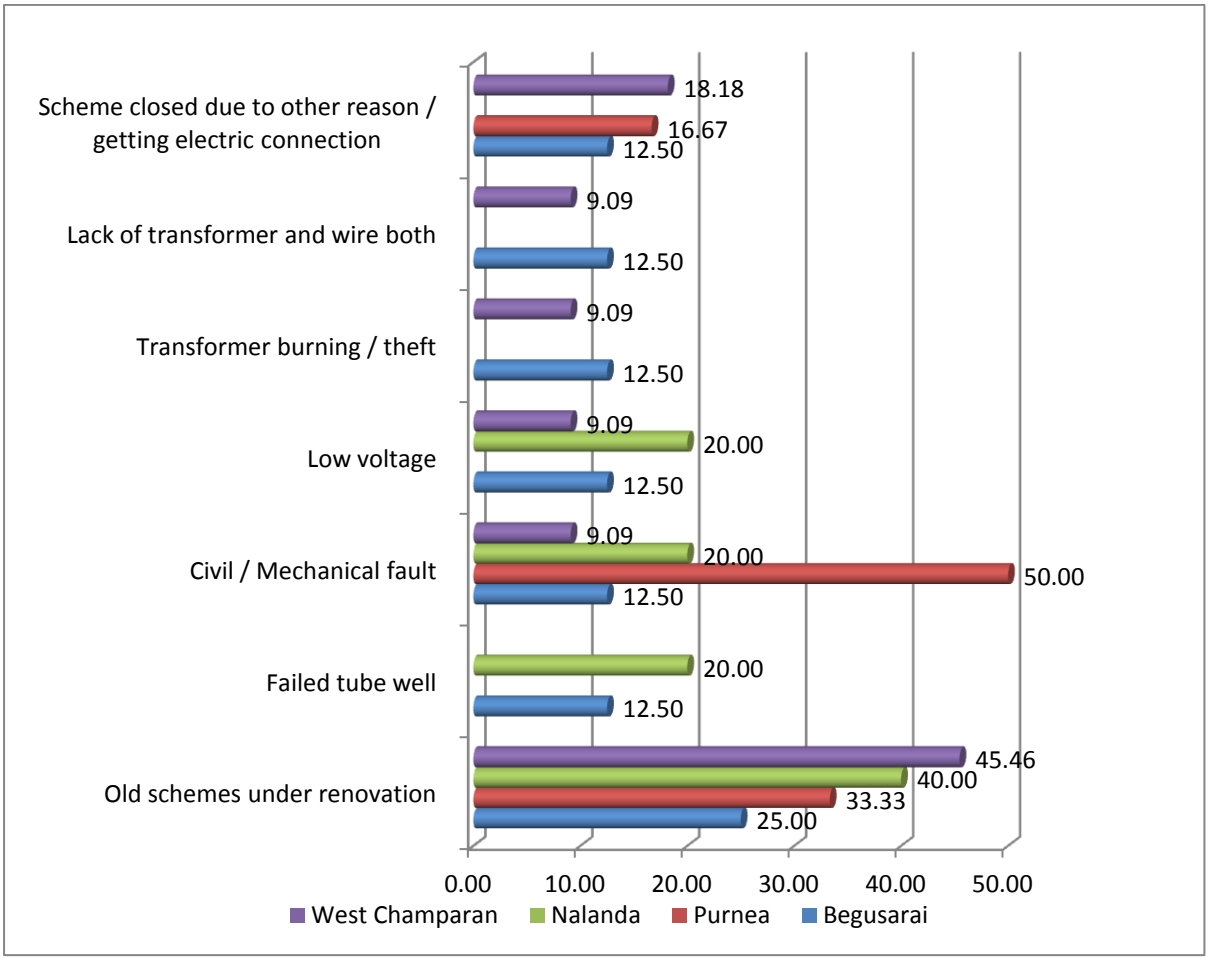


Figure 3.6.2.1: Reasons for Schemes becoming defunct

The operation & maintenance issues regarding various hand pump and pipe water schemes were assessed during the household survey and are presented below:

Table 3.6.3: Number of times nearest water source became non-functional in last one year

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
1-2 times	65.79%	56.52%	65.77%	82.20%	67.69%
3-5 times	29.82%	21.74%	27.93%	14.41%	23.36%
6-10 times	2.63%	8.70%	2.70%	2.54%	4.15%
Never	1.75%	13.04%	3.60%	0.85%	4.80%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

It appears that majority of the households (67.69%) reported that the primary drinking water became non-functional 1-2 times in the last 1 year. 23.36% households reported the occurrence of non-functionality of drinking water source 3-5 times in the last 1 year.

The reasons for dysfunction of water source were assessed during the household survey and are presented in the table below:

Table 3.6.4: Reasons for dysfunction of water source

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Polluted	0.00%	0.00%	3.60%	0.85%	1.09%
Layer Problem	2.63%	2.61%	0.90%	0.00%	1.53%
Machinery problem (handle, washer, etc.)	53.51%	62.61%	18.92%	19.49%	38.65%
Damage of electric motor	0.00%	12.17%	0.00%	8.47%	5.24%
Leakage of water pipe	1.75%	3.48%	0.90%	37.29%	11.14%
Don't know	40.35%	6.09%	72.07%	33.05%	37.55%
Not dysfunctional	1.75%	13.04%	3.60%	0.85%	4.80%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

It is apparent from the above table that most commonly occurring problem is fault in the machinery like handle, washer etc. whereas some households reported damage of electric motor.

Table 3.6.5: Repair of damaged water sources by various stakeholders

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Govt.	0.00%	16.52%	6.31%	77.97%	25.76%
GP	0.00%	1.74%	1.80%	0.00%	0.87%
People / Self	79.82%	55.65%	88.29%	19.49%	60.26%
Others	20.18%	24.35%	2.70%	2.54%	12.45%
Don’t know	0.00%	1.74%	0.90%	0.00%	0.66%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

It is apparent from the above table that nearly 60% households reported that people themselves repair non-functional water sources whereas in 25% cases Govt. repairs non-functional water sources. The larger proportion of self repair cases may be for the larger incidence of personal hand pumps in use.

It is noteworthy that since so many households invest personal resources in upkeep of drinking water sources, with proper capacity building and awareness generation regarding use and upkeep of pipe water sources, people may contribute in operation and maintenance of water sources.

Average time taken to repair damaged water source was assessed during the household survey and is presented in the table below:

Table 3.6.6: Time taken to repair damaged water source

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
1 Day	38.60%	32.17%	22.52%	18.64%	27.95%
Within 1 Week	16.67%	33.91%	1.80%	11.02%	15.94%
More than 1 Week	2.63%	20.00%	0.00%	38.98%	15.72%
Don't Know	42.11%	13.91%	75.68%	31.36%	40.39%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

It is apparent from the above table that 43.89% households reported that damages water source gets repaired within a week whereas 15.72% households reported that it takes more than a week in repair of damaged water source. Gram Panchayats expressed their views according to which it takes 6-7 days on an average to repair a damaged water source.

3.7 Evaluation of sample pipe water schemes

In order to get deeper insight into the working and condition of pipe water schemes in sample districts, we covered 18 pipe water schemes in operation across the districts. To have a holistic analysis, we sample all different types of schemes currently operational in the state viz. Mini WSS, Single Village WSS, Multi Village WSS, Quality affected WSS. To include Multi Village in Multi GP (Surface Water) scheme, we went beyond the four sample districts and covered the only such scheme operating in Bhojpur district.

3.7.1 Activities during Planning & Implementation of Schemes

The grounding of schemes start with the identification of the schemes demanded by peoples' representatives or under special externally-aided projects. The state office advises the district to identify the project and prepare estimate.

The entire scheme cycle comprises multiple steps as detailed below:

- Preparation of estimate on the basis of request received from the state office
- Technical approval by Competent authority
- Administrative approval by State office according to delegated authority
- Preparation of DPR by District office
- Technical Sanction by Competent technical authority
- Preparation of BOQ and its approval
- Floating tender asking for technical and financial bids
- Opening of technical bids and approval by Competent authority
- Opening of financial bids and approval by Competent authority
- Work allotment
- Execution of Agreement
- Issue of Work Order
- Start of Work
- Procurement of Material
- Installation of Tube Well
- Construction of Various Tanks
- Construction of Pump House
- Construction of OHT
- Getting Electric Connection
- Installation of Motor / Pump
- Laying out of Distribution System
- Installation of Stand Posts
- Actual Supply of Water
- Household Connection
- Continuous Monitoring

The entire project planning & implementation activities on an average take 2.5-3 years for single village WSS and 3.5-4 years for multi village WSS as observed during evaluation of sample schemes. There is scope to reduce the cycle time at least by a year through proper project management and monitoring using project management tools like PERT, CPM etc. The proposed activities during pre-planning, planning & implementation phases for both single-village and multiple village schemes in a Gantt chart format is suggested below for efficient project management.

But to realize this goal, changes in work culture would also need to be initiated. Employees should be motivated and oriented to approaches of working towards goals in a time-bound manner. Capacity building through management development programs should be undertaken to develop a project-based approach of completing work within deadlines. Better communication between various wings and divisions is a must for better project management. Entire progress of projects should be made available online for review by higher authorities and triggers should be incorporated for timely alerts. Besides, a system of rewards and punishments may also be thought of to encourage and motivate people.

The suggested activities during pre-planning & planning of pipe water schemes represented in a Gantt chart format are depicted below:

Planning process for Pipe water schemes									
Initial Activities in Scheme Implementation	**Month 1**	**Month 2**	**Month 3**	**Month 4**	**Month 5**	**Month 6**	**Month 7**	**Month 8**	**Month 9**
Conceptualization of the Scheme									
Pre-planning Activities									
Preparation of Estimate									
Technical Approval by Competent Authority									
Administrative Approval									
Preparation of DPR by District Office									
Technical Sanction									
Preparation of BOQ and its Approval									
Tendering Process									
Continuous Monitoring									

Figure 3.7.1 Planning process for Pipe water schemes represented in a Gantt chart format

The suggested activities during implementation of single village schemes represented in a Gantt chart format are depicted below:

Implementation scheduling for Single Village schemes (Expected Completion Time= 2 years)								
Activities in Scheme Implementation	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**
Work Allotment, Agreement,Work Order								
Procurement of Material								
Installation of Tube Well								
Construction of Various Tanks								
Construction of Pump House								
Construction of OHT								
Getting Electric Connection								
Installation of Motor / Pump								
Laying out of Distribution System								
Installation of Stand Posts								
Actual Supply of Water								
Household Connection								
Continuous Monitoring								

Figure 3.7.2: Implementation scheduling for Single Village schemes represented in a Gantt chart format

The suggested activities during implementation of multi village schemes represented in a Gantt chart format are depicted below:

Implementation Scheduling for Multi-village schemes (Expected Completion Time = 2.5 years)											
Activities in Scheme Implementation	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Q11**
Work Allotment, Agreement, Work Order											
Procurement of Material											
Installation of Tube Well											
Construction of Various Tanks											
Construction of Pump House											
Construction of OHT											
Getting Electric Connection											
Installation of Motor / Pump											
Laying out of Distribution System											
Installation of Stand Posts											
Actual Supply of Water											
Household Connection											
Continuous Monitoring											

Figure 3.7.3: Implementation Scheduling for Multi-village schemes represented in a Gantt chart format

3.7.2 Observations on Design, Implementation, Operation & Maintenance of Schemes

3.7.2.1 Mini Water Supply Scheme

Mini water supply schemes have been designed to cater to a compact area with 1000-1500 population. These are generally operated by solar energy. As there is no dependence on electricity to run these schemes, all such schemes were found to be functional during the field visit. However, the duration of water supply was found to be 5-6 hours per day.

The major observations regarding mini water supply schemes (solar-based) are as follows:

- Design of the schemes has been done considering the standard norms for various structures and was found to be reasonable
- Design has been done for 40 LPCD for the projected population for 15 years; the mechanical and electrical equipments have been designed for projected population for 15 years and the distribution network, OHT and other structures have been designed for projected population of 30 years

- Land was not a major issue in sample schemes as they are built on Govt. land or on land donated by people
- Gram Panchayat / villagers were not involved in site selection and planning of the schemes resulting in poor people participation and ownership
- As the schemes are solar powered, they do not function in cloudy and foggy weather conditions and thus affect water availability
- There were only 10-15 household connections from all the 5 schemes which shows that household connection is low
- Total no. of standpost in the 5 schemes is 89 (18 on an average) and 9 of them were damaged
- Records of Water testing of the schemes was not available
- Iron Filtering unit was attached to the scheme in iron affected areas in 3 schemes but the Hargawan scheme in Nalanda despite being Fluoride affected, didn't have the filtering unit
- In 2 schemes, no water treatment initiatives like chlorination were observed
- Cemented platforms were not constructed near standposts resulting in water-logging
- As most of these schemes are newly operationalized, they are being maintained by the implementing agency as part of their O&M contract
- Transfer of schemes has not been initiated
- Beneficiaries don't have any idea about the water charges and no efforts for collection of water charges has been made

Considering the above issues and the utility and potential of Mini WSS (solar-based) we recommend the following measures:

- Effort should be made in the future to inform the villagers and Gram Panchayat regarding planning of new schemes and to sensitize them to take ownership in overseeing the schemes during implementation
- Site for construction of the water works should be identified in the beginning of the planning process in consultation with Gram Panchayat / villagers. If Govt. land is not available, cost of acquiring land should be included in project cost.
- Considering the emerging need of the people, the design criteria of 40 LPCD may suitably be enhanced in tune with the state water policy

- Alternative source of power should be installed as a backup for cloudy and foggy weather conditions to ensure uninterrupted water supply in all seasons
- Awareness creation and organizing camps for giving household connections may help in increasing coverage through taps inside premises
- Condition of standposts may be monitored regularly and the damaged ones should be repaired
- Cemented platforms with proper drainage system may be constructed near the standposts
- Water testing on a regular basis (half-yearly / yearly) may be done and the report may be displayed at the scheme site
- Regular monitoring of water treatment measures like chlorination may be structured and strengthened
- Steps should be initiated for formation of Village Water & Sanitation Committee (VWSC)
- Capacity building efforts need to be boosted at the VWSC level so that operation and maintenance can be transferred in a phased manner
- Water tariff may be revised in phased manner to make it financially viable and awareness regarding the same should be generated among people
- Procedure & mechanism for collection of water charges may be detailed and appropriate authority may be given for timely collection

3.7.2.2 Single Village Water Supply Scheme

Single village water supply schemes have been designed to cater to 5000-15000 population. Most of these schemes are electricity operated. As power situation in rural areas of Bihar is grim, most of these schemes experience frequent power shortage. All such schemes were tubewell based ground water schemes. The depth of tubewell was 125 meters to 140 meters with 30-36 meters of strainer. The major observations regarding single village water supply schemes are as follows:

- Design of the schemes has been done considering the standard norms for various structures and was found to be reasonable
- Design has been done for 40 LPCD for the projected population for 15 years; the mechanical and electrical equipments have been designed for projected population for 15 years and the distribution network, OHT and other structures have been designed for projected population of 30 years

- Land was not a major issue in sample schemes as they are built on Govt. land or on land donated by people
- Gram Panchayat / villagers were not involved in site selection and planning of the schemes resulting in poor people participation and ownership
- As the schemes are electricity operated, due to limited availability of power in rural areas, water supply gets disrupted frequently
- Out of the 5 schemes covered, Sabnahua scheme at Harnaut, Nalanda was supplying water for 3 hours and there are 400 household connections; In Taulaha (Ramnagar block), W. Champaran the OHT, sluice valve and distribution system were leaking in many places and hence direct pumping was limited to only 1 hour; Water supply in Sikta, W. Champaran has not been started after the trial run as leakage was observed at many points in the distribution system; Chak and Jalalgarh schemes in Purnea were not supplying water due to leakage in OHT
- It gives clear indication of lack of monitoring during the implementation of schemes
- Total no. of standpost in the 5 schemes is 112 (24 on an average) and 22 of them were damaged
- Records of Water testing of the schemes was not available
- Iron Filtering unit was attached to the scheme in iron affected areas in 2 schemes
- In 3 schemes, no water treatment initiatives like chlorination were observed
- Cemented platforms were not constructed near standposts resulting in water-logging
- All these schemes are being operated and maintained by PHED
- Transfer of schemes has not been initiated
- Beneficiaries don't have any idea about the water charges and no efforts for collection of water charges has been made

Considering the above issues in single village WSS we recommend the following measures:

- Effort should be made in the future to inform the villagers and Gram Panchayat regarding planning of new schemes and to sensitize them to take ownership in overseeing the schemes during implementation
- Site for construction of the water works should be identified in the beginning of the planning process in consultation with Gram Panchayat / villagers. If Govt. land is not available, cost of acquiring land should be included in project cost.

- Considering the emerging need of the people, the design criteria of 40 LPCD may suitably be enhanced in tune with the state water policy
- Alternative source of power should be considered as a backup
- Strong project monitoring of the schemes during implementation, trial run and thereafter may be done to ensure quality and avoid leakage in distribution system
- Awareness creation and organizing camps for giving household connections may help in increasing coverage through taps inside premises
- Condition of standposts may be monitored regularly and the damaged ones should be repaired
- Cemented platforms with proper drainage system may be constructed near the standposts
- Water testing on a regular basis (half-yearly / yearly) may be done and the report may be displayed at the scheme site
- Regular monitoring of water treatment measures like chlorination may be structured and strengthened
- Steps should be initiated for formation of Village Water & Sanitation Committee (VWSC)
- Capacity building efforts need to be boosted at the VWSC level so that operation and maintenance can be transferred in a phased manner
- Water tariff may be revised in phased manner to make it financially viable and awareness regarding the same should be generated among people
- Procedure & mechanism for collection of water charges may be detailed and appropriate authority may be given for timely collection

3.7.2.3 Multi Village Water Supply Scheme

Multi village water supply schemes are designed to cater to population of 50000-100000. But most of the multi village schemes visited catered to population ranging 7000-15000. These schemes are not multi-village in true sense but cater to the need of more than 1 village. Most of these schemes are electricity operated. As power situation in rural areas of Bihar is grim, most of these schemes experience frequent power shortage. All such schemes were tubewell based ground water schemes. The depth of tubewell was 125 meters to 140 meters with 30-36 meters of strainer. The only difference between the single and multi village schemes is the

design population and coverage of more than 1 village. The major observations regarding multi village water supply schemes are as follows:

- Design of the multi-village schemes has been done considering the standard norms for various structures and was found to be reasonable
- Design has been done for 40 LPCD for the projected population for 15 years; the mechanical and electrical equipments have been designed for projected population for 15 years and the distribution network, OHT and other structures have been designed for projected population of 30 years
- Land was not a major issue in sample schemes as they are built on Govt. land or on land donated by people
- Gram Panchayat / villagers were not involved in site selection and planning of the schemes resulting in poor people participation and ownership
- The time taken to complete the work in all respect including obtaining electricity connection, ranges from 4 to 6 years in most of the schemes
- As the schemes are operated by electricity, due to limited availability of power in rural areas, water supply gets disrupted frequently
- Out of the 4 schemes covered, Chandasi scheme at Noorsarai, Nalanda was supplying water for 2 hours; Lauria scheme in W. Champaran was supplying water for 2 hours directly from pump as the OHT is still not connected to tubewell and there was also some leakage in distribution system; Water supply in Nautan, W. Champaran is regular for 4 hours daily and the scheme is working well; Dhamdaha scheme in Purnea has not yet started water supply after trial-run
- It gives clue to make monitoring of schemes during the implementation more effective
- Shortage of staff was observed to be responsible for poor monitoring of schemes during implementation and day-to-day operation
- Total no. of standpost in the 4 schemes is 121 (30 on an average) and 9 of them were damaged
- Records of Water testing of the schemes was not available
- Iron removal plant was attached to the scheme in iron affected area
- In 2 schemes, no water treatment initiatives like chlorination were observed
- Cemented platforms were not constructed near standposts resulting in water-logging

- All these schemes are being operated and maintained by PHED
- Transfer of schemes has not been initiated
- Beneficiaries don't have any idea about the water charges and no efforts for collection of water charges has been made

Considering the above issues in multi village WSS we recommend the following measures:

- Effort should be made in the future to inform the villagers and Gram Panchayat regarding planning of new schemes and to sensitize them to take ownership in overseeing the schemes during implementation
- Site for construction of the water works should be identified in the beginning of the planning process in consultation with Gram Panchayat / villagers. If Govt. land is not available, cost of acquiring land should be included in project cost.
- As stated for single village and mini WSS, considering the emerging need of the people, the design criteria of 40 LPCD may suitably be enhanced in tune with the state water policy
- Strong project monitoring unit may be constituted to ensure timely completion of schemes including obtaining electricity connection; Project management tools like PERT, CPM may be used to reduce the cycle time at least by a year
- Alternative source of power should be considered as a backup
- Strong project monitoring of the schemes during implementation, trial run and thereafter may be done to ensure quality and avoid leakage in distribution system
- Awareness creation and organizing camps for giving household connections may help in increasing coverage through taps inside premises
- Condition of standposts may be monitored regularly and the damaged ones should be repaired
- Cemented platforms with proper drainage system may be constructed near the standposts
- Water testing on a regular basis (half-yearly / yearly) may be done and the report may be displayed at the scheme site
- Regular monitoring of water treatment measures like chlorination may be structured and strengthened

- Steps should be initiated for formation of Village Water & Sanitation Committee (VWSC)
- Capacity building efforts need to be boosted at the VWSC level so that operation and maintenance can be transferred in a phased manner
- Water tariff may be revised in phased manner to make it financially viable and awareness regarding the same should be generated among people
- Procedure & mechanism for collection of water charges may be detailed and appropriate authority may be given for timely collection

3.7.2.4 Multi Village in Multi GP (Surface Water) Supply Scheme

Generally groundwater is the main source for safe drinking water supply in rural Bihar. Exploitation of surface water for drinking purposes is imitated to only one scheme currently operational in Bhojpur district at Maujampur village which supplies safe drinking water to 39 villages which were facing problems with arsenic contamination. The source of water is Ganga river. The scheme is designed for 30 years of projected population (121,000).

The surface water scheme consists of collecting tank, high-level filter tank, storage and distribution tank, OHT (12) and distribution system. Undergroud storage tank for treated water has a capacity of 3200 meter cube. The observations regarding this scheme is as under:

- Design of the multi-village scheme has been done considering the standard norms for various structures and was found to be reasonable
- Design has been done for 40 LPCD for the projected population for 30 years except for engine and pump which are designed for 15 years
- Gram Panchayat / villagers were not involved in site selection and planning of the schemes resulting in poor people participation and ownership
- The scheme was completed within 4 years which is commendable for such a large scheme size
- Duration of supply is limited to 2 hours daily on an average
- Less water pressure was observed due to frequent power failure and leakage in distribution network
- Shortage of staff was observed
- Distribution of standposts is not in proportion to population being served

- Sanitation is one of the major indirect causes for deteriorating water quality in distribution network
- Regular water testing of the scheme is being done on monthly basis
- Water treatment is being done through Pre settling, aeration, coagulation, flocculation, sedimentation and rapid sand filtration
- Other treatment initiatives like chlorination is being taken regularly
- The scheme is being operated and maintained by PHED
- Transfer of scheme has not been initiated
- Beneficiaries don't have any idea about the water charges and no efforts for collection of water charges has been made

Considering the above issues in multi village WSS we recommend the following measures:

- Effort should be made in the future to inform the villagers and Gram Panchayat regarding planning of new schemes and to sensitize them to take ownership in overseeing the schemes during implementation
- As stated for single village and mini WSS, considering the emerging need of the people, the design criteria of 40 LPCD may suitably be enhanced in tune with the state water policy
- Alternative source of power should be considered as a backup
- To ensure continuous water supply, gravity feed supply system may be incorporated. In case of Maujampur (Bhojpur) water supply system, total 12 elevated storage tanks are provided in which one is master storage tank with about 30 meter height. Other 11 elevated tanks having 10 to 12 meter height are fed by gravity from master elevated tank. This model may be followed in upcoming projects to ensure continuous water supply. This model provides freedom from frequent power failure. Only correction should be incorporated, provision to store water in elevated tanks may be increased up to maximum level.
- Awareness creation and organizing camps for giving household connections may help in increasing coverage through taps inside premises
- Condition of standposts may be monitored regularly and the damaged ones should be repaired

- Cemented platforms with proper drainage system may be constructed near the standposts
- Steps should be initiated for formation of Village Water & Sanitation Committee (VWSC)
- Capacity building efforts need to be boosted at the VWSC level so that operation and maintenance can be transferred in a phased manner
- Water tariff may be revised in phased manner to make it financially viable and awareness regarding the same should be generated among people
- Procedure & mechanism for collection of water charges may be detailed and appropriate authority may be given for timely collection

3.7.2.5 Quality affected Water Supply Scheme

All mini, single village and multi village water supply schemes drawing contaminated ground water in quality affected areas can be classified as quality affected water supply schemes. Such schemes have in-built mechanism to tackle the contamination problem through an attached filtering unit. The issues and problems in these schemes were similar to the above related schemes. Only additional issue is regarding the backwash and maintenance of filtering unit and its proper monitoring. Hence proper monitoring is required timely cleaning, backwash and maintenance of the filtering unit and material required from time to time.

3.8 Current Service Delivery Levels in Bihar

3.8.1 Water Availability

Per day minimum requirement of drinking water as per NRDWP guidelines is 40 LPCD (Litres Per Capita / Day). The draft policy document of the state has a vision to take this service delivery standard to 70 LPCD (pipe water). The current level of service delivery among various communities in the state and in the four sample districts (as per PHED Website) is furnished in the table below:

Table 3.8.1: Current Service Delivery Levels

Particulars	Category	Begusarai	Nalanda	Paschim Champaran	Purnea	Bihar
% of population covered with > = 40 LPCD	SC (%)	97.74	84.01	94.29	98.85	90.75
	ST (%)	77.62	91.76	94.94	99.42	95.91
	GEN (%)	97.51	85.00	93.46	99.16	90.02
	Total (%)	97.54	84.79	93.60	99.13	90.21
% of population covered with < 40 LPCD	SC (%)	2.26	15.99	5.71	1.15	9.25
	ST (%)	22.38	8.24	5.06	0.58	4.09
	GEN (%)	2.49	15.00	6.54	0.84	9.98
	Total (%)	2.46	15.21	6.40	0.87	9.79

It is apparent from the above table that more than 90% of population in Bihar gets the minimum daily requirement of 40 Litres of drinking water. 9.79% of the population is getting less than 40 LPCD of drinking water. Among the four sample districts, Purnea reports the best levels of service delivery (99.13%) whereas Nalanda reports the lowest level of service delivery (84.79%). The district-wise service delivery levels and block-wise service delivery levels for the 4 sample districts is given in Annexure 5-A & 5-B respectively.

From the focus group discussion in the sample GPs, it came out that 52 LPCD of drinking water is required for daily needs. The details are given the table below:

Table 3.8.1.1: Daily requirement of drinking water per day per person (in Litres) as expressed in FGD

Sl. No.	Purpose	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
1	Drinking	6	6	5	4	5
2	Cooking	10	21	8	6	11
3	Bathing and Washing the cloth	20	23	20	11	18.5
4	Latrine/sanitation	7	17	19	7	12.5
5	Others	6	-	-	12	4.5
6	Total per capita daily requirement	49	67	52	40	52

It is noteworthy that this daily requirement doesn't include water needed for animals.

The position of overall water availability and during summer season was ascertained in the focus group discussion. For 68.4% of the FGDs, the overall water availability was rated as good and for the rest 31.6%, it was rated average. This is captured in the table below:

Table 3.8.1.2: Rating of Overall Water availability in FGD

Response	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Good	60.00%	20.00%	100.00%	100.00%	68.4%
Average	40.00%	100.00%	0.00%	0.00%	31.6%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

For summer season, the rating for good water availability dropped to 52.63% and 10.53% of the FGDs reported poor water availability during summer season due to water table going down.

During the household survey, availability of sufficient quantity of drinking water was assessed and is presented in the table below:

Table 3.8.1.3: Availability of sufficient drinking water for daily requirements in sample households

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Getting	85.96%	94.78%	97.30%	62.71%	84.93%
Getting but not Sufficient	14.04%	5.22%	2.70%	37.28%	15.06%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

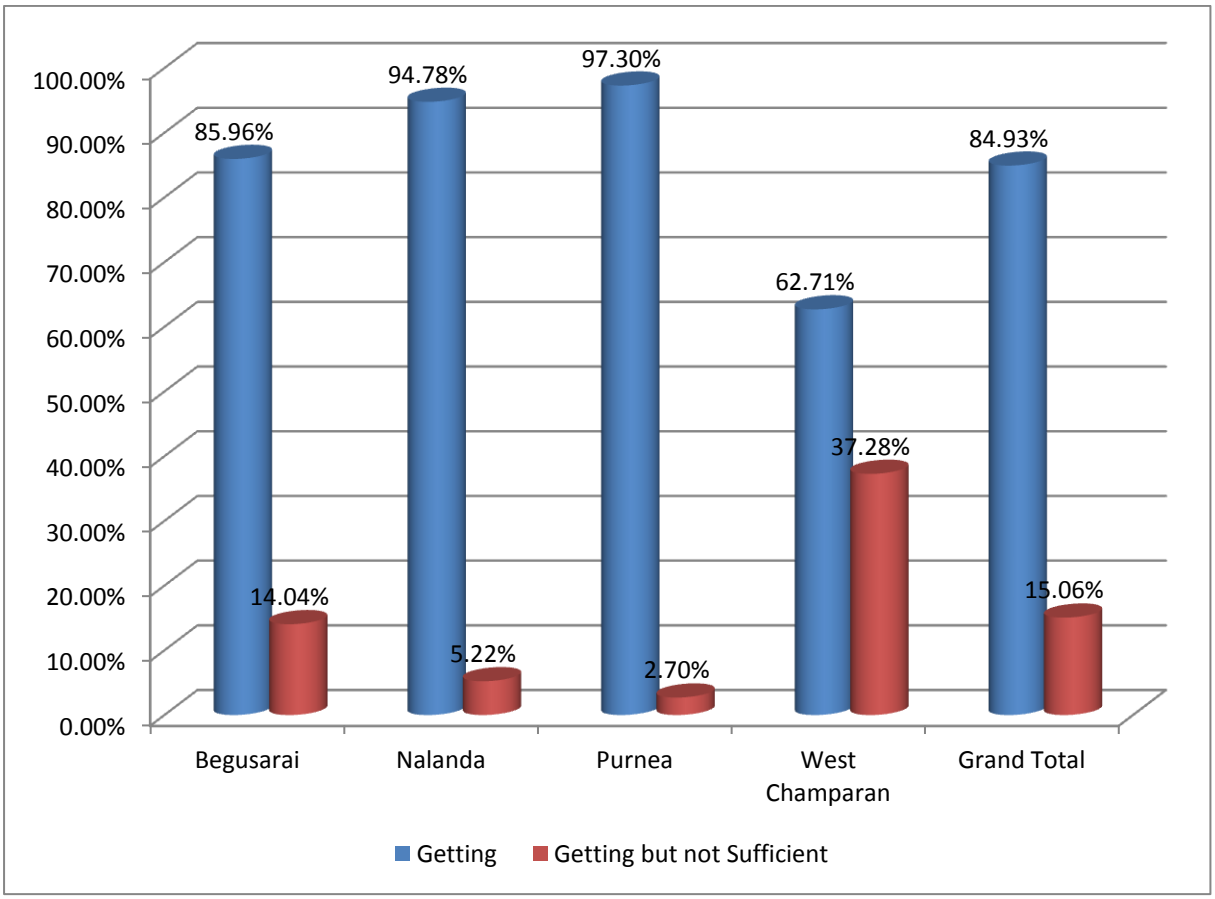


Figure 3.8.1.3: Availability of sufficient drinking water for daily requirements in sample households

It is apparent from the above table that nearly 85% households get enough drinking water to meet their daily requirements. The remaining 15% households get lesser quantity of drinking water than required.

The water sufficiency was assessed for summer months and is presented in the table below:

Table 3.8.1.4: Availability of sufficient drinking water during summer months in sample households

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Getting	47.37%	79.13%	13.51%	57.63%	49.78%
Getting but not sufficient	52.63%	20.87%	86.49%	32.37%	50.22%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

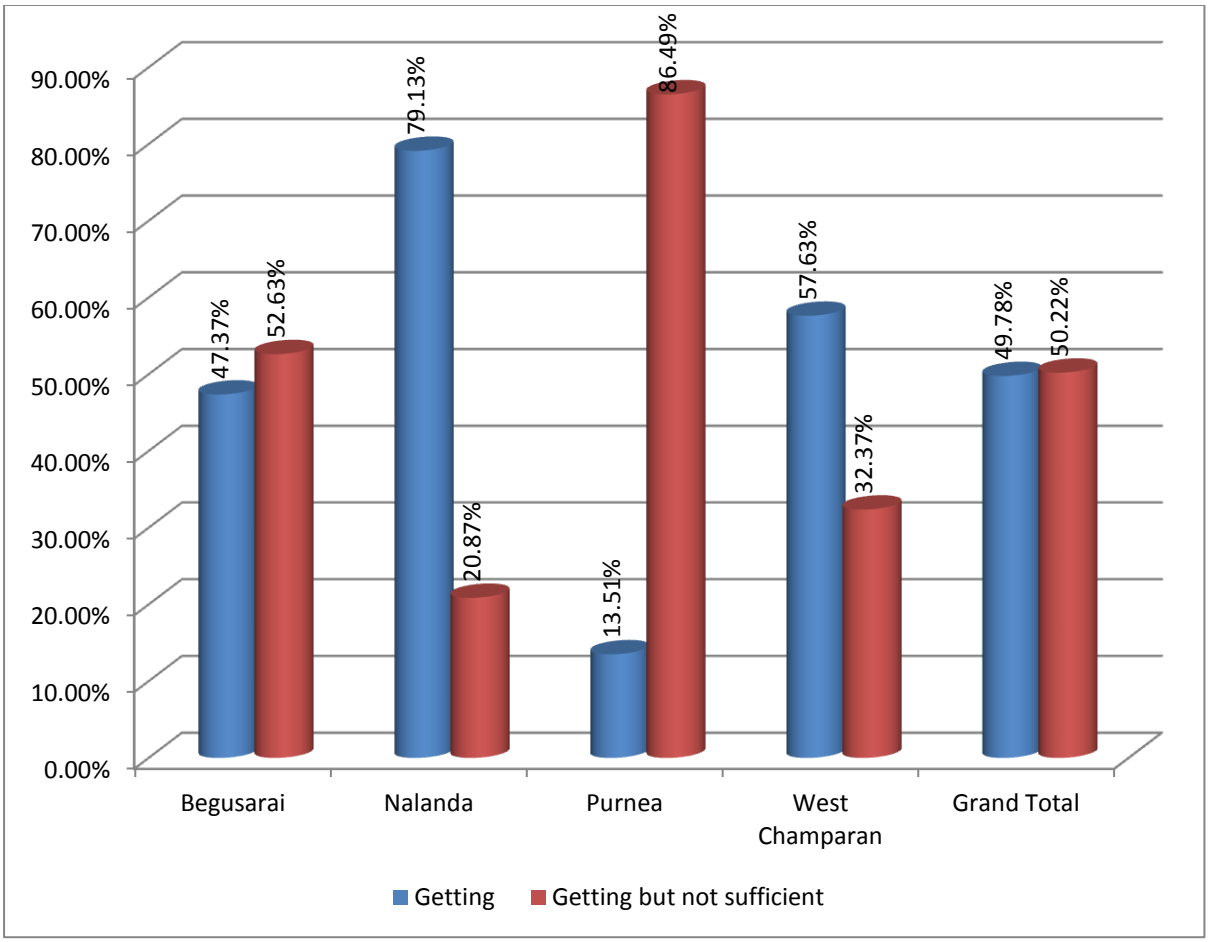


Figure 3.8.1.4: Availability of sufficient drinking water during summer months in sample households

The above analysis shows that availability of sufficient quantity of drinking water declines during summer months drastically. The reasons may be water table going down and frequent faults in hand pumps during summer as reported in the FGDs and household survey.

3.8.2 Emergency Supply

The source of water in case of emergency was ascertained during the household survey and the response is presented in the table below:

Table 3.8.2: Access to drinking water in case of emergency

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Neighbour's hand pump	0.00%	40.87%	5.41%	12.71%	14.85%
Distant hand pump	2.63%	32.17%	75.68%	22.03%	32.75%
Wells	7.89%	15.65%	0.00%	0.85%	6.11%
From anywhere in the village	89.47%	11.30%	18.92%	64.41%	46.29%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

It is apparent from the table above that nearly 46% households don't have a fixed water source as a backup during emergency. More than 32% households depend on hand pumps located at some distance in the village if their primary water source goes defunct.

3.9. Water Quality

There is no major quality problem in the state except for Arsenic, Iron and Fluoride contamination in some patches. 1590 habitations i.e. 1.48% habitations of the state in 50 blocks are affected by Arsenic contamination. 4157 habitations i.e. 3.86% habitations of the state, in 98 blocks are affected by Fluoride contamination. 18673 habitations i.e. 17.35% habitations of the state, in 101 blocks are affected by Iron contamination. Also, presence of nitrate in ground water is emerging as a future threat to water quality.

The issue of water quality was deliberated in detail during focus group discussions and 42.1% of the groups were satisfied with the overall quality of water. The various problems related to water quality during FGDs are presented in the table below:

Table 3.9.1: Problems related to quality of drinking water

Sl. No.	Facility	Begusarai (N=5)	Nalanda (N=5)	Purnea (N=4)	West Champaran (N=5)	Grand Total (N=19)
1	Water is muddy	1	2	0	1	4
		20.0%	40.0%	0.0%	20.0%	21.1%
2	Contaminated with fluoride/iron/arsenic	4	3	4	0	11
		80.0%	60.0%	100.0%	0.0%	57.9%
3	Water is hard	3	1	0	0	4
		60.0%	20.0%	0.0%	0.0%	21.1%
5	No Problem	1	1	2	4	8
		20.0%	20.0%	0.0%	80.0%	42.1%

Majority of the groups talked about water contamination problems like Arsenic, Fluoride and Iron and water being muddy.

Due to quality problems in drinking water, groups reported isolated cases of Vomiting and Diarrhea, Nausea, Constipation, other stomach related problems.

Various parameters pertaining to water quality were also assessed in the household survey.

Table 3.9.2: Quality of Drinking Water as perceived by Households

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Good	65.79%	70.43%	93.69%	69.49%	74.67%
Generally good but occasionally bad	34.21%	25.22%	6.31%	30.51%	24.24%
Bad	0.00%	4.35%	0.00%	0.00%	1.09%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

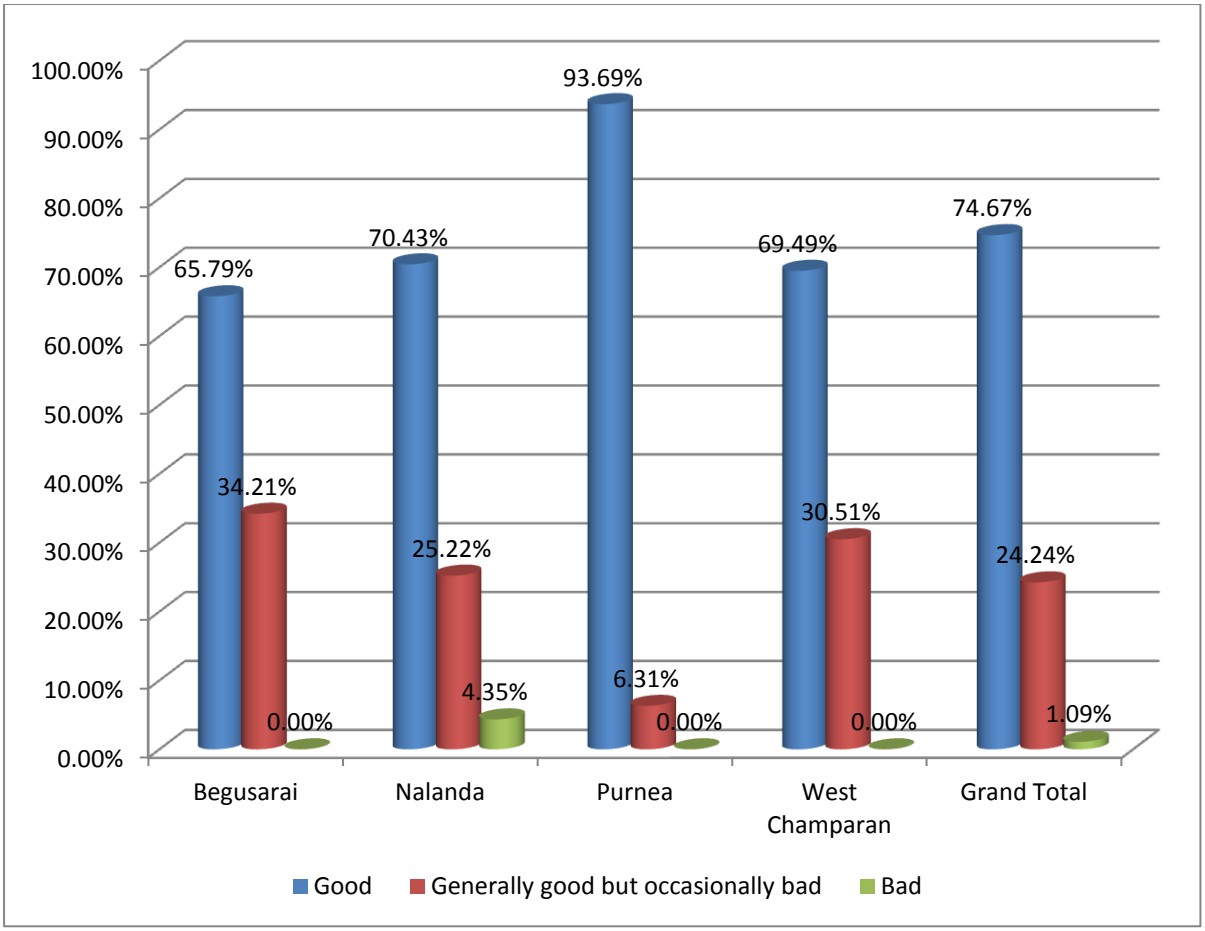


Figure 3.9.1: Quality of Drinking Water as perceived by Households

It is apparent from the above table and graph that according to the sample households, quality of drinking water is perceived as good by nearly 75% households.

Table 3.9.3: Various quality related problems in drinking water

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Hard water	16.67%	6.09%	0.00%	0.00%	5.68%
Polluted	0.88%	7.83%	1.80%	6.78%	4.37%
Salty & Muddy	16.67%	15.65%	4.50%	23.73%	15.28%
No Problem	65.79%	70.43%	93.69%	69.49%	74.67%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

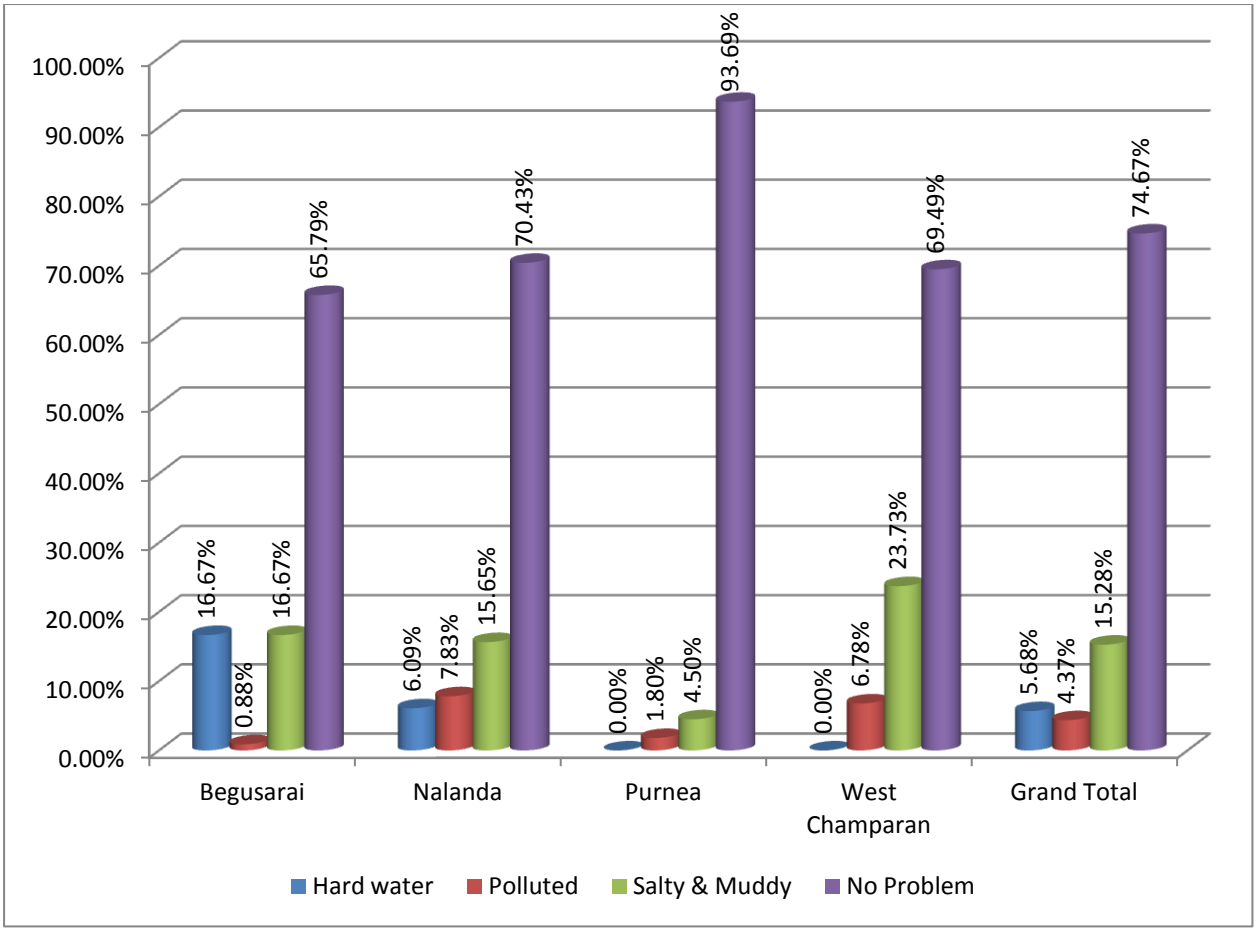


Figure 3.9.2: Various quality related problems in drinking water

It is apparent from the above table and graph that nearly 74% households reported no quality related problem in drinking water. Around 15% households reported salty and muddy water and remaining problems were hard and polluted water. W. Champaran reported problems related to water pollutants from sugar mills.

The presence of contamination problems in drinking water was assessed during the household survey and is presented below:

Table 3.9.4: Type of contamination problems in drinking water

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Iron	18.42%	7.83%	3.60%	0.85%	7.64%
Fluoride	0.00%	2.61%	0.00%	0.00%	0.66%
Don't know	15.79%	19.13%	2.70%	29.66%	17.03%
No Problem	65.79%	70.43%	93.69%	69.49%	74.67%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

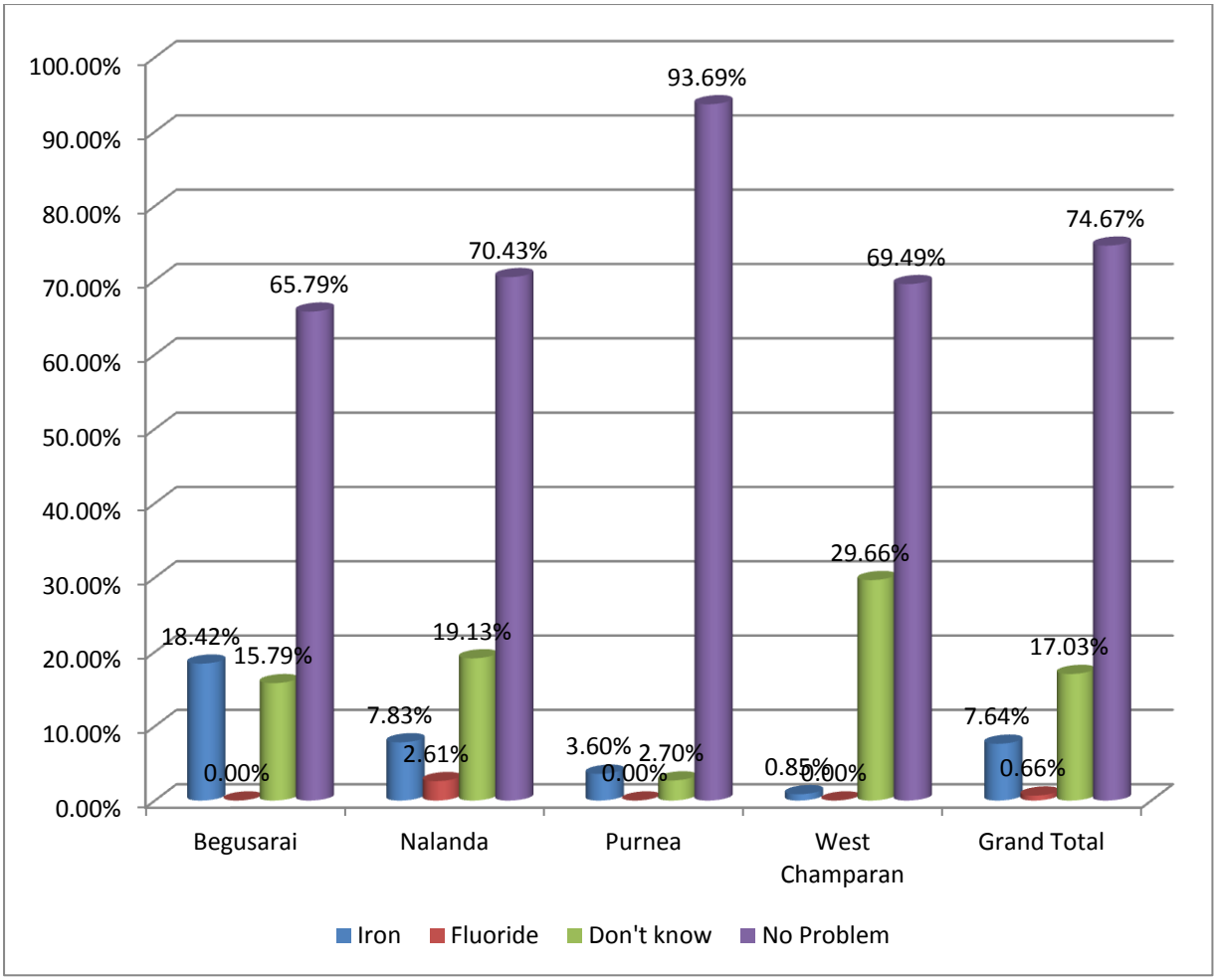


Figure 3.9.3: Type of contamination problems in drinking water

It is apparent from the above table and graph that nearly 75% households didn't experience contamination problems. However Iron was reported in 7.64% and Fluoride in 0.66%. Since close to 17% of the respondents could not answer due to lack of awareness, Arsenic contamination could not be captured.

Arrangements and frequency of water testing initiatives was assessed during the household survey and is presented in the table below:

Table 3.9.5: Frequency of water testing initiatives as reported by sample households

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
1 times	4.39%	20.00%	7.21%	4.24%	8.95%
2 times	0.00%	0.00%	0.00%	0.85%	0.22%
Not done	95.61%	80.00%	92.79%	94.91%	90.83%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

It is apparent from the above table that sample water testing initiative is in place in all the sample districts and water testing is being carried out as reported by nearly 9% of the sample households.

Measures taken by households to purify drinking water were assessed during the household survey and are presented below:

Table 3.9.6: Purification of drinking water by sample households

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Yes	9.65%	6.09%	21.62%	19.49%	14.19%
No	82.46%	25.22%	68.47%	76.27%	63.10%
Don't know	7.89%	68.70%	9.91%	4.24%	22.71%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

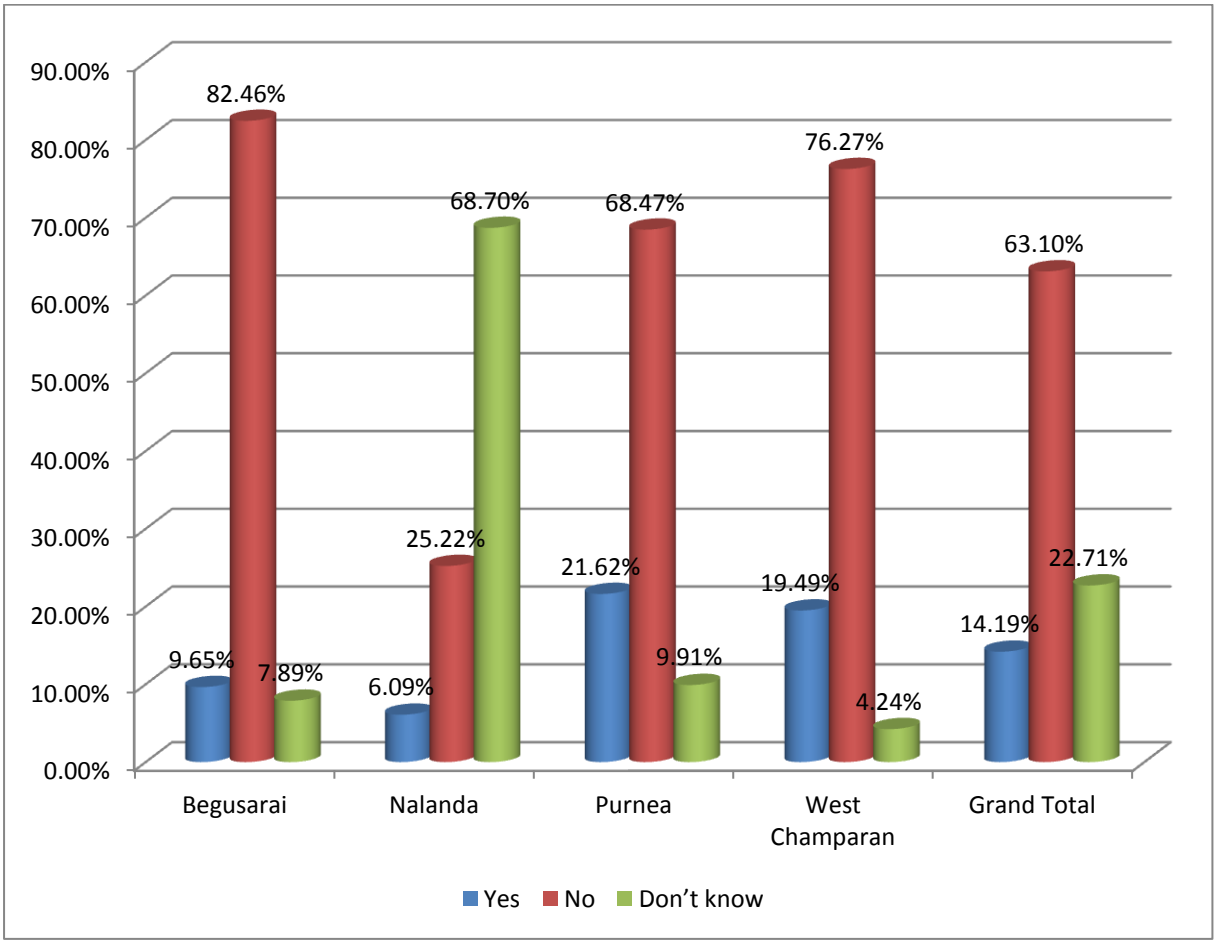


Figure 3.9.4: Purification of drinking water by sample households

It is apparent from the above table and graph that awareness regarding purification of drinking water is very low and only 14.19 % households take traditional measures like boiling and filtering through sedimentation to purify water.

Table 3.9.7: Various measures taken by households to purify drinking water

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Filter Machine	1.75%	0.87%	0.90%	5.08%	2.18%
Boiling	6.14%	1.74%	6.31%	11.86%	6.55%
Boiling & Filtering	1.75%	0.87%	12.61%	2.54%	4.37%
Other measures	0.00%	2.61%	1.80%	0.00%	1.09%
Not purifying	90.35%	93.91%	78.38%	80.51%	85.81%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

The above table reflects that 85.81% of the sample households do not take any measures to purify drinking water. Others mainly depend on traditional measures like boiling (6.55%) and filtering through sedimentation.

Arrangement for disinfection of water sources was assessed during the household survey and is presented below:

Table 3.9.8: Arrangement for disinfection of water sources

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Yes	6.14%	13.04%	13.51%	0.00%	8.08%
No	64.91%	79.13%	79.28%	98.31%	80.57%
Don't know	28.95%	7.83%	7.21%	1.69%	11.35%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

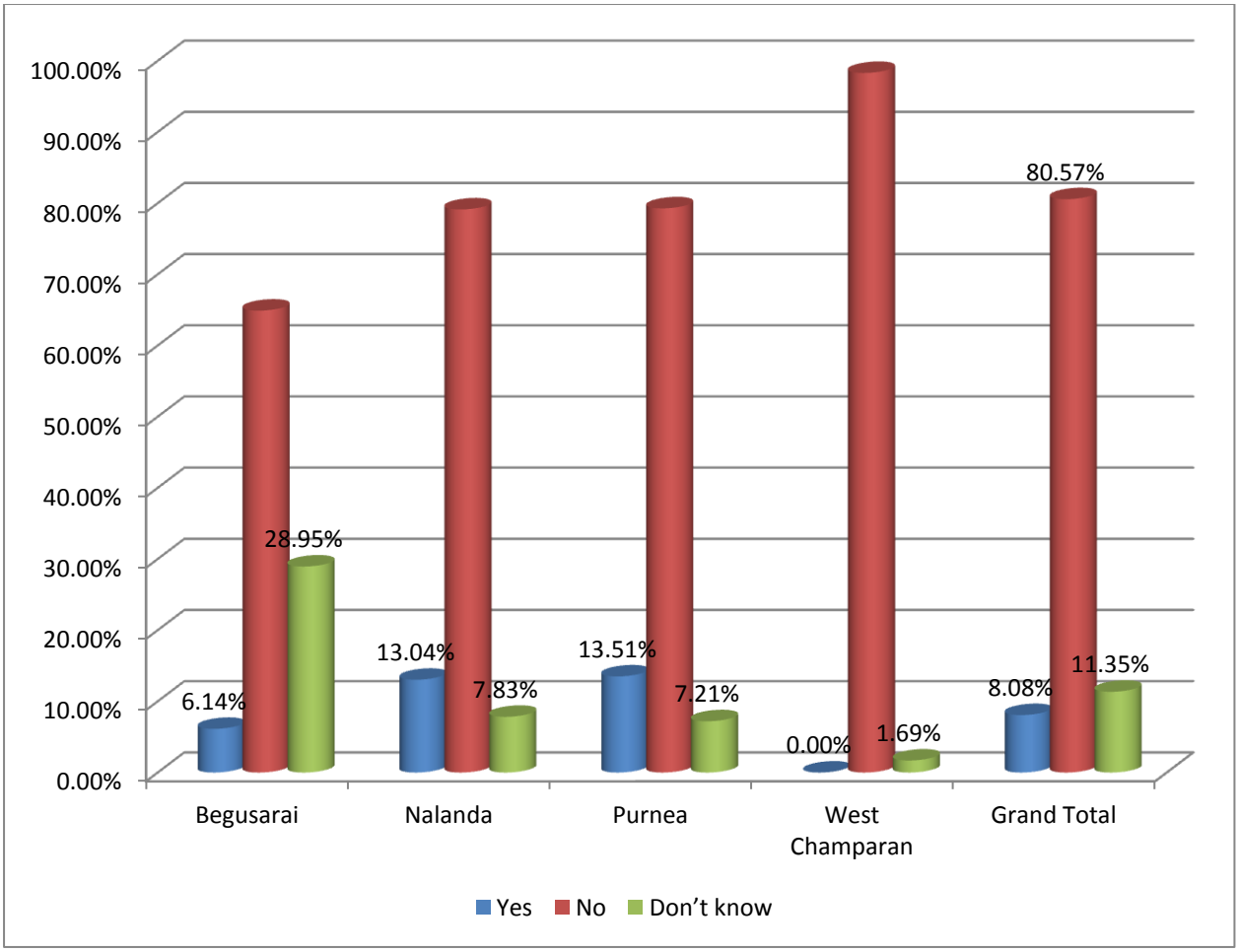


Figure 3.9.5: Arrangement for disinfection of water sources

It is apparent from the above table and graph that nearly 8% households reported regular disinfection of water sources. Majority of the respondents pointed out that no arrangements for disinfection of water sources is made.

Various measures taken for disinfection of water sources is presented below:

Table 3.9.9: Various measures for disinfection of water sources

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Bleaching Powder	0.00%	1.74%	0.90%	0.00%	0.66%
Cleaning frequently	6.14%	11.31%	12.61%	0.00%	7.42%
Not done	93.86%	86.96%	86.49%	100.00%	91.92%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

It is apparent from the above table that application of bleaching powder and frequent cleaning of source are the main measures for disinfection of water sources.

Overall Satisfaction level of drinking water services

Table 3.9.10: Overall satisfaction level with drinking water services in sample rural households

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Very satisfied	33.33%	7.83%	13.51%	58.47%	28.60%
Moderately satisfied	27.19%	34.78%	31.53%	24.58%	29.48%
Average	13.16%	28.70%	32.43%	11.86%	21.40%
Not satisfied	26.32%	16.52%	18.92%	4.24%	16.38%
Completely Dissatisfied	0.00%	12.17%	3.60%	0.85%	4.15%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**	**100.00%**

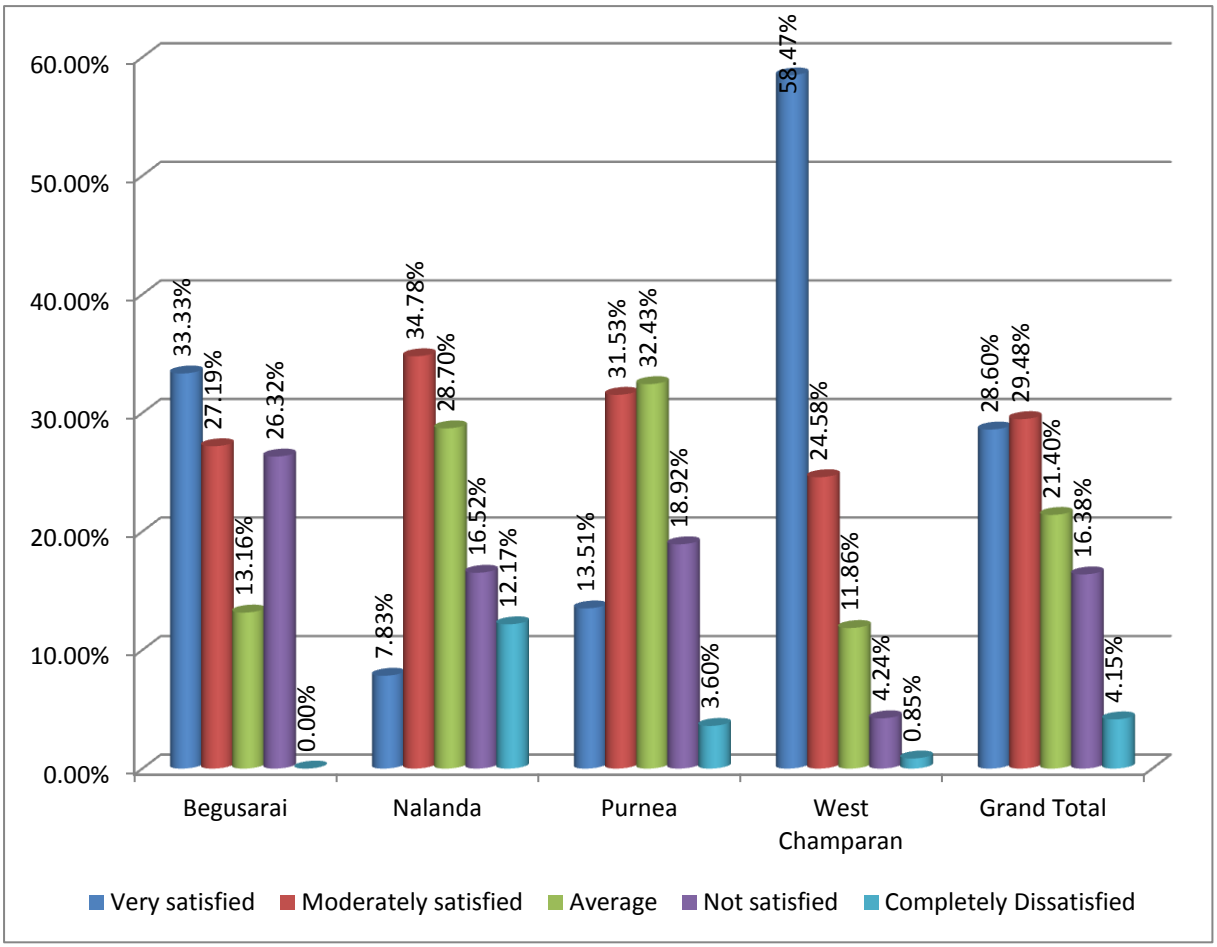


Figure 3.9.6: Overall satisfaction level with drinking water services in sample rural households

It is apparent from the above table and graph that 28.6% of households report high level of satisfaction with current drinking water services. Nearly 29% of households report moderate level of satisfaction whereas 21.4% household report average level of satisfaction with drinking water services.

3.10 Availability of Ground Water and Surface Water in Bihar

Sufficient quantities of ground water and surface water are available in Bihar. However there are certain limitations like contamination and pollution problems that need to be tackled.

3.10.1 Ground Water

The major part of the state is covered with Indo-Gangetic alluvium besides consolidated formations in the southern parts. Ground water development in the phreatic zone is generally through dug wells and shallow tube wells. The yield of these wells generally ranges from 3-10 lps. The dynamic ground water resources in the state have been estimated block-wise. The district wise estimation of dynamic ground water resource in the state is furnished in Annexure 6. It appears from the Annexure 6 that the Annual Replenishable Ground Water Resources of the state have been estimated as 28.63 bcm and the Net Annual Ground Water Availability is 26.21 bcm. The Annual Ground Water Draft for all uses is 11.36 bcm and Stage of Ground Water Development of the state is 43% indicating sufficient balance resources for development of ground water in the state. The range of development in the various districts is given in the table below:

Table 3.10.1: Stage of Development of Ground Water in Bihar

Stage of Development of Ground water	Number of District	Percentage of District	Name of District
Less than 30%	4	10.53	Aurangabad, Kishanganj, Munger, West Champaran
30-40%	10	26.32	Araria, Banka, Bhabua, Bhagalpur, Buxar, Jamui, Madhubani Rohtas, Saharsha, Supaul

41-50%	11	28.95	Arwal, Bhojpur, Darbhanga, East Champaran, Gaya, Khagaria, Lakhisarai, Nawada, Purnea, Samastipur, Sitamarhi
51-60%	11	28.95	Begusarai, Gopalganj, Katihar, Madhepura, Muzaffarpur, Patna, Saran, Shekhpura, Sheohar, Siwan, Vaishali
61-70%	2	5.26	Jahanabad, Nalanda

The depth of shallow aquifer and deep aquifer and the yield potential of shallow aquifer and deep aquifer of the various districts is given in Annexure 7. The depth of shallow aquifer ranges from 3 meter to 90 meters. While the depth range of deep aquifer varies from 21 to 314 meters. The yield potential of shallow aquifer ranges from 4 cubic meter per hour to 180 cubic meter per hour. The yield potential of deep aquifer is between 20 cubic meter per hour to 200 cubic meter per hour. The State Ground Water Directorate and Minor Irrigation Department Govt. of Bihar have identified 72 blocks in 21 districts where deep tube wells are required. The name of the blocks and the districts is given in the table below:

Table 3.10.1.1: List of Blocks where deep tube wells are required

Name of the district	Number of block	Name of block
Rohtas	3	Nauhatta, Sasaram, Dihri
Aurangabad	3	Kutumbba, Dev, Nabinagar
Gaya	12	Mohanpur, Konch, Barachatti, Manpur, Tekari, Imamganj, Wazirganj, Fatehpur, Bodh Gaya, Dumaria, Gurua, Sherghati
Nawadah	6	Rajouli, Akbarpur, Hisua, Govindpur, Manjhauli, Sirdalla
Nalanda	3	Islampur, Rajgir, Ekangarsarai
Jamui	3	Jamui, Sono, Khaira
Munger	2	Tarapur, Sangrampur
Bhagalpur	4	Sanhaula, Jagdishpur, Sultanganj, Sahkund
Banka	7	Banka, Barahat, Belhar, Amarpur, Rajon, Shambhuganj, Dhoraiya
Buxar	2	Buxar, Itarhi
Muzaffarpur	1	Saraiya
Saran	3	Sonepur, Dariyapur, Singhma

Vaishali	3	Goraul, Lalganj, Neura
Samastipur	2	Rosara, Bela
Kaimur	3	Durgawati, Chand, Bhagwanpur
Lakhisarai	1	Suryagarha
Begusarai	1	Barauni
Madhubani	2	Pandaul, Sikrahna
Sitamarhi	2	Belsand, Runni Saidpur
East Champaran	2	Chiralan, Raxaul
West Champaran	7	Narkatiaganj, Sikta, Manjhaulia, Lauria, Chanpattia, Gaunaha, Mainatand

The block wise ground water resources availability, utilization and stage of development for all the 10 districts identified for RWSS-LIS program is enclosed as Annexure 8. Out of 533 blocks in the state, 529 have been categorized as Safe and following 4 blocks have been categorized as Semi-critical.

District	Block
Gaya	Gaya Sadar
Nalanda	Nagar Nausa
	Rajgir
Nawada	Meskaur

The higher development areas are mostly located in isolated patches. There are marginal changes in the recharge and draft estimates of 2009 in the State as compared to 2004 estimate. The annual replenishable resource has marginally decreased while annual ground water draft has slightly increased in 2009 as compared to 2004 suggesting water conservation measures and better water management practices.

This gives clear indication that availability of ground water is abundant but there are limitations such as contamination problems in certain areas, low yield of tube wells in some pockets of districts like Saran, Gaya & Madhubani and presence of rocky layer beneath the soil making drilling difficult by the available drilling machines.

Contamination problems in ground water and pollution in surface water is discussed in detail in Chapter 8 “Environmental aspects”.

3.10.2 SURFACE WATER RESOURCES

There are many perennial and seasonal rivers in the state. Perennial rivers are Ganga, Kosi, Gandak, Mahananda, Burhigandak and Sone. The seasonal rivers in the state are Badua (Length 130 km, catchment area 2215 sq km), Chandan (Length 118 km, catchment area 4093 sq km), Kiul Harohar (Catchment area 17225 sq km), Kamla Balan (120 km, catchment area 4488 sq km) etc. Geographically the river Ganga divides the State into two parts. The land on the Northern Bank of the river is popularly known as North Bihar and that on the Southern Bank is known as South Bihar. North Bihar lies at the foothills of Himalaya and has border with Nepal. The rivers namely Kosi, Gandak, Bagmati & Mahananda originate in Nepal and flow through North Bihar before draining into river Ganga which acts as a master drain for these tributaries. During monsoons when the drainage capacity of Ganga is reduced due to its being in spate, North Bihar faces severe natural disaster in the form of floods, water logging & erosion. The floods and the water logging helps in recharge of ground water.

Ganga

Length of Ganga in Bihar is 445 km. The catchment area of the river is 19322 sq. km. It is joined by the three great effluents – the Ghaghra, the Gandak, and the Son and their tributaries in Patna district. Further Punpun joins it at Fatuha in Patna district, Koshi joins it at Khagaria district while the Harohar and the Kiul join it near Surajgarha, District – Lakhisarai. It passes through the cities & towns – Patna, Barh, Mokama, Begusarai, Munger, Khagaria, Bhagalpur, Kahalgaon, Pirpainti, in Bihar and exit to Saheb Ganj in Jharkhand and then to West Bengal.

Ghaghara

Length of Ghaghara in Bihar is 83 km. The catchment area of the river is 2995 sq km. Ghaghara is a perennial trans-boundary river, originating from the Tibetan Plateau near Lake Mansarovar in Nepal. It is a major left bank and largest tributary of the Ganges. After meeting with tributaries in UP it enters into Bihar near Guthani of Siwan district and joins Ganga at Ravilganj (Chapra) in district Saran. It carries more water than the Ganges before its confluence. Towns of Ghaghra River catchment area are Siwan, Saran (Chapra) and Sonepur in Bihar.

Gandak

Length of Gandak in Bihar is 260 km. The catchment area of the river is 4188 sq km. The Gandak river originates from melting of snow, glaciers and from lakes of Himalayan streams in Nepal and its border with Tibet, which contribute substantially to the lean season flows of the river. It enters into Bihar at the Indo-Nepal border Triveni (in Nepal) and Valmikinagar in Bagha sub division of West Champaran. The Gandak flows through West Champaran, East Champaran, Gopalganj, Saran, Muzaffarpur and Vaishali districts. It joins the Ganges near Patna just downstream with one of river bank at near Kaunhara Ghat, Hajipur, District – Vaishali and the another at near Hariharnath Mandir, Sonepur, District – Saran. In the year 2012, the minimum discharge of Gandak at Valmikinagar D/S was 33000 cusec on 17th June, 2012.

Sone

Length of Sone in Bihar is 202 km. The catchment area of the river is 15820 sq km. The Sone originates from the hills of Madhya Pradesh near Amarkantak. It enters to Bihar, near south of District – Kaimur. It passes through Aurangabad, Dehri – on – Sone, Rohtas, Daudnagar (Jahanabad), Koilwer, and rural areas of Patna district and finally joins the Ganges in downstream of Chapra, nearby Doriganj, District – Saran. The Sone has a steep gradient with quick run-off and ephemeral regimes, becoming a roaring river with the rain-waters in the catchment area butturning quickly into a fordable stream. The Sone, being wide and shallow, leaves disconnected pools of water in the remaining part of the year. In the year 2012, the minimum discharge of Sone at Indrapuri Barrage was 1580 cusec on 16th June, 2012. In June 2012 discharge was almost nil.

Punpun

Length of Punpun in Bihar is 235 km. The catchment area of the river is 9026 sq km. The Punpun River is a tributary of the Ganges. It originates in Palamu district of Jharkhand and flows through Chatra (Jharkhand), Aurangabad, Gaya and Patna districts of Bihar. The river joins the Ganges at Fatuha, 25 km downstream of Patna. Fed and carries little water in the dry season.

Kosi

Length of Kosi in Bihar is 260 km. The catchment area of the river is 11410 sq km. The Kosi is a trans-boundary river flowing through Nepaland India. In Nepal it emerges from the mountains with other tributaries and becomes the Koshi. After flowing through Birat nagar & other places in Nepal it enters into Bihar near Bhimnagar, district Supaul and after flowing approx. 260 km joins the Ganges near Kursela, district Katihar. In the year 2012, the minimum discharge of Kosi at Barah was 47150 cusec on 16th June, 2012. The discharge at Birpur Barrage downstream on the same date was 56855 cusec.

Bagmati

Length of Bagmati in Bihar is 394 km. The catchment area of the river is 6500 sq km. The Bagmati originates from Shivapuri Hills about few kms from Kathmandu in Nepal. It is a rain fed river and passes the center of Kathmandu, Tarai then enters into India near Dheng, district Sitamarhi, Bihar. It flows across Sitamarhi, Sheohar, Muzaffarpur and Darbhanga districts. Main tributaries of this river are Manusmar, Lakhandei and Kamla Balan. It finally joins BudhiGandak near Hayaghat, District-Darbhanga. This river is also causing flood in northern Bihar which results damage of lives and property.

Budhi Gandak

Length of Budhi Gandak in Bihar is 320 km. The catchment area of the river is 9601 sq km. The Budhi Gandak originates from Chautarwa Chaur near Bisambharpur, West Champaran, Bihar. It is a rain fed river and flows through West Champaran, East Champaran, Muzaffarpur, Samastipur, Begusarai and ultimately flows in to the Ganges in Khagaria. This river initially known as Sikrahana River upto Lalbagia Ghat, East Champaran, From its downwards journey it is known as BudhiGandak. The main tributaries of this river are Ramrekha, Harboura, Kohra, Sirisia and Bagmati.

Mahananda

Length of Mahananda in Bihar is 376 km. The catchment area of the river is 6150 sq km. Mahananda River is one of the tributaries of the Ganga. The origin of this mighty Mahananda River is hills of Darjeeling, West Bengal. The Mahananda River flows through Siliguri, then enters Bihar at Thakurganj, District-Kishanganj, Bihar and flows through the fertile agricultural area of Purnea & Katihar and then leaves to West Bengal. The Mahananda River

is mainly rain fed in the mansoon and flood also occur by this river. It has a low water level during the summer or winter.

Falgu River

Falgu River has historical importance as Gaya is located on the bank of this river. Falgu is not a separate river. It finds its existence by combination of Niranjana and Mohana rivers. Niranjana originates from Simaria region of western Hazaribagh District of Jharkahnd.

Although there are many perennial and seasonal rivers in the state, following issues pose concern in development of surface water:

- Emerging pollutants like antibiotics, pesticides even in minimal quantity are harmful
- Although the rivers are perennial, availability of water in summer season is limited

Still there is sufficient scope for exploitation of surface water for drinking purposes especially in areas near the surface water sources and in areas where ground water is contaminated.

The river basins of Bihar are depicted below:

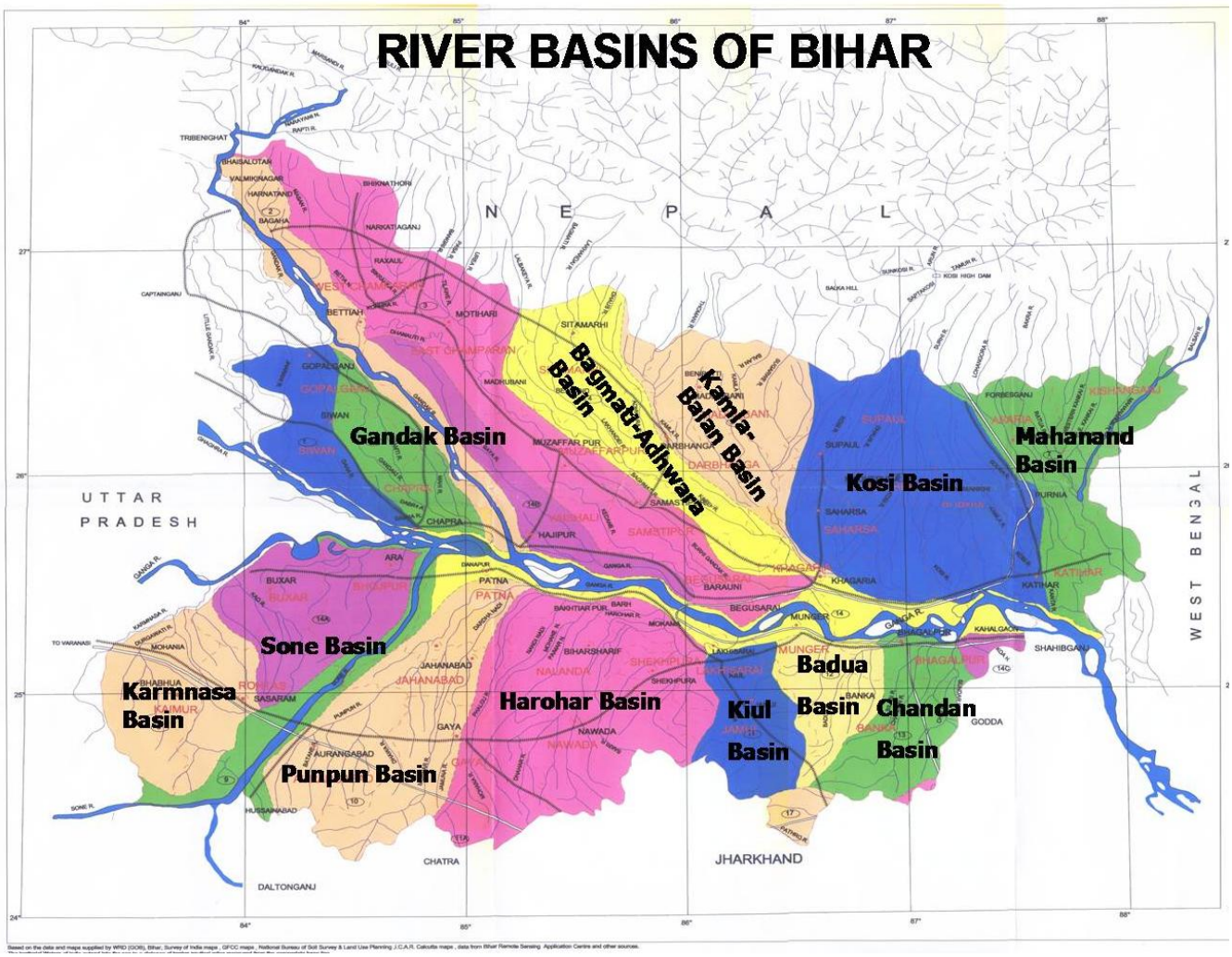


Figure 3.10.2: River basins of Bihar

3.10.3 Other water bodies

There are 28 dams viz. Kharagpur Lake, Nagi, Kohira, Amrity, Badua, Srikhandi, Kolmahadeo, Chandan, Jalkund, Morway, Satgharwa (N.F.), Job, Kailash Ghati, Nakti, Tarakol (N.F.), Baskund, Upper Badua (N.F.) Belharna, Phulwaria, Anjan, Batane, Orhani, Bilasi, Barnar, Durgawati, North Koel, Sindhwarni, Upper Kiul. The details of dam and their capacity is given in Annexure 9.

Although the availability of water in the summer season is limited, considering the abundant rainfall (details in Annexure 10) some drinking water schemes can be developed from the available water by according priority to water utilization for drinking purposes over irrigation / other uses.

Based on the availability and quality of ground and surface water resources in the state, we suggest conjunctive use of ground and surface water resources in most of the 10 districts identified for the World Bank assisted RWSS-LIS program.

Table 3.10.3 Suitability of water sources for districts identified for World Bank assisted RWSS-LIS Program:

Districts	Ground Water based	Surface Water based	Conjunctive Use
Banka	✓		✓
Begusarai		✓	✓
Munger		✓	✓
Muzaffarpur	✓		✓
Nalanda	✓		
Nawada	✓		✓
Patna		✓	✓
Purnea	✓		✓
Saran	✓		✓
W. Champaran	✓		✓

3.11. Issues that aid / limit improved service levels

Various issues which restrict improved service levels were identified in focus group discussions and are presented below:

- Leakage in distribution system
- Distribution system does not cover entire village
- Damage of Hand Pumps / Water supply schemes
- Damage of standposts
- Water logging near standposts
- Leakage in sluice valves

- Leakage in some OHT
- OHT not connected with the water source
- Water quality not tested
- Water treatment not done due to lack of supply of liquid chlorine
- Irregular supply of water
- Operator has not been posted in some water supply schemes
- Irregular monitoring of water supply scheme
- Irregular supply of electricity restricting duration of water supply
- Limited household connection
- High cost of household connection
- Solar plant does not work in fog and cloudy weather and no alternative arrangements
- No provision of drinking water for animals in current service delivery standard of 40 LPCD prescribed by NRDWP
- Gram Panchayat does not have requisite knowledge and resource to operate and maintain pipe water supply schemes

Some recommendations emerging out of focus group discussions to improve service levels are listed below:

- Develop a Citizen Charter for all activities related to water supply
- Organize capacity building programs for contractors to improve worksmanship for pipe water supply schemes
- Repair of non-functional hand pumps
- Repair of non-functional water supply schemes
- Water treatment should be done by ensuring liquid chlorine supply and proper monitoring
- Distribution system should cover the entire village
- Dedicated line for electric supply
- Timely Supply of water and increase duration of water supply
- Alternative power back up for solar system
- Organizing camp for creating awareness and giving household connection
- Proper arrangement of drainage from the water source / standpost to avoid microbial contamination
- Repair of damaged stand posts

CHAPTER 4

SECTOR POLICIES AND PROGRAMS

Access to improved water supply is not only vital for human health but is also necessary for the people's convenience and dignity. Various research findings point to substantial health and economic benefits for households and individuals as a result of improved water supply. Providing adequate and safe drinking water is one of the major challenges that face our governments, both at Central and State levels. A number of policies and programs have been adopted in Bihar to ensure that adequate and contamination-free drinking water reaches the rural population. The focus is on ensuring equity in distribution, specifically to the marginalized poor.

The present chapter attempts to assesses the sector policies, plans, programs and strategies operating at the State level. It highlights, *inter alia*, the major initiatives and schemes taken up in the State; the performance of these initiatives/ schemes; current service standards and norms of implementation; current subsidies, incentives and cost sharing structures; and water security issues.

4.1 Sector Policies, Plans, Programs and Strategies

In rural India, the major traditional sources of drinking water are community-managed open wells/ shallow hand pumps, private wells/ shallow hand pumps, ponds and small-scale irrigation reservoirs. The first government-installed rural water supply schemes were implemented in the 1950s as part of the Government of India policy to provide basic drinking water supply facilities to the rural population. However, the Government's effective role in the rural drinking water supply sector started in 1972-73 with the launch of Accelerated Rural Water Supply Program (ARWSP). During the initial years, till mid 1980s, the major thrust of the ARWSP was to ensure that sufficient drinking water reaches the rural community through the Public Health Engineering System. In the next phase, a Technology Mission was launched in 1986-87, which was renamed in 1991-92 as Rajiv Gandhi National Drinking Water Mission. During 1999-2000, the thrust shifted to Sector Reform Projects that aimed to involve community in planning, implementation and management of drinking water related schemes. This was later scaled up as Swajaldhara in 2002. Rural drinking water is one of the six components of Bharat Nirman, a program to build rural infrastructure, which was launched by the Government of India in 2005. ARWSP has been modified as National Rural

Drinking Water Program (NRDWP) since 2009. The Rural Water Supply (RWS) sector policy places major emphasis on ensuring sustainability of water availability in terms of potability, adequacy, convenience, affordability and equity while also adopting decentralized approach involving PRIs and community organizations. Adequate flexibility is afforded to the States and Union Territories (UTs) to enable them to incorporate the principles of decentralized, demand driven, area specific strategy taking into account all aspects of the sustainability of the source, system, finance and management of the drinking water supply infrastructure. Adoption of appropriate technology, revival of traditional systems, conjunctive use of surface and ground water, conservation, rain water harvesting and recharging of drinking water sources have been emphasised under the program.

Rural drinking water supply is a State subject and has been included in the Eleventh Schedule of the Constitution of India, among the subjects that may be entrusted to Panchayats by the States. Public Health Engineering Department (referred to as PHED hereafter), Government of Bihar, has drafted a State Water Policy (draft dated 10th March 2010) available in public domain that is yet to be finalized and adopted. The State Water Policy paper needs to be finalized and adopted on an urgent basis.

In this draft State Water Policy, the Government of Bihar aims to adopt a radical shift from 'predominantly engineering-based solutions to local community-based water and sanitation management solutions'. This essentially entails a shift towards community-level empowerment and responsibility for water and sanitation management. To make it effective, a combination of 'bottom-up' decision-making from the people side and 'top-down' technical support from the Government/ PHED is advocated. Thus, the government authorities will operate as multi-disciplinary technical service providers and facilitator rather than central control organizations. Many of the policy issues herein are intended to function from this new perspective. The key imperatives highlighted in the proposed State Water and Sanitation Policy are:

- Ensuring safe water availability to the population on sustainable basis through supportive policy and legal frameworks
- Planned development of water resources
- Shifting the norms for coverage from habitation to household level
- Fixing priorities for different uses of water
- Ensuring equity in use of surplus water

- Developing a framework with cost effective methods to ensure safe water to all
- Maintaining existing projects along with the construction of new projects
- Developing a proper management information system for efficient water resources planning
- Replacing the supply based management towards demand based water management
- Encouraging participation and capacity building of community based organizations (GPs/VWSCs) to develop a sense of owner ship on water resources
- Controlling the constantly declining ground water table and efficient water management
- Initiate rational water pricing
- Capacity Building to enhance the working efficiency of water related departments
- Integrating water and sanitation at community and institution level
- Reducing irrigation water demand through both increased irrigation efficiency, and optimum utilization of the available surface water resource.

After a closer look at the policy paper, and also field level survey and discussions, the following observations and suggestions are made:

- Although the Water Policy paper is not finalized as yet, the State Government is acting on almost all the issues mentioned therein.
- The water availability has been ensured to the entire population of the State primarily through handpumps.
- The number of pipe water supply schemes is only 906 which supplies water to 2.5% of the rural household. Since quality of water through pipe water schemes is more reliable and assured, there is an urgent need to shift the thrust now from handpumps to pipe water supply schemes**.**
- There is little use of surface water for drinking purpose by the State. Since the surface water is available in rivers and dams/ other water bodies, a strategy may be developed to utilize surface water for drinking purpose at least in the areas near to the surface water source and areas having ground water contamination**.**
- The norms for coverage are till date coverage of habitations rather than coverage of households. Whatever household coverage is there is by private shallow handpumps. Of course it is essential that in initial stages, coverage of all habitations need to be ensured. However, it would be better if over time focus of pipe water schemes

coverage is shifted from habitation coverage towards household coverage through household connections. It will ensure better people participation and revenue generation.

- The present study observed that in the sample districts there is high demand for household connections. However, often the beneficiaries are not aware of the procedure and the persons to be contacted for getting the connection. Organization of a camp at waterworks after due publicity may help in getting the application for household connections.
- The State government has given first priority of water use for drinking purpose. However, it is difficult to ascertain that the drinking water is not being misused for other purposes. Levying water tariff, even in small amounts, may ensure better accountability by users.
- Although capacity building effort is being made but looking at the capacity of the various institutions involved in drinking water, it becomes evident that capacity building programs on even larger scale is required**.**
- The government has already initiated integration of water and sanitation programs.
- A web-based MIS for monitoring has been developed by the department.
- It was observed that in the sample districts Village Water Supply Communities (VWSCs) committees are yet to be formed. These VWS committees need to be formed in all districts at the earliest.
- Public participation in pipe water schemes need to be enhanced by consulting/ involving the Panchayat system/ VWSC in the process of site selection, planning and monitoring of work during implementation. As it is observed that there is a gap in the capacity of Gram Panchayat/ Villagers, specifically in the field of technical knowhow and finance, a strategy should be evolved to provide technical inputs and basic revolving fund for maintenance to Gram Panchayats before transferring the schemes to Gram Panchayats/ VWSC. Simultaneously, capacity building of the Gram Panchayat functionaries/ VWSC members should be essential ingredient to empower the Gram Panchayat for taking up the responsibility of maintenance.
- Water pricing policy exists at Rs.5 per household per month but collection is not done because of lack of clarity about the use of the corpus formed. It has been observed during survey that people are willing to pay small amounts of money per month

provided they get regular water supply. Collection of the tariff may be started and rationalizing of current tariff rate may be made.

4.2 Major Initiatives and Schemes

The rural drinking water supply schemes are being implemented under various programs in the State with funding from the following sources:

- NRDWP –: This is the largest fund source for drinking water. The fund has two components viz program fund, mainly utilized for implementing projects related to drinking water and support funds, utilized for Quality Control and IEC activities.
- State Plan: Each year state earmarks a fund for drinking water
- Deposit work from Health, Education Department
- MNREGA funds: Handpumps installed for watering saplings planted under MGNREGS also used as source of drinking water
- BRGF funds: This untied nature of fund is utilized to bridge critical gap in drinking water.
- Fund recommended under Central and State Finance Commission
- NABARD funds

Major thrust in the State for the last ten years was on increasing rural household coverage with hand pumps. This was because better coverage and equity could be achieved through less per capita investment. One handpump can cover 250 persons at per capita cost of Rs.80 – 185. For pipe water schemes the per capita cost varies between Rs. 1000 to Rs.5000 depending on the type of scheme, the time period of installation, and the geographical coverage. It has been observed that as the population/ area coverage by a pipe water scheme increases, the per capita cost also increases.

The total number of handpumps installed by PHED as on 31st April 2012 are 828272, out of which 667163 are reported functional. It could be concluded that these handpumps is sufficient to cover rural population of 9.20 crores, even at the 60% potential utilization. This has been done for the sake of equity and providing drinking water to all on the available budget. Due to this reason the pipe water supply schemes have not got adequate attention. There are 906 pipe water supply schemes covering only 2.5% of the rural households.

Even though the thrust has been on hand pumps to increase coverage and ensure equity, the no. of pipe water supply schemes has increased from 300 to this current level of 906 schemes within the last 10 years. 500 pipe water schemes have been undertaken for renovation and rehabilitation. Mini water supply schemes based on solar energy have been initiated in the state. 38 water testing laboratories have been established in all the 38 district headquarters.

4.3 Sectoral Assessment of Current Service Standards and Norms of Implementation

Under the ARWSP guideline the norms that have been adopted since the inception of the program (1972) for providing potable drinking water to the rural population based on basic minimum need is 40 litres per capita per day (lpcd) for humans. To meet the requirements based on basic minimum need which has been continued in NRDWP also is shown in Table 4.3.

Table 4.3: Basic minimum water need

Purpose	Quantity (lpcd)
Drinking	3
Cooking	5
Bathing	15
Washing utensils and house	7
Ablution	10
Total	40

The above norms may be assessed by the respective State Governments and they may fix their own higher norms based on water availability, demand, capital cost involved, affordability etc. For purposes of comparability coverage means provision within a distance of 500 meters from the household for fetching water.

In Bihar also the current service standard norms is 40 lpcd. However, the draft State Water Policy specifies that the Government will ensure the provision of adequate potable drinking water to every citizen, shifting from habitation based norms to family level water security. It also states that the service level for rural areas will be at least 70 lpcd (pipe water).

The implementation norms suggested in the draft policy are:

- Implementation and monitoring of the action plan of state water policy
- Benchmarking of all the water resources project to improve their efficiencies and make the system transparent and accountable

- Prioritize water resources development projects on the basis of economic, social, environmental and financial criteria
- Possible integration of projects with surface and ground water resources
- Quantitative estimation of future water demands by stakeholders with line-department's technical assistance
- Encouraging Public Private Partnership in development and management of water systems

On the basis of study through primary and secondary data, focus group discussion and discussion with functionaries of Gram Panchayat the observations are as under:

- The State has achieved 100% coverage in 2005. Due to disfunctionality of schemes, increase in population some of the habitations have slipped back to partially covered category.
- 90.21% percent of the population are getting 40 lpcd and above as on 31st 2012 and only 9.79% are getting less than 40 lpcd water
- In the sample districts, the percentage of population getting 40 lpcd and above are 97.5% in Begusarai, 85% in Nalanda, 93.6% in West Champaran and 99.13% in Purnea.
- The field survey shows that average per capita water requirement is around 52 lpcd. The current 40 lpcd norm may be phase wise increased to 50, 60 and 70 lpcd for pipe water schemes in the coming years to make it more realistic and achievable.

4.4 Sectoral Assessment of Current Subsidies, Incentives and Cost Sharing Structures in the Schemes

The various components under the NRDWP are:

- Coverage for providing safe and adequate drinking water supply
- Sustainability to encourage States to achieve drinking water security at the local level,
- Provide potable drinking water to water Quality affected habitations
- Mitigate drinking water problems in rural areas in the wake of Natural Calamities,
- Operation & Maintenance (O&M) for expenditure on running, repair and replacement costs of drinking water supply projects, and
- Support activities

At the Central level 30% of the annual NRDWP funds are allocated for Coverage, 20% for tackling water quality problems, 10% on Operation and Maintenance (O&M) of rural drinking water supply schemes and 20% for Sustainability. States prepare district-wise Drinking Water Security Plan and funds under NRDWP are used to fund the gap in the plan. This funding pattern is on 50:50 centre-state sharing basis. 5% of NRDWP funds on a 100% Central share basis will be used for different support activities which will be required to be carried out in order to enable the rural communities to have access to assured availability of potable drinking water, use of advanced technology, viz. satellite data/ imagery; GIS mapping; MIS and computerization; etc. and other sector support activities, viz. water quality monitoring & surveillance program; IEC; water testing laboratories; HRD in the sector; training, conferences, seminar, R&D activities, CCDU, etc. 5% of the NRDWP funds are retained by Center and used for providing assistance to States to mitigate drinking water problems in the rural areas in the wake of natural calamities.

The government of India has introduced an incentive scheme for encouraging transfer of management of rural drinking water schemes (RWS) to the Panchayati Raj Institutions and for that purpose an incentive of 10% of the NRDWP allocation has been earmarked for the States that transfer the management.

As regard the cost sharing structure between government and the community, the entire cost of installation of the hand pumps/ waterworks is borne by the government. There is no reported incidence cost sharing by the community. In limited cases, the land was donated by individual for construction of water works. Although the government has fixed Rs. 5 per connection per month long ago for household connection, but the same has not been collected. The cost sharing of maintenance was also not noticed in any of the sample schemes. In this context following suggestions are being made:

- A strategy for cost sharing in the maintenance of the schemes in phased manner need to be implemented through participatory approach.
- The water charges need to be revised as per economic rate
- Clear guidelines need to be developed for recovering the above amount. Also, the person responsible for the collection and the use/ treatment of the corpus needs to be delineated.
- Incentive schemes may be designed for encouraging the Panchayats to take up the management of the schemes.

4.5 Status of Research and Development Initiatives

Research and development initiatives are essential for any sector to ensure efficient service delivery. Research and development in the field of Rural Water Supply and Sanitation program is one of the support activities of Ministry of Drinking Water Supply (MDWS) for which 100% funding to research organizations including NGOs is given by the Central Government. A Research Advisory Committee (RAC) under the Chairpersonship of Secretary (DWS) has been constituted primarily to promote research and development activities for the sector, to generate new ideas for research & development and fix priority for R&D project and decide thrust areas. To strengthen the R&D facilities in the concerned Departments in various States, State Governments has been encouraged to establish R&D cells with adequate manpower and infrastructure and fund State specific research projects from the NRDWP (Support) funds.

The draft policy paper of the State makes the following provisions for Research & Development initiatives in the water sector:

1. To place emphasis upon applied water resources research, focused upon Bihar's most critical water-sector issues and promote an ethos of cooperation between academic and government institutions for the same
2. To explore the possibilities for both internal and external cooperation in research, particularly with relevant specialist institutions, both inter-state and internationally.
3. To promote research to harness new learning to the benefit of the community

During the course of present study, it was observed that significant R&D efforts are yet to be initiated in the state. The State needs to initiate steps at the earliest on the following:

- Critical water sector issues need to be identified and collaboration with specialists / institutions for conducting R&D activities
- Research and Development in the areas like applied water resources technology for low-cost water quality enhancement for rural areas and water-health interaction in the socioeconomic cultural set up should be selected
- Research and Development proposals on the identified issues can be invited from third party or specialized institutions for conducting the R&D work.

- A special cell may also be constituted by the Government to initiate and coordinate the R&D activities

4.6 Legal and Regulatory Framework in Water Supply, Water Quality and Water Resources

The Draft State Water Policy stipulates that the following regulatory mechanisms may be in place to ensure water security for rural population in Bihar:

- A critical review of the laws related to water sector
- Repeal of out dated law and amendment of existing law to suit efficient integrated water and sanitation management.
- Legal specification of role, responsibility and authority of local community structures (VWSC) to allow them for managing their own water resources.
- Making legal provision for socially inclusive groups to have a substantive voice in their local water-user group.
- Development of legal framework for the regulation and management of groundwater extraction in general and in the 'Critical and Overexploited' zones in particular.
- Legislation to address the need for compensatory water conservation and recharge measures to be taken by the bulk water consumers.
- A legal framework to deal with conflict resolution within the water sector, which may start with community-based resolution, with subsequent appeal mechanisms at successively higher levels.
- Develop a legal framework to preserve existing water bodies from un-authorized construction, pollution and encroachment.
- Employing local water-user group to remedy the source of pollution, using technical and material assistance from the appropriate department.

On review of the existing legal frameworks and guidelines, the following were observed:

- Bihar ground water (regulation and control of development and Management) Act 2006 to regulate and control the development of ground water has already been enacted and notified on 29th January 2007 by the government of Bihar. Simultaneously, this Act also provides inclusion of rooftop rain water harvesting

(RTRWH) in building by law. There is mandatory provision of RTRW structure in the building plan in an area of 1000 sq. meter or more.

- Till date, critical review of existing laws regarding drinking water sector has not been attempted in detail.
- Legal framework and guidelines for VWSC are yet to be available with the District officials.
- Regulatory framework for water conservation measures by consumers are yet to be made available

It is essential that the following steps be taken to address the above issues:

- Activity mapping delineating roles and responsibilities of various stakeholders need to be done
- A detailed study of existing laws need to be made and amendments proposed, if required.
- Legal framework and guidelines for VWSC need to be developed
- Water conservation measures need to be made legally binding for consumers

4.7 Water Security, Water Quality and Water Safety Initiatives

Water security has been defined as the reliable availability of "an acceptable quantity and quality of water for health, livelihoods and production, coupled with an acceptable level of water-related risks". Throughout the world, ensuring water security is a matter of concern. Even going by the more limited definition of "the capacity of a population to ensure that they continue to have access to potable water", ensuring the same is a massive task; aggravated by population growth, climate change, droughts, depletion of ground water table, and chemical and faecal contamination of sources. NRDWP aims to ensure permanent drinking water security in rural India through measures to improve/augment existing drinking water sources and conjunctive use of groundwater, surface-water and rain water harvesting based on village water budgeting and security plan prepared by the community/local government.

The principles of Reduce, Recycle and Reuse of water security may be used that involves conservation and storage of water by utilising different sources for different use viz. properly collected and stored rainwater, treated surface water/ground water for drinking and cooking, untreated water for bathing and washing and grey water/spent water for flushing of

toilets. In such case, the use rather than the source should determine the quality of the water supplied. Health based target needs to be established for using groundwater surface water, rainwater and reused/recycled water.

Water quality refers to the chemical, physical and biological characteristics of water. It is most frequently used by reference to a set of standards against which compliance can be assessed. The most common standards used to assess water quality relate to health of ecosystems, safety of human contact and drinking water. Assurance of quality and safety of drinking-water is the key for prevention and control of waterborne diseases. World Health Organization (WHO) suggests international norms on water quality and human health in the form of guidelines that are used by countries developing and developed as the basis for regulation and standard setting.

For ensuring quality of water, Bureau of Indian Standards (BIS) formulated the IS: 10500 in 1990. World Health Organization (WHO) has also issued modified guidelines for Drinking Water Quality (2004) and guidelines for safe use of wastewater and grey water (2006). Both the guidelines adopted health based target setting approach based on the total exposure of an individual to contamination and moves from reliance on end product testing of water quality to risk assessment and risk management of water supplies commonly known as '**Water Safety Plan**'. Water safety plan links the identification of a water quality problem with a water safety solution. It includes both water quality testing and also sanitary inspection to determine appropriate control measures. It is a quality assurance tool that ensures protection of the water quality from the catchment to the consumer and from the tap to the toilet. Proper short-term & long-term strategies for water security, adopting the international and BIS guidelines and standards should be in place.

Water is defined as safe if it is free from biological contamination (guinea worm, cholera, typhoid etc.) and within permissible limits of chemical contamination (excess fluoride, brackishness, iron, arsenic, nitrates, etc.) as per IS-10500 standard of BIS.

Table 4.7 below shows the various water quality parameters and their permissible/ desirable limits as specified by BIS and WHO.

Table 4.7 : Standard water quality parameters and their limits

S. N.	Parameters	Unit	BIS (IS:10500)-1990		WHO Desirable Limits
			Desirable Limits	Max. Permissible limits	
1	pH	-	6.5 TO 8.5	6.5 TO 8.5	6.5-9.2
2	Arsenic	mg/L	0.05	0.05	0.01
3	Fluoride	Mg/L	1.0	1.5	1.5
4	E-Coli	Number/ 100 ml	Absent	Absent	Absent
5	TDS	mg/ L	500	2000	1,200
6	Nitrate	mg/L	45	45	50
7	Iron	mg/L	0.30	1.0	0.30
8	Calcium (as Ca)	mg/L	75	200	No specification
9	Magnesium (as Mg)	mg/L	30	100	No specification
10	Sulphate	mg/L	200	400	500
11	Alkalinity	mg/L	200	600	No specification
12	Turbidity	NTU	5	10	10

In Bihar, the water testing is done on 15 parameters including Conductivity (Umho/cm), Total hardness as $CaCO_3$ (mg/l) and Chloride (mg/ l).

The pollution of surface water sources are measured in terms of pH, Dissolved oxygen (DO in mg/l), Bio-chemical Oxygen Demand (BOD in mg/l), Total Coli-form (TC in MPN per 100 ml) and Faecal Coli-form (FC in MPN per 100 ml). A classification is also made of the surface water on the basis of these and a few more criteria to find its suitability for various purposes like drinking, bathing, animals, irrigation and fisheries propagation.

Thirteen, eleven and nine districts in Bihar are affected by Arsenic, Fluoride and Iron respectively. Iron is found on the shallow aquifer in most of the districts. A substantial proportion of illnesses in rural areas can be attributed to use of contaminated drinking water. The National Rural Drinking Water Quality Monitoring & Surveillance (WQM&S) Program was launched nationally in February 2006 (2005-06) with the prime objective of institutionalization of community participation and involvement of PRIs for water quality monitoring & surveillance of all drinking water sources.

Such a quality assurance program need to be adopted in the State for water supplies to reduce the potential risk of contamination of water supply. There needs to be a close collaboration between water supply agencies and health authorities for successful implementation of the program. All drinking water sources need to be tested by grass-root level workers in each Gram Panchayat by simple-to-use field test kits and joint sanitary surveys. One Field test kit is to be provided to every Gram Panchayat in the country for this purpose. The positively tested samples would then be tested at the District/State level laboratories for confirmation.

Ensuring source security is an essential part of water security and it is essential to serve the minimum specified amount of water (40 lpcd) in case of emergency or contamination problem or breakdown of primary source. Because of its vulnerability under different circumstances, in order to achieve water security at the individual household level, the water supply system should not depend on a single source. During natural calamity or pollution of different sources, the single drinking water source may either become non-potable or inaccessible resulting in acute shortage of drinking water availability to many, especially to the marginalized communities and cattle. Stress needs to be given on use of multiple sources and conjunctive use of various water sources.

The Draft State Water Policy (draft dated 10th March 2010), Government of Bihar, emphasizes the goal of water security for all. To achieve that water quality assurance initiatives are being undertaken by the State. Water Quality Testing Laboratories have been set up in all 38 districts with latest equipments and trained personnel. One State level laboratory is also functioning at Patna. A Quality Control Cell, headed by Director (Quality Control) has been set up in State PHED. Regular testing of water quality is being done from randomly collected samples. All the district laboratories are testing water for a minimum of two hundred samples per month and sending the report to State Laboratory. Simultaneously State Laboratory is also collecting samples from all over the State through their sample collectors. A comprehensive monthly report is being prepared and sent to headquarters. The entire thrust of water testing is on hand pumps water samples and the pipe water supply schemes are being overlooked. During the visit of pipe water schemes it was observed that regular water testing is not being done. A structured strategy for testing the water of the pipe water supply schemes quarterly/ half-yearly basis should be institutionalized and monitored properly.

It is thus evident that a lot needs to be done towards realizing the goal of water security for all individual rural households. Efforts should be made towards bringing awareness regarding water quality through IEC to address ownership of systems, health hazards, hygiene etc. Discharge of contaminated untreated effluents into natural streams and ground water must be prohibited by law. Exploitation of water must be done only from deep aquifer where chances of contamination are substantially reduced. There is requirement of augmentation of staff or specialist personnel like qualified chemist or microbiologist in quality testing laboratories as many posts are currently lying vacant. Laboratories need to be set up at sub-divisional levels with facilities for microbial testing. To ensure household level drinking water security and potability, community standalone water purification systems could also be promoted long term.

In order to safeguard the availability and quality of rural drinking water in India, this sector must have effective priority over other uses. Therefore, protection of ground water sources from excessive abstraction must be addressed, otherwise the costs of providing safe drinking water will continue to escalate. These issues can only be addressed with a multi-sectoral approach and a broad resource management perspective. Formulation of District Water Security Plans is an imperative. This will require development of institutional capabilities at the District Planning Board/ZP and GP/village level for preparing holistic plans for which provision must be made through allocation of funds as well as defining the institutional mechanism for capacity building and management of the RWS sector.

4.8 Demand and supply side capacities

The current rural population in Bihar is 9.2 crores. Assuming a growth rate of 2.45% per annum, the expected population at 2022 will be approximately 12 crores (120065827). Assuming that 97.5% of the population is not yet covered under pipe water schemes, only 23 lakh people are covered as of now. Remaining more than 11.7 crore people will have to be covered by year 2022 (for full coverage). **Table 4.8** shows a projection of the people to be covered and investment required to achieve various coverage levels from 20% through 90%.

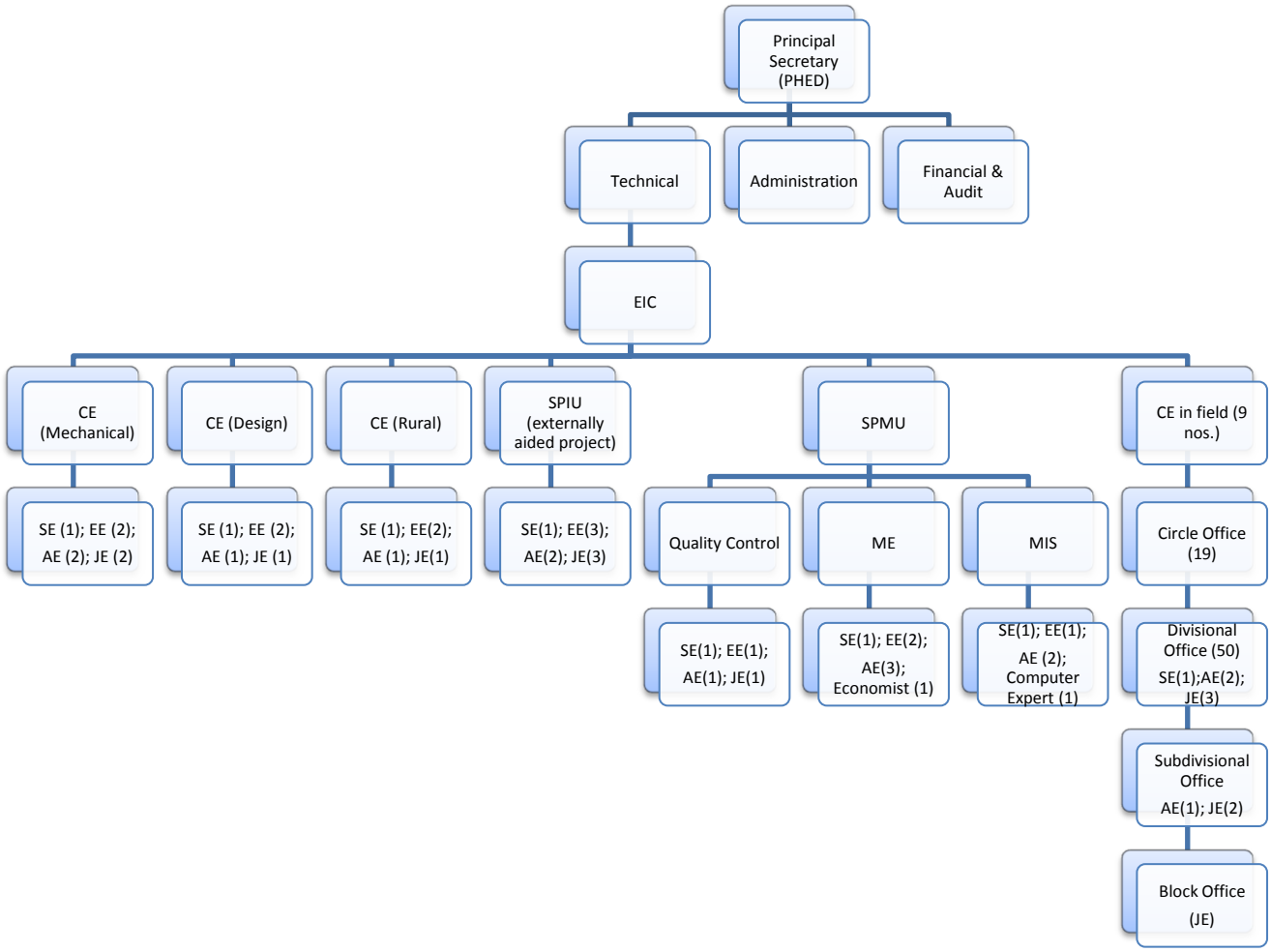
Table 4.8: Desired coverage vs. Projected investment levels

% Population to be covered in 2022	20	30	40	50	60	70	80	90
No. of additional people to be covered (crores)	2.36	3.53	4.71	5.89	7.07	8.24	9.42	10.60
Additional Investment needed@Rs.5000 per person(Rs. Crores)	11776.58	17664.87	23553.17	29441.46	35329.75	41218.04	47106.33	52994.62
Per Annum investment in 10 years (Rs. Crores)	1177.66	1605.90	2141.20	2676.50	3211.80	3747.09	4282.39	4817.69

Since the present level of pipe water coverage is 2.5% in rural Bihar (Census 2011), considering the plan size, infrastructure, departmental setup, State Govt. desires to increase this coverage to 20% by 2022. It is apparent from the above table that an investment of 1177 crores per annum would be required for achieving this. The current level of investment is to the tune of Rs.600 crores per annum, including investment on hand pumps. Hence, massive investment is required for the sector in the coming years. Thus, government can plan for externally-aided projects and may also think of Public Private Partnership (PPP). Govt. may also insist Central Govt. to increase the allocation under NRDWP. Govt. may also consider increasing the outlay by availing more funds from rural infrastructure development fund of NABARD.

But only additional monetary resources will not be enough to undertake such an ambitious expansion of coverage over the next 10 years. It has to be ably supported by gradual expansion and massive capacity development of the people in the organization. The current organization should be expanded in a phased manner through dedicated recruitment and training efforts. Vacancies at the field level must be filled immediately and separate units for implementation and monitoring of externally-aided projects must be set up. The State Project Monitoring Unit (SPMU) should have separate divisions to manage quality, to perform

continuous monitoring & evaluation and to manage the MIS effectively. Strengthening of existing organization can also be attempted by creating additional circles and divisions based on the number of pipe water schemes proposed to be implemented in the respective areas. Accordingly posts of Superintending Engineers, Executive Engineers, Assistant Engineers and Junior Engineers would have to be created for state office and field offices. A proposed organizational expansion in a phased manner is represented below where the numbers in parentheses show the minimum requirement of manpower for the increased requirements. The changes may happen slowly and are projected for the year 2023:



(EIC – Engineer in Chief, CE – Chief Engineer, SPIU – State Project Implementation Unit, SPMU – State Project Monitoring Unit, SE – Superintending Engineer, EE – Executive Engineer, AE – Assistant Engineer, JE – Junior Engineer)

Figure 4.8 Proposed Organizational Structure for expansion of coverage till 2013

The present study through focus group discussion in several villages in four sample districts estimated that the requirement of drinking water for individual households was around 52

lpcd. There is no problem from the supply side in the State. The present level of ground water development is only 43% with only 4 blocks in the semi critical category. There are a number of perennial and seasonal rivers are flowing in the State. Water Resources Department has also developed 28 dams/ water bodies. The surface water has not yet been utilized except in the multi-village scheme in Ara. Hence, it can be concluded that abundant water resources (underground and surface) are available.

However, to utilize the above available resources there is requirement of a well thought out plan along with additional fund, additional manpower in the department, additional infrastructure and massive capacity building effort to train the manpower as well as community.

4.9 Emerging Issues

The issue of sustainability of source and system for ensuring supply of potable water are cited as the two major constraints in achieving the goal of providing drinking water to all. Some major and critical emerging issues in the drinking water sector can be summarized as follows:

- There is *considerable gap between the designed service level* for which the infrastructure has been created *and the service available* at the household level. This is mainly due to low operational efficiency of water resources systems and wastage of water in distribution system.
- Further, the program has so far mainly been managed by the Government, *without active participation of the stakeholders*. This has posed a hindrance to the development of more sustainable, efficient and lower cost options for service delivery.
- In the years to come, the rural water supply program will face serious challenges by way of meeting the *expanding needs* of a fast growing population and increasing demand for higher service levels.
- There are noted instances of systems becoming defunct, poor ownership of water supply systems and sources by the rural community and poor operation and maintenance and neglect of traditional water which may over time result in rapid deterioration of water supply facilities
- High cost of service, low cost recovery and low level of expenditure on O&M is a major challenge.

- Stakeholders' involvement in construction, maintenance, revenue collection and O & M is needed for sustainable results.

We present below a SWOT analysis of PHED, Govt. of Bihar to tackle the emerging issues:

STRENGTHS	WEAKNESSES
• The department has installed 828272 hand pumps and 906 pipe water schemes • 81.19% habitation fully covered mostly through hand pumps • Availability of sufficient ground and surface water • Good organizational setup of PHED from State to sub-divisional/Section level • Availability of funds under NRDWP, State Plan, other externally aided projects, RIDF of NABARD • State has a draft Water Policy in place • Satisfaction level of users of handpumps high • PHED has 38 water testing laboratories • PHED has Monitoring/MIS Cell, Water Quality Division at head office • Provision exists for water quality testing of samples brought by individuals at nominal charges	• 18.81% habitation partially covered due to slipped back • Only 2.5% coverage through pipe water schemes • Low efficiency of existing pipe water schemes • Shortage of staff at lower levels and at Monitoring Cell at district & sub-divisional level • Capability of staff at lower level inadequate • Utilisation of fund is a concern • Draft State Water Policy not yet finalized and adopted • Water charges not collected • Sample testing of pipe water schemes not structured • Cleanliness and de-germination of waterworks not regular • Delegation of authority is limited • Low level of involvement of people/ Panchayats in pipe water schemes • Decentralized decision making limited • Lack of R&D and evaluation study (no technical officer) • Obtaining land is a limiting factor for undertaking new schemes • Present level of investment not sufficient to achieve target of 20% coverage as decided by State Govt. by 2022 • Lack of awareness among villagers about water quality testing provision •
OPPORTUNITIES	**THREATS**
• Adequate scope of pipe water supply • High demand for household connections • Willingness of beneficiaries to pay if regular & timely supply provided • Can attract funds from external agencies or under PPP mode	• Declining depth of ground water table • Contamination problems (Iron, Arsenic, Fluoride) • Surface water from all regions cannot be exploited for presence of sanctuaries/ endangered species

4.10 Integration and Convergence with Other Programs

The guidelines of National Rural Drinking Water Program (NRDWP) stresses the need to integrate water supply program with Sanitation Program and the State has adopted the Rural Water Supply and Sanitation (RWSS) program to ensure water security and total sanitation and cleanliness in rural areas in a holistic manner.

Besides NRDWP and State earmarked funds for drinking water, the fund for drinking water are also available under Central and State finance commissions. National Rural Health Mission (NRHM), Integrated Child Development Services (ICDS), Sarva Shiksha Abhiyan (SSA) and Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS) are being implemented in the State and there is some component of drinking water under the above schemes. The work under these schemes is being done by the PHED as deposit work.

On the basis the discussion with the various stakeholders and the primary and secondary data available with us our observations are as under:

- There is need to converge the drinking water components of all the above mentioned programs viz. NRHM, ICDS, SSA and MGNREGS programs being implemented in the State
- Operationalizing this integration will require understanding of different dimensions of water security and sanitation
- For ground and surface drinking water sources, it is of utmost importance to protect the catchment to prevent its pollution from human and animal excreta and other sources of bacteriological contamination. Well designed bunds, channels, bed protection, and convergence with Total Sanitation Campaign and Mahatma Gandhi National Rural Employment Guarantee Scheme for low cost waste water management, are a pre-requisite for ground and surface drinking water source protection.
- Convergence with the MGNREGS program for construction of new ponds and rejuvenation of the old ponds, including de-silting, should be built into the system design and execution to increase infiltration and percolation of ground water which will help in ground water recharge.

CHAPTER 5

INSTITUTIONAL ASPECTS OF DELIVERY OF DRINKING WATER SERVICES

The basic Institutional Goal & Vision of the Government in providing rural drinking water facilities is as under:

- Ensure provision of 70 lpcd potable drinking water in sustainable manner to every citizen
- Shift from habitation based norms to family level water security

For ensuring drinking water supply, different institutions are involved in activities ranging from creation of infrastructure to operation and maintenance; water quality testing and monitoring, etc. It might be useful to take a closer look at the institutions involved; their roles, functions and limitations for ensuring better co-ordination, convergence and support to the rural drinking water supply services program.

5.1. Institutions in Rural Drinking Water Supply

5.1.1 National Level

5.1.1.1 Ministry of Drinking Water & Sanitation, Govt. of India.

Government of India's major intervention in water sector started in 1972-73 through Accelerated Rural Water Supply Program (ARWSP) for assisting States/UTs to accelerate the coverage of drinking water supply. In 1986, the entire program was given a mission approach with the launch of the Technology Mission on Drinking Water and Related Water Management. The Technology Mission was later renamed as Rajiv Gandhi National Drinking Water Mission (RGNDWM) in 1991-92. In 1999, Department of Drinking Water Supply (DDWS) was formed under the Ministry of Rural Development (MoRD) to give emphasis on rural water supply as well as on sanitation. In 1999-2000, Sector Reform Projects were evolved to involve the community in planning, implementation and management of drinking water related schemes. In 2002, this was scaled up as the Swajaldhara program. The program was revised w.e.f. 1.4.2009 and named as National Rural Drinking Water Program (NRDWP). The National Rural Drinking Water Program (NRDWP) is a centrally sponsored scheme aimed at providing adequate and safe drinking water to the rural population of the country. DDWS remains an important institution to support the States/UTs in serving the rural population with water and sanitation related services all across India. Keeping in view

the extreme importance given to the sector by the Government, it was conferred the Ministry status in 2011. Ministry of Drinking Water and Sanitation is the nodal department for the overall policy, planning, funding and coordination of programs of drinking water and sanitation in the country.

5.1.1.2 National Rural Drinking Water and Sanitation Council

The High Level National Rural Drinking Water and Sanitation Council, headed by the Hon'ble Minister of Rural Development, with Hon'ble Ministers of State for Drinking Water & Sanitation, Secretaries from related Ministries, civil society and experts in the field of drinking water & sanitation as members, was set up in 2010. The purpose of setting up this Council is to bring in greater convergence and coordination amongst different Ministries/Departments of the Central Government and between Centre and States on issues related to drinking water and sanitation. The Council focuses on measures needed to improve the status of drinking water supply and sanitation in rural areas, strengthen the sustainability of drinking water supply schemes and give guidance to reduce contamination of drinking water sources so as to provide adequate and safe drinking water to the rural population.

5.1.1.3 National Resource Centre (NRC)

A National Resource Centre with 2 Team Leaders and 8 Consultants was set up in 2010 in the Ministry of Drinking Water and Sanitation. The NRC is functioning as a knowledge bank and provides expert technical assistance to the Ministry and to the States in implementing the rural drinking water and sanitation programs.

5.1.2 State Level

5.1.2.1 Bihar State Water and Sanitation Mission (BSWSM)

As a step towards achieving coordination and convergence among various State Departments dealing with Rural Drinking Water Supply, Rural Sanitation, Health, Women and Child Development, Water Resources, Agriculture, etc. Bihar State Water and Sanitation Mission (BSWSM) has been set up in the State. This mission provides operational flexibility with the desired thrust for an integrated implementation and institutionalizing community participation under NRDWP and Total Sanitation Campaign (TSC). The BSWSM comprises two committees for its functioning viz. Apex Committee (Governing body) and Executive Committee. Apex Committee is headed by the Development Commissioner with Secretaries

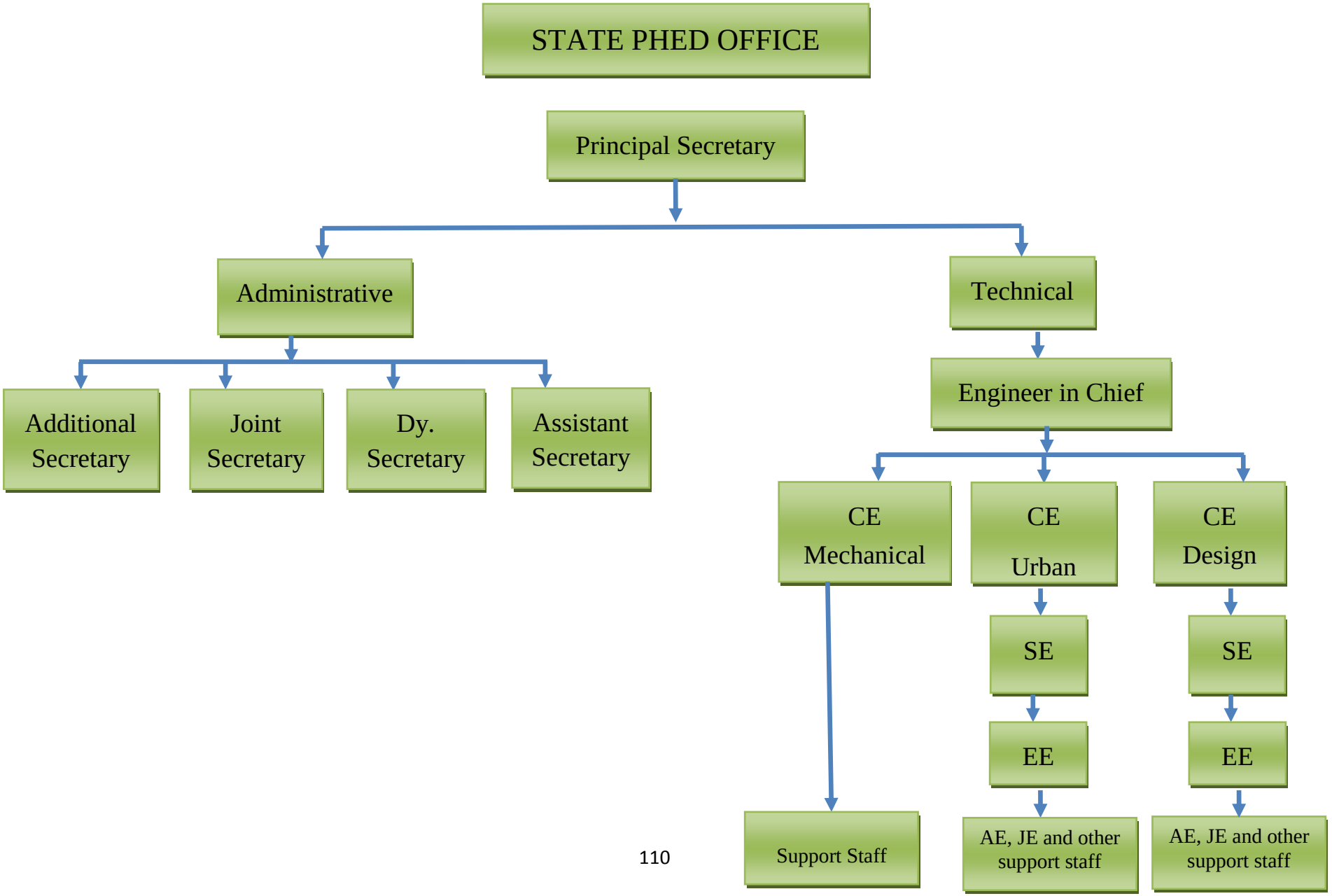
in/charge of PHED and other concerned Departments as members. Principal Secretary, PHED is the member secretary of Apex Committee. Apex Committee is responsible for all policy issues related to drinking water and sanitation in the state. Experts in the field of Hydrology, IEC, HRD, MIS, Media, NGOs, etc. have been co-opted as members. Executive Committee is headed by Principal Secretary, PHED and Engineer-in-Chief is the member secretary of the committee. Experts in the field of Hydrology, IEC, HRD, MIS, Media, NGOs, etc. have been co-opted as members in Executive Committee also.

5.1.2.2 Public Health Engineering Department

Public Health Engineering Department is headed by Principal Secretary, PHED. There are two wings of PHED i.e. Administrative and Technical. Technical wing is headed by Engineer-in-Chief. There are three Chief Engineers namely Mechanical, Urban and Design. Each has been supported by Superintending Engineers, Executive Engineers, Assistant Engineers, Junior Engineers, Draftsmen and other support staff. The department has four regional field offices located at Patna, Muzaffarpur, Purnea and Bhagalpur, which are headed by respective chief engineers and supported by superintending engineers / executive engineers to guide the district PHED offices under their control. The state office of Public Health and Engineering Department is responsible for undertaking the following tasks:

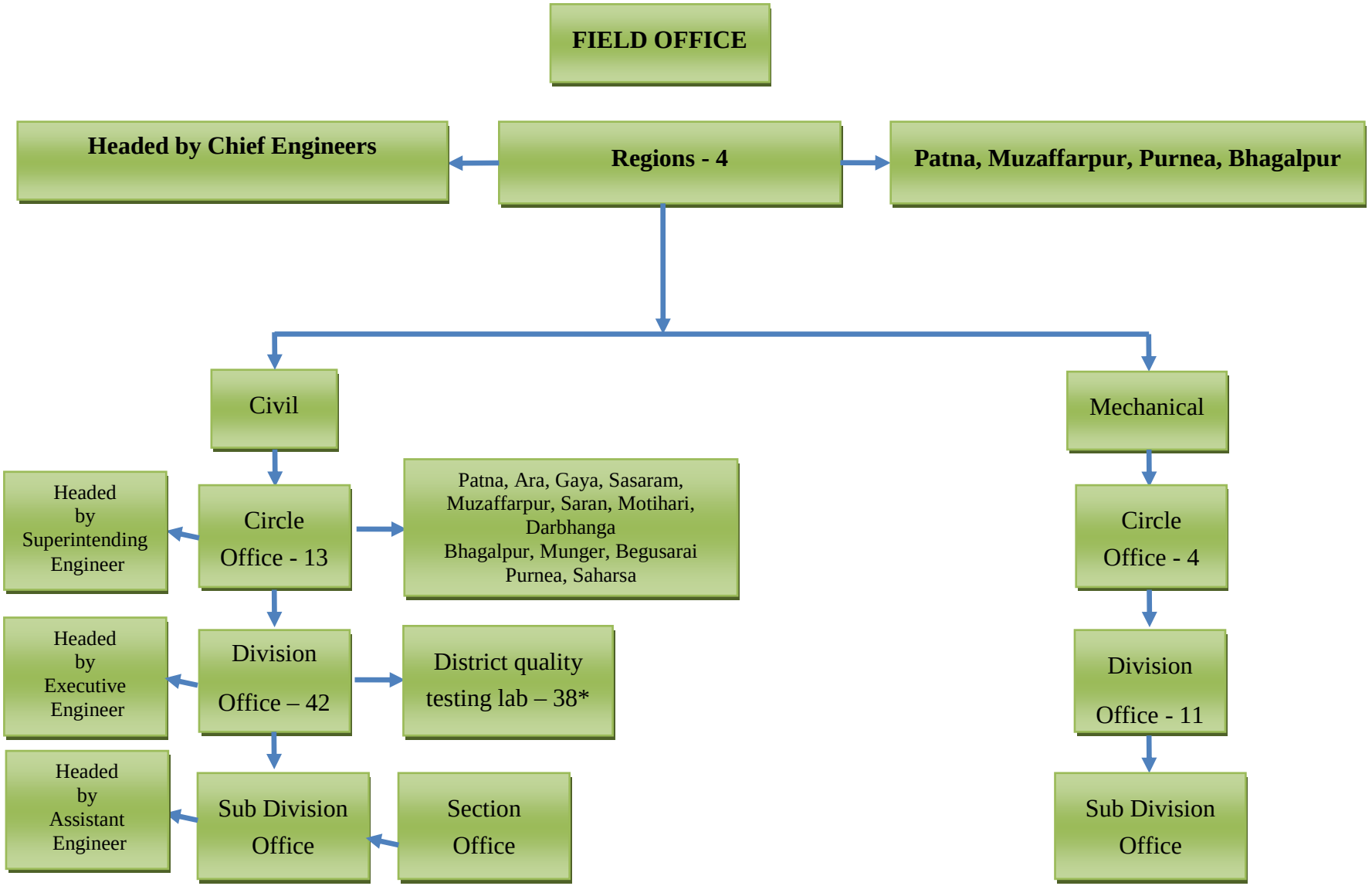
- Making Policy guidelines
- Administrative and Technical control of the regional offices / district offices
- Planning, Appraisal & Approval of schemes
- Monitoring of the schemes
- Quality Control

The organizational chart of the department is as under:


STATE PHED OFFICE
Principal Secretary
Administrative
Technical
Additional Secretary
Joint Secretary
Dy. Secretary
Assistant Secretary
Engineer in Chief
CE Mechanical
CE Urban
CE Design
SE
SE
EE
EE
Support Staff
AE, JE and other support staff
AE, JE and other support staff

5.1.3 Regional Offices

As mentioned earlier there are four regional offices of the PHED located at Patna, Muzaffapur, Purnea and Bhagalpur headed by respective Chief Engineers and supported by Superintending Engineers, Executive Engineers, Assistant Engineers and Junior Engineers. There are two separate wings: civil and mechanical in each region. The organizational chart of the field offices is furnished below.



***1 district level water testing lab in each district.**

5.1.4 District Level

5.1.4.1 District Water and Sanitation Mission (DWSM)

The District Water and Sanitation Mission (DWSM) was constituted at the district level, under the supervision, control and guidance of chairmen of Zila Parishads. The DWSM supervises preparation of the District Water Security Plan and its implementation. At the district level, convergence of some of the major development programs like the MNREGS, Central and State Finance Commission funds, and Irrigation schemes of the Ministry of Agriculture are also ensured through this mission. The DWSM engages qualified professionals in the field of IEC, M&E and MIS, HRD, Sanitation and Hydro geology to assist the activities at the district level. The District Magistrate is the Executive Chairman of the committee. DDC acts as the member secretary. MPs, MLAs, Executive Engineers of PHED, DEOs, Civil Surgeons, DRDA Director, District Welfare Officers and Panchayati Raj Officers, DPROs are the members of this committee. The committee holds half yearly / yearly meetings.

5.1.4.2 District Level Water and Sanitation Committee

District Level Water and Sanitation Committee has been formed under the chairmanship of DDC. The Executive Engineer PHED is the member secretary of this committee. The others members are DEOs, Civil Surgeons, DRDA Director, District Welfare Officers, DPROs, Panchayati Raj Officers etc. They have also nominated a person from the PHED department as district co-ordinator. The major functions of this committee are to review the implementation of rural drinking water and sanitation program, secure coordination amongst various departments and convergence of various programs related to rural drinking water and sanitation. The committee conducts monthly meetings.

5.1.4.3 Office of the Executive Engineer PHED

Each district has an office of PHED headed by Executive Engineer and supported by Assistant Engineers, Junior Engineers and Estimation Officer, Draftsmen, Work Sarkar, Mistry, Khalasi and other support staff. The district office is mainly responsible for planning, operation, preparation of detailed project report, implementation, maintenance and monitoring of the schemes. The district offices are facing huge shortage of staff at the level of Assistant Engineer,

Junior Engineer, Work Sarkar, Mistry and Khalasi. The current strength of staff in sample districts against the sanctioned posts is as under.

Table 5.1.4.3: Technical staff positions in sample districts

SI. No.	Particulars of Post	No. of sanctioned posts	Present strength	% of position of staff
District West Champaran				
1.	Assistant Engineer	4	2	50
2.	Junior Engineer	9	5	55.55
3.	Work Sarkar	18	4	22.22
4.	Mistry and Khalasi	1 for 250 hand pumps	31	-
District Nalanda				
1.	Assistant Engineer	3	3	100
2.	Junior Engineer	8	5	62.5
3.	Work Sarkar	Not available	Not available	-
4.	Mistry and Khalasi	Not available	Not available	-
District Purnea				
1.	Assistant Engineer	3	1	33.33
2.	Junior Engineer	9	2	22.22
3.	Work Sarkar	14	5	35.72
4.	Mistry and Khalasi	Not available	Not available	-
District Begusarai				
1.	Assistant Engineer	4	2	50
2.	Junior Engineer	10	3	30
3.	Work Sarkar	18	1	5.55
4.	Mistry and Khalasi	33	23	69.7

Similarly in mechanical division, only one Junior Engineer is posted in the district. The repair, maintenance and supervision / monitoring of pumps gets a set back because of the severe staff shortage. Due to the shortage of staff in civil wing, monitoring and supervision of the existing schemes gets disrupted, affecting functioning of the scheme.

The district offices also lack various other infrastructure related resources like adequate computers, software, broadband connectivity and vehicles for monitoring.

Urgent steps are required to create new posts and fill up vacant posts through campus recruitment in order to take up the load of the proposed projects. Simultaneously, outsourcing of the work of pump operators and maintenance may also be thought of.

5.1.5 Sub Division Level

Sub Divisional Office has been setup in each district for better monitoring and coordination. The office does not have adequate staff and infrastructure.

5.1.6 Section Office

In each sub-division, there are sectional offices. A JE has been allotted 3-4 blocks. Hence blocks are being looked after by a JE posted in Section Office. Block Level Office is required for strengthening the support system at the lowest level.

5.1.7 Gram Panchayat Level

Presently Gram Panchayat is not involved in planning, monitoring and maintenance of drinking water schemes. It was also observed that the awareness level and capability of the Gram Panchayat members to handle monitoring and maintenance was poor. To secure their involvement, Gram Panchayat should be involved in planning and site selection so that they feel ownership and responsibility towards the water supply schemes. Simultaneously, capacity building and creating awareness to increase the level of participation in rural drinking water schemes should be taken up. Capacity building for monitoring and maintenance of the water supply schemes and water tariff recovery by Gram Panchayats should also be attempted.

5.1.8 Village Level Water and Sanitation Committee

Village Water and Sanitation Committee (VWSC) is not yet constituted. VWSCs may play a crucial role in planning, implementation, operation and maintenance of the assets created. It was observed that the awareness level and capability of the villagers to handle monitoring and maintenance was poor. To secure their involvement, VWSC should be involved in planning and site selection so that they feel ownership and responsibility towards the water supply schemes. Simultaneously, capacity building and creating awareness to increase the level of participation in rural drinking water schemes should be taken up. Capacity building for monitoring and maintenance of the water supply schemes and water tariff recovery by VWSCs should also be attempted.

Based on the study of the present organizational structure, various roles and responsibilities from state to village level, the salient features of the institutional arrangements of rural drinking water schemes can be summed up as under.

- PHED has a well-structured organizational setup in place from State to Sub-Divisional Offices
- There is no structured organization / office at Block / GP level
- Mechanical and Civil are two main wings of technical service
- Construction is taken up by Civil while Mechanical wing looks after getting electricity connection and operation of machines
- Some gaps in coordination were observed among the two wings at district and sub-divisional level resulting in undue delay thus affecting the functioning of schemes
- Acute shortage of manpower was observed at the level of Assistant Engineers, Junior Engineers, Pipe Inspectors, Khalasi, Plumber, Mistry and Operators affecting project formulation, implementation, monitoring and repair work in schemes
- Capability of staff at lower levels to tackle the emerging challenges and cope up with new technology is low

The department may consider the following suggestions for effective implementation and monitoring of schemes:

- Creation of additional posts and filling-up of vacant posts through campus recruitments to take up the load of proposed projects. Since the state desires to cover 20% rural population through pipe water schemes by 2022, strengthening of PHED in terms of additional staff and requisite infrastructure in phased manner should be attempted to cope with the increased work load.
- Massive capacity building of field staff in areas like motivation, team building, new technology and participatory management
- Outsourcing of operation & maintenance
- Better coordination between civil and mechanical wings at district level and below

5.2 Institutional arrangements for quality control

The state headquarter has one water quality department headed by Director, quality control. One water testing laboratory has been established in each district under the overall control of

respective executive engineers of the districts. One state level laboratory is located in Patna. Thus, there are 39 water testing laboratories in the state. The water testing lab is equipped with latest tools / machines / equipments. The water testing labs conduct tests on 15 parameters viz. pH, Turbidity, Conductivity, TDS, Total Hardness, Calcium, Magnesium, Chloride, Alkalinity, Iron, Nitrate, Sulphate, Fluoride, Arsenic, Coli form organisms. The method of analysis being adopted at state and district laboratories is stated below.

Table 5.2: The method of analysis adopted in quality testing lab.

SI. No.	Parameters	Testing Method	
		At State Level Lab	At District Level Lab
1.	pH Value	pH meter	pH meter
2.	Turbidity, NTU, Max	Nephelometric	Nephelometric
3.	Conductivity, umho/cm	Conductivity meter	Conductivity meter
4.	Total Dissolved Solid, mg/l, Max.	Conductivity meter	Conductivity meter
5.	Total Hardness (as $CaCO_3$), mg/l, Max	EDTA method	EDTA method
6.	Calcium (as Ca), mg/l, Max	EDTA method	EDTA method
7.	Magnesium (as Mg), mg/l, Max	EDTA method	EDTA method
8.	Chloride (as Cl), mg/l, Max.	Titration	Titration
9.	Alkalinity (as $CaCO_3$), mg.l, Max.	Titration	Titration
10.	Iron (as Fe), mg/l, Max.	Phenonthroline	Phenonthroline
11.	Nitrate (as NO_3), mg/l, Max.	UV-method	UV-method
12.	Sulphate (as SO_4), mg/l, Max.	Turbidimetric	Turbidimetric
13.	Fluoride (as F), mg/l, Max.	SPANDS	SPANDS
14.	Arsenic (as As), mg/l, Max.	AAS	Spectro Photo meter
15.	Coliform Organisms, MPN/100ml	M-Test-Tube Technique	Stripe method

On an average, 200 samples are tested each month in each district laboratory and they submit the report in soft copy to state level lab. State level lab on an average collects 1140 samples throughout the state per month for water testing. Consolidated report of district and state laboratories are sent to the Director, Quality Control at state head quarters.

It was observed during the visit to water supply schemes in the field that regular water testing is limited to water samples mostly from hand pumps.

5.3. ADMINISTRATIVE APPROVAL

The delegation for according administrative approval is presented below.

- Principal Secretary: Up to 2.5 crores
- Minister PHED: 2.5 to 10 crores
- Finance Minister: 10 crores to 20 crores
- Cabinet on the basis of recommendations of the empowered committee headed by Development Commissioner: Above 20 crores

It appeared during the discussion with the Executive Engineers at field level that considerable time was required to get administrative approval of the schemes as proposals sent from regions were not complete and gaps were observed in such proposals. The time taken for administrative approval can be reduced by furnishing completed proposals.

5.4 DELEGATION OF POWER

The delegation of power for according technical approval, technical sanction and sanctioning of schemes, vested at various levels is presented below.

- Executive Engineer : Upto 3.5 Lakhs
- Superintending Engineer : Upto 70 Lakhs
- Chief Engineer : Upto 3.5 Crores
- Committee under the Chairmanship of Engineer-in-Chief : More than 3.5 Crores

The delegation of authority at the level of Executive Engineer and Superintending Engineer is not adequate. Most of the pipe water supply schemes were beyond the delegated authority of the Executive Engineer and Superintending Engineer. It was observed that delay occurs in according technical sanction and acceptance of tender due to inadequate delegation of power. Adequate sanctioning authority should be given at EE and SE levels.

5.5 STATUS OF DECENTRALIZATION OF SCHEMES

The decentralization of schemes was reviewed at the district level, and in focus group discussions and during discussion with Gram Panchayats. Salient observations in this regard are as under.

- DWS Mission & DWS Committee have been constituted in each district and are reviewing the implementation of schemes
- Very low level of transfer of schemes to GPs / VWSCs mostly due to unwillingness of GPs, lack of skills, knowledge, capabilities of the GPs / VWSCs
- Very low level of involvement of GPs / VWSCs in Planning, Implementation, Operation & Maintenance due to lack of awareness, knowledge and capabilities
- GPs which have taken charge are not equipped with requisite resources and capabilities to handle O & M of schemes
- VWSCs are yet to be formed in most villages in all the sample districts

Before transferring the schemes to Gram Panchayat / VWSC for operation and maintenance of the schemes, capacity building of Gram Panchayat / VWSCs should be undertaken to handle field situation. With this in mind the following operational strategies are suggested:

- Awareness campaigns should be organized to educate villagers on proper use of drinking water and sanitation
- Massive capacity building effort is needed to prepare VWSC / GP for handling operation & maintenance
- Mobilization at village level should be initiated for participatory management
- Involvement of the GPs / VWSCs from the beginning i.e. from planning, site selection etc. should be ensured

- Transferring the schemes in phased manner with fund for maintenance in the beginning under the supervision of PHED

5.6 MONITORING & EVALUATION OF SCHEMES

The department has monitoring wing at head office and monitors the implementation of the schemes in the field with support from district level office. Besides, regional office also monitors the implementation of the schemes with support from district level office. The present arrangement of monitoring and evaluation of the scheme was studied in sample districts. It was observed that Junior Engineers, Assistant Engineers and Executive Engineers at district level were responsible for monitoring of the schemes. Due to shortage of staff they were not in a position to conduct structured monitoring. Salient observations regarding the monitoring and evaluation of the schemes at field level were as under:

- Web-based Integrated Management Information System (MIS) has been developed
- Monitoring of schemes is not structured. Due to poor monitoring, quality gets a setback. Many handpumps and stand posts were damaged. There were leakage in the distribution system
- Focus group discussion clearly reveled that in spite of villager's willingness to take household connection; household connection is minimal as nobody is helping the villager in getting household connection and completing formality for the same.
- No third party evaluation studies have been conducted

We also discussed the ways and means for making the monitoring and evaluation more robust from the district level officials and during focus group discussions. Our recommendations regarding the same are as below:

- Dedicated staff and vehicles for monitoring may be deployed
- Broadband connectivity with adequate hardware and software support may be provided at district and sub-divisional office
- Monitoring of schemes may be structured and strengthened to ensure quality and timely repair of damaged sources
- Third-party evaluation study may regularly be conducted

CHAPTER 6

ECONOMIC AND SECTOR FINANCES

Basic Services, like drinking water, is a primary requirement for improving the quality of life of poor and marginalized sections of society. It is widely accepted that the state should take the responsibility of providing basic services to its citizens. In both developed and developing countries the government is responsible for such services. Till recently, the government, with its multilayer existence, was solely responsible for providing these public goods. It is only since the last two decades or so that the concept of participatory management in basic services started. The idea is to involve people in the planning and implementation as well as cost sharing of projects for sustainable use of resources and community empowerment. The present chapter evaluates different types of investments in the drinking water sector in rural Bihar and presents opportunities for cost sharing and participatory management.

6.1 Types of Cost and Expenditure involved in Projects

The six types of costs involved in implementing this project are:

(i) Capital Expenditure
(ii) Cost of Capital
(iii) Operation and Maintenance Expenditure
(iv) Capital Maintenance Expenditure
(v) Expenditure on Direct Support
(vi) Expenditure on Indirect Support

Table 6.1 gives details of each of the above type of cost. People involved in implementing projects should keep in mind all these components of cost for effective implementation and smooth functioning of projects. The expenditures on Capital, Maintenance, Direct Support and Indirect Support need to be carefully taken into account especially, as these expenditures have long term impact of the economics of project. However, these expenditures are often neglected and overlooked.

Table 6.1: Different types of Cost and Expenditure involved in Project

Categories	Characteristics
Capital Expenditure	Initial costs of putting new service into place. Hardwares such as pipes and pumps and software such as training and consultation.
Cost of Capital	Cost of borrowing money or investing in the service instead of another opportunity. It has direct impact on ability to maintain a service financially.
Operation and Maintenance Expenditure	Routine maintenance and operation costs crucial to keep services running. Its neglect has long term consequences for service delivery.
Capital Maintenance Expenditure	Occasional large maintenance costs for renewal, replacement and rehabilitation of a system. These essential expenditures are required before failure occurs to maintain a level of service and need to be planned in. This is one of the most frequently 'forgotten cost'.
Expenditure on Direct Support	Pre and post construction support costs not directly related to implementation e.g. training for community or user group. These costs are often forgotten in rural water supply scheme estimate but are necessary to achieve long term functionality and scale.
Expenditure on Indirect Support	The cost of planning and policy making at the government level and capacity building of professionals and technicians. This cost has long term impact on sustainability.

Source: IRC International Water and Sanitation Centre (2011)

6.2 Sources and Level of Investment

In the present study various drinking water sources in rural Bihar have been grouped into six categories viz. own hand pump, private hand pump, public hand pump, pipe water connection, wells and others. Across the State, 95% of sample households are found to depend on hand pumps for their drinking water. It was also found that 43% of sample households have their own hand pumps which are their main source of drinking water. Dependency on different types of handpumps varies across the sample districts. While in Begusarai and Purnea sample households are mostly dependent on their own hand pumps, in West Champaran and Nalanda households mainly depend upon public hand pumps. Dependence on public water supply is more in West

Champaran district compared to other sample districts. Figure 6.1 shows the drinking water sources of households in the sample districts.

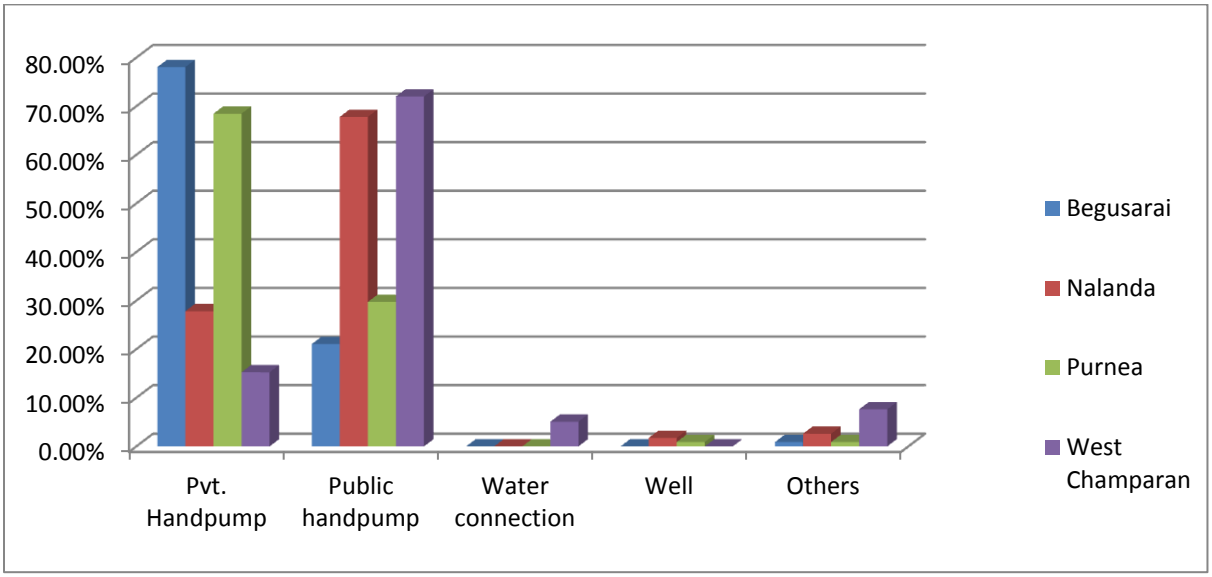


Figure 6.2: Drinking Water Sources in sample districts

6.3 Level of Public Investment in Rural Drinking Water

The following programmes are in operation from which the public hand pumps are set up

1. NRDWP
2. State Plan (Mukhyamantri Chapakal Yojana)
3. District Programs

Other than the above programs, Gram Panchayats (GPs) are also investing in hand pumps under different schemes like Backward Regions Grant Fund (BRGF), Fund recommended by 13th Central Finance Commission and 4th State Finance Commission. For instance, in 2011-12 the entire amount under BRGF program was utilized to install hand pumps by GPs. PHED is the sole agency for supplying pipe water in rural areas investing under NRDWP and State Plan.

Table 6.3: Plan and Expenditure on Drinking Water

SI. No.	Year	State Plan			NRDWP				Total expenditure	% of Total expenditure
		Available Fund	Expenditure	% of expenditure	Available Fund	expenditure	% of expenditure	Total Available Fund		
1	2	3	4	5	6	7	8		9	10
1	2007-08	16027.85	14812.84	92.42	45865.95	17479.15	38.11	61893.8	32292	52.17
2	2008-09	32527.85	13801.8	42.43	73624.8	7993.59	10.86	106152.65	21795.4	20.53
3	2009-10	22700	16258.51	71.62	83984.71	28487.16	33.92	106684.71	44745.7	41.94
4	2010-11	22340.74	20785.68	93.04	71820.91	42139.85	58.67	94161.65	62925.5	66.83
5	2011-12	25948.74	22470.59	86.6	49424.39	36422.17	73.69	75373.13	58892.8	78.13

(Source: PHED, Govt. of Bihar)

The main sources of fund for drinking water are under two programs, viz. NRDWP and State earmarked fund for drinking water. It is evident that the State and Central Governments invest a substantial amount every year in improvement of rural drinking water in Bihar. In the last five years, the state government had earmarked Rs. 1195.48 crores for drinking water supply, out of which Rs. 881.33 crores was utilized (table 6.3). Apart from state government funds, earmarked funds from central government through National Rural Drinking Water Program (NRDWP) were also utilized. In the last five years Rs. 3247.26 crores were made available out of which Rs. 1325.28 crores were utilized for drinking water services. Table 6.3 gives the detailed planned expenditure and utilization on drinking water in Bihar in the last five years. The year wise available fund under NRDWP and State Plan and their expenditure shows that in 2007-08, department was able to utilize 92.4% of State Plan fund and 38.1% of total fund made available under NRDWP and together 52.1% of the total available fund was utilized. The year 2008-09 shows lesser utilization of the available fund. Only 20.5% of the total available fund was utilized in the year 2008-09. Though it is found that in the year 2008-09 the available funds under State Plan as well as under NRDWP were almost doubled compared to the previous year, still the the low rate of utilization is evident. Though the next year the department was able to cope with the situation and was able to utilize 71.6% of the available fund under State Plan and 33.9% fund

under NRDWP. In last two years, viz. 2010-11 and 2011-12 department has been able to utilize 66.8% and 78.1% of the total available fund in the respective years.

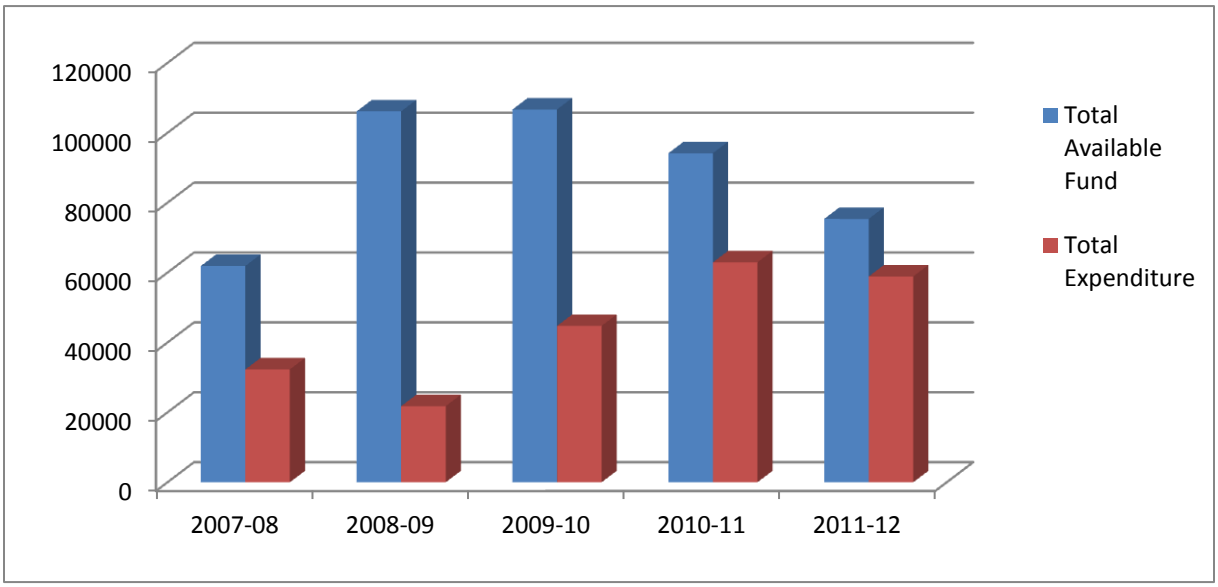


Figure 6.3: Plan and Expenditure on Drinking Water

Year wise Total Available Fund and Total Expenditure

It is evident that, the utilization trend of fund under State plan is more than the utilization rate of fund under NRDWP. It is also evident that there is under utilization of fund. In last five years a sum of Rs. 444274.99 lakh was made available to the department and out of this, Rs. 220660.34 lakh has been utilized, which is 49.6% of the total available fund in last five years.

6.4 District wise Expenditure

The present study explores the expenditure pattern in the sample districts on drinking water. Table 6.4 presents expenditure by PHED at the sample district level in last five years. This expenditure includes expenditure on installing hand pumps and pipe water schemes. Table 6.4 shows that there is significant difference in expenditure on drinking water across the sample districts. The lowest expenditure level is at West Champaran, whereas the highest is at Nalanda, followed by Begusarai. Despite year wise fluctuations in all districts, the difference between Nalanda / Begusarai and West Champaran / Purnea are perceptibly high.

Table 6.4: Expenditure on drinking water by PHED in Sample Districts

	Districts (Rs. In Lakhs)			
Year	West Champaran	Begusarai	Nalanda	Purnea
2007-08	121.34	1595.73	600.53	NA
2008-09	85.15	428.48	862.05	205.00
2009-10	547.50	92.15	1353.35	606.15
2010-11	204.58	1475.79	1416.34	963.97
2011-12	327.79	1773.37	2035.21	380.59

(Source: Data Collected from PHED in Sample Districts)

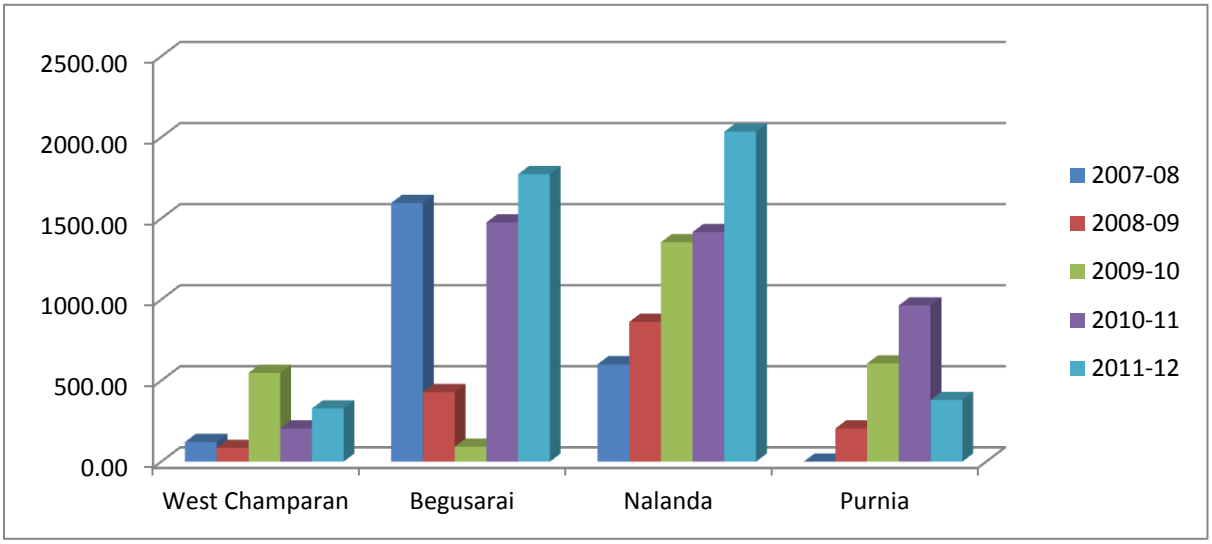


Figure 6.4: Expenditure on Drinking Water in Sample Districts

Total expenditure in Nalanda is highest among the sample districts. In terms of expenditure Nalanda stands out as this is the only district where there is a consistent increase in expenditure. Whereas in other districts, there are year-wise fluctuations in expenditure. In Begusarai, in the year 2008-09 expenditure dropped by 73% compared to previous year and in the year 2009-10 expenditure dropped more than 78% compared to previous year. The next year expenditure in this district increased by 1501% i.e. expenditure increased from Rs. 92.15 lakh to Rs. 1475.79 lakh. The fluctuation in expenditure is also evident in other districts but their

magnitude is less than what exists in Begusarai district. This fluctuation in expenditure is a concern which needs to be taken in to account carefully.

Opportunity Cost of Drinking Hand pump water

The study found that across the districts most people rely on hand pumps for drinking water. Two kinds of opportunity costs are involved in using hand pumps:

(i) The focus group discussions and the household level data confirms that though a large section of households have handpumps in their premises, they spend much time in pumping and bringing water. It is found that, on an average, households spend 60 minutes daily in pumping and fetching water, which mounts up to 1800 minutes per month which is equal to 3.75 numbers of working days taking 8 hrs per working day. Taking Rs. 150 per working day for unskilled labour the opportunity cost of fetching water works out to Rs. 562 per month. If the household opts for pipe water with household connection, it can save Rs. 562 per month.

(ii) Although there is no such problem of availability of drinking water the quality of water is a concern. People have to take medicine to combat the diseases due to contaminated water. For example, in sample households of Purnea district it is revealed that, on an average, a person spends Rs 100-150 on medicines per month to combat indigestion and other diseases due to iron contaminated water. So, a family of five spends on an estimated average amount of Rs. 500-750 on medicines. Using pipe water from schemes with iron removal plant can provide pure water through which the medicinal expenses may be reduced.

The issue of cost sharing was discussed in the process of focus group discussions and it was found through discussions that that more than 80% of people are ready to share the capital cost as well as monthly user charges of pipe drinking water if they are provided with household connection. The study through these focus group discussions and household level survey revealed that more than 80% of people are ready to pay for capital expenditure and people are ready to pay Rs.50 to Rs. 2000 as capital expenditure and, on an average, Rs. 25 per household per month as user charges.

A Case study below highlights the share of private and public investment in drinking water as observed in three GPs of one of the sample districts.

Share of Private and Public Investment in Drinking Water

This analysis was conducted in three Gram Panchayats of West Champaran district to assess the share of private and public expenditure on drinking water.

The methodology was to collect approximate number of private hand pumps and work out the total investment in private handpumps by taking Rs. 6000 for each hand pump. To calculate public expenditure on drinking water, the number of public hand pumps in a GP area get collected and investment in hand pump work out by taking Rs. 24000 for each public hand pump. Along with this, the cost of pipe water in the GP area is also added as public expenditure.

The following table gives the amount of expenditure met by private and government on drinking water

Gram Panchayat	Total Private Expenditure	Total Public Expenditure	Share of Private Expenditure
Nautan	9600000	13100000	42%
Sikta	10800000	11820000	48%
Taulaha	16818000	7293000	70%

The above table shows that there exists GP-wise variation in investment on drinking water. However, it is also evident that out of the total investment in drinking water, around 50% are borne by the villagers. It remains to be seen whether this may be generalized for other parts of the district or even for the State as a whole.

6.5 Different Schemes in Operation and Per Capita Cost

Apart from private initiatives and some Gram Panchayat initiatives, PHED is the sole agency for supplying drinking water to the people of rural Bihar. Presently there are six systems are in operation for providing drinking water to rural people of Bihar. These are:

(i) Private Hand pump

(ii) Public Hand Pump (Singur / India Mark II / India Mark III)

(iii) Mini Water Supply (Solar-based / Electricity-based)

(iv) Single Village Pipe Water Supply Scheme

(v) Multi Village in Single GP water Supply scheme

(vi) Multi village in multi GP Water Supply Scheme

Table 6.5 below shows various schemes and technologies in operation in the state, their intended coverage and per capita cost.

Table 6.5: Schemes and Technologies in Operation and their per capita cost

Type of Scheme	Key Factors	Per Capita Cost	Remarks
Private Hand pump	30-60 feet sank into shallow aquifers	4000-6000 per hand pump	
Hand Pump (Singur / India Mark II / India Mark III)	I HP for 250 population	Rs. 80 – 185	More coverage at lower cost
Mini Water Supply (Solar-based / Electricity-based)	1 scheme for 1000-1500 population	Rs. 1000 – 1500	Supply of water to a compact area
Single Village Technology	1 scheme for 5000 – 15000 population	Rs. 1500 - 2000	Operation & Maintenance is easy
Multi Village in Single GP Technology	Coverage of more than 1 village in 1 GP	Rs. 2000 – 2500	Operation & Maintenance is easy
Multi Village in Multi GP Technology	Coverage of more than 1 GP	Rs. 3000 – 5000	Operation & Maintenance is difficult;
Quality-affected	Any of the above schemes to tackle contamination problem	Rs. 2500-3500	Operation & Maintenance is difficult

Private hand pumps are the low cost and simple technology schemes which cost between Rs. 4000-6000 for each hand pump. These hand pumps are mainly take water from the shallow aquifer and average depth varies between 25-40 feet. The hand pumps which are set up by

PHED involve more sophisticated technology private hand pumps. These hand pumps are set up on habitation basis and for use of 250 people in the habitation on an average per capita cost of Rs. 80-185. Per capita cost of pipe water supply is much more than hand pumps. The widely used model for pipe water is mini pipe water scheme. These schemes run on both electricity and solar power. The scheme is commonly used to supply drinking water in a compact area through 20-25 stand posts with an over head tank with capacity of 40000 litres. The other schemes viz. single village and multi village schemes are comparatively more complex and these schemes are run mainly through electricity. These schemes are planned to cater to 6000-7000 people with an over head tank capacity varying between 200000-450000 litres, along with water treatment plant, for quality affected areas. Per capita cost of supplying drinking water from these schemes varies between Rs. 1500-2500. There is only One Multi Village Multi Gram Panchayat scheme in operation in Bihar, which is located in Ara under Bhojpur district. This scheme cost around Rs. 52 crores and the per capita cost comes between Rs. 3000-5000. This scheme treats and supplies surface water for drinking.

6.6 Water Tariff Policy and Willingness to Pay

The Eighth Five-Year Plan in India (1992-97) introduced the concept of water as a commodity that should be supplied based on effective demand, the cost recovery principle and managed by private local organizations. The approach shifted from supply driven to demand driven to enable

(a) more efficient supply through providing the beneficiary the decision making power to make the project more realistic and need based

(b) cost recovery for more sustainable use and expansion.

A joint World Bank and Government of India's review of water resources management in 1999 advocated adoption of a comprehensive approach emphasizing four overarching factors:

(a) A shift from supply-driven to demand-oriented approaches

(b) Division of sectoral responsibilities between the government and non-government stakeholders

(c) Recognizing that water as an economic good having characteristics of public and private goods

(d) Decentralizing decision-making to include non-government stakeholders in service delivery, while reorienting the role of government to being a facilitator and enabler.

The draft water policy paper by Government of Bihar acknowledge drinking water as scarce and economic good and advocates levying water tariff for recovery of cost of providing drinking water. But the water tariff policy decision is yet to be implemented. The present study, during consultation with state level officials, found that the user charges and tariff has yet to be decided. The visit to 25 sample GPs under four sample districts also reveals the same. But, from the study, it may be inferred that there is ample scope for adopting the water tariff policy. Focus group discussions at GP level and household level surveys confirmed the assumption. The household level data showed that 86% of households are ready to pay for improved drinking water and 83% of households are ready to pay for pipe drinking water. It was also found that people are ready to share a part of capital cost of the drinking water project. It was revealed that they are ready to pay Rs. 50 to Rs. 2000 to share the capital cost of drinking water project. They are also ready to pay an average of Rs. 25 as monthly user charges if they get household connection of pipe drinking water.

This calls for revision of water tariff policy and cost sharing mechanism as the old tariff of Rs. 5 per household per month may not be realistic.

6.6.1 Contribution and Willingness to Pay for Drinking Water Project

During the focus group discussions it was revealed that people contribute to repair the local hand pumps for uninterrupted supply of drinking water. From the GP level discussions it was found that in 46% of sample GPs, people contribute for maintenance of drinking water sources. The household level survey found that 32% of sample households have contributed for repair of local hand pumps constructed for common use.

The willingness to pay for pipe water supply tells a different story. During the focus group discussions the issue of payment for pipe water system was discussed and analyzed and it was found that more than 80% people in focus group discussions were ready to pay for pipe water service and for household connection. It was also found during the focus group discussions that people are also ready to share a part of capital cost of implementation of drinking water

project as well as monthly user charges. The range of payment they agreed varies from Rs.50 to Rs. 2000 for sharing capital cost and for monthly charges they are ready to pay on an average Rs. 25 per household per month. The household survey also reveals a similar picture: 86% of sample households are ready to pay for improved drinking water through pipe water and other means and 83% of sample households found are ready to pay for pipe water services.

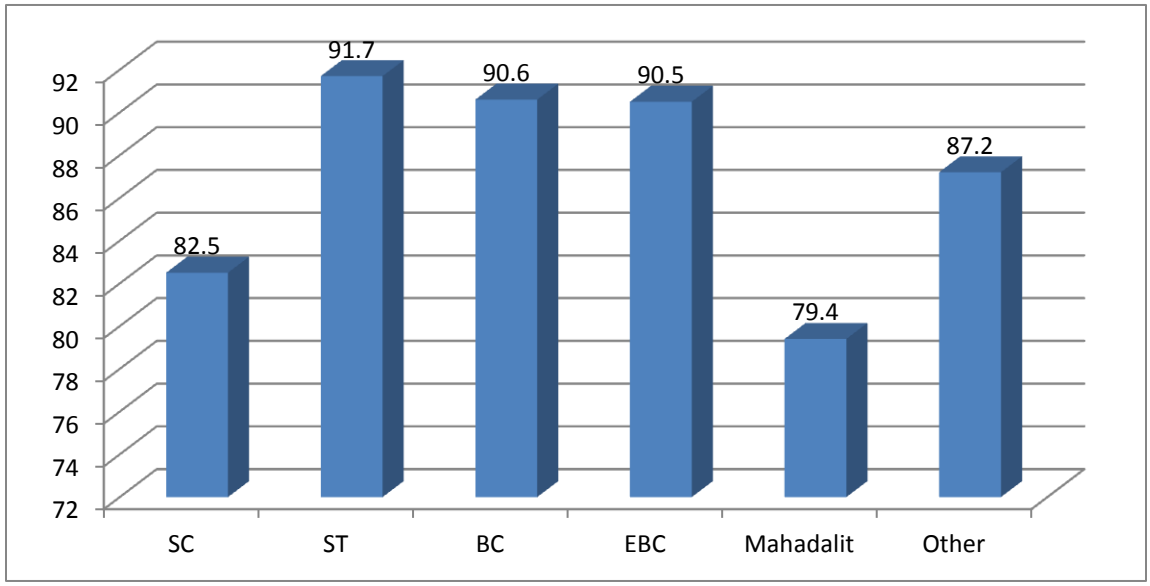


Figure 6.6.1: Community-wise willingness to pay for Pipe Water

Figure 6.6.1 represents community's readiness to pay for pipe water. It is found that out of total sample SC households, 82.5% are ready to pay for pipe water. The same for other communities viz. ST, BC, EBC, Mahadalit and Others are 91.7%, 90.6%, 90.5%, 79.4%, 87.2% respectively. It is evident that though willingness to pay for pipe water among SC and Mahadalit communities is marginally less compared to other communities, most of the households, irrespective of social status, are willing to pay for improved drinking water services.

6.7 Accountability, Audit and Social Audit

The system of regular financial audit by the Government Auditor is in place. The financial audit is being conducted by the District Government Auditor. The present system of accountability is a vertical one which prevails in the PHED. The study proposes a horizontal audit system in implementation which includes a system of social audit of drinking water schemes for more effective and sustainable delivery of services.

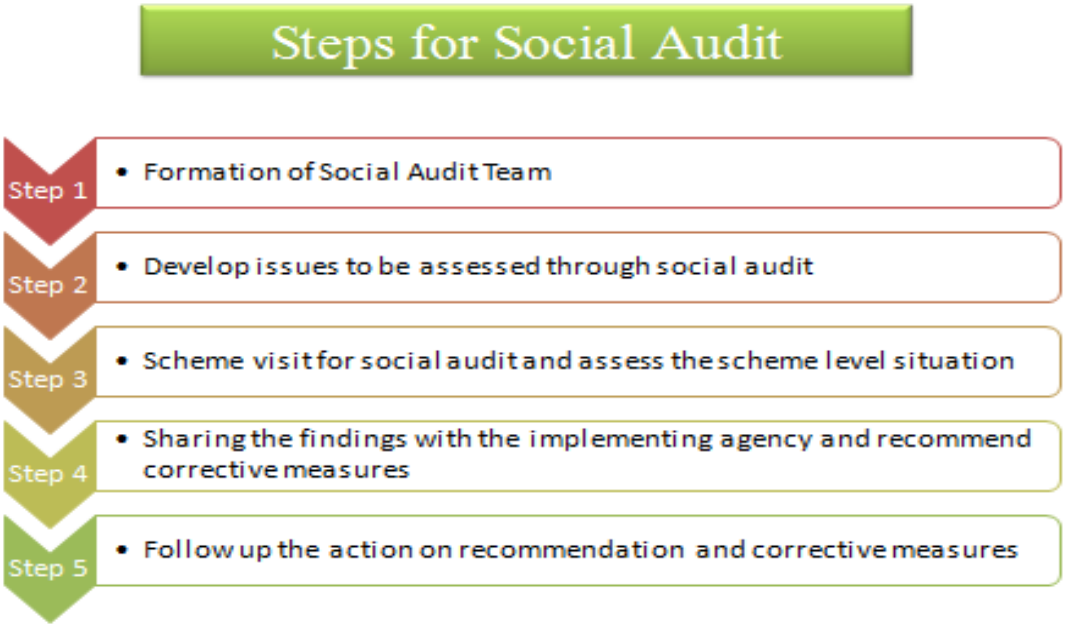
6.8 Social Audit

It has been well recognized that there has been a shift in the role of people in governance. The role of people has changed from users and beneficiaries to policy makers. More intensively, the role of people is now not limited into policy formulation and decision making but also in monitoring and evaluation. The new paradigm of people's participation is the consideration of people's view in programme evaluation through the process of Social Audit. It has been well acknowledged that the invited space for people's participation empower people to develop their own identities and voice and it provides an opportunity to people to negotiate with government and service providing agency directly to hold them accountable for better performance. The process of Social Audit not only empowers people and provides them with an instrument to evaluate the services and hold the service provider accountable for lapses; it also helps in taking the necessary corrective measures, which ultimately improves the quality of services. The essence of Social Audit is that it is done by the Stakeholders of a particular project, scheme or programme. The success of social audit depends on the participation of all stakeholders involved in implementing the project. The process of social audit uses participatory techniques to involve all stakeholders in measuring, understanding, reporting and improving the social performance of the organization or agency or service provider.

The present study proposes a model for social audit to improve efficiency and quality in the service delivery of drinking water.

6.8.1 Methodology of Social audit

A five step methodology of social audit can be adopted for evaluating drinking water projects.



The above steps are explained in detail below.

6.8.1.1 Formation of Social Audit Team

At each Gram Panchayat (GP), a team for social audit needs to be formed to implement the social audit in the field. The proposed team may include the following members

- One nominated member from VWSC
- One elected member of GP
- Working/retired primary/secondary school teacher residing in the GP
- Working/retired government official residing in the GP
- Two women members from Mahila Samakhya and /or local self help group

The Social Audit team may be constituted in a specially convened meeting in the presence of all GP members, all VWSC members and one government representative.

6.8.1.2 Develop issues to be assessed through social audit

After constitution of the team, in their first meeting, the team shall select a Team Leader amongst themselves. In this meeting the team shall discuss about the issues to be evaluated in the drinking water scheme implementation like regular supply, duration, quality, water testing, water treatment, leakage in distribution system, condition of stand-posts, cleanliness of source, supply of water to people at the tail end, household connection, recovery charges etc. They may prepare a list of these issues in a questionnaire type document. The team will fill this at the time of review at the implementation location.

6.8.1.3 Scheme visit for social audit and assess the field level situation

The team shall visit the implementation site to evaluate the predetermined issues and other issues if any. The nominated member of VWSC and the GP member will liaison with VWSC and GP for providing documents related to planning and implementation. At the implementation site the team will study the issues and keep a note on them. They will also assess the gaps in implementation and operations.

6.8.1.4 Sharing the findings with the implementing agency and recommend corrective measures

In a meeting on a pre-determined date, the social audit team shares their findings with all GP members, VWSC members, PHED officials. In this meeting the team also recommends corrective measures based on findings. The team leader will prepares a report and communicates it to the district level (DWSM and PHED).

6.8.1.5 Follow up the action on recommendation and corrective measures

In their next social audit visit, the team would assess the present conditions as well as compliance to their earlier recommendations. The findings would be discussed in the meeting and the report to be communicated to the district.

6.8.1.6 Frequency: The social audit may be conducted monthly or bi-monthly.

6.9 Recommendations

The following recommendations are being made based on the observations and analysis done during the study:

- At the time of implementation of drinking water project different types of expenditures involved in the project, especially capital maintenance expenditure, expenditures on direct and indirect support should be taken care of.
- There is ample scope for providing pipe drinking water in rural Bihar. Government and its agencies should go for participatory management of pipe drinking water.
- Adoption of strategies for decentralized decision making on drinking water service may be a useful one.
- The water tariff policy needs to be revised to make it more realistic for providing uninterrupted supply of pipe water.
- A system of social audit may be introduced to empower people to hold the service provider accountable for effective delivery.

CHAPTER 7

SOCIAL ASPECTS OF DRINKING WATER SERVICES

Participation of people in local level decision making, especially services that affect their lives, has been regarded as a way to improve poverty targeting, build social capital and increase demand for good governance. Underlying this shift was the belief that giving the poor a greater say in decisions that affect their lives by involving them in at least some aspects of project design and implementation can result in a closer connection between development aid and its intended beneficiaries. Evidences from different parts of the world confirm that improvement in service delivery through participatory management is a critical factor, especially in rural drinking water services (Isham et al, 1995).

The present study makes an attempt to explore different social dimensions and evaluate the existing participatory practices in the context of rural Bihar.

7.1 Accessibility of Drinking Water Sources

In an attempt to explore the accessibility of drinking water sources by households, it became evident that 43% of households collect drinking water from their own hand pumps. Figure 7.1 shows the different drinking water sources in rural Bihar and the proportion of sample households using these sources.

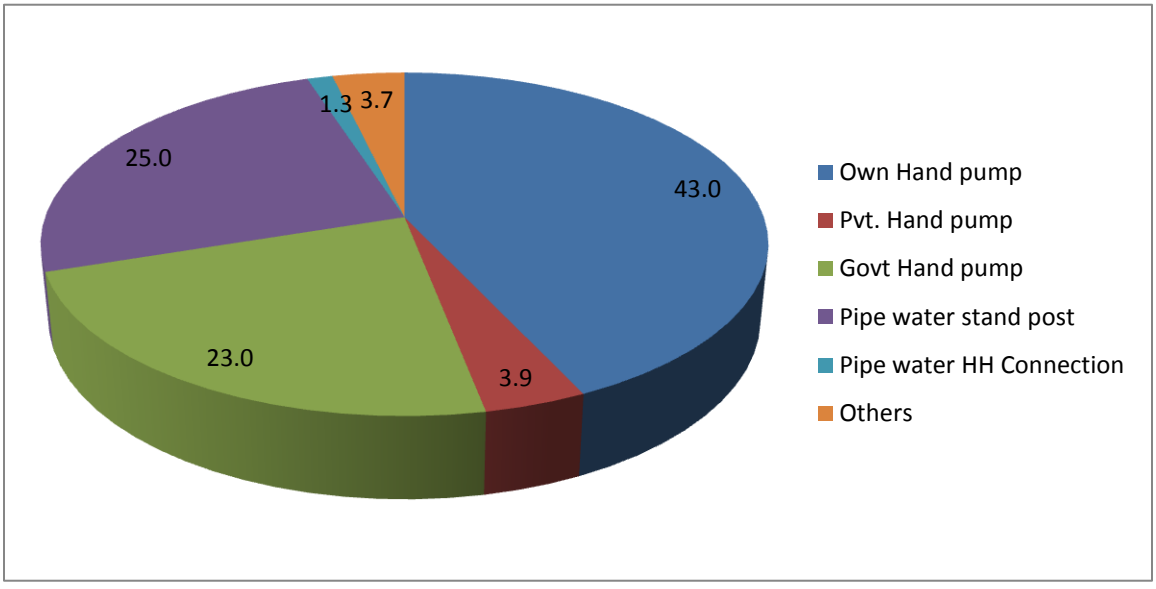


Figure 7.1: Sources of Drinking Water in sample households

The next step was to understand whether restrictions to access drinking water sources exist, specifically in terms of taking permissions or time restrictions. It is found that 43% households have their own hand pumps, so it is expected that there would not be any restriction to access drinking water. Also, it was found that more than half of the sample households who do not have their own source, can access drinking water without any restriction. Even where the restriction exists, 43.7% of them face only time restriction. It is found that only a small fraction, i.e. 2.8 % of sample households required taking permission to collect water from others' sources. However, there is no district specific or community specific restriction of accessing water. These findings signify that though some restriction exists in access to drinking water in rural society in Bihar but magnitude is very less and it can be inferred that there is hardly any restriction among communities in accessing drinking water.

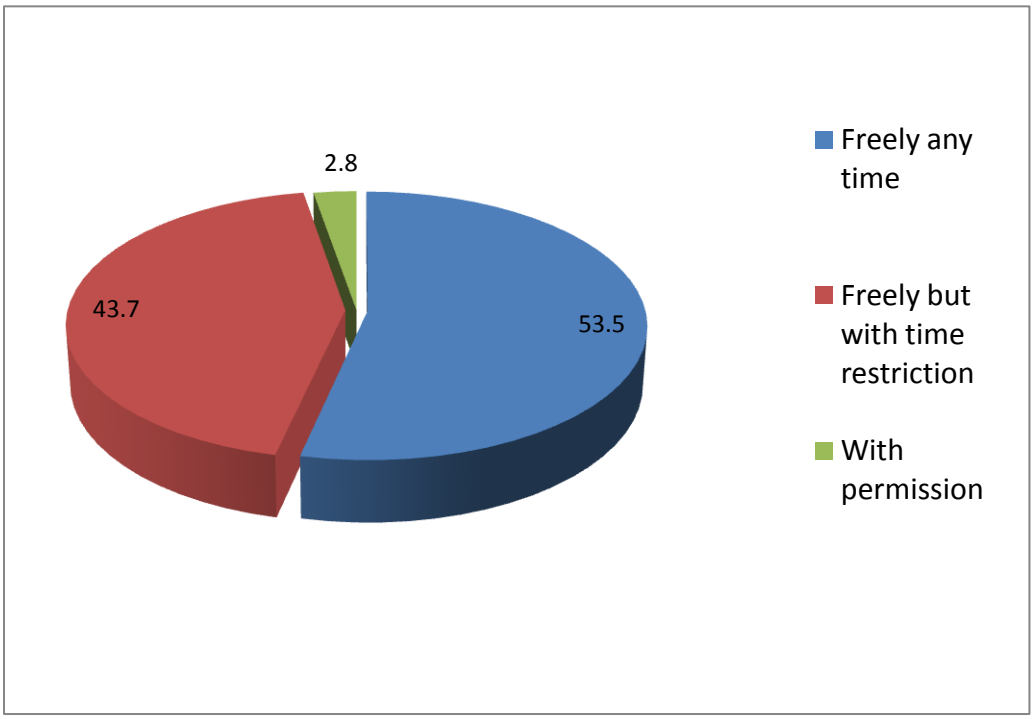


Figure 7.2: Accessibility to Drinking Water

7.2 Existing Spaces of Participation in Rural Bihar

There are two different types of spaces of participation found in rural Bihar. First, *Gram Sabha*, which can be defined as invited space[1] of participation. Meetings of *Gram Sabha* are organised by *Gram Panchayat* to include people in the planning process. These are held at village level 3-4 times in a year. *Gram Sabha* meetings are held to identify beneficiaries and schemes to be implemented in the respective villages. The other space of participation is *Aam Sabha*, which can be defined as popular space[2] of participation where people come on their own to discuss, deliberate or to take decision regarding local development or other issues.

7.3 People's participation in Drinking Water Services

[1] An invited space is provided by the government and often used for deliberation or communication and at times, it takes the shape of regularised institutions. (Cornwall, 2004).

[2] Popular space is defined as a space in which people come together at their own will. Popular space may be the outcome of the passion of the people about any relevant issues or it may take the form of any association or group.

The rationale for involving households in the management of supply of drinking water is to ensure that project designs are responsive to local needs and realities. Women should assume a greater role in decision-making because they are the ones who best know these local realities and are the primary beneficiaries of the projects. The other aspect of participatory management, i.e. cost recovery through user charges has another dimension. Cost recovery through user fees serves three purposes. First, requiring households to pay for services, once operational, provides revenues to keep the system running and reduce dependence on government agencies. Second, charging households the capital cost of system construction, prior to installing the water supply system, establishes a 'demand filter' that prevents water systems from being built in communities where they are of low-priority. Third, requiring capital contributions by communities is expected to foster a sense of community ownership of the facilities, which in turn is expected to solidify a commitment to use and maintain the facilities (Whittington et al, 2008).

There are two main sources of drinking water in rural Bihar viz. Hand pump and Pipe water. Supply of pipe water is very low in rural Bihar. Reliance on hand pump is almost total. These hand pumps are installed from three sources either privately by the household, or by the concerned GP or by the PHED. In the second case the hand pumps are set up based on the demand from the beneficiaries or communities. People demand hand pumps through Gram Sabha or other means. GP includes the demand in their annual plan and based on the availability of fund, hand pumps are given for common uses. But in the third case when PHED installs handpumps, it was found that GP or people of village are hardly been consulted regarding the construction of tube well. In some cases GP has not been informed about the implementation. In the case of the supply of pipe drinking water it was found that neither GP nor the people are consulted before setting up the schemes or selection of location of stand posts. This situation calls for rationalizing peoples' participation in deciding supply points for drinking water.

If we analyse the participation of people in local development, it can be said that people are participating. Creation of popular space namely *Aam Sabha* is a proof of that. There are situations when people come to discuss about any issue pertaining to their village and people are also seen to take responsibility of implementing the decisions taken. This participatory attitude among people can be an asset which can be utilised for improving drinking water facilities through participatory management.

7.3.1 Level of Participation

The present study attempts to analyse participation of households in drinking water service in three aspects, viz. demand related to drinking water, role of households in planning of drinking water supply and willingness to pay for improved water services.

During the focus group discussions at the GP and village levels, a large section of people expressed their demand for improved drinking water supply especially through pipe water supply system. It was found during the survey that, availability of drinking water is not a problem in the sample GPs but quality of water is. During focus group discussions it was revealed that around 80% households get water in their premises or nearby. Very few households need to fetch water from more than 500 meters away, which is mainly evident in Begusarai and Nalanda district. During the household level survey 94% of households expressed desire for improved drinking water service, especially through pipe water.

Figure 7.3.1 shows the proportion of households raised demand for improved drinking water in the sample districts. It may be observed from the figure that West Champaran has the highest proportion (37.8%) of sample households who showed demand related to drinking water. The proportions of households that expressed desire in Nalanda, Purnea and Begusarai are 29.3%, 18.9% and 14% respectively.

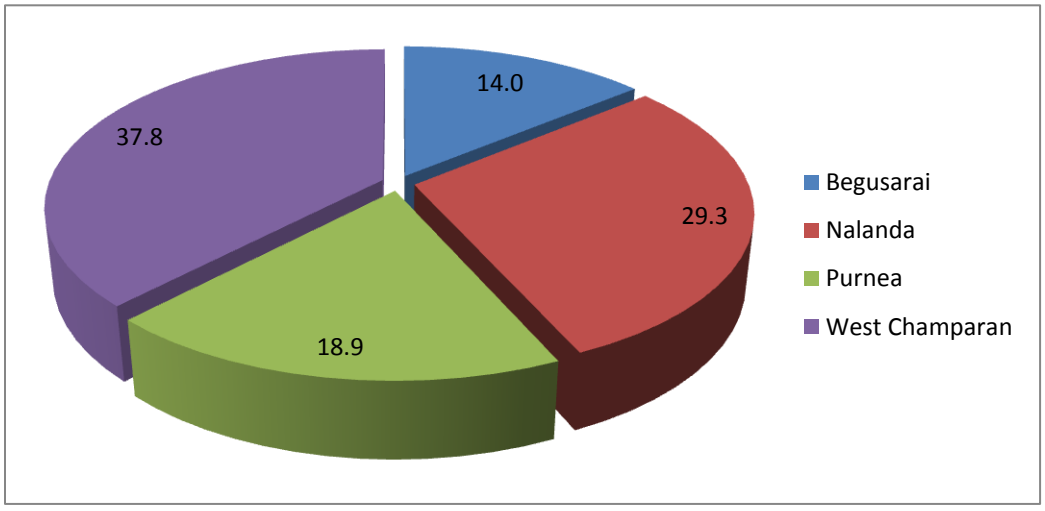


Figure 7.3.1: Proportion of Households expressing demand in sample districts

The intensity of participation in terms of expressing demand for drinking water supply among the communities is presented in Table 7.3.2. It is evident that out of total sample SC households, 30% expressed desire related to drinking water. The proportion for ST, BC and EBC are 33.3%, 38.4% and 35.7% respectively. Though there is not much difference among communities, proportion of the mahadalit households (41.2%) which expressed strong desire to have better drinking water is found to be highest.

Table 7.3.2: Community Intensity of Raising Demand

Caste	Percentage of Raising Demand
SC	30.0
ST	33.3
BC	38.4
EBC	35.7
Mahadalit	41.2
Other	33.0

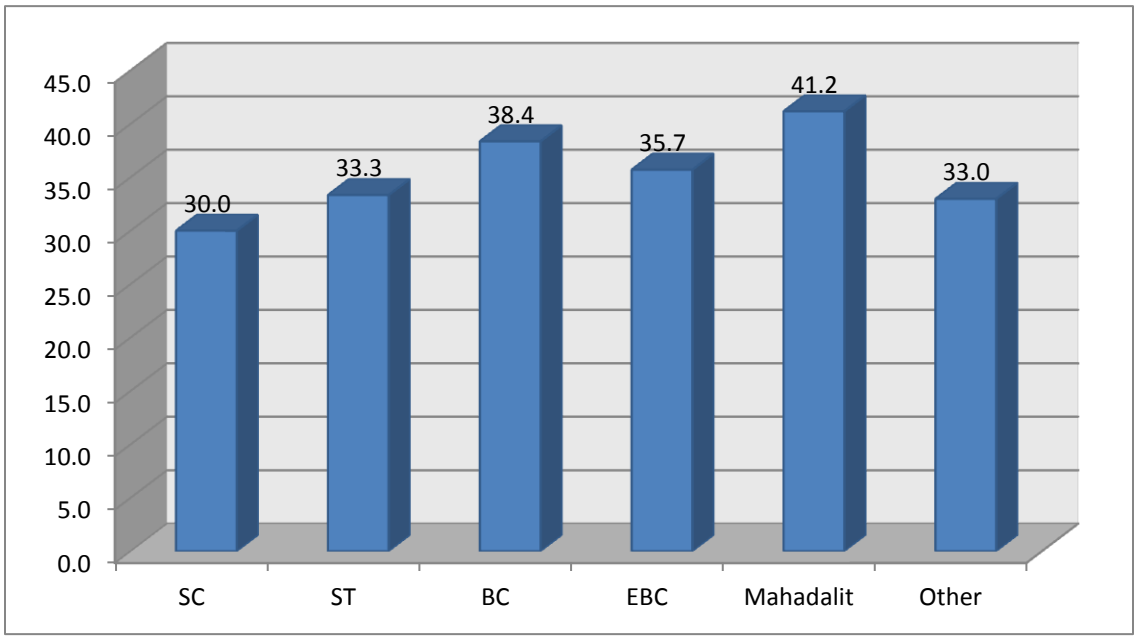


Figure 7.3.2: Community intensity of raising demand

It is evident from the above analysis that there is no significant difference among the communities in expressing demand. This finding also portrays that there is less incidence of

'capture' or oppression in the rural society. People can express their demand irrespective of their social status.

However, the above analysis is about the household raised their demand, it is also found that among these households, who responded that they have some amount of demand related to drinking water services, 64% of them did not communicate their demand. Probing into the reasons, it was found that 44% of them did not have any clear idea as to whom the demand should be communicated to, while 6% of them had the presumption that it would not be effective. The situation calls for creation of more spaces for participation and interaction.

7.4 Consultation of People

Inclusion of people at the time of planning, for any water supply scheme, was found to be very limited. People are rarely consulted at the time of selection of schemes, selection of location of pipe water scheme as well as at the time of setting up of hand pumps by PHED. During the focus group discussions it was found that very few people were consulted during implementation of drinking water scheme. The household level survey confirms this finding and found that only 7% of total sample households said they had been consulted at the time of planning. However, it was found that there are inter-district differences in inclusion of people in planning process. While, in West Champaran, it is found that no one has ever been consulted during the planning processes the situation is somewhat better in other districts. While 15.32% of the sample households of Purnea responded that they were consulted during planning of rural water supply scheme implementation, for Begusarai and Nalanda the same are 4.39% and 8.70% respectively. This situation calls for district specific orientation strategies for inclusion of people into the planning process.

Table 7.4 : Proportion of households consulted for providing drinking water

Response	Begusarai	Nalanda	Purnea	West Champaran	Total
Yes	4.39%	8.70%	15.32%	0.00%	6.99%
No	95.61%	91.31%	84.69%	100.00%	93.01%

Among the people consulted, it is found that 34.1% belongs to Backward Caste, 19.5% belongs to Extremely Backward Caste and 7.3% belongs to Mahadalit community. The same is reflected in Figure 7.4 below.

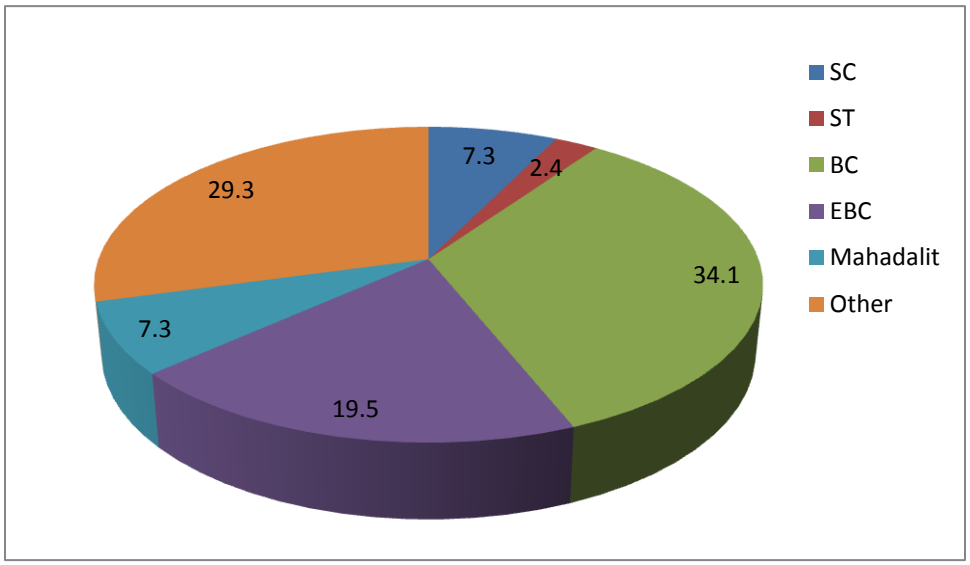


Figure 7.4: Community Share in consultation

Table 7.4.1: Community Intensity of Consultation

Communities	Proportion of Consulted HH in each community	Condition of Consulted Household	
		Schooling	Income
SC	7.5	7	2633
ST	4.2	12	4000
BC	8.8	8.1	5107
EBC	9.5	6.1	5000
Mahadalit	8.8	7	3167
Other	12.8	6.7	7542

Table 7.4.1 shows that out of total SC households, 7.5% has been consulted. Out of total ST households 4.2% has been consulted. The same for BC, EBC, Mahadalit and other communities are 8.8%, 9.5%, 8.8% and 12.8% respectively. The community responses to consultation shows that very small sections of each the community has been consulted. It is evident that there is no such community preference evident in the consultation of the community. It also evident that out of the households who have been consulted in each community there is no preference in terms of education or income across communities. This finding reconfirms our earlier inference that no oppression or control by any community in regard to decision making is in practice in rural Bihar.

7.5 Possibilities of participatory Management

Participatory management of drinking water services was discussed several times in different forum of sample GPs in the four districts. The common finding is that people prefer to get pipe water connection as part of better drinking water services. It is found that there is not much problem in availability of drinking water, but the quality of water is questionable. People like to have quality drinking water to avoid diseases and reduce medicinal costs. It is also revealed that people want to have pipe water in their households to reduce time spent to fetch water from hand pumps. People are not only ready to pay monthly charges, a large section of them are also ready to pay and share the capital investment costs. This opens up the avenue for a distinct kind of participatory management often termed as 'co-production'. The concept of co-production is related primarily to the involvement of citizens or clients in production i.e. direct involvement of users in delivering public services. It is way to establish synergy between efforts of government and citizens.

7.6 Role of Gram Panchayat

Gram Panchayat as a village level institution is responsible for ensuring delivery of basic services to its people. GP can play a pivotal role in participatory management of rural drinking water supply services. On the one hand the GP can mobilise people for collecting user charges, and on the other, it can bridge the gap between people and implementing agency through proper measures.

It is found that in delivering pipe drinking water supply GPs are rarely involved. Even when the GPs are involved, their roles were found limited to selection of sites. Discussions with

the GP functionaries of two GPs of Purnea (Dagarwa and Jalalgarh) reveal that they are not prepared enough for operation and monitoring of pipe water supply. It has been found that, except two cases in Purnea district, no other sample scheme of pipe water has been transferred to GP for operation and maintenance.

The formation of Village Level Water and Sanitation Committee (VWSC) may be helpful in management of drinking water locally. The formations of these committees are yet to be initiated.

7.7 Constraints related to Participatory Management

- The current study found no evidence of caste based polarization in rural society of Bihar. However, community dimension of rural society need to be taken into consideration during implementation.
- Taking community as a homogeneous entity may limit the success of any project. Social dimensions and cultural aspects of different communities need to be taken care of at the time of designing the water supply project.
- 'One size fits all' idea may not work in the field. So community and district specific strategies need to be devised.
- One of the most controversial policy advices in the demand driven community management model is requirement of households to pay a share of the capital costs, and all of the operation and maintenance costs, of providing rural drinking water services.
- Long term financial sustainability of projects encompassing rehabilitation and expansion needs special attention. Insufficient recovery of capital cost and collection of tariff may affect replacement of structure, repairing of major breakdown or expansion of supply network to cater to growing population.
- Determining the mechanism of replacing system after 15-20 years down the line where the system would be depreciated need to be taken care of.
- Orientation of the people regarding participatory management is lacking. This may affect sustainability of any participatory project. Households might be willing to pay for improved drinking water services but management of any drinking water scheme in a participatory way requires action in more cohesive way. To implement the project through village level water and sanitation committee with the involvement of GP,

orientation of GP functionaries regarding participatory management is essential which the study found wanting.

- Lack of commitment from community during and after implementation may make the project unsuccessful and need to be taken care of.
- It is also found that the lack of a local water committee for pipe systems can hinder performance, but the presence of a water committee is no guarantee of improved performance. (Isham and Kähkönen, 1999). To avoid this kind of problem, project funding agencies and staff need to place high priority on the training and monitoring of water committees.
- Lack of the resource mobilizing power of GP is found to be another issue of concern which needs to be addressed for ensuring sustainability of the project.

7.8 Recommendations

The following recommendations are being made based on the observations and analysis done during the study:

- At the time of implementation of the project the community dimensions need to be taken care of for effective implementation, functioning and delivery of drinking water projects. One of the most often used approach of involving community and incorporating its view is through participatory social and resource mapping, which need to include all members of community especially women members. The mapping shall be an effective tool to intervene into the community to understand the social dimensions and act accordingly.
- Initiative needs to be taken to orient and capacitate the community and GP functionaries regarding participatory processes and management prior to launching a project.
- District specific orientation strategy may be more suitable.
- Village Level Water and Sanitation Committee needs to be constituted to manage and maintain water supply schemes in participatory mode.
- Orientation and building capacity of VWSC members and GP functionaries regarding mobilizing resources also need to be done. Adequate power needs to be delegated to VWSC and GP for mobilising resources locally.
- GP functionaries need to be oriented to build capacity of VWSC members regarding participatory management and resource mobilization.

- Professionals may be engaged in capacity building and empowering GP and rural communities regarding participatory management tools.
- A proposed model for community awareness and participatory management is given below.
- Increasing investment in social mobilization is also seen to be fruitful. Further inquiry in this area, however, is still needed to assess the expected costs and benefits of participatory management, social mobilization and its intended and unintended consequences.
- Involvement of community based organization and other strong local organizations need to be ensured.

7.9 Model for Proposed Community Awareness Programme

The model for community awareness programme has been developed and presented below.

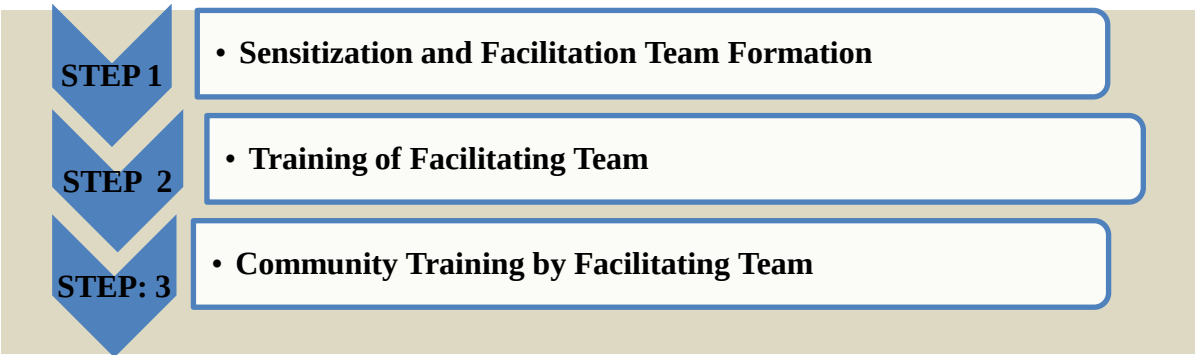
Model for Proposed Community Awareness Programme

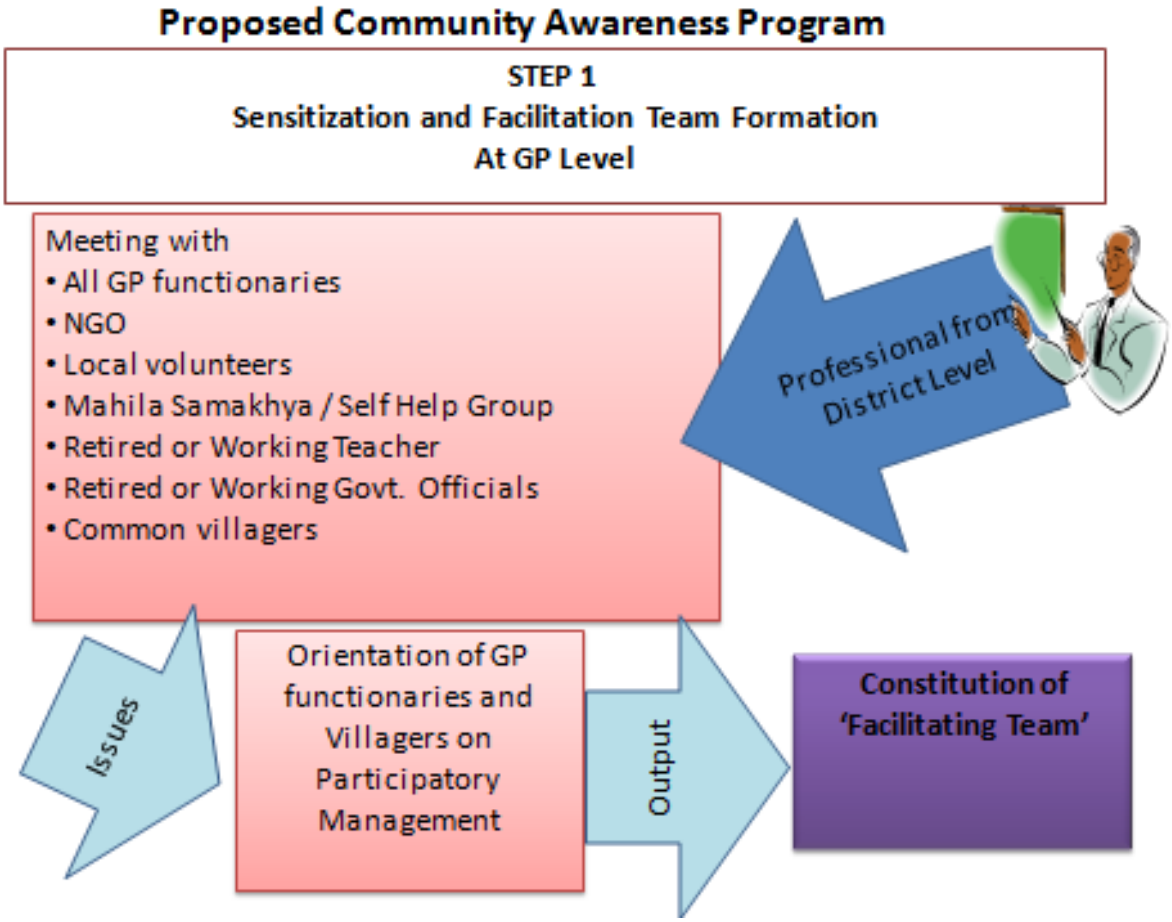
	Steps	Strategies	Issues
INITIAL STAGE: BEFORE IMPLEMENTATION	Step 1: 1st Meeting Community Sensitization and Facilitating Team Formation	• At the Gram Panchayat Level • To be facilitated by the district team consisting of professionals in community mobilization • The meeting should be with a larger group consisting of All GP functionaries, NGOs, Local volunteers, Mahila Samakhya/ Self Help Group, Retired or Working Teacher/Govt Officials and common villagers	• Orientation of GP functionaries and other participants regarding participatory approach to management of drinking water and details of the approach.
		'Facilitating Team' consisting of 20 members would be constituted with the Village level Water and Sanitation Committee members and other volunteers.	
	Step 2: 2nd Meeting Two-day Training Facilitating Team	• At the Gram Panchayat Level • To be facilitated by the district team consisting of professionals in community mobilization • The meeting would be with the Facilitating Team and VWSC members	• On the first day different participatory methods and tools would be discussed and analyzed. • Theoretical and practical aspects of PRA/PLA and social mapping would be discussed

			• On the second day the Facilitation Team members shall be taken to nearby hamlets in different groups to do hand on practice /training of social mapping.
	Step 3: Community Training by Facilitating Team	• The Facilitating Team shall be divided into 4-5 groups and identify village/neighborhood for visiting. • They develop awareness on the neighborhood about participatory management of drinking water and use of simple tool of participatory social mapping. • This exercise would also help to design the service delivery network, location of stand-posts. Households willing to take household connections also be identified. • Problems related to delivery and participatory management shall also be identified and solutions to be sorted out.	• Make the community aware on participatory management • Designing service network, location of stand posts and households for connection to be identified
IMPLEMENTATION STAGE	• Joint Supervision by VWSC and Facilitating Team Supervision of Projects	Supervision and assessment of progress of implementation would be assessed.	A separate monitoring format specially designed for monitoring by Facilitating Team would be developed.

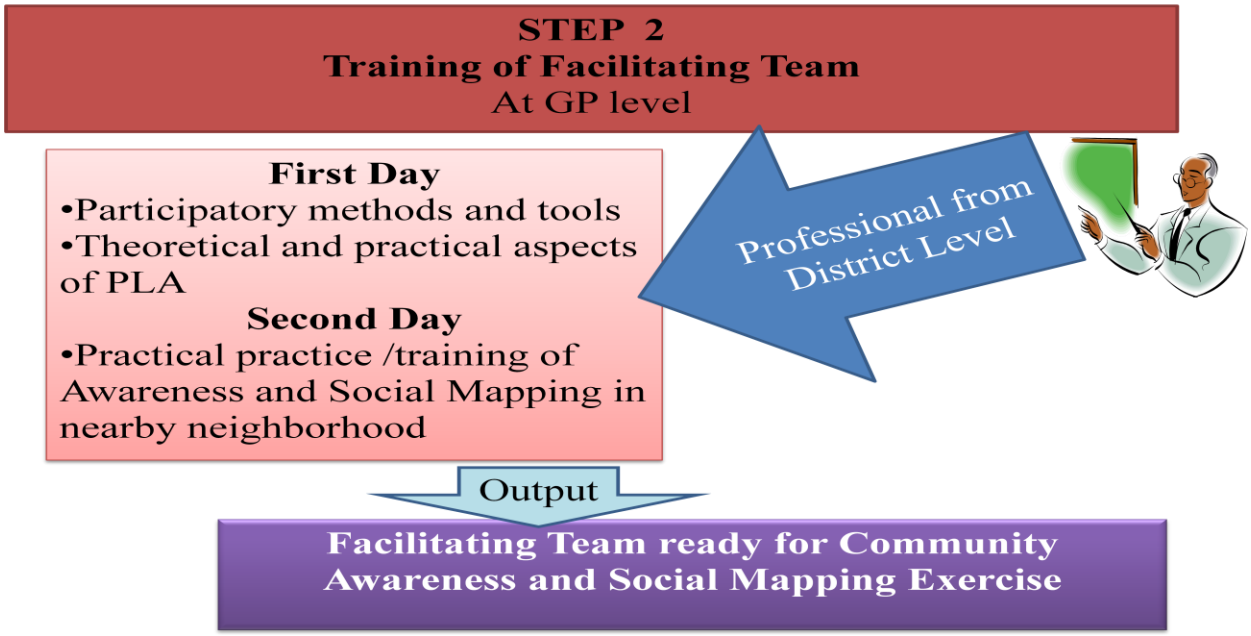
The steps for community awareness and involvement for the proposed community awareness programme is explained below.

Steps of Community Awareness and Involvement

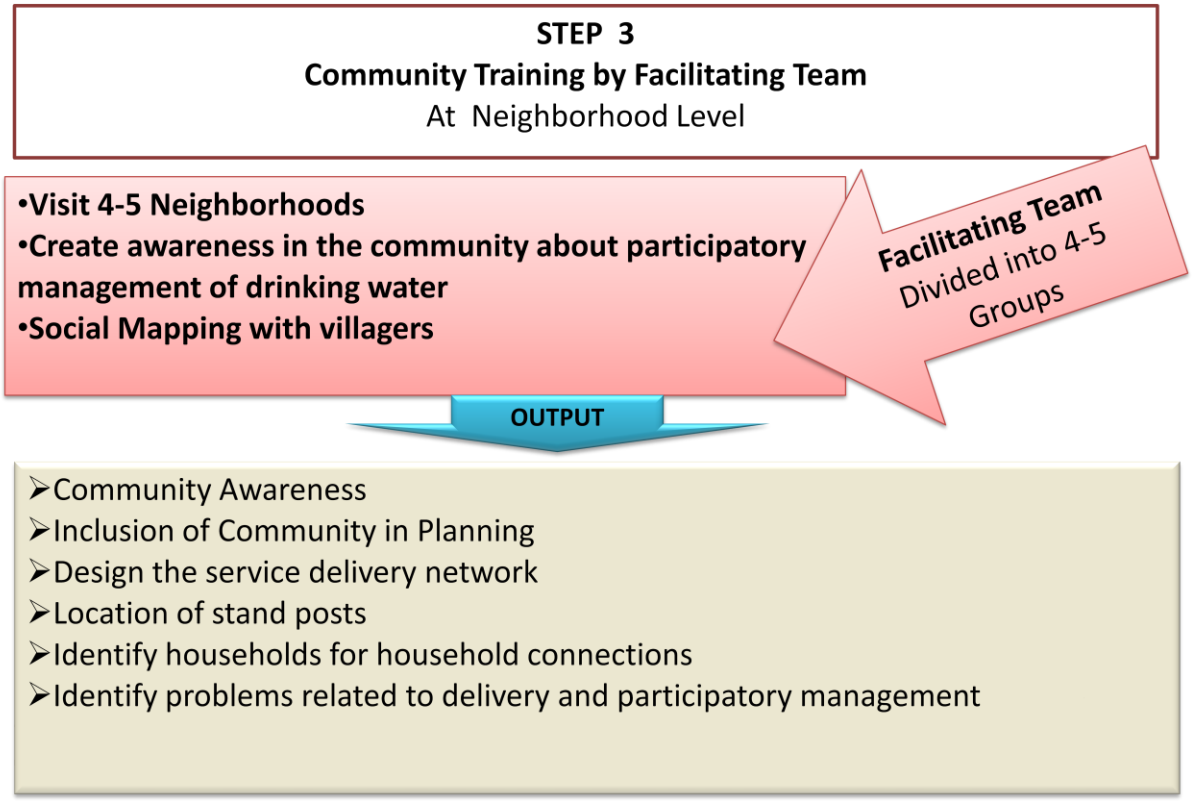




Proposed Community Awareness Programme



Proposed Community Awareness Program



CHAPTER 8

ENVIRONMENTAL ASPECTS OF DRINKING WATER SERVICES

Environmental issues are important for the survival of this planet and its inhabitants. The environment is a work in process and it constantly changes. While we may not be able to affect some of those changes, we can prevent destruction caused by humans. Pollution is one of the greatest threats to the environment and it is a direct effect of our actions. The availability of safe drinking water is an environmental issue that affects all of us. Drinking water is a basic requirement for life and a determinant of standard of living. The strength of the environment has a direct correlation with our health.

However, besides government efforts, supply and demand side factors of both surface and groundwater determine the level of drinking water available to people. The supply and demand factors change with the natural and human factors like pollution which limits drinking water supply provision and raises the delivery cost. Decline in groundwater table and limited availability of surface water, particularly in summer months, creates obstacles in ensuring drinking water security for all. Poor water quality because of contamination and other issues has also been observed in a large number of habitations.

In Bihar more than 95 percent of habitations, especially rural, depend upon groundwater for drinking purposes and face major risks due to depletion of the ground water table. The pressures exerted by supply and demand side factors on water resources have caused following environmental problems in drinking water supply

- Inadequate quantity of drinking water supply, a problem of scarcity and governance
- Scarcity of drinking water in summer months, a problem of natural factors, seasonality, water supply management and governance
- Scarcity of drinking water during floods. Some of the hand pumps get inundated due to floods, especially in North Bihar, a problem of natural factors, and seasonality
- Depletion of drinking water sources and issue of sustainability, a problem of resource management and
- Deteriorating quality of drinking water, a direct environmental problem.

Major environmental problem in the state is due to high dependence on groundwater. The major source of drinking water is hand pump and tube well supplying water to 91.4% of households in rural area. Out of total households in rural Bihar only 2.5% households receive pipe water. It is found that, out of the total 906 pipe water supply schemes run by PHE Department, which is the sole agency for providing pipe drinking water, only one scheme in Bhojpur district utilizes surface water. Groundwater has been experiencing wide fluctuations and declining cyclically due to geographical and geological conditions, rainfall fluctuations, low recharge rate, coupled with high drawdown etc. It is important to note that depletion of groundwater (a supply factor) and over-extraction (a demand factor) also contribute significantly to this depletion. The rapid and accelerated withdrawal of groundwater to meet competing demands from agriculture, industry and other sectors has led to decline in the groundwater table. Another related cause of inadequate drinking water supply is limited availability of surface water, in rivers and other water bodies, particularly during the summer season. Supply capacity of surface sources like rivers, lakes, reservoirs and tanks decrease owing to forest degradation, siltation, uncertainty and fluctuations in rainfall. The general neglect in conserving rainwater has resulted in waste of rainfall by way of run-off and evaporation. Discharging untreated waste, sewage flow, etc., to rivers and other water bodies also causes deterioration of water resources.

Groundwater extraction is growing rapidly as it is used for drinking, irrigation and industrial purposes. Groundwater demand for agriculture sector has risen significantly with increased number of wells in the state, which is the major source of drafting groundwater. All these factors reduce groundwater availability in aquifers, particularly during summer season, creating wide fluctuations in drinking water supply. However State Government and Central Government have accorded first priority to drinking water over other uses. Besides the above supply and demand driven factors, lack of operation and maintenance of water supply schemes (a matter of management and governance) is another important cause for inadequate drinking water supply. Leakages in the distribution network and power fluctuations also make water supply schemes sub-optimal. The leakage occurs mainly due to corroded pipes in distribution network; damages caused during road widening and repair work. These problems may aggravate due to poor materials used and poor workmanship. Most of the beneficiaries pointed out that good maintenance strategy would help in making the defunct / non-functional structure functional through repair without any loss of time and will help in source sustainability. Public awareness

and knowledge would facilitate the process of efficient maintenance. In consultation with the stakeholders, the following strategies have been identified for sustainability of source.

- There are a number of Ahar / Pynes / Ponds / Tanks in the villages. These water bodies are depleted due to siltation and lack of maintenance. Restoration of these water bodies like Ahar / Pynes / Ponds / Tanks / Irrigation wells will increase infiltration and percolation ultimately leading to recharge of ground water.
- Construction of artificial recharge structure in marginal alluvium and piedmont areas of South Ganga Plain
- Rain water harvesting in fields
- Roof top rain water harvesting
- Recycling / reuse of waste water after treatment at least for irrigation purpose
- Development of proper sewerage system

An attempt should be made to educate the people and create awareness regarding the above technology for sustainability of water resources. This phased approach with proper emphasis on capacity building would lead to adoption of sustainable practices for water management.

Deterioration in drinking water quality, either at source or in the distribution system, has been caused by factors such as natural, human made (or demand driven) and institutional (like lack of monitoring system) factors. Natural factors such as geological and geographical characteristics lead to inorganic contamination with excess fluoride, iron, nitrate, etc., while human made factors like over extraction of groundwater, discharging pollutants to surface and ground water bodies, inadequate and improperly designed drainage and sewerage systems too add to their share of pollution. In addition, the common practice of using open places for defecation, washing clothes and animals, bathing around water bodies, also pollute water sources. Industrial effluents discharged in open places and in water bodies is another major cause for decline in water quality. It was observed that industrial effluents from sugar industries located at Lauriya, Ramnagar, Chanpatia and Narkatiyaganj in West Champaran district and at other places too had contaminated ground water at shallow layer. Although, as per the Government policy, the industry has to follow zero discharge option, it is reported that treatment plants remains out of order frequently either due to fault or power shortage affecting water

quality. Drinking water, apart from source level, also gets contaminated in the distribution network when sewage or other waste materials enter through broken or leaking pipes. These problems get magnified due to intermittent water supply and lack of adequate pressure in the pipe.

8.1 Ground water contamination

Presence of Arsenic, Fluoride, Iron, Chlorides and Nitrate make ground water unsafe for drinking purposes. The PHED, Central Ground Water Department and state ground water department carries out extensive groundwater explorations to ascertain the level of pollution and pollution free aquifer. The districts affected by Arsenic, Fluoride and Iron are given below in table 8.1.

Table 8.1.: Districts affected by Arsenic, Fluoride and Iron Contamination in Ground Water

Arsenic	Fluoride	Iron
1. Saran	1. Kaimur	1. Supaul
2. Vaishali	2. Rohtas	2. Araria
3. Samastipur	3. Aurangabad	3. Kishanganj
4. Darbhanga	4. Gaya	4. Saharsa
5. Buxar	5. Nalanda	5. Purnea
6. Bhojpur	6. Sheikhpura	6. Katihar
7. Patna	7. Jamui	7. Madhepura
8. Begusarai	8. Banka	8. Begusarai
9. Khagaria	9. Munger	9. Khagaria
10. Lakhisarai	10. Bhagalpur	
11. Munger	11. Nawada	

12. Bhagalpur		
13. Katihar		

Source: Central Ground Water Board (CGWB)

About 13 districts are affected by Arsenic, 11 by Fluoride and 9 by Iron. Generally, the entire district is not affected by the contaminants. Contamination is often observed in patches in certain Blocks, Villages and habitations. The Arsenic effected Blocks, and Habitations are furnished in table 8.1.1.

Table 8.1.1 Arsenic affected areas in Bihar

S.No	District Name	Total Block	Total affected block	Total affected Habitations
1	BEGUSARAI	18	4	84
2	BHAGALPUR	16	4	159
3	BHOJPUR(AARA)	14	4	31
4	BUXAR	11	4	385
5	DARBHANGA	18	1	5
6	KATIHAR	16	5	26
7	KHAGARIA	7	4	246
8	LAKHISARAI	7	3	204
9	MUNGER	9	4	118
10	PATNA	23	4	65
11	SAMASTIPUR	20	4	154
12	SARAN	20	4	37
13	VAISHALI	16	5	76
	Total:	**195**	**50**	**1590**

Source: Public Health Engineering Department, Govt of Bihar

It can be observed from the above table that 1590 habitations i.e. 1.48% habitations of the state in 50 blocks are affected by Arsenic contamination. It was reported that higher concentration of Arsenic is confined to the top aquifers occurring up to 100m below ground. It was also reported by the PHC located at Begusarai that skin, lung and liver cancer cases are rising in the Arsenic

affected areas. Arsenic safe aquifers were observed at depths beyond 100m-130m below ground level. The map showing the level of Arsenic contamination in different parts of the state is given below in figure 8.1.1.

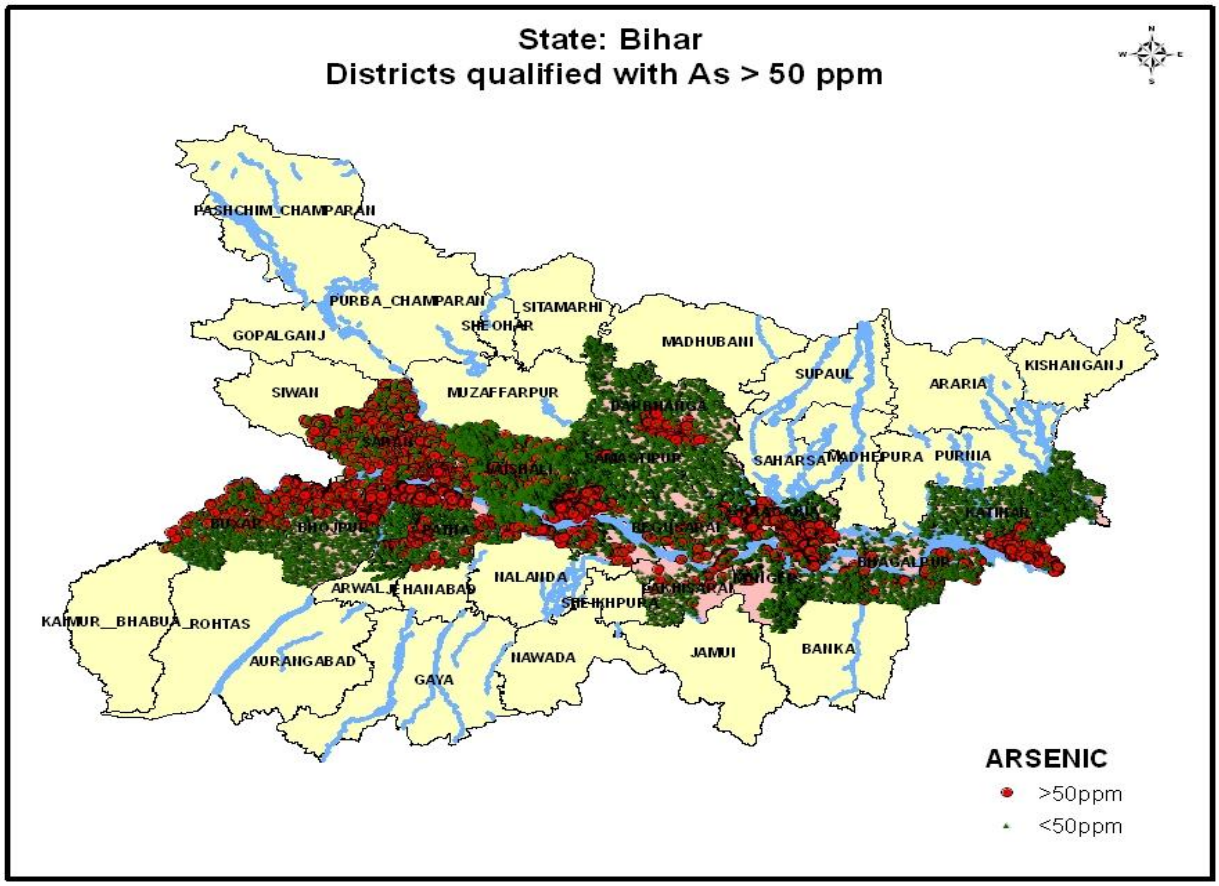


Figure 8.1.1: Arsenic contaminated area in Bihar

Source: PHED, Govt. of Bihar

Instead of treating arsenic, it is advisable to tap safe water from arsenic free deeper aquifer and to explore other sources of water such as surface water supply. Installation of treatment plant for arsenic contaminated water should be done only where arsenic free water or surface water source is not available.

8.1.2. Fluoride Contamination

The Fluoride affected Blocks, and Habitations are furnished in table 8.1.2.

Table 8.1.2 Fluoride Contamination in Bihar

Sl. No.	District	Total no. of blocks in district	Total no. of affected blocks	Total no. of affected habitations
1	Nalanda	20	20	213
2	Aurangabad	11	8	37
3	Bhagalpur	16	1	224
4	Nawada	14	5	108
5	Rohtas	19	6	106
6	Kaimur	11	11	81
7	Gaya	24	24	129
8	Munger	9	9	101
9	Banka	11	6	1812
10	Jamui	10	10	1153
11	Seikhpura	6	6	193
TOTAL		**151**	**98**	**4157**

Source: Public Health Engineering Department, Govt of Bihar

It can be observed from the above table that 4157 habitations i.e. 3.86% habitations of the state, in 98 blocks are affected by Fluoride contamination. It was also reported that the contamination problems are in patches, in the above habitations. Some locations are also free from fluoride in same habitations. Skeleton disorders as well as disorders in teeth were seen in villages in Nalanda which may be a result of excess concentration of fluoride in drinking water. Hence, attempts should be made to construct fluoride free water wells by selecting proper sites through exploratory ground water drilling. Alternatively, water can be transported from the nearby fluoride free habitations through underground distribution system. Exploitation of surface water in fluoride affected areas may also serve as a good alternative. Treatment plants for fluoride should be installed only in cases were fluoride free water becomes impossible. The map

showing the level of Fluoride contamination in different parts of the state is given below in figure 8.1.2.

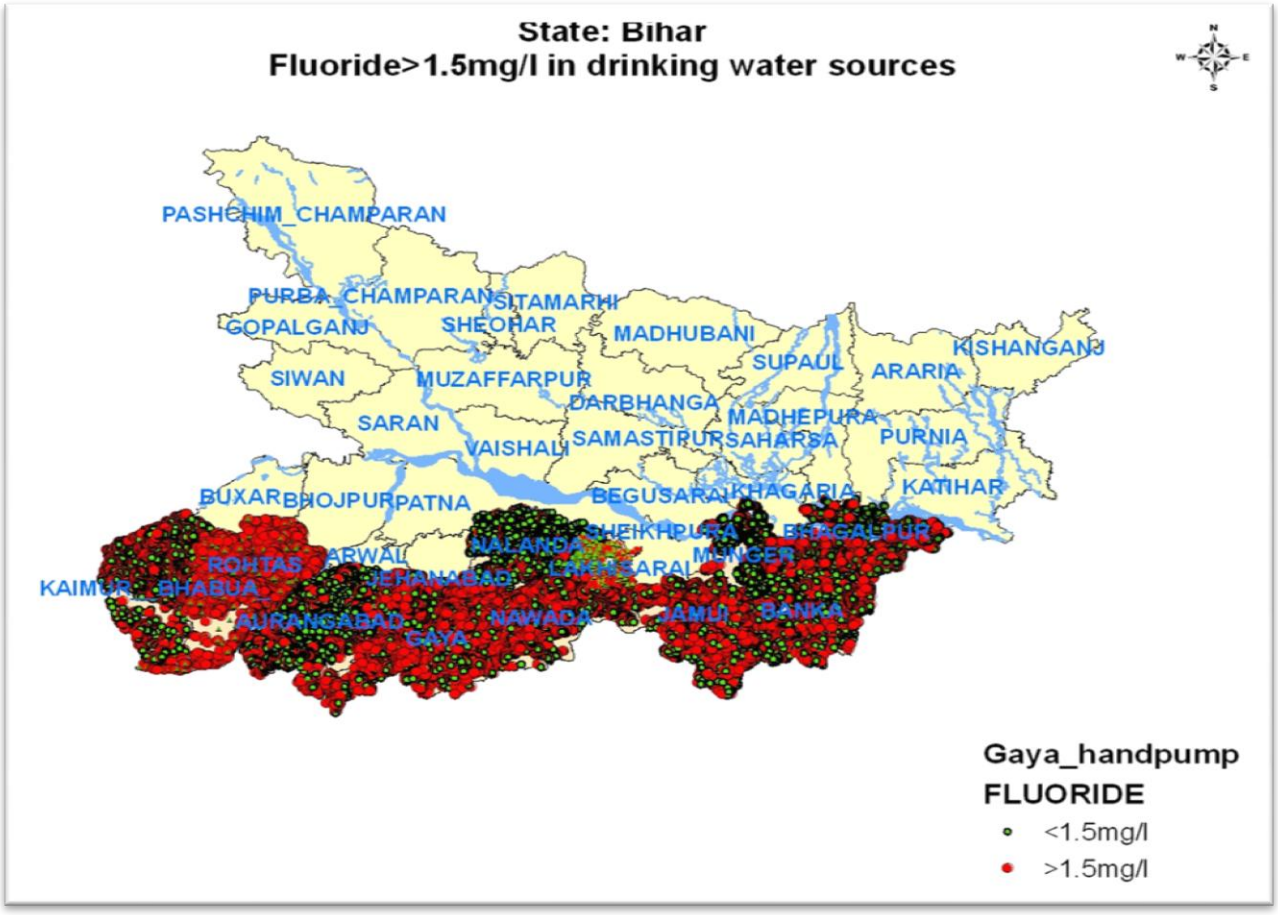


Figure 8.1.2: Fluoride contaminated area in Bihar

Source: PHED, Govt. of Bihar

8.1.3. Iron Contamination

The Iron contaminated Blocks, and Habitations are furnished in table 8.1.3.

Table 8.1.3: Iron Contamination in Bihar

Sl. No.	District	Total no. of blocks in district	Total no. of affected blocks	Total no. of affected habitations
1	Khagaria	7	3	417
2	Purnea	14	14	3505
3	Katihaar	16	16	766
4	Araria	9	9	2069
5	Supaul	11	11	3397
6	Kisanganj	7	7	1593
7	Begusarai	18	18	2206
8	Madhepura	13	13	2445
9	Saharsha	10	10	2275
Total		**105**	**101**	**18673**

Source: Public Health Engineering Department, Govt of Bihar

It can be observed from the above table that 18673 habitations i.e. 17.35% habitations of the state, in 101 blocks are affected by Iron contamination. The iron concentration was found to be more than the permissible limit for drinking purpose (1.0mg/l, as per I.S.: 10,500 1991) in 20% analyzed ground water samples of Bihar by CGWB. The maximum concentration of iron was found to be 12mg/l in Chausa block of Madhepura district. Iron concentration was found 0.3 – 1.0 mg/l in 27% groundwater samples. It was found during focus group discussion as reported by the beneficiaries in Purnea and Begusarai districts that color and odour of the water changes after sometimes due to presence of iron in the water. Primary Health Centres at Begusarai and Purnea also reported that cases for digestive problems were more in the district mainly due to presence of iron in the water. The people of both the districts pointed out that discoloration of cloths happen regularly due to presence of iron in water. It was also reported that iron

contamination is found in shallow aquifer up to the depth of 30m. Hence tapping of deep aquifer can be the solution for Iron contamination. The map showing the level of iron contamination in different parts of the state is given below in figure 8.1.3.

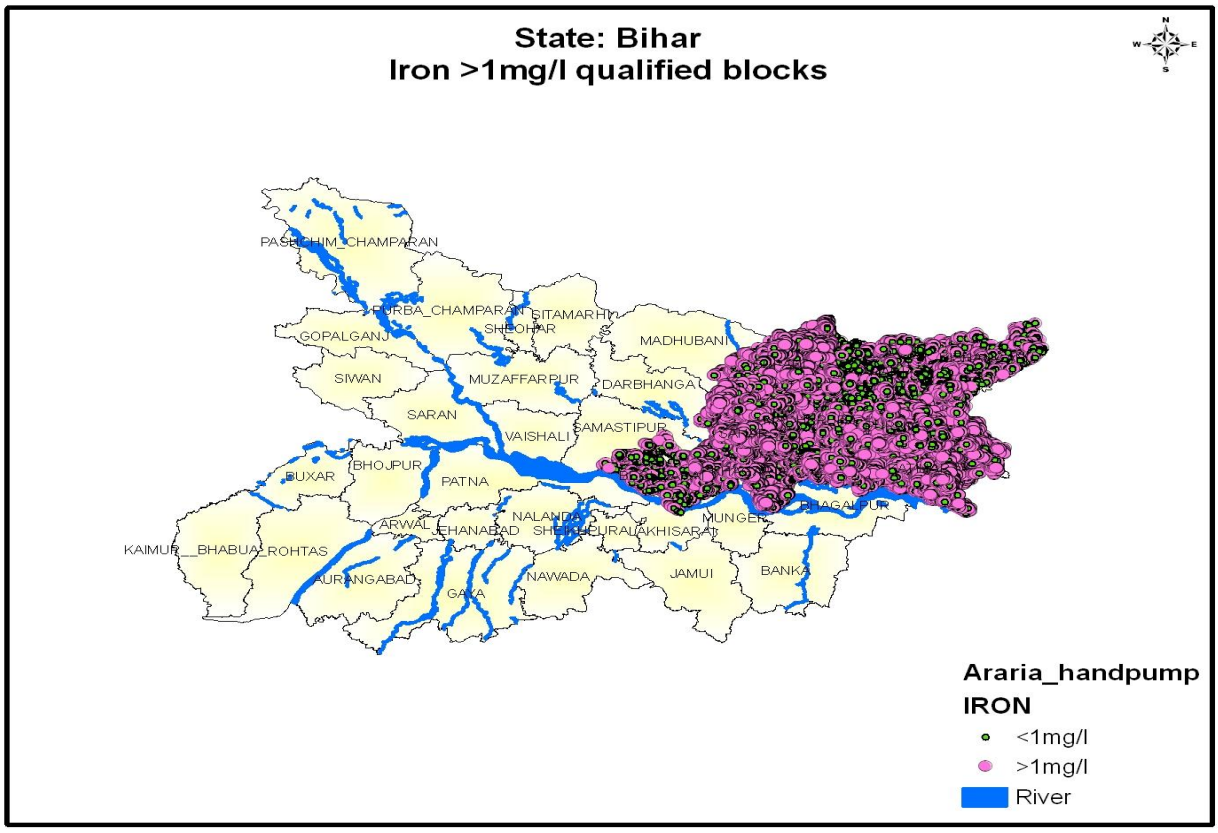


Figure 8.1.3: Iron contaminated area in Bihar

Source: PHED, Govt. of Bihar

8.1.4: Spatial variation of chloride in ground water

ISOCHLOR map of chloride content in ground water in Bihar was developed by CGWB. The same is presented below in figure 8.1.4.

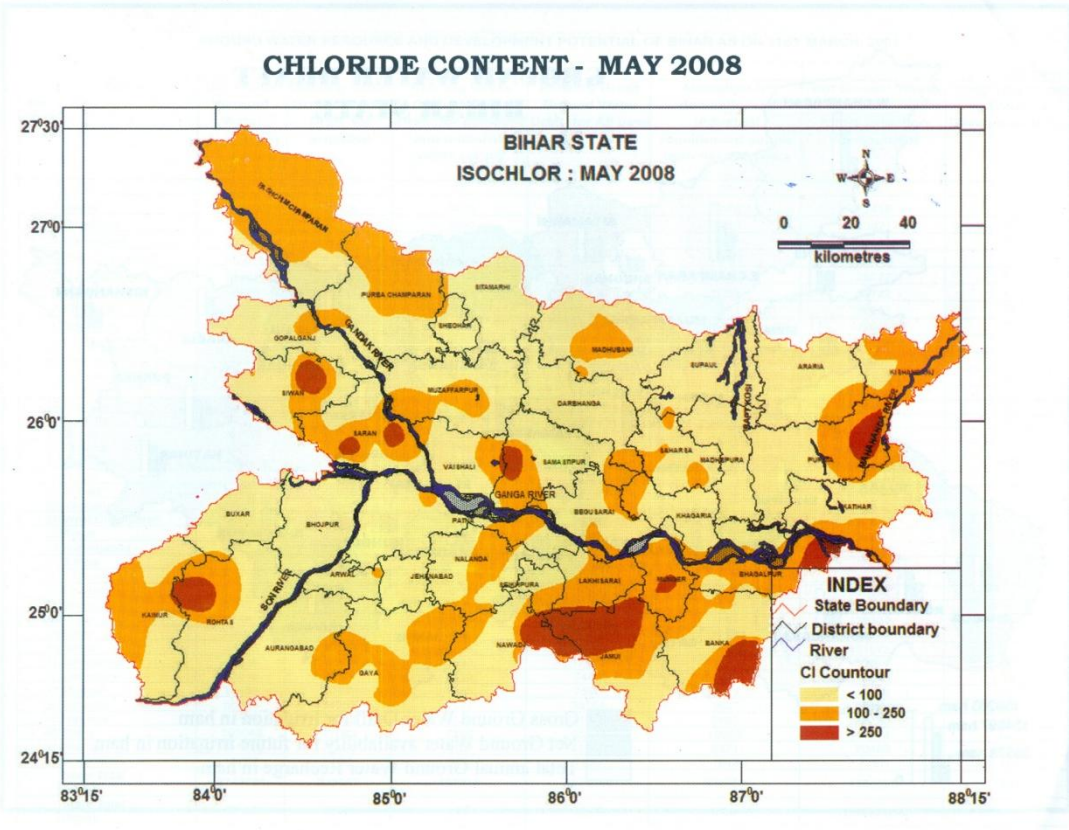


Figure 8.1.4: ISOCHLOR map of Bihar

Source: Central Ground Water Board (CGWB)

According to CGWB report, in majority of the samples collected, concentration of chloride in ground water was found within the desirable limit for drinking i.e. 250 mg/l as per IS10500:1991. Only in 13 samples Chloride concentration was found to be more than 250 mg/l. Isochlor map indicates that Chloride is less than 100 mg/l in major parts of the state except some small patches in Siwan, Saran, East Champaran, West Champaran, Madhubani, Kishanganj, Purnea, Vaishali, Samastipur and Muzaffarpur district in NBP and Bhagalpur, Banka, Munger, Jamui, Lakhisarai, Seikhpura, Nalanda, Nawada, Gaya, Rohtas and Kaimur district in SBP, where it occurs in the range of 100 to 250 mg/l. Chloride contamination of more than 250 mg/l was found in very small patches in the above mentioned districts. Therefore chloride is not the major problem in any district.

8.1.5 Spatial variation of electrical conductivity in ground water

Electrical conductivity (EC) of water is not included as a parameter for the determination of suitability of water for drinking purposes. However it provides an estimate about dissolved solids in water thus becoming an important parameter for drinking water. ISOCON map of Bihar prepared by CGWB is given below in figure 8.1.5.

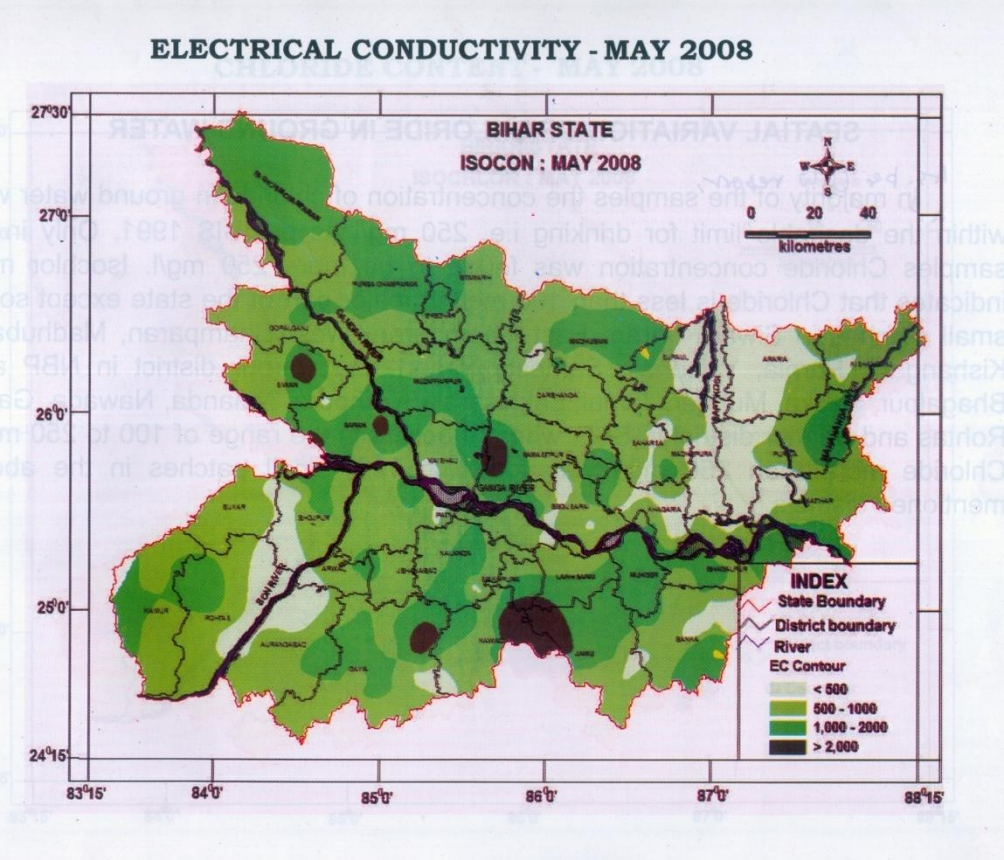


Figure 8.1.5: ISOCON map of Bihar

Source: Central Ground Water Board (CGWB)

CGWB collected samples for the determination of EC from Kosi region, along the Sone river and from a few isolated patches in Vaishali and Begusarai districts. In most of the cases EC was found less than 500 µS/cm. Only in 90 samples EC was found in the range of 500-1000 µS/cm and in 47 samples EC was found in the range of 1000-2000 microS/cm. However in very few samples (only 7) collected from Siwan, Saran and Samastipur districts in

North Bihar Plain and Jamui, Nawada and Gaya districts in South Bihar Plain, EC was found more than 2000 microS/cm. Therefore EC (actually dissolved solid) is not a major issue in any district of Bihar.

8.1.6 Presence of Nitrate

More than 45 mg of nitrate per liter of water was found in 0.5% samples tested by the state laboratory. The affected areas are Bhagalpur, Buxar, Araria, Aurangabad, Darbhanga, Munger and Sekhpura. However increasing trend of nitrate presence in groundwater may be considered as a future problem in the state.

8.2 Surface Water Contamination

Indiscriminate discharge of sewage and ineffective sewerage treatment plants, wherever located, create contamination of surface water. Less than 10% of the population is connected to sewerage network. Wastewater treatment facility is only limited to urban area in Patna. Thus it would not be wrong to say 100% wastewater generated from rural areas goes into open drains and subsequently into the river. From drains, it also percolates into the groundwater and is a major source of contamination of ground water. The pollution levels of surface water in various rivers are being monitored by Pollution Control Board. According to them the pollution level of various rivers in Bihar is given in table 8.2.

8.2: Pollution of Surface Water Sources (2011-12)

SI. No.	River	pH	DO (mg/l)	BOD (mg/l)	TC (MPN/100ml)	FC (MPN/100 ml)
1	Ganga at Chausa, Buxar	8.1	8.5	2.7	5900	2733
2	Sone at Koelwar	7.75	8.2	2.6	2058	942
3	Ghaghara at Chhapra	7.85	8.6	2.6	2275	1050
4	Gandak at Sonpur	7.87	8.5	2.5	1708	783

5	Sikrahna at Chanpatia	7.95	7.8	2.7	2666	1250
6	Daha at Siwan	7.79	7.8	2.6	2380	840
7	Dhos at Madhubani	7.81	7.4	2.7	3950	1650
8	Sirsia at Raxaul	7.96	6.8	12.0	2400	6333
9	Parmar at Jogwani	7.7	7.5	2.9	3183	1550
10	Mahananda at Thakurganj Kishanganj Road	7.8	7.5	2.6	2583	1200
11	Burhi Gandak at Akharagaht, Muzaffarpur	7.78	8.9	2.3	2400	900
12	Punpun at Patna Fatuha Road	7.86	7.4	2.7	3366	1458
13	Koshi at Kurshela Bridge, Katihar	7.7	7.12	2.5	2325	820
14	Kamla at Benipati, Madhubani	7.91	8.06	2.6	1600	700
15	Bagmati at Muzaffarpur Sitamarhi Road Bridge	7.75	8.86	2.5	1366	566

DO – Dissolved oxygen, BOD – Bio-chemical Oxygen Demand

TC – Total Coli-form – FC – Fecal Coli-form

COD – Chemical Oxygen Demand

The detailed pollution level of all rivers at various stretches is enclosed as Annexure 11. Table 8.3 indicates the probable use of surface water for various purposes depending upon pollution load. It could be observed from the comparison between Table no. 8.2 and 8.3, that surface water falls under Class C and could be suitable for drinking purposes after conventional treatment. Hence surface water based water supply scheme should be started in the state, at least in areas affected by Arsenic, Fluoride and Iron.

Table 8.3: Designated best use classification of inland surface water

Criteria	Class A	Class B	Class C	Class D	Class E
DO (mg/L)	6	5	4	4	
BOD (mg/L)	2	3	3		
Total Coliform Count (MPN/100 mL)	50	500	5,000		
pH	6.5-8.5	6.5-8.5	6-9	6.5-8.5	6.5-8.5
Free Ammonia (mg/L)				1.2	
Conductivity (micro mho/cm)					2,250
Sodium Absorption Ratio					26
Boron (mg/L)					2

Class A	Fit for drinking water only after disinfection
Class B	Suitable for outdoor bathing
Class C	Suitable for drinking after conventional treatment
Class D	Suitable for propagation of wildlife and fisheries
Class E	Suitable for irrigation, industrial cooling, controlled waste disposal

8.3 Microbial Contaminations

The broken platform in handpumps, non-availability of cemented platforms in stand posts and leakages in distribution system coupled with inadequate pressure and intermittent supply could be possible reasons for microbial contamination of drinking water. Water logging near the source of water is also responsible for microbial contamination, mosquitoes and related problems. Further, water logging also affects village roads and makes them muddy. Similarly, water logging and muddy conditions after receding of flood water near the sources of drinking water also causes microbial contamination. The following strategies may be adopted to address these issues.

- Water must be disinfected before supply
- Repair of damaged platforms of handpumps
- Construction of platforms for stand posts
- Proper drainage system to drain water accumulated near stand posts and hand pumps
- Regular repair of leakage in distribution system
- Sufficient pressure must be maintained in water supply pipe line
- Continuous water supply system should be ensured in place of intermittent water supply
- Facility for microbial contamination testing should be installed at district and sub divisional level

CHAPTER 9

MAJOR FINDINGS & RECOMMENDATIONS

This study on drinking water sector was conducted with a view to assess the current situation of drinking water services in rural Bihar. An attempt has been made to assess, specifically, the technical and service delivery aspects of rural drinking water supply coverage in Bihar, examine the existing policy and programs of rural drinking water supply services, assess the performance of existing schemes for rural drinking water supply, assess institutional set-up : roles & responsibilities, delivery mechanisms and sector capacities of the rural drinking water services, examine the economic and sector finances for rural drinking water supply delivery and assess the social and environmental aspects of the rural drinking water supply schemes.

The field study was conducted in four sample districts viz. Nalanda, Begusarai, Purnea and West Champaran. To assess the only operational surface water scheme supplying water to multiple villages in multiple Gram Panchayats (GPs), Bhojpur district was also visited. The sample consisted of Gram Panchayats (20), schemes in operation (24), village level institutions (22) and households (458) in 40 villages. Focus group discussions were conducted at the scheme level. Data was also collected from secondary sources and the entire data was tabulated and analyzed to have deeper insights into the existing situation.

Based on the data analysis and discussions with various stakeholders, the major findings and recommendations below emerged:

Technical & Service Delivery

Major Findings:

- The overall coverage of drinking water through tap water sources in Bihar is 4.4% of households. In rural areas, only 2.5% of households get water from taps.
- There has been a marginal improvement in supply of pipe water from 1.4 % to 2.5 % of rural households during the last 10 years
- Hand pumps remain the major source of drinking water in rural areas supplying water to 91.4% households. However during the household survey this figure was reported to be 94.9%

- Trend analysis of the source of drinking water for the last 10 years shows that Wells which used to constitute nearly 23% of the primary drinking water sources have now become obsolete and now less than 1% households depend on them for their drinking water needs. Similarly, the dependence on ponds, river and streams has declined during the last 10 years from 10.7% to 3.06%. Most households have shifted to hand pumps for the sake of better quality of water throughout the year.
- Similarly dependence on hand pumps for majority households among SC population was observed. However Hand pumps (77.77%) and tap water (2.97%) coverage is slightly less among ST households.
- Hand pumps and tube wells are the primary sources of drinking water even among the marginalized communities in rural areas of Bihar. The distribution pattern of households by primary source of drinking water is similar to the overall picture in rural Bihar except for a higher percentage of ST households (10.1%) that depend on wells for their drinking water needs. It is also noteworthy that only 82.4% of ST households have access to hand pumps / tube wells as their primary source of drinking water.
- The penetration of Tap Water for drinking remains a major concern in all the four sample districts. Except for Nalanda which leads the pack with 7.9%, all the other sample districts report current penetration levels of less than 4% of households. The coverage through treated tap water is even lower (less than 2.5%) in all the sample districts except Nalanda which reports 5.4% coverage.
- All the districts north of Patna and 6 other districts viz. Arwal, Bhojpur, Buxar, Rohtas, Aurangabad and Jehanabad have almost full dependence (more than 90%) on Hand Pumps / Tube Wells as primary sources of drinking water. Districts like Patna, Lakhisarai, Munger, Jamui, Banka and Bhagalpur have least dependence on Hand pumps (less than 80%) as primary source of drinking water. Other districts range between 80-90% dependence on hand pumps for drinking water needs.
- According to Census 2011 figures, there has been significant improvement in rural areas in terms of availability of primary source of drinking water inside premises. More than 10 percentage point jump was observed in households having primary source of water within the premises in rural areas. This has happened at the cost of reduction in the percentage of households who had the sources of drinking water near their houses. But there is still a significant proportion (12.6%) of households where people have to travel for more than 500 meters in rural areas to get drinking water for their daily needs.

- The proportion for primary drinking water source inside and near the premises has increased considerably in sample rural households over the last 10 years. The proportion of sources away has gone down to less than 1 % from more than 15% ten years back, which might be due to Govt. efforts in installing hand pumps in all habitations during these years.
- Around 18-20% SC / ST households in rural Bihar travel more than 500 meters to fetch drinking water for their daily needs whereas the same figure for total rural population is just 12.6% which clearly shows that marginalized households are at a disadvantage. Many people in rural areas have got their own shallow hand pumps inside premises. A major portion of marginalized households have to depend on Govt. hand pumps or other sources outside the premises. Because of poor accessibility, they spend considerable time in fetching water and, hence, lose productive work hours.
- Availability of primary drinking water source inside the premises is much lower among marginalized households even in the four sample districts. More SC / ST households in these sample districts travel more than 500 meters to fetch drinking water for their daily needs whereas the same figure for total rural population is lesser, which clearly shows that marginalized households have a disadvantage. Even among the marginalized communities, SC households seem to have poorer accessibility (inside and near premises) to drinking water sources as compared to ST households.
- The PHED, Govt. of Bihar, had fully covered 100% habitations in Bihar for drinking water in 2004-05. For full coverage and to ensure equity within available budget, the Govt. concentrated more on hand pumps.
- 18.81% of habitations have slipped back into partially covered category. Major reasons for slip-back of these habitations as per information gathered in field offices and during focus group discussions are:
    - Sources go dry
    - Water supply schemes become defunct
    - Water sources become quality affected
    - Systems operate below capacity due to poor maintenance
    - Some schemes became old and wear out
    - Increase in population leads to emergence of new habitations affecting drinking water availability
- 6,67,163 hand pumps are currently in use. As most of these hand pumps are installed in public places, as per Govt. policy, we can assume that each hand pump services at least

200 population which implies the full coverage of more than 13 crores of population. This clearly spells out the sufficiency of hand pumps.

- 66.78 % of the existing pipe water schemes are currently functional in the state. Remaining 33.22 % schemes are non-functional.
- Reasons for non-functionality of the schemes are mechanical and civil fault, non-availability of electricity, theft of wires and transformer etc. Majority of the non-functional schemes suffer due to the problems related to electricity like irregular power supply, no electricity connection, burning of transformers and theft of wires. In civil fault, major issues are leakage in distribution system, damage of standposts, leakage in sluice valve, leakage in OHT and OHT not connected to pump etc.
- Majority of the households (67.69%) reported that the primary drinking water became non-functional 1-2 times in the last 1 year. 23.36% households reported the occurrence of non-functionality of drinking water source 3-5 times in the last 1 year.
- Most commonly occurring problem is fault in the machinery like handle, washer etc. Some households reported damage of electric motor.
- Nearly 60% households reported that people themselves repair non-functional water sources whereas in 25% cases Govt. repairs non-functional water sources. The larger proportion of self repair cases may be for larger incidence of personal hand pumps in use.
- It is noteworthy that since so many households invest personal resources in upkeep of drinking water sources, with proper capacity building and awareness generation regarding use and upkeep of pipe water sources, people may contribute in operation and maintenance of water sources.
- 43.89% households reported that damaged water source gets repaired within a week whereas 15.72% households reported that it takes more than a week in repair of damaged water source. Gram Panchayats expressed their views, according to which it takes 6-7 days on an average, to repair a damaged water source.
- The entire project cycle on an average takes 3-3.5 years for single village WSS and 4-4.5 years for multi village WSS.
- Design of the schemes has been done considering the standard norms for various structures and was found to be reasonable
- Design has been done for 40 LPCD for the projected population for 15 years; the mechanical and electrical equipments have been designed for projected population for 15

years and the distribution network, OHT and other structures have been designed for projected population of 30 years

- Land was not a major issue in sample schemes as they are built on Govt. land or on land donated by people. However, discussion with PHED officials revealed that availability of land is a limiting factor in undertaking new schemes. During FGDs, people were found willing to make land available with adequate compensation provided regular and timely supply of drinking water is ensured.
- More than 90% of population in Bihar gets the minimum daily requirement of 40 Litres of drinking water. 9.79% of the population is getting less than 40 LPCD of drinking water. Among the four sample districts, Purnea reports the best levels of service delivery (99.13%) whereas Nalanda reports the lowest level of service delivery (84.79%).
- From the focus group discussions in the sample GPs, it came out that 52 LPCD of drinking water is required for daily needs.
- For 68.4% of the FGDs, the overall water availability was rated as good and for the rest 31.6%, it was rated average. The rating for good water availability for summer season dropped to 52.63% and 10.53% of the FGDs reported poor water availability during summer season due to water table going down.
- Nearly 85% households get enough drinking water to meet their daily requirements. The remaining 15% households get lesser quantity of drinking water than required.
- Nearly 46% households don't have any fixed water source as a backup during emergency. More than 32% households depend on hand pumps located at some distance in the village if their primary water source stops.
- According to the sample households, quality of drinking water is perceived as good by nearly 75% households.
- Nearly 74% households reported no quality related problem in drinking water. Around 15% households reported salty and muddy water and remaining problems were hard and polluted water. W. Champaran reported problems related to water pollutants from sugar mills.
- Nearly 75% households didn't experience contamination problems. However Iron was reported in 7.64% and Fluoride in 0.66%. Since close to 17% of the respondents could not answer due to lack of awareness, Arsenic contamination could not be captured.

- Sample water testing initiative is in place in all the sample districts and water testing is being carried out, as reported by nearly 9% of the sample households.
- Awareness regarding purification of drinking water is very low and only 14.19 % households take traditional measures like boiling and filtering through sedimentation to purify water.
- Nearly 8% households reported regular disinfection of water sources. Majority of the respondents pointed out that no arrangements for disinfection of water sources is made.
- 28.6% of households report high level of satisfaction with current drinking water services. Nearly 29% of households report moderate level of satisfaction whereas 21.4% household report average level of satisfaction with drinking water services.
- Development of ground water is 43% at present indicating sufficient balance water resources
- All blocks have been categorized as safe except 4 blocks, which are categorized as semi-critical

There are marginal changes in the recharge and draft estimates of 2009 in the State as compared to year 2004. The annual replenishable water resource has marginally decreased while annual ground water draft has slightly increased in 2009 as compared to 2004 suggesting the need for water conservation measures and better water management practices. This gives clear indication that availability of ground water is abundant but there are limitations such as contamination problems in certain areas, low yield of tube wells in some pockets of districts like Saran, Gaya & Madhubani and presence of rocky layer beneath the soil making drilling difficult by the available drilling machines.

Although there are many perennial and seasonal rivers flowing through the state, the following issues pose concern in development of surface water:

- Emerging pollutants like antibiotics, pesticides even in minimal quantity are harmful
- Although the rivers are perennial, availability of water in summer season is limited

Still there is sufficient scope for exploitation of surface water for drinking purposes especially in areas near the surface water sources and in areas where ground water is contaminated.

- There are 28 dams and other water bodies in the state. Although the availability of water in the summer season is limited, some drinking water schemes can be developed from the

available water by according priority to water utilization for drinking purposes over irrigation / other uses.

Various issues which aid / limit improved service levels, as identified during visit to schemes and focus group discussions are:

- Leakage in the water distribution system
- Distribution system does not cover entire village
- Damaged Hand Pumps / other constructions in water supply schemes
- Damaged standposts
- Water logging near standposts due to the absence of cemented platforms and proper drainage
- Leakage in sluice valves
- Leakage in some OHT and OHT not connected with the water source
- Water quality not tested
- Water treatment not done due to lack of supply of liquid chlorine
- Irregular supply of water
- Operator has not been posted in some water supply schemes
- Irregular monitoring of water supply scheme
- Irregular supply of electricity restricting duration of water supply
- Limited household connection and High cost of household connection
- Solar plant does not work in fog and cloudy weather with no alternative arrangements
- No provision of drinking water for animals in the current service delivery standard of 40 LPCD prescribed by NRDWP

Recommendations:

- Since the Govt. has already achieved water security to the existing population mainly through hand pumps, the thrust of Govt. should be on the following issues:
    - Proper repair and maintenance of existing hand pumps
    - Installation of new hand pumps only in slipped back habitations
    - Enlarging the coverage of pipe water supply schemes
    - Ensuring quality through water testing and treatment

- Reduce the project cycle time at least by a year through proper project management and monitoring using project management tools like PERT, CPM etc.
- Develop a Citizens Charter for all activities related to water supply
- Site for construction of the water works should be identified in the beginning of the planning process in consultation with Gram Panchayat / villagers. If Govt. land is not available, cost of acquiring land should be included in project cost.
- Organize capacity building programs for contractors to improve worksmanship for pipe water supply schemes
- Repair non-functional hand pumps, immediately
- Repair non-functional water supply schemes soon
- Distribution system should cover the entire village
- Dedicated line for electric supply
- Timely Supply of water and increased duration of water supply
- Alternative power back up for solar system
- Proper arrangement of drainage from the water source / standpost to avoid microbial contamination
- Considering the emerging need of the people, the design criteria of 40 LPCD may suitably be enhanced in tune with the state water policy
- Alternative sources of power should be considered as a backup.
- Strong project monitoring of the schemes during implementation, and thereafter trial run may be done to ensure quality and avoid leakage in distribution system
- Awareness creation and organizing camps for giving household connections may help in increasing coverage through taps inside premises
- Condition of standposts may be monitored regularly and damaged ones should be repaired
- Cemented platforms with proper drainage system may be constructed near the standposts
- Water testing on a regular basis (half-yearly / yearly) may be done and the report may be displayed at the scheme site

- Regular monitoring of water treatment measures like chlorination may be structured and strengthened

Sector Policy & Programs

Major Findings:

- Public Health Engineering Department (referred to as PHED hereafter), Government of Bihar, has drafted a State Water Policy (draft dated 10th March 2010) available in public domain. This is yet to be finalized and adopted.
- Although the Water Policy paper is not finalized as yet, the State Government is acting on almost all the issues mentioned therein.
- The State has achieved 100% coverage in 2005. Due to some schemes becoming non-functional and increase in population, some of the habitations have slipped back to partially covered category.
- Drinking water availability has been ensured to the entire population of the State primarily through handpumps.
- The number of pipe water supply schemes is only 906 which supplies water to 2.5% of the rural households.
- Abundant water resources (underground and surface) are available in the State.
- There is very little utilization of surface water for drinking purpose by the State.
- The norms for coverage are, till date, coverage of habitations rather than coverage of households.
- In the sample districts there is high demand for household connections. However, often the beneficiaries are not aware of the procedure and the persons to be contacted for getting the connection.
- The State government has given first priority of water use for drinking purpose. However, it is difficult to ascertain that the drinking water is not being misused for other purposes.

- Often rural households depend on a single source of potable water
- Capacity building effort is being made in the State. However, looking at the capacity of the various institutions involved in drinking water, it becomes evident that there is a gap between existing capacity and requirements**.**
- A web-based MIS for monitoring has been developed by the department.
- It was observed that in the sample districts Village Water Supply Communities (VWSCs) committees are yet to be formed.
- Public participation in pipe water schemes need to be enhanced by consulting/ involving the Panchayat system/ VWSC in the process of site selection, planning and monitoring of work during implementation. It is observed that there exists a gap in the capacity of Gram Panchayat/ Villagers, specifically in the field of technical knowhow and finance.
- As regards the cost sharing structure between government and the community, the entire cost of installation of the hand pumps/ waterworks is borne by the government. There is no reported incidence of cost sharing by the community.
- Water pricing policy exists at Rs.5 per household per month but collection is not done because of the lack of clarity about the use of the corpus formed. It has been observed during survey that people are willing to pay small amounts of money per month provided they get regular water supply.
- During the course of the present study, it was observed that significant R&D efforts in the area of drinking water are yet to be initiated in the state.
- Bihar ground water (regulation and control of development and Management) Act 2006 to regulate and control the development of ground water has already been enacted and notified on 29th January 2007 by the government of Bihar. Simultaneously, this Act also provides inclusion of rooftop rain water harvesting (RTRWH) in buildings by law. Mandatory provision of RTRW structure in the building plan for buildings in an area of 1000 sq. meter or more.
- Till date, critical review of existing laws regarding drinking water sector has not been attempted in detail.

- Legal framework and guidelines for VWSC are yet to be made available with the District officials.
- Regulatory framework for water conservation measures by consumers are yet to be made available
- Thirteen, eleven and nine districts in Bihar are affected by Arsenic, Fluoride and Iron respectively. Iron is found on the shallow aquifer in most of the districts. A substantial proportion of illnesses in rural areas can be attributed to use of contaminated drinking water.
- Since the present level of pipe water coverage is 2.5% in rural Bihar (Census 2011), considering the plan size, infrastructure, departmental setup, State Govt. desires to increase this coverage to 20% by 2022. An investment of 1177 crores per annum would be required for achieving this. The current level of investment is to the tune of Rs.600 crores per annum, including investment on hand pumps. Hence, massive investment is required for the sector in the coming years.
- The government has already initiated integration of water and sanitation programs.

Recommendations:

- The State Water Policy paper needs to be finalized and adopted on an urgent basis.
- Since quality of water through pipe water schemes is more reliable and assured, there is an urgent need to shift the thrust now from handpumps to pipe water supply schemes.
- The current 40 LPCD norm may be phase wise increased to 50, 60 and 70 LPCD for pipe water schemes in the coming years to make it more realistic and achievable.
- Since the surface water is available in rivers and dams/ other water bodies, a strategy may be developed to utilize surface water for drinking purpose at least in the areas near to the surface water sources and areas having ground water contamination**.**

- Over time, the focus of pipe water schemes coverage may be shifted from habitation coverage towards household coverage through household connections. It will ensure better peoples participation and revenue generation.
- Organization of a camp at waterworks, after due publicity, may help in getting the application for household connections.
- Levying water tariff, even in small amounts, may ensure better accountability by users and prevent misuse of drinking water.
- Stress needs to be given on the use of multiple sources and conjunctive use of various water sources.
- Capacity building programs of various institutions involved in drinking water on a larger scale is required**.**
- The VWS committees need to be formed in all districts at the earliest.
- A strategy needs be evolved to provide technical inputs and basic revolving funds for maintenance to Gram Panchayats before transferring the schemes to Gram Panchayats/ VWSC. Simultaneously, capacity building of the Gram Panchayat functionaries/ VWSC members should be undertaken as an essential ingredient to empower the Gram Panchayat for taking up the responsibility of maintenance.
- A strategy for cost sharing in the maintenance of the schemes in phased manner need to be implemented through participatory approach.
- The water charges need to be revised at an economic rate. Clear guidelines need to be developed for recovering the collected amount. Also, the person responsible for the collection and the use/ treatment of the corpus needs to be delineated.
- Incentive schemes may be designed for encouraging the Panchayats to take up the management of the schemes.
- Critical water sector issues need to be identified and collaboration with specialists / institutions for conducting Research and Development (R&D) activities be strengthened. R&D in the areas like applied water resources technology for low-cost water quality

enhancement for rural areas and discussions on water-health interface in the socio-economic-cultural set up should be initiated.

- Research and Development proposals on the identified issues can be invited from third party or specialized institutions for conducting the R&D work.
- A special cell may also be constituted by the Government to initiate and coordinate the R&D activities.
- Activity mapping delineating roles and responsibilities of various stakeholders need to be done.
- A detailed study of existing laws needs to be made and amendments proposed, if required.
- Legal framework and guidelines for VWSC need to be developed / modified.
- Water conservation measures need to be made legally binding for consumers.
- The principles of 'Reduce, Recycle and Reuse' to ensure water security may be used as it involves conservation and storage of water by utilizing different sources for different uses viz. properly collected and stored rainwater, treated surface water/ground water for drinking and cooking, untreated water for bathing and washing and grey water/spent water for flushing of toilets.
- A quality assurance program needs to be adopted in the State for water supplies to reduce the potential risk of contamination in water supplied. There needs to be close collaboration between water supply agencies and health authorities for successful implementation of the program. All drinking water sources need to be tested by grass-root level workers in each Gram Panchayat by simple-to-use field test kits and joint sanitary surveys. One Field test kit is to be provided to every Gram Panchayat in the state for this purpose. The samples tested positive would then be tested at the District/State level laboratories for confirmation.
- A lot needs to be done towards realizing the goal of water security for all individual rural households. Efforts should be made towards bringing awareness regarding water quality through IEC to address ownership of systems, health hazards, hygiene etc. Discharge of

contaminated untreated effluents into natural streams and ground water must be prohibited by law. Exploitation of water must be done only from deep aquifer where chances of contamination are substantially less. There is a requirement of augmentation of staff or specialist personnel like qualified chemist or microbiologist in quality testing laboratories as many posts are currently lying vacant. Laboratories need to be set up at sub-divisional levels with facilities for microbial testing. To ensure household level drinking water security and potability, community standalone water purification systems could also be promoted in the long term.

- In order to safeguard the availability and quality of drinking water, this sector must have effective priority over other uses. Therefore, protection of ground water sources from excessive abstraction must be addressed, otherwise the costs of providing safe drinking water will continue to escalate. These issues can only be addressed with a multi-sectoral approach in a broad resource management perspective. Formulation of District Water Security Plans is an imperative. This will require development of institutional capabilities at the District Planning Board/ZP and GP/village level for preparing holistic plans for which provision must be made through allocation of funds. Defining the institutional mechanism for capacity building and management of the RWS sector, should also be initiated.

- To utilize the available water resources there is requirement for a well thought out plan along with additional funds, additional manpower in the department and additional infrastructure and massive capacity building effort to train the manpower as well as community.

- Government can plan for externally-aided projects and may also think of Public Private Partnership (PPP). Govt. may also insist Central Govt. to increase the allocation under NRDWP. Govt. may also consider increasing the outlay by availing more funds from rural infrastructure development fund of NABARD.

- There is a need to converge the drinking water components of NRHM, ICDS, SSA and MGNREGS programs being implemented in the State. Operationalizing this integration will require understanding of different dimensions of water security and sanitation.

- For ground and surface drinking water sources, it is of utmost importance to protect the catchment to prevent its pollution from human and animal excreta and other sources of bacteriological contamination. Well designed bunds, channels, bed protection, and convergence with Total Sanitation Campaign and Mahatma Gandhi National Rural Employment Guarantee Scheme for low cost waste water management, are a pre-requisite for ground and surface drinking water source protection.
- Convergence with the MGNREGS program for construction of new ponds and rejuvenation of the old ponds, including de-silting, should be built into the system design and execution to increase infiltration and percolation of ground water which will help in ground water recharge.

Institutional

Major Findings:

- PHED has a well-structured organizational setup in place from State up to Sub-Divisional Offices
- There is no structured organization / office at Block / GP level
- Mechanical and Civil are two main wings of technical service
- Construction is taken up by Civil wing while Mechanical wing looks after getting electricity connection and operation of machines
- Some gaps in coordination were observed among the two wings at district and sub-divisional level resulting in undue delay, thus affecting the functioning of schemes
- Acute shortage of manpower was observed at the level of Assistant Engineers, Junior Engineers, Pipe Inspectors, Khalasis, Plumbers, Mistrys and Operators affecting project formulation, implementation, monitoring and repair work in schemes
- Capability of staff at lower levels to tackle the emerging challenges in drinking water services and cope up with new technology is low

- The delegation of authority at the level of Executive Engineer and Superintending Engineer is not adequate. Most of the pipe water supply schemes were beyond the delegated authority of the Executive Engineer and Superintending Engineer. It was observed that delay occurs in according technical sanction and acceptance of tender due to inadequate delegation of powers.
- DWS Mission & DWS Committee have been constituted in each district and are reviewing the implementation of schemes
- Very low level of transfer of schemes to GPs / VWSCs mostly due to unwillingness of GPs, lack of skills, knowledge, capabilities of the GPs / VWSCs
- Very low level of involvement of GPs / VWSCs in Planning, Implementation, Operation & Maintenance due to lack of awareness, knowledge and capabilities
- GPs which have taken charge are not equipped with requisite resources and capabilities to handle O & M of schemes
- VWSCs are yet to be formed in most villages in all the sample districts
- Web-based Integrated Management Information System (MIS) has been developed
- Monitoring of schemes is not structured. Due to poor monitoring, quality gets a setback. Many handpumps and stand posts were damaged. There were leakages in the distribution system and was observed.
- Focus group discussions clearly revealed that in spite of villager's willingness to take household connection, household connection is few as nobody is helping the villager in getting household connection and completing all formalities for the same.
- No third party evaluation studies have been conducted

Recommendations:

- Creation of additional posts and filling-up of vacant posts through campus recruitments to take up the load of proposed projects. Since the state desires to cover 20% rural population through pipe water schemes by 2022, strengthening of PHED in terms of

additional staff and requisite infrastructure in phased manner should be attempted to cope with the increased work load.

- Massive capacity building of field staff in areas through training in areas like motivation, team building, new technology and participatory management
- Outsourcing of operation & maintenance
- Better coordination between civil and mechanical wings at district level and below
- Adequate sanctioning authority should be given at EE and SE levels.
- Awareness campaigns should be organized to educate villagers on proper use of drinking water and sanitation
- Massive capacity building effort is needed to prepare VWSC / GP for handling operation & maintenance
- Mobilization of users at the village level should be initiated for participatory management
- Involvement of the GPs / VWSCs from the beginning i.e. from planning, site selection etc. should be ensured
- Transferring the schemes in a phased manner with funds for maintenance in the beginning must be ensured under the supervision of PHED
- Dedicated staff and vehicles for monitoring must be deployed
- Broadband connectivity with adequate hardware and software support should be provided at district and sub-divisional office
- Monitoring of schemes should be structured and strengthened to ensure quality and timely repair of damaged sources
- Third-party evaluation study may regularly be conducted

Economic & Sector Finances

Major Findings:

- The Eighth Five-Year Plan in India (1992-97) introduced the concept of water as a commodity that should be supplied based on effective demand, the cost recovery principle and managed by private or local organizations.
- The approach shifted from supply driven to demand driven for (a) more efficient supply through providing the beneficiary the decision making power to make the project more realistic and need based (b) cost recovery for more sustainable use and expansion.
- Drinking water sources in rural Bihar can be categorized into six categories viz. own hand pump, private hand pump, public hand pump, pipe water connection, wells and others.
- Across the State, the study found that 95% of sample households depend on hand pumps for their drinking water needs.
- It was also found that 43% of sample households have their own hand pumps which are their main source of drinking water.
- In two of the sample districts, Begusarai and Purnea, sample households are mostly dependent on their own hand pumps, whereas in two other sample districts, West Champaran and Nalanda, households mainly depend upon public sources.
- In last five years, the state government has earmarked Rs. 1195.48 crores for drinking water supply, out of which Rs. 881.33 crores have been utilized.
- There is large variation in expenditure on drinking water across the sample districts
- Household level data show that for 47.6% of sample households, the main source of drinking water is either their own hand pump or some other private sources.
- 49.3% sample households depend upon public supply of water through hand pump or pipe water.
- The opportunity cost of drinking water from hand pump worked out to be around Rs. 500 to Rs. 750.

- More than 80% people were found to be ready to share the capital costs as well as monthly usage fees for pipe water, provided they get household connection.
- People are found ready to pay Rs. 50 to Rs. 2000 to share capital costs and Rs. 25, on an average, as monthly usage charges for drinking water through pipe.
- Sharing of investment on drinking water by public and private worked out for the sample district West Champaran found that, more than 40% of investment in drinking water are from private sources.
- There is a paradigm shift in water resource management from supply-driven to demand-oriented approaches.
- Decentralized decision making and participation of stakeholders have been increasingly recognized as strategies for sustainable and effective service delivery.
- Government of Bihar, through their draft Water Policy Paper acknowledges drinking water as scarce and as an economic good and advocates for collection of water tariff for recovery of cost for providing drinking water
- The accountability system in PHED is found to be vertical
- Though there is system of financial audit in practice, there is no practice of social audit in implementation.

Recommendations:

- At the time of implementation of water projects, different types of expenditures involved in the projects, especially capital maintenance expenditure, expenditures on direct and indirect support should be taken care of well.
- There is ample scope for providing pipe drinking water in rural Bihar. Government and its agencies should opt for participatory management of pipe drinking water as people are ready to share the capital costs and bear the monthly user charges.
- Adoption of strategies for decentralized decision making for drinking water services may be useful in future.

- The water tariff policy needs to be revised to make it more realistic for providing uninterrupted supply of pipe drinking water
- A system of social audit may be introduced to empower people to hold the service provider accountable for effective delivery

Social

Major Findings:

- There is hardly any social restriction observed in accessing drinking water from different sources. People are found to access drinking water from other private sources and public sources without any restriction.
- There are two distinct kinds of participatory spaces that exist in rural Bihar. One is *Gram Sabha* which is an Invited Space of participation and the other one is *Aam Sabha* which is categorized as popular space of participation. This implies the arrangement of participatory process in rural Bihar regarding any decision making process related to local issues.
- It is found from the discussions with villagers and other GP level functionaries that *Gram Sabha* meetings are irregular so also the level of participation of people in these meetings is low
- People are rarely consulted regarding implementation of hand pumps or pipe water schemes by PHED
- It is found from household level survey that only 7% of sample households have been consulted during planning for drinking water. There are also district wise variations in consulting people during planning. There is no such community preference evident in community consultation.
- The household survey found that 94% of sample households have demanded for improved drinking water services. It is also found that they hardly communicate their demand as a large section (44%) of them did not have any clear idea as to whom the

demand should be communicated and a section (6%) did not raise it because of their assumption that their demand will not be considered.

- No significant differences among communities in intention to raise demand were observed. The intensity of raising demand across the communities is similar. This signifies that there is less incidence of 'capture' or oppression in the rural Bihar society. People can raise their demand irrespective of their social status.
- The household level survey found that 32% of sample households have contributed for repair of local hand pumps constructed for common use.
- People are ready to share a part of the capital cost of implementation of pipe drinking water project. They also expressed their willingness to pay monthly usage charges.
- People are found ready to pay Rs.50 to Rs. 2000 for capital cost and are ready to pay, on an average, Rs. 25 per household per month as monthly charges.
- It is found that 83% of sample households are ready to pay for pipe water services irrespective of their socio-economic status.
- It is found that people want to have pipe water in their houses to reduce time spent to fetch water from hand pumps as well as to have quality drinking water to avoid diseases and reduce medicinal costs.
- It is observed that, in delivering pipe drinking water supply, GPs are rarely involved. Even when the GPs are involved, their roles were found limited to selection of sites.
- In case of GPs, to whom pipe water supply project has been transferred, it is found that they are not prepared to undertake operation and maintenance of pipe water supply.
- The formation of Village Level Water and Sanitation Committee (VWSC) is helpful in management of drinking water locally.
- The formations of Village Level Water and Sanitation Committees (VWSC) are yet to be initiated.

Recommendations:

- At the time of implementation of project, the community dimensions need to be taken care of for effective implementation, functioning and delivery of drinking water projects. One of the mostly used approach to involve community and incorporating its view is through participatory social and resource mapping, which needs to include all members of community, especially women members. The mapping shall be an effective tool to intervene into the community to understand the social dimensions and act accordingly.
- Initiative needs to be taken to orient and capacitate the community and GP functionaries regarding participatory processes and management, prior to launching a project.
- District specific orientation strategy may be more suitable.
- Village Level Water and Sanitation Committee needs to be constituted to manage and maintain the water supply schemes in participatory ways.
- Orientation and building capacity of VWSC members and GP functionaries regarding mobilizing resources also need to be done. Adequate power needs to be delegated to VWSC and GP for mobilizing resources locally.
- GP functionaries need to be oriented to build capacity of VWSC members regarding participatory management and resource mobilization.
- It is also found that the lack of a local water committee for pipe systems can hinder performance, but the presence of a water committee is no guarantee of improved performance. (Isham and Kähkönen, 1999). To avoid this kind of problem, project funding agencies and staff need to place a high priority on the training and monitoring of water committees.
- Professionals may be engaged in capacity building and empowering GP and community regarding participatory management tools.
- A proposed model for community awareness and participatory management given in this report can be adopted
- Increasing investment in social mobilization is also argued to be fruitful. Further inquiry in this area, however, is still needed to assess the expected costs and benefits of

participatory management, social mobilization and its intended and unintended consequences.

Environment

Major Findings:

- About 13 districts are affected by Arsenic, 11 by Fluoride and 9 by Iron. Generally, the entire district is not affected by the quality problem. Contamination is observed in patches in certain Blocks, Villages and habitations.
- 1590 habitations i.e. 1.48% habitations of the state in 50 blocks are affected by Arsenic contamination. It was reported that higher concentration of Arsenic is confined to the top aquifers occurring up to 100m below ground. It was also reported by the PHC located at Begusarai that skin, lung and liver cancer cases are rising in the Arsenic affected areas. Arsenic safe aquifers were observed at depths beyond 100m-130m below ground level.
- 4157 habitations i.e. 3.86% habitations of the state, in 98 blocks are affected by Fluoride contamination. It was also reported that the contamination problems are in some patches, in the above habitations. Some locations are also free from fluoride in same habitations. Skeleton disorders as well as disorders in teeth were seen in villages in Nalanda which may be a result of excess concentration of fluoride in drinking water.
- 18673 habitations i.e. 17.35% habitations of the state, in 101 blocks, are affected by Iron contamination
- It was found during focus group discussions with beneficiaries in Purnea and Begusarai districts that color and odour of the water changes after sometimes due to presence of iron in the water. Primary Health Centres at Begusarai and Purnea also reported that cases of digestive problems were more in the district mainly due to presence of iron in the water. The people of both the districts pointed out that discoloring of cloths happen regularly due to presence of iron in water.
- Chloride is not the major problem in any district

- Electrical Conductivity (actually dissolved solid) is not a major issue in any districts of Bihar
- Increasing trend of nitrate presence in groundwater may be considered as a future problem in the state
- Surface water can be made suitable for drinking purposes after conventional treatment.
- The broken platform in handpumps, non-availability of cemented platforms in stand posts and leakages in distribution system, coupled with inadequate pressure and intermittent supply could be possible reasons for microbial contamination of drinking water. Water logging near the source of water is also responsible for microbial contamination, mosquitoes and related problems. Further, water logging also affects village roads and makes them muddy. Similarly, water logging and muddy conditions, after receding of flood water near the sources of drinking water, also causes microbial contamination.

Recommendations:

In consultation with the stakeholders, the following strategies have been identified for sustainability of source.

- There are a number of Ahar / Pynes / Ponds / Tanks in the villages. These water bodies are depleted due to siltation and lack of maintenance. Restoration of these water bodies like Ahar / Pynes / Ponds / Tanks / Irrigation wells will increase infiltration and percolation ultimately leading to recharge of ground water.
- Construction of artificial recharge structure in marginal alluvium and piedmont areas of South Ganga Plain
- Rain water harvesting in fields
- Roof top rain water harvesting
- Recycling / reuse of waste water after treatment at least for irrigation purpose
- Development of proper sewerage system

- Instead of treating arsenic, it is advisable to tap safe water from arsenic free deeper aquifer and to explore other sources of water such as surface water supply. Installation of treatment plant for arsenic contaminated water should be done only where arsenic free water or surface water source is not available.
- Attempts should be made to construct fluoride free water wells by selecting proper sites through exploratory ground water drilling. Alternatively, water can be transported from the nearby fluoride free habitations through underground distribution system. Exploitation of surface water in fluoride affected areas may also serve as a good alternative.
- It was also reported that iron contamination is found in shallow aquifer up to the depth of 30m. Hence tapping of deep aquifer can be the solution for Iron contamination.
- Surface water based water supply scheme should be started in the state, at least in areas affected by Arsenic, Fluoride and Iron.

The following strategies may be adopted to address microbial contamination issues.

- Water must be disinfected before supply
- Repairing of damaged platforms of handpumps
- Construction of platforms for stand posts
- Proper drainage system to drain water accumulated near stand posts and hand pumps
- Regular repair to avoid leakage in distribution system
- Initiatives to keep and maintain sufficient pressure in water supply pipe line
- Continuous water supply system should be ensured in place of intermittent water supply
- Facility for microbial contamination testing should be installed at district and sub divisional level

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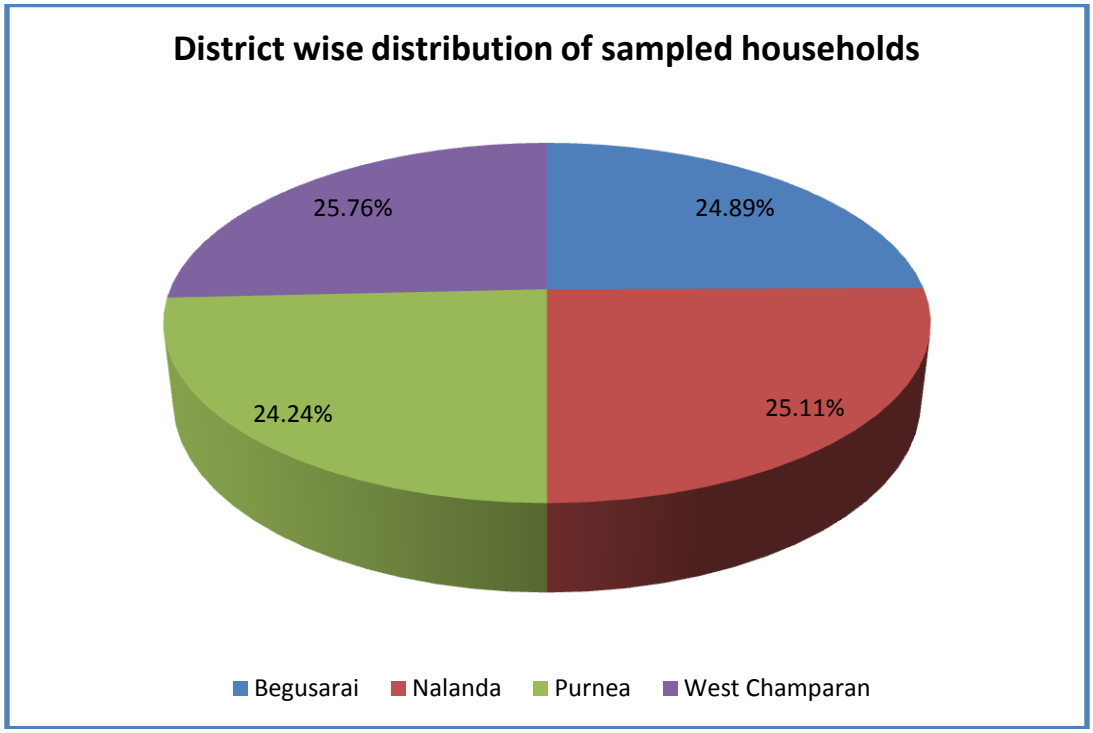
ANNEXURE 1

PROFILE OF SAMPLE HOUSE HOLDS

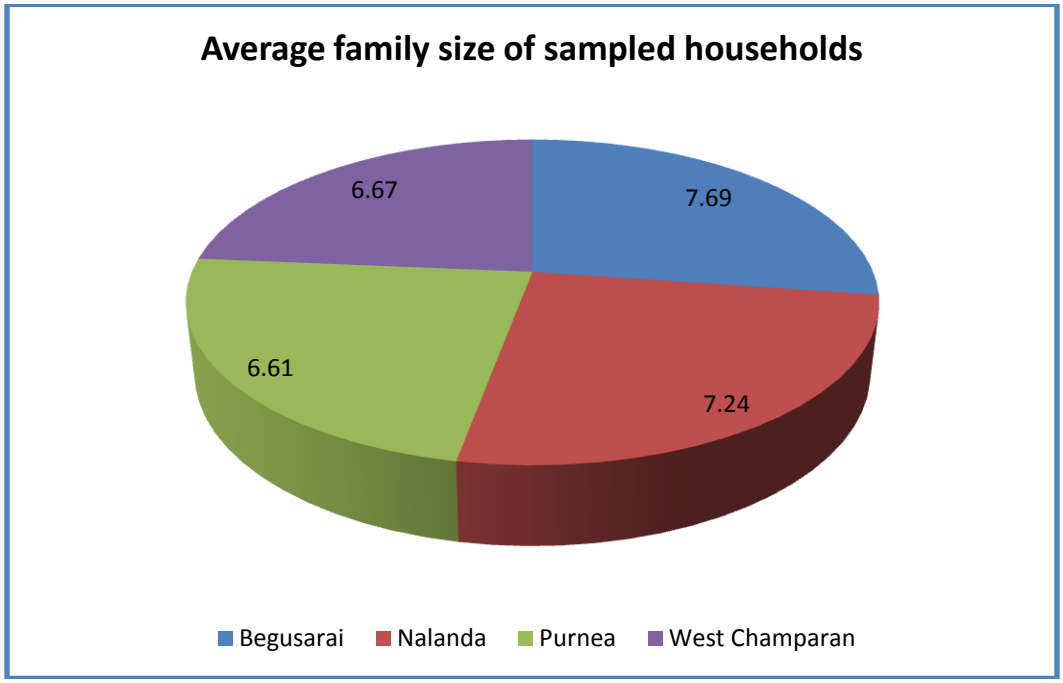
1. District wise distribution of sample households

District	Number	Percent
Begusarai	114	24.89%
Nalanda	115	25.11%
Purnea	111	24.24%
West Champaran	118	25.76%
Grand Total	**458**	**100.00%**



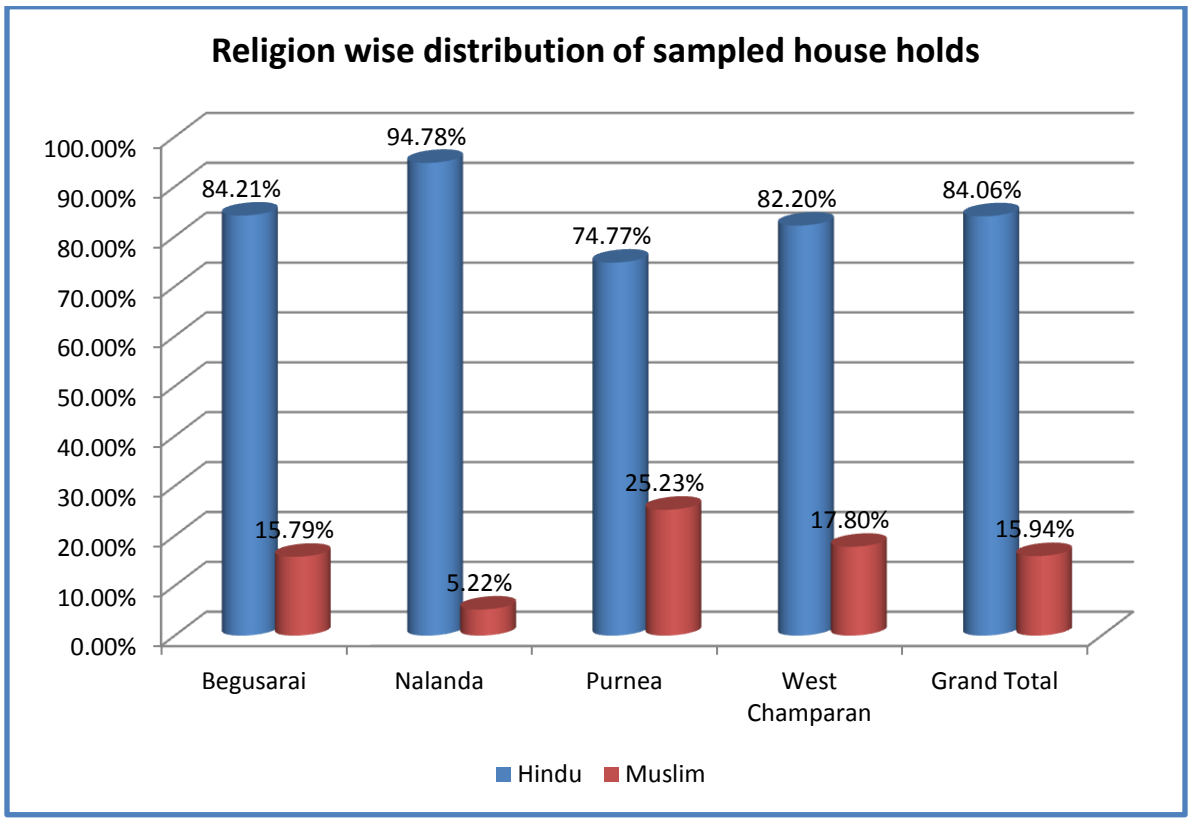
2. Average family size of sample households

District	Average HHs Size
Begusarai	7.69
Nalanda	7.24
Purnea	6.61
West Champaran	6.67
Grand Total	**7.05**



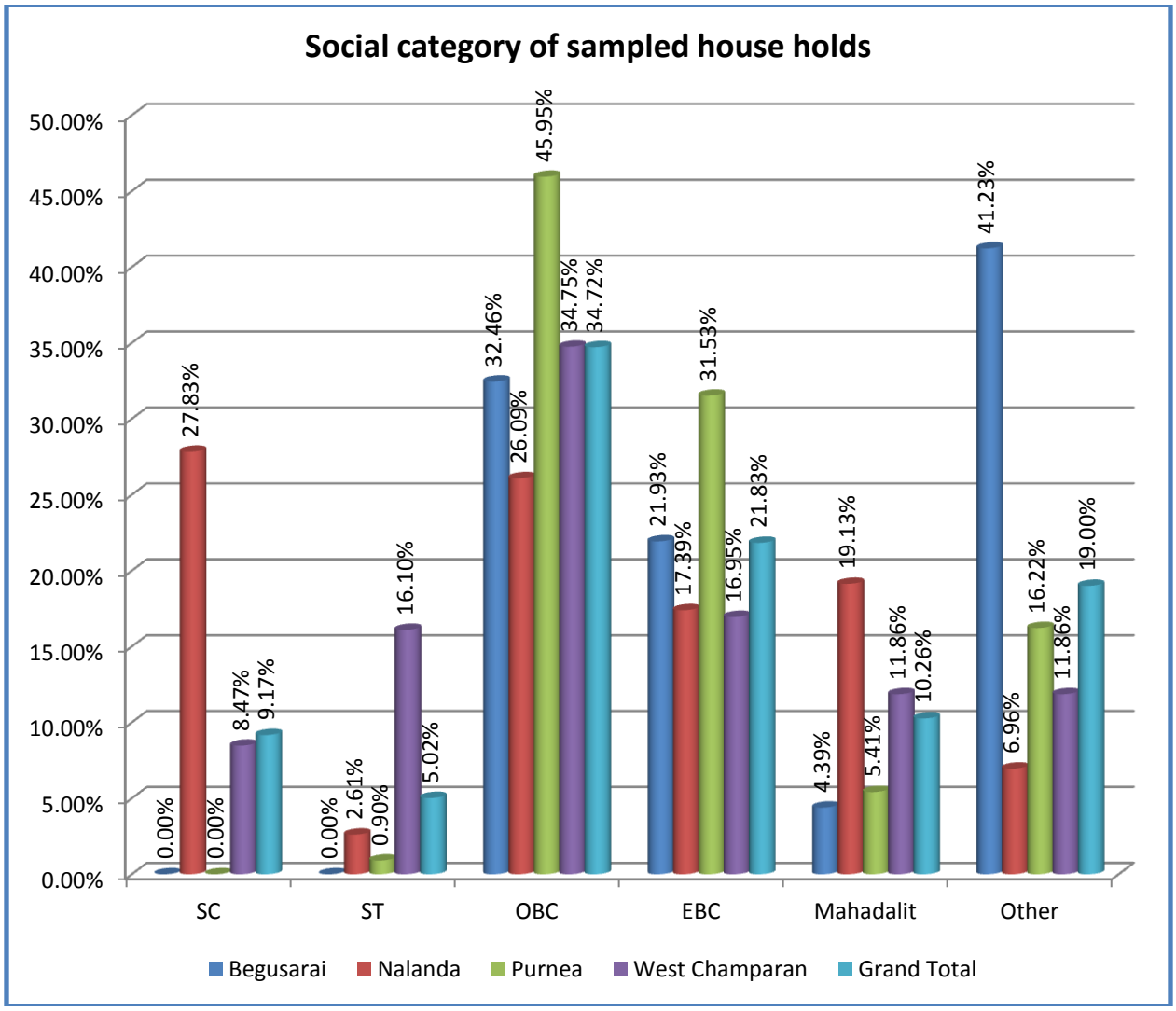
3. Religion wise distribution of sample house holds

Religion	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Hindu	96	109	83	97	385
	84.21%	94.78%	74.77%	82.20%	84.06%
Muslim	18	6	28	21	73
	15.79%	5.22%	25.23%	17.80%	15.94%
Total	**114**	**115**	**111**	**118**	**458**
	100.00%	**100.00%**	**100.00%**	**100.00%**	**100.00%**



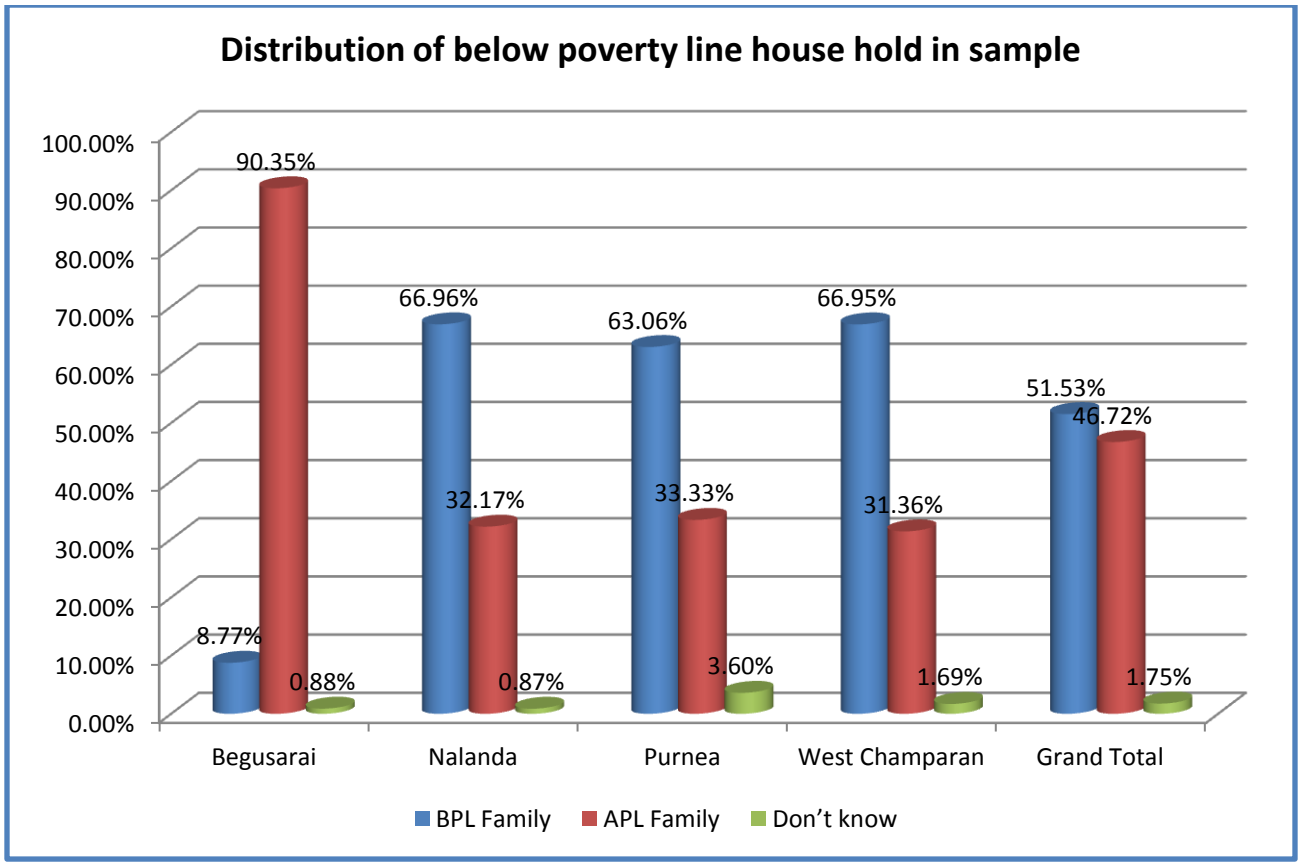
4. District wise / social category of sample house holds

Caste	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
SC		32		10	42
	0.00%	27.83%	0.00%	8.47%	9.17%
ST		3	1	19	23
	0.00%	2.61%	0.90%	16.10%	5.02%
OBC	37	30	51	41	159
	32.46%	26.09%	45.95%	34.75%	34.72%
EBC	25	20	35	20	100
	21.93%	17.39%	31.53%	16.95%	21.83%
Mahadalit	5	22	6	14	47
	4.39%	19.13%	5.41%	11.86%	10.26%
Other	47	8	18	14	87
	41.23%	6.96%	16.22%	11.86%	19.00%
Total	**114**	**115**	**111**	**118**	**458**
	100.00%	**100.00%**	**100.00%**	**100.00%**	**100.00%**


Social category of sampled house holds
50.00%
45.00%
40.00%
35.00%
30.00%
25.00%
20.00%
15.00%
10.00%
5.00%
0.00%
0.00%
27.83%
0.00%
8.47%
9.17%
0.00%
2.61%
0.90%
16.10%
5.02%
32.46%
26.09%
45.95%
34.75%
34.72%
21.93%
17.39%
31.53%
16.95%
21.83%
4.39%
19.13%
5.41%
11.86%
10.26%
41.23%
6.96%
16.22%
11.86%
19.00%
SC
ST
OBC
EBC
Mahadalit
Other
Begusarai
Nalanda
Purnea
West Champaran
Grand Total

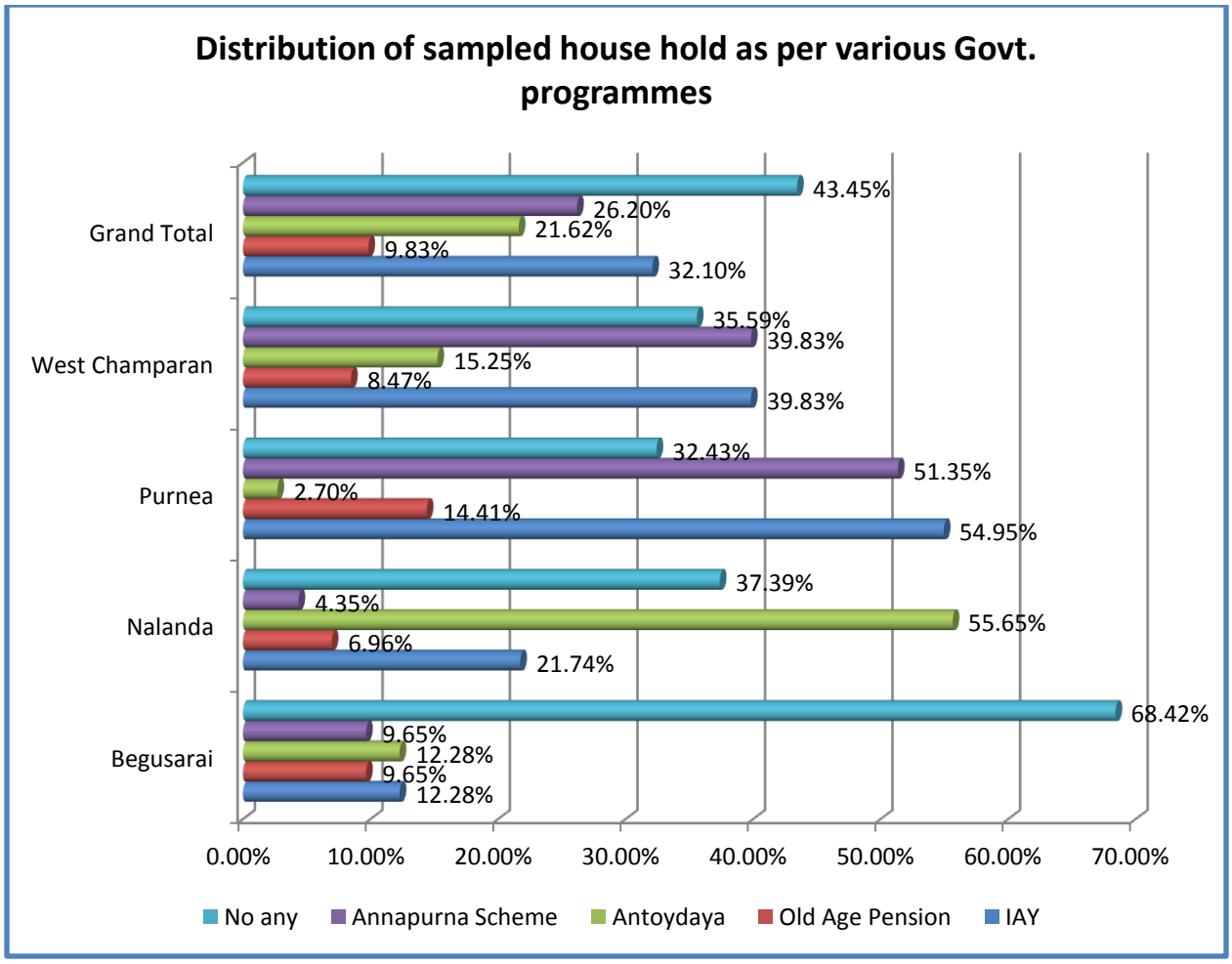
5. Distribution of below poverty line house hold in sample

Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
BPL Family	10	77	70	79	236
	8.77%	66.96%	63.06%	66.95%	51.53%
APL Family	103	37	37	37	214
	90.35%	32.17%	33.33%	31.36%	46.72%
Don't know	1	1	4	2	8
	0.88%	0.87%	3.60%	1.69%	1.75%
Total	**114**	**115**	**111**	**118**	**458**
	100.00%	**100.00%**	**100.00%**	**100.00%**	**100.00%**



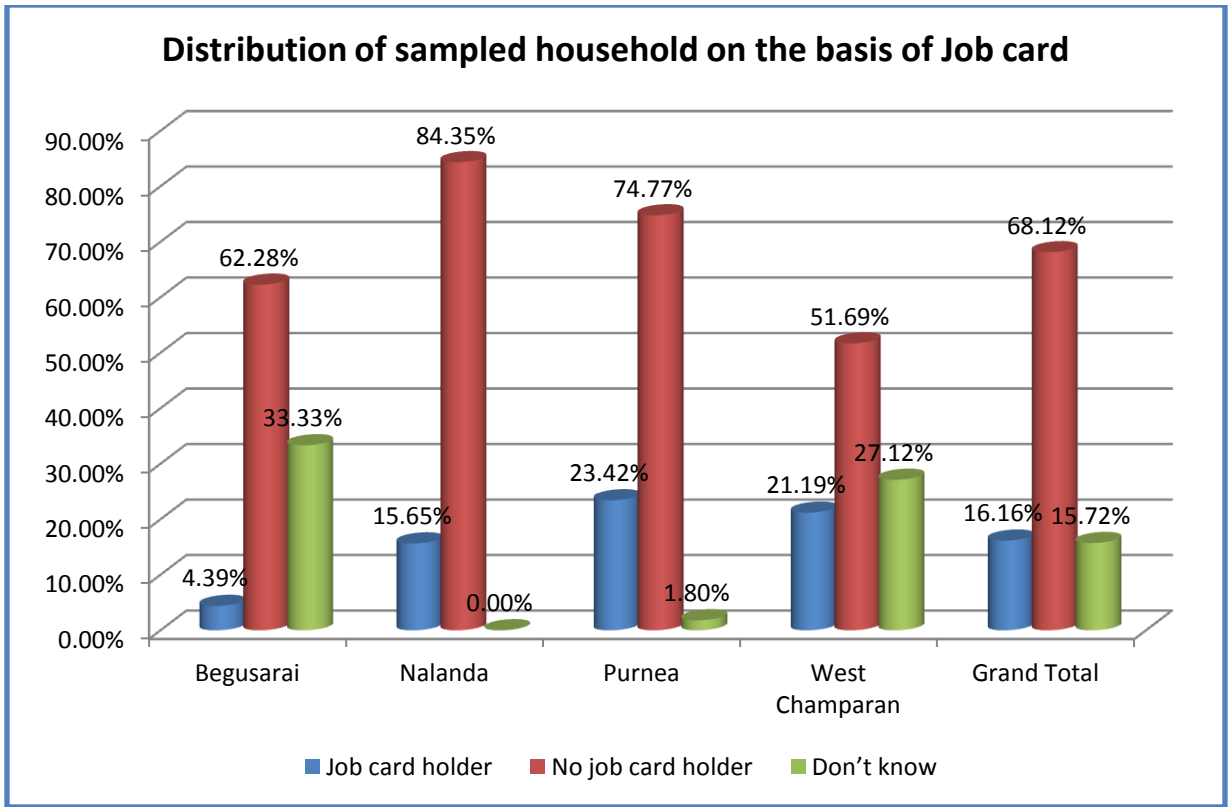
6. Distribution of sample households as per various Govt. programs

Programs	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
IAY	14	25	61	47	147
	12.28%	21.74%	54.95%	39.83%	32.10%
Old Age Pension	11	8	16	10	45
	9.65%	6.96%	14.41%	8.47%	9.83%
Antyodaya	14	64	3	18	99
	12.28%	55.65%	2.70%	15.25%	21.62%
Annapurna Scheme	11	5	57	47	120
	9.65%	4.35%	51.35%	39.83%	26.20%
No any	78	43	36	42	199
	68.42%	37.39%	32.43%	35.59%	43.45%
Total	**114**	**115**	**111**	**118**	**458**
	100.00%	**100.00%**	**100.00%**	**100.00%**	**100.00%**



7. Distribution of sample household on the basis of Job card.

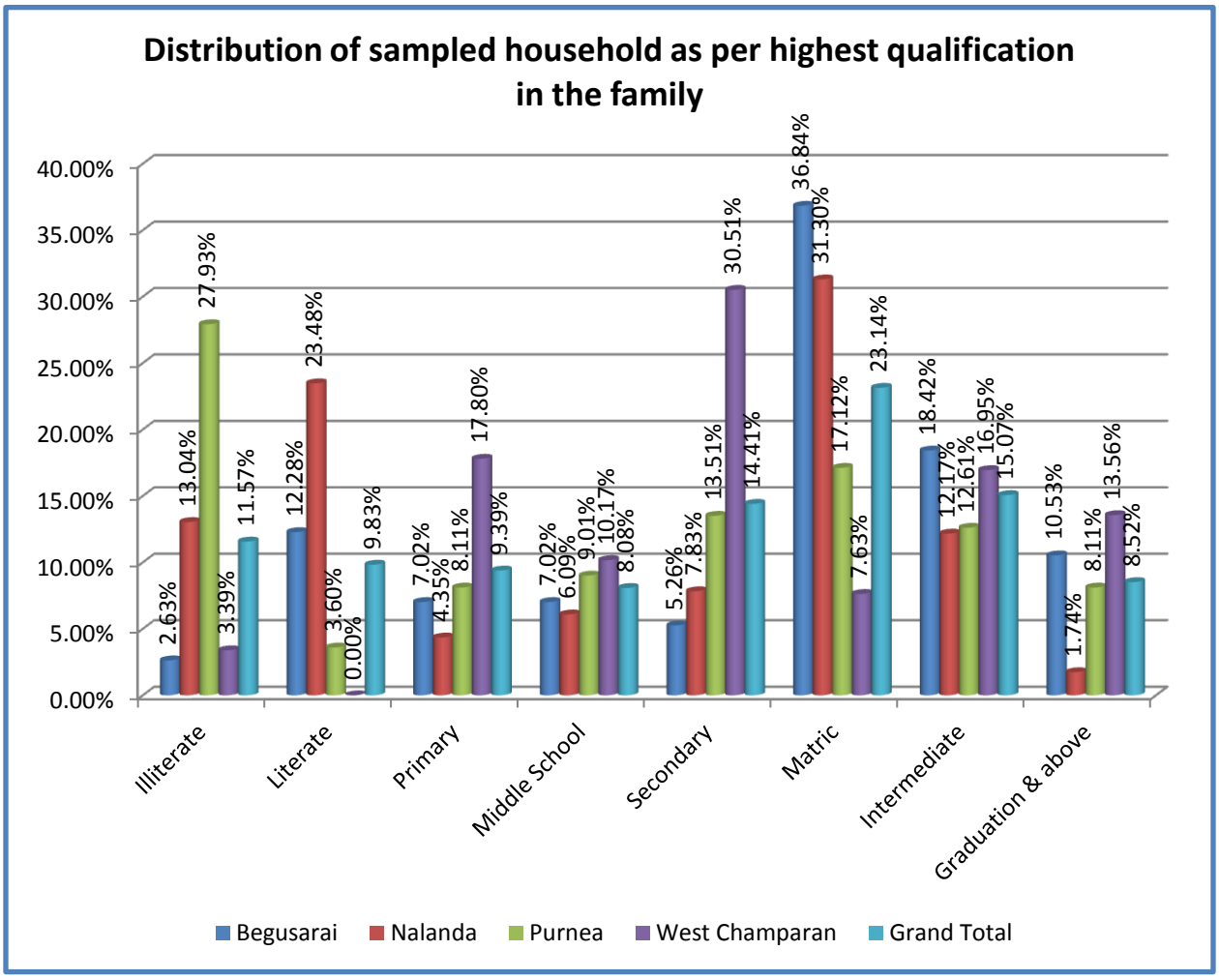
Particulars	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Job card holder	5	18	26	25	74
	4.39%	15.65%	23.42%	21.19%	16.16%
No job card holder	71	97	83	61	312
	62.28%	84.35%	74.77%	51.69%	68.12%
Don't know	38		2	32	72
	33.33%	0.00%	1.80%	27.12%	15.72%
Total	**114**	**115**	**111**	**118**	**458**
	100.00%	**100.00%**	**100.00%**	**100.00%**	**100.00%**



8. Distribution of sample household as per highest qualification in the family.

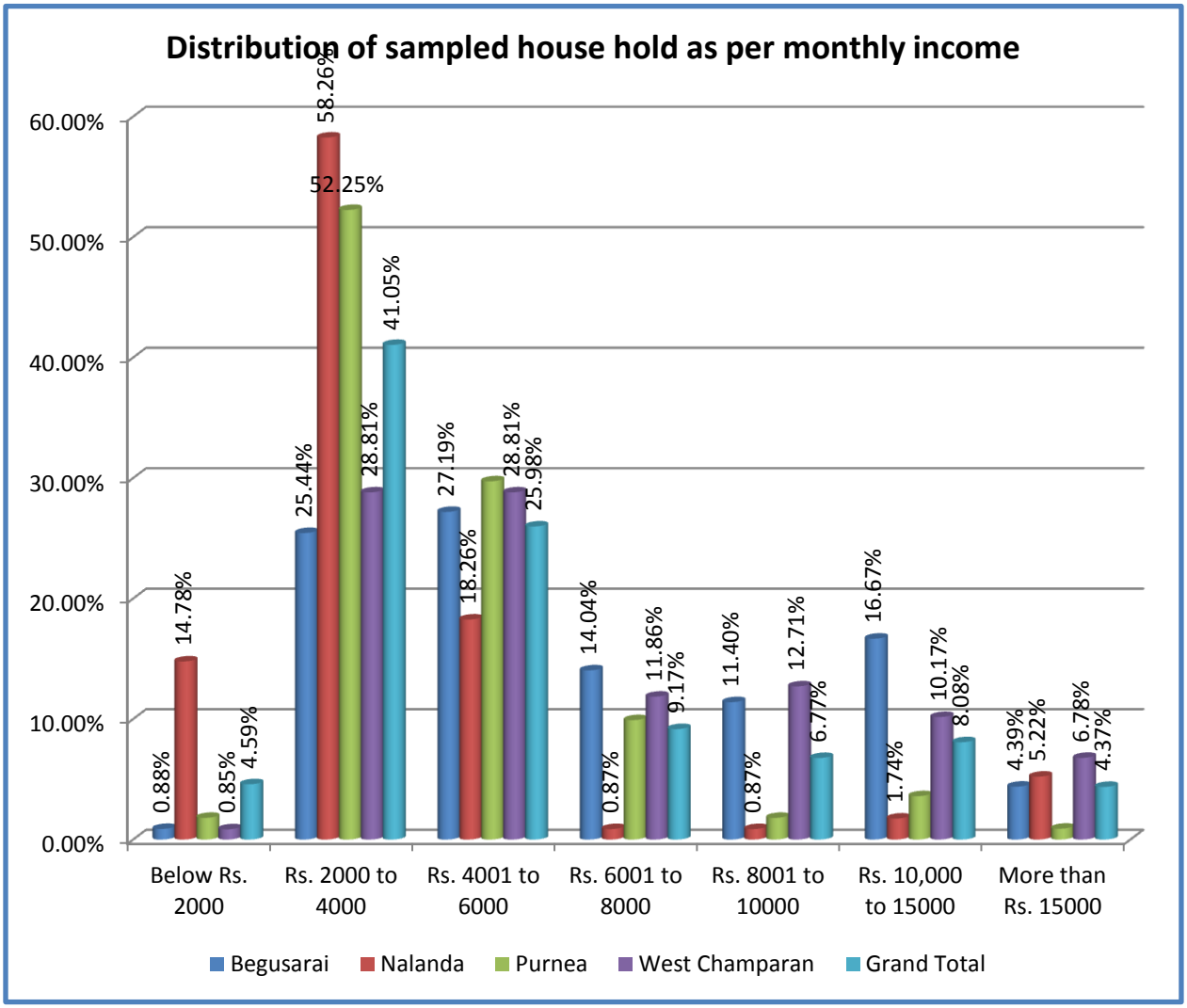
Educational Qualifications	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Illiterate	3	15	31	4	53
	2.63%	13.04%	27.93%	3.39%	11.57%
Literate	14	27	4		45
	12.28%	23.48%	3.60%	0.00%	9.83%
Primary	8	5	9	21	43
	7.02%	4.35%	8.11%	17.80%	9.39%
Middle School	8	7	10	12	37
	7.02%	6.09%	9.01%	10.17%	8.08%
Secondary	6	9	15	36	66
	5.26%	7.83%	13.51%	30.51%	14.41%
Matric	42	36	19	9	106
	36.84%	31.30%	17.12%	7.63%	23.14%

Intermediate	21	14	14	20	69
	18.42%	12.17%	12.61%	16.95%	15.07%
Graduation & above	12	2	9	16	39
	10.53%	1.74%	8.11%	13.56%	8.52%
Total	**114**	**115**	**111**	**118**	**458**
	100.00%	**100.00 %**	**100.00 %**	**100.00%**	**100.00%**



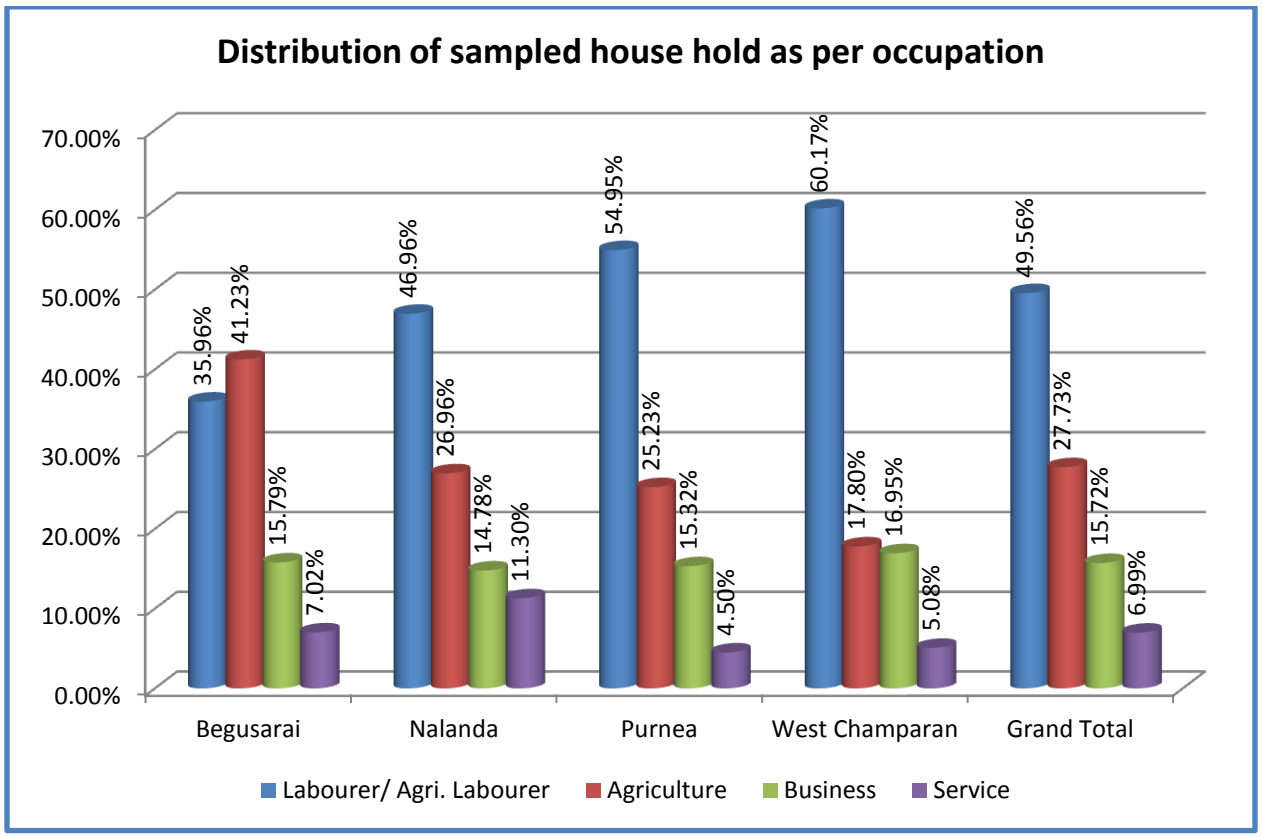
9. Distribution of sample households as per monthly income

Monthly Income	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Below Rs. 2000	1	17	2	1	21
	0.88%	14.78%	1.80%	0.85%	4.59%
Rs. 2000 to 4000	29	67	58	34	188
	25.44%	58.26%	52.25%	28.81%	41.05%
Rs. 4001 to 6000	31	21	33	34	119
	27.19%	18.26%	29.73%	28.81%	25.98%
Rs. 6001 to 8000	16	1	11	14	42
	14.04%	0.87%	9.91%	11.86%	9.17%
Rs. 8001 to 10000	13	1	2	15	31
	11.40%	0.87%	1.80%	12.71%	6.77%
Rs. 10,000 to 15000	19	2	4	12	37
	16.67%	1.74%	3.60%	10.17%	8.08%
More than Rs. 15000	5	6	1	8	20
	4.39%	5.22%	0.90%	6.78%	4.37%
Total	**114**	**115**	**111**	**118**	**458**
	100.00%	**100.00%**	**100.00%**	**100.00%**	**100.00%**


Distribution of sampled house hold as per monthly income
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
0.88%
14.78%
0.85%
4.59%
25.44%
58.26%
52.25%
28.81%
41.05%
27.19%
18.26%
28.81%
25.98%
14.04%
0.87%
11.86%
9.17%
11.40%
0.87%
12.71%
6.77%
16.67%
1.74%
10.17%
8.08%
4.39%
5.22%
6.78%
4.37%
Below Rs. 2000
Rs. 2000 to 4000
Rs. 4001 to 6000
Rs. 6001 to 8000
Rs. 8001 to 10000
Rs. 10,000 to 15000
More than Rs. 15000
Begusarai
Nalanda
Purnea
West Champaran
Grand Total

10. Distribution of sample households as per occupation.

Occupation	Begusarai	Nalanda	Purnea	West Champaran	Grand Total
Labourer/	41	54	61	71	227
Agri. Labourer	35.96%	46.96%	54.95%	60.17%	49.56%
Agriculture	47	31	28	21	127
	41.23%	26.96%	25.23%	17.80%	27.73%
Business	18	17	17	20	72
	15.79%	14.78%	15.32%	16.95%	15.72%
Service	8	13	5	6	32
	7.02%	11.30%	4.50%	5.08%	6.99%
Total	**114**	**115**	**111**	**118**	**458**
	100.00%	**100.00%**	**100.00%**	**100.00%**	**100.00%**



(Source: Primary Data)

ANNEXURE 2

STATUS OF TAP WATER SUPPLY AS ON 2001 & 2011 IN VARIOUS STATES

SI. No.	Area Name	Percentage of Households getting Tap water				Percentage of Households getting Treated - Tap water			
		Total		In Rural Area		Total		Rural	
		2001	2011	2001	2011	2001	2011	2001	2011
1	Andaman & Nicobar Islands	76.20	85	66.30	77.50		68.80		55
2	Andhra Pradesh	48.10	69.90	40.30	63.40		49		36.40
3	Arunachal Pradesh	67.80	65.50	63.30	59.30		26.40		19.70
4	Assam	9.20	10.50	5.40	6.80		9.20		5.80
5	Bihar	3.70	4.40	1.40	2.50		3.10		1.60
6	Chandigarh	91.90	96.70	85	95.20		93.70		88.80
7	Chhattisgarh	15.50	20.70	5	8.80		12.30		3.30
8	Dadra and Nagar Haveli	28.20	46.50	25.20	42.50		26		15.80
9	Daman and Diu	72.90	75.20	62.80	84.80		54.60		76.50
10	Delhi	75.30	81.30	51.60	59.40		75.20		49.60
11	Goa	69	85.40	57.20	77.80		82		72.90
12	Gujarat	62.30	69	49.10	55.80		39.80		16.70

13	Haryana	48.10	68.80	37.80	63.60		55.90		47.40
14	Himachal Pradesh	84.10	89.50	82.90	88.70		83.90		82.70
15	India	36.70	43.50	24.30	30.80		32		17.90
16	Jammu & Kashmir	52.50	63.90	40.70	55.70		34.70		22.30
17	Jharkhand	12.60	12.90	2.70	3.70		10		2.10
18	Karnataka	58.90	66.10	48.50	56.40		41.20		22.90
19	Kerala	20.40	29.30	13.90	24.50		23.40		17.20
20	Lakshadweep	3.10	20.30	4.40	31		9.10		0.80
21	Madhya Pradesh	25.30	23.40	10.70	9.90		16.40		4.70
22	Maharashtra	64	67.90	45.50	50.20		56.30		32
23	Manipur	29.30	38.60	20.60	29.50		25.60		12.70
24	Meghalaya	34.50	39.30	24.40	28.70		27.80		16.70
25	Mizoram	31.90	58.70	19.30	41.40		39.40		14.60
26	Nagaland	42	47.20	44.30	51.80		6.10		6.10
27	Orissa	8.70	13.80	2.80	7.50		10		4

28	Puducherry	89.30	95.30	87.30	95		90.80		88.60
29	Punjab	33.60	51	15.80	34.90		41.10		25.30
30	Rajasthan	35.30	40.60	21.60	26.90		32		17.90
31	Sikkim	70.30	85.30	66.50	82.60		29.20		13.40
32	Tamil Nadu	62.50	79.80	60.50	79.30		55.80		46.10
33	Tripura	24.60	33.20	18.10	25.20		20.30		11.40
34	Uttar Pradesh	23.70	27.30	16	20.20		20.20		13.10
35	Uttarakhand	65.90	68.20	60.50	63.90		53.90		46
36	West Bengal	21.40	25.40	7	11.40		21		7.60
	India	36.70	43.50	24.30	30.80		32.00		17.90

(Source: Census Info 2011)

ANNEXURE 3

MAIN SOURCE OF DRINKING WATER (RURAL) AS ON 2001 & 2011 IN BIHAR

State/District code	State/District	Tap water				Well water				Handpump/Tubewell water		Other sources of water	
		2011			2001	2011			2001				
		Treated	Un-treated	Total		Covered	Un-covered	Total		2011	2001	2011	2001
	Bihar	**1.6**	**0.9**	**2.5**	**1.4**	**0.6**	**3.8**	**4.4**	**13.1**	**91.4**	**84.7**	**1.7**	**0.7**
01	Pashchim Champaran	1.5	0.8	2.3	1.5	0.3	0.9	1.2	3.0	95.6	95.2	0.8	0.3
02	Purba Champaran	1.0	0.6	1.6	1.5	0.4	0.7	1.1	7.0	96.6	91.2	0.7	0.3
03	Sheohar	0.9	0.5	1.4	0.3	0.3	0.3	0.6	1.8	97.5	97.7	0.6	0.2
04	Sitamarhi	0.8	0.5	1.3	0.7	0.3	0.3	0.6	1.8	97.2	97.3	0.9	0.2
05	Madhubani	1.3	0.8	2.1	0.6	0.7	0.3	1.0	1.5	95.5	97.4	1.4	0.4
06	Supaul	0.8	0.4	1.2	0.7	0.3	0.3	0.6	2.2	96.6	96.6	1.7	0.4
07	Araria	0.8	0.4	1.2	0.7	0.2	0.1	0.3	0.7	97.0	97.9	1.4	0.6
08	Kishanganj	0.6	0.3	0.9	0.4	0.2	2.3	2.5	8.7	94.2	90.1	2.4	0.9
09	Purnea	0.8	0.4	1.2	0.8	0.3	0.2	0.5	1.3	95.3	97.4	3.0	0.5
10	Katihar	0.8	0.3	1.2	0.4	0.3	0.4	0.7	2.2	95.3	96.4	2.8	0.9
11	Madhepura	1.1	0.4	1.5	0.8	0.3	0.4	0.7	2.8	96.1	95.8	1.7	0.7
12	Saharsa	1.0	0.5	1.5	0.5	0.3	1.0	1.2	3.2	95.2	95.9	2.1	0.4
13	Darbhanga	1.3	0.7	2.0	0.8	0.4	0.1	0.5	0.5	96.1	98.2	1.3	0.5
14	Muzaffarpur	1.6	1.1	2.7	1.2	0.9	0.8	1.6	6.9	94.2	91.4	1.5	0.5
15	Gopalganj	2.5	1.1	3.6	1.4	0.5	0.2	0.7	2.3	94.9	95.9	0.8	0.4

16	Siwan	2.4	0.8	3.2	1.9	0.4	0.4	0.7	3.3	95.4	94.4	0.6	0.4
17	Saran	2.3	0.9	3.2	2.1	0.6	3.7	4.3	12.6	91.4	84.9	1.1	0.4
18	Vaishali	1.4	0.9	2.4	1.5	0.8	4.8	5.6	21.5	90.8	76.4	1.2	0.5
19	Samastipur	1.3	0.7	1.9	1.3	0.4	2.4	2.8	13.1	94.2	85.2	1.1	0.4
20	Begusarai	1.7	0.9	2.6	3.1	0.4	2.6	3.1	10.6	92.7	85.9	1.7	0.4
21	Khagaria	1.9	0.9	2.9	1.2	0.4	0.5	0.9	3.6	95.0	94.7	1.2	0.5
22	Bhagalpur	3.3	2.1	5.4	2.0	0.9	11.5	12.5	33.4	79.3	63.4	2.8	1.2
23	Banka	2.2	1.5	3.7	1.1	1.3	25.4	26.7	46.9	66.4	48.3	3.1	3.7
24	Munger	4.7	2.1	6.8	1.6	1.7	22.0	23.7	56.2	67.7	41.2	1.9	1.0
25	Lakhisarai	3.2	1.9	5.1	1.9	1.6	14.2	15.9	44.5	76.7	51.7	2.4	1.8
26	Sheikhpura	2.4	1.5	3.9	1.0	1.4	7.5	8.9	43.0	85.2	54.8	2.0	1.1
27	Nalanda	2.2	1.7	3.9	1.8	1.6	7.7	9.3	37.2	84.4	59.8	2.5	1.2
28	Patna	2.8	1.8	4.6	2.2	1.0	4.4	5.4	31.1	87.9	65.6	2.1	1.1
29	Bhojpur	2.4	0.9	3.4	2.1	0.7	1.2	1.9	9.1	93.5	88.1	1.3	0.7
30	Buxar	2.4	1.1	3.5	2.5	0.8	1.8	2.6	11.7	92.5	84.8	1.4	0.9
31	Kaimur (Bhabua)	2.3	1.3	3.6	2.4	1.2	7.6	8.8	24.7	85.5	71.7	2.0	1.3
32	Rohtas	2.3	0.7	3.0	2.9	0.7	1.9	2.6	7.2	92.9	89.2	1.5	0.7
33	Aurangabad	2.2	1.2	3.4	1.7	1.1	3.6	4.7	16.7	90.3	80.8	1.6	0.7
34	Gaya	1.6	1.3	2.9	1.4	1.0	9.4	10.4	30.3	85.0	67.2	1.7	1.2
35	Nawada	1.4	1.2	2.5	1.1	1.1	7.0	8.2	25.7	86.6	71.9	2.6	1.3
36	Jamui	2.0	1.7	3.6	1.0	1.7	40.3	42.0	60.5	51.1	35.3	3.3	3.2
37	Jehanabad	1.3	1.0	2.3	1.5	0.9	3.1	4.0	19.0	92.0	78.2	1.6	1.3
38	Arwal	1.0	0.4	1.4	1.6	0.5	2.1	2.6	12.6	94.9	85.0	1.1	0.7

(Source: Census Info 2011)

ANNEXURE 4

ACCESSIBILITY OF DRINKING WATER IN VARIOUS DISTRICTS OF BIHAR (RURAL) AS ON 2001 & 2011

State / District code	State / District	Rural					
		Within the premises		Near the premises		Away	
		2011	2001	2011	2001	2011	2001
10	Bihar	47.1	36.3	40.4	51.1	12.6	12.6
01	Pashchim Champaran	44.1	24.4	39.0	42.6	7.6	5.9
02	Purba Champaran	42.8	24.5	42.1	45.1	7.9	7.6
03	Sheohar	36.8	25.3	49.6	63.1	9.8	9.2
04	Sitamarhi	30.8	18.2	47.8	59.5	16.4	11.9
05	Madhubani	36.5	19.4	44.8	56.1	15.4	11.1
06	Supaul	58.8	40.9	32.0	32.0	4.6	3.8
07	Araria	52.1	45.2	36.9	31.1	5.3	5.2
08	Kishanganj	35.6	36.1	45.7	33.0	9.5	4.4
09	Purnia	41.8	40.4	40.5	36.4	7.8	4.9
10	Katihar	44.2	36.6	37.4	37.3	9.8	7.4
11	Madhepura	51.5	40.2	37.3	37.8	7.0	5.4
12	Saharsa	41.6	29.9	41.6	45.9	9.1	5.5
13	Darbhanga	36.6	20.2	39.2	48.8	15.0	14.4
14	Muzaffarpur	40.0	23.5	42.1	43.2	8.6	11.0
15	Gopalganj	55.7	37.3	32.9	37.5	5.4	4.6
16	Siwan	61.4	41.7	28.5	33.4	5.0	5.9

17	Saran	53.3	36.9	30.5	36.3	7.4	6.8
18	Vaishali	37.6	23.3	45.0	46.6	11.5	14.0
19	Samastipur	39.0	22.7	44.6	47.8	13.0	11.8
20	Begusarai	40.2	31.8	32.4	41.2	9.3	9.6
21	Khagaria	39.9	24.4	44.3	48.9	11.1	9.7
22	Bhagalpur	31.8	19.9	33.3	40.0	16.4	15.4
23	Banka	26.5	14.2	41.6	55.3	28.4	18.9
24	Munger	28.2	16.3	31.3	36.2	14.0	13.0
25	Lakhisarai	36.0	18.8	33.0	37.6	16.6	15.6
26	Sheikhpura	27.5	17.2	37.1	31.8	18.8	19.2
27	Nalanda	35.2	21.4	30.9	35.8	18.3	13.9
28	Patna	27.4	17.8	21.3	22.8	8.1	8.5
29	Bhojpur	63.2	44.8	17.5	24.7	5.4	6.4
30	Buxar	64.3	41.3	19.3	25.1	6.6	8.0
31	Kaimur (Bhabua)	52.1	27.3	26.6	34.7	17.2	12.0
32	Rohtas	65.5	43.3	14.3	17.6	5.2	5.2
33	Aurangabad	56.3	36.9	25.1	29.6	9.5	9.4
34	Gaya	35.2	23.6	34.2	38.2	17.9	13.7
35	Nawada	35.9	24.6	36.5	37.0	18.1	15.2
36	Jamui	17.2	9.3	47.3	53.7	27.5	21.8
37	Jehanabad	45.4	31.8	31.4	31.5	11.1	12.2
38	Arwal	64.8	46.7	22.9	31.8	5.3	6.5

(Source: Census Info 2011)

ANNEXURE 5 A

DISTRICT WISE POPULATION COVERAGE AS ON 31/03/2012 IN BIHAR

S.N.	District	Total Population				% of Total Population Covered with >=40 LPCD				% of Total Population Covered with < 40 LPCD			
		SC	ST	GEN	Total	SC (%)	ST (%)	GEN (%)	Total (%)	SC (%)	ST (%)	GEN (%)	Total (%)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Araria	329759	33648	2198181	2561588	94.30	92.40	94.38	94.35	5.70	7.60	5.62	5.65
2	Arwal	147728	104	563139	710971	91.34	100.00	89.71	90.05	8.66	0.00	10.29	9.95
3	Aurangabad	549010	1037	1713436	2263483	97.40	97.11	97.45	97.49	2.60	2.89	2.55	2.51
4	Banka	238740	83764	1566063	1888567	83.11	90.93	81.87	82.43	16.89	9.07	18.13	17.57
5	Begusarai	465802	277	2618456	3084535	97.74	77.62	97.51	97.54	2.26	22.38	2.49	2.46
6	Bhagalpur	263981	64059	2028012	2356052	98.60	99.84	98.50	98.55	1.40	0.16	1.50	1.45
7	Bhojpur (Aara)	365773	8649	1860794	2235216	98.08	99.50	98.56	98.49	1.92	0.50	1.44	1.51
8	Buxar	242701	7379	1337534	1587614	99.78	98.33	95.22	95.93	0.22	1.67	4.78	4.07
9	Darbhanga	605558	43	3208638	3814239	85.47	100.00	88.30	87.87	14.53	0.00	11.70	12.13
10	Gaya	1293024	2759	2711252	4007035	89.59	87.82	89.36	89.44	10.41	12.18	10.64	10.56
11	Gopalganj	254537	4836	1889648	2149021	92.91	91.34	86.78	87.52	7.09	8.66	13.22	12.48
12	Jamui	272547	80591	1200975	1554113	98.43	99.35	98.07	98.34	1.57	0.65	1.93	1.66
13	Jehanabad	198448	60	832606	1031114	95.40	100.00	94.19	94.42	4.60	0.00	5.81	5.58
14	Kaimur (Bhabua)	336968	40265	1132740	1509973	97.06	97.76	95.67	96.04	2.94	2.24	4.33	3.96
15	Katihar	246678	161828	2157185	2565691	96.58	96.86	94.62	94.95	3.42	3.14	5.38	5.05
16	Khagaria	222207	194	1123275	1345676	98.21	100.00	97.55	97.66	1.79	0.00	2.45	2.34
17	Kishanganj	81958	55338	1154574	1291870	97.80	98.96	99.45	99.33	2.20	1.04	0.55	0.67
18	Lakhisarai	127080	4327	636669	768076	62.63	43.96	71.19	69.62	37.37	56.04	28.81	30.38
19	Madhepura	363045	20602	1734147	2117794	97.72	97.51	97.16	97.26	2.28	2.49	2.84	2.74
20	Madhubani	569549	592	3632611	4202752	87.20	98.82	87.91	87.82	12.80	1.18	12.09	12.18
21	Munger	136668	14595	807064	958327	98.89	92.23	96.90	97.11	1.11	7.77	3.10	2.89
22	Muzaffarpur	576707	3371	2998675	3578753	98.52	100.00	97.62	97.76	1.48	0.00	2.38	2.24

23	Nalanda	502195	546	1870879	2373620	84.01	91.76	85.00	84.79	15.99	8.24	15.00	15.21
24	Nawada	501059	2470	1493821	1997350	92.33	91.01	91.89	92.00	7.67	8.99	8.11	8.00
25	Pashchim Champaran	499413	45831	2856228	3401472	94.29	94.94	93.46	93.60	5.71	5.06	6.54	6.40
26	Patna	641976	1752	2734409	3378137	83.11	86.64	81.64	81.92	16.89	13.36	18.36	18.08
27	Purba Champaran (Motihari)	612720	7491	4019695	4639906	70.24	47.59	67.98	68.28	29.76	52.41	32.02	31.72
28	Purnia	387914	131500	2484078	3003492	98.85	99.42	99.16	99.13	1.15	0.58	0.84	0.87
29	Rohtas	464749	19381	1936897	2421027	89.18	94.44	89.82	89.73	10.82	5.56	10.18	10.27
30	Saharsa	299565	4067	1409881	1713513	81.60	90.85	78.47	79.04	18.40	9.15	21.53	20.96
31	Samastipur	752448	10315	3229662	3992425	99.79	100.00	99.88	99.87	0.21	0.00	0.12	0.13
32	Saran	416483	5464	3153689	3575636	93.61	94.86	89.84	90.29	6.39	5.14	10.16	9.71
33	Sheikhpura	109943	42	420752	530737	91.56	100.00	91.57	91.60	8.44	0.00	8.43	8.40
34	Sheohar	91690	90	550303	642083	69.05	87.78	63.19	64.03	30.95	12.22	36.81	35.97
35	Sitamarhi	415437	2439	2962014	3379890	87.97	66.75	86.45	86.63	12.03	33.25	13.55	13.37
36	Siwan	354900	8337	2669984	3033221	95.73	90.84	94.86	94.96	4.27	9.16	5.14	5.04
37	Supaul	310663	4608	1630526	1945797	86.28	82.38	82.01	82.70	13.72	17.62	17.99	17.30
38	Vaishali	639098	1431	2448827	3089356	79.55	96.37	77.82	78.37	20.45	3.63	22.18	21.63
Total		14888721	834082	74977319	90700122	90.75	95.91	90.02	90.21	9.25	4.09	9.98	9.79

(Source: Website of MDWS)

ANNEXURE 5 B

BLOCK WISE POPULATION COVERAGE AS ON 31/03/2012 – NALANDA DISTRICT

S.No.	Block	Total Population				% of Total Population Covered with > = 40 LPCD				% of Total Population Covered with < 40 LPCD			
		SC	ST	GEN	Total	SC (%)	ST (%)	GEN (%)	Total (%)	SC (%)	ST (%)	GEN (%)	Total (%)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Asthawan	39104	2	122568	161674	86.34	100.00	86.24	86.26	13.66	0.00	13.76	13.74
2	Ben	20140	0	90589	110729	79.15	0.00	76.41	76.91	20.85	100.00	23.59	23.09
3	Bihar	39797	143	133746	173686	85.74	100.00	87.83	87.36	14.26	0.00	12.17	12.64
4	Bind	13455	6	50532	63993	92.85	100.00	89.83	90.46	7.15	0.00	10.17	9.54
5	Chandi	30838	0	111831	142669	98.11	0.00	96.67	96.98	1.89	100.00	3.33	3.02
6	Ekangarsarai	48925	0	247355	296280	88.08	0.00	88.68	88.58	11.92	100.00	11.32	11.42
7	Giriak	17726	34	64549	82309	82.32	2.94	73.40	75.29	17.68	97.06	26.60	24.71
8	Harnaut	37064	0	127027	164091	70.60	0.00	71.16	71.03	29.40	100.00	28.84	28.97
9	Hilsa	27796	0	112639	140435	96.69	0.00	95.85	96.01	3.31	100.00	4.15	3.99
10	Islampur	16197	145	79853	96195	98.96	100.00	99.21	99.17	1.04	0.00	0.79	0.83
11	Karai Parsurai	15230	0	51577	66807	100.00	0.00	98.89	99.15	0.00	100.00	1.11	0.85
12	Katrisarai	12629	44	44325	56998	64.16	100.00	65.68	65.37	35.84	0.00	34.32	34.63
13	Nagar Nausa	20394	5	61784	82183	100.00	100.00	100.00	100.00	0.00	0.00	0.00	0.00
14	Noorsarai	37768	102	119744	157614	63.06	88.24	71.07	69.16	36.94	11.76	28.93	30.84
15	Parbalpur	12687	0	65097	77784	100.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00
16	Rahui	34204	0	112033	146237	70.89	0.00	68.55	69.10	29.11	100.00	31.45	30.90
17	Rajgir	16147	0	71455	87602	82.90	0.00	84.69	84.36	17.10	100.00	15.31	15.64
18	Sarmera	20034	41	68571	88646	67.74	100.00	73.01	71.83	32.26	0.00	26.99	28.17
19	Silao	30499	0	88213	118712	83.79	0.00	82.90	83.13	16.21	100.00	17.10	16.87
20	Tharthari	11561	24	47391	58976	100.00	100.00	100.00	100.00	0.00	0.00	0.00	0.00
	Total	502195	546	1870879	2373620	84.01	91.76	85.00	84.79	15.99	8.24	15.00	15.21

Block wise population coverage as on 31/3/2012 – Begusarai District

S.No.	Block	Total Population				% of Total Population Covered with > = 40 LPCD				% of Total Population Covered with < 40 LPCD			
		SC	ST	GEN	Total	SC (%)	ST (%)	GEN (%)	Total (%)	SC (%)	ST (%)	GEN (%)	Total (%)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Bachhwara	39887	0	203278	243165	100.00	0.00	99.83	99.88	0.00	100.00	0.17	0.12
2	Bakhri	26029	133	108287	134449	97.42	54.14	98.87	98.54	2.58	45.86	1.13	1.46
3	Balia	28081	0	215279	243360	100.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00
4	Barauni	50084	55	295742	345881	100.00	100.00	99.60	99.66	0.00	0.00	0.40	0.34
5	Begusarai	60538	73	312944	373555	92.32	98.63	93.56	93.36	7.68	1.37	6.44	6.64
6	Bhagwanpur	29069	1	135045	164115	100.00	100.00	99.49	99.58	0.00	0.00	0.51	0.42
7	Birpur	16301	0	88590	104891	100.00	0.00	99.04	99.19	0.00	100.00	0.96	0.81
8	Cheria Bariarpur	33052	0	145320	178372	100.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00
9	Chorahi	19820	0	87838	107658	100.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00
10	Dandari	16977	7	62255	79239	95.62	100.00	94.05	94.39	4.38	0.00	5.95	5.61
11	Garhpura	17644	0	79231	96875	100.00	0.00	97.99	98.35	0.00	100.00	2.01	1.65
12	Khudabandpur	12748	0	68430	81178	100.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00
13	Mansurchak	16240	0	63951	80191	100.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00
14	Matihani	22569	0	179629	202198	99.64	0.00	99.23	99.27	0.36	100.00	0.77	0.73
15	Naokothi	16649	0	80762	97411	100.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00
16	Sahebpur Kamal	19904	0	162935	182839	100.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00
17	Shamho Akha Kurha	5131	0	32050	37181	100.00	0.00	100.00	100.00	0.00	100.00	0.00	0.00
18	Teghra	35079	8	296890	331977	87.56	100.00	88.50	88.40	12.44	0.00	11.50	11.60
Total		465802	277	2618456	3084535	97.74	77.62	97.51	97.54	2.26	22.38	2.49	2.46

Block wise Population coverage as on 31/03/2012 – Purnia District

S.N	Block	Total Population				% of Total Population Covered with > = 40 LPCD				% of Total Population Covered with < 40 LPCD			
		SC	ST	GEN	Total	SC (%)	ST (%)	GEN (%)	Total (%)	SC (%)	ST (%)	GEN (%)	Total (%)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Amour	11357	2781	271818	285956	100.00	100.00	100.00	100.00	0.00	0.00	0.00	0.00
2	Baisa	14385	1700	177172	193257	97.45	92.35	97.59	97.54	2.55	7.65	2.41	2.46
3	Baisi	13774	300	217705	231779	93.73	100.00	98.12	97.86	6.27	0.00	1.88	2.14
4	Banmankhi	70430	24177	256538	351145	95.54	97.39	95.95	95.97	4.46	2.61	4.05	4.03
5	Barhara	27789	9918	102554	140261	100.00	100.00	100.00	100.00	0.00	0.00	0.00	0.00
6	Bhawanipur	19654	5333	165992	190979	100.00	100.00	100.00	100.00	0.00	0.00	0.00	0.00
7	Dagarua	20013	6967	186924	213904	100.00	100.00	100.00	100.00	0.00	0.00	0.00	0.00
8	Dhamdaha	45067	29156	222251	296474	100.00	100.00	100.00	100.00	0.00	0.00	0.00	0.00
9	Jalalgarh	23951	1399	87372	112722	99.57	100.00	97.81	98.21	0.43	0.00	2.19	1.79
10	Kasba	12121	7542	135923	155586	100.00	100.00	99.76	99.79	0.00	0.00	0.24	0.21
11	Krityanand Nagar	47002	12508	170719	230229	100.00	100.00	100.00	100.00	0.00	0.00	0.00	0.00
12	Purnia East	31157	16836	171954	219947	100.00	100.00	100.00	100.00	0.00	0.00	0.00	0.00
13	Rupauli	21459	2254	188777	212490	100.00	100.00	100.00	100.00	0.00	0.00	0.00	0.00
14	Srinagar	29755	10629	128379	168763	100.00	100.00	100.00	100.00	0.00	0.00	0.00	0.00
Total		387914	131500	2484078	3003492	98.85	99.42	99.16	99.13	1.15	0.58	0.84	0.87

Block wise population coverage as on 31/03/2012 – Champaran District

S.N	Block	Total Population				% of Total Population Covered with > = 40 LPCD				% of Total Population Covered with < 40 LPCD			
		SC	ST	GEN	Total	SC (%)	ST (%)	GEN (%)	Total (%)	SC (%)	ST (%)	GEN (%)	Total (%)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Bagaha	92514	29959	450479	572952	93.97	95.73	93.62	93.78	6.03	4.27	6.38	6.22
2	Bairia	21659	37	172231	193927	97.74	100.00	96.24	96.41	2.26	0.00	3.76	3.59
3	Bettiah	11612	902	69035	81549	100.00	100.00	99.71	99.75	0.00	0.00	0.29	0.25
4	Bhitaha	4515	200	60033	64748	87.60	96.50	88.24	88.22	12.40	3.50	11.76	11.78
5	Chanpatia	37107	447	215948	253502	82.53	89.71	84.87	84.53	17.47	10.29	15.13	15.47
6	Gaunaha	30904	2359	170680	203943	92.92	76.90	90.97	91.10	7.08	23.10	9.03	8.90
7	Jogapatti	30020	935	202644	233599	94.99	100.00	94.90	94.93	5.01	0.00	5.10	5.07
8	Lauria	29410	443	193910	223763	99.50	100.00	94.07	94.79	0.50	0.00	5.93	5.21
9	Madhubani	10803	599	67736	79138	95.99	100.00	96.39	96.37	4.01	0.00	3.61	3.63
10	Mainatanr	24420	1322	150715	176457	92.71	84.19	94.22	93.93	7.29	15.81	5.78	6.07
11	Majhaulia	51022	398	273395	324815	97.68	100.00	92.88	93.64	2.32	0.00	7.12	6.36
12	Narkatiaganj	52988	1531	262848	317367	97.56	97.06	97.64	97.62	2.44	2.94	2.36	2.38
13	Nautan	30232	210	187148	217590	86.12	69.05	89.75	89.23	13.88	30.95	10.25	10.77
14	Piprasi	5818	0	33185	39003	88.71	0.00	96.69	95.50	11.29	100.00	3.31	4.50
15	Ramnagar	35013	6177	147305	188495	96.94	97.99	93.58	94.35	3.06	2.01	6.42	5.65
16	Sikta	23714	103	153898	177715	96.26	100.00	97.18	97.06	3.74	0.0	2.82	2.94
17	Thakrahan	7662	209	45038	52909	99.23	100.00	92.28	93.33	0.67	0.00	7.72	6.67
Total		499413	45831	2856228	3401472	94.29	94.94	93.46	93.60	5.71	5.06	6.54	6.40

(Source: Website of MDWS)

ANNEXURE 6

GROUND WATER RESOURCES AVAILABILITY, UTILIZATION AND STAGE OF DEVELOPMENT BIHAR AS PER ESTIMATION DONE IN 2009

S. N.	District	Annual Replenishable Ground Water Resource					Natural Discharge During Non Monsoon Period	Net Ground Water Availability	Annual Ground Water Draft			Projected demand for Domestic and Industrial uses upto 2025	Net Ground Water Availability for Future Irrigation use	Stage of Ground Water Development (%)
		Monsoon Season		Non Monsoon Season		Total			Irrigation	Domestic & Industrial Water Supply	Total			
		Recharge from Rainfall	Recharge From Other Sources	Recharge from Rainfall	Recharge From Other Source									
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Araria	61908	8338	16078	2720	89043	8646	80397	21120	4496	25615	6104	53174	32
2	Arwal	12140	6793	1978	2539	23451	1843	21607	9247	1038	10285	1639	10722	48
3	Aurangabad	72783	13364	9315	4576	100038	8991	91046	17302	3831	21132	6464	67280	23
4	Banka	28525	9454	6732	1696	46408	3670	42738	12774	3017	15791	4333	25630	37
5	Begusarai	49136	4279	7198	5966	66579	6496	60083	30735	4415	35150	7611	21737	59
6	Bhabhua	56239	12846	11757	5275	86117	7169	78947	22951	2344	25294	4005	51992	32
7	Bhagalpur	58080	3845	11795	2409	76128	6546	69583	17971	4970	22941	7665	43947	33
8	Bhojpur	45416	18245	7308	11908	82877	7592	75285	27395	4361	31756	6308	41582	42
9	Buxar	33930	17916	4869	8990	65706	6553	59153	17994	3099	21093	5288	35871	36
10	Darbhanga	48022	4603	7548	3002	63175	4449	58726	21992	2394	24386	12327	24406	42
11	E. Champaran	77722	27400	14626	18903	138652	13790	124861	45309	7527	52836	11754	67797	42
12	Gaya	83653	14471	12210	3765	114099	9466	104634	42961	7703	50664	12390	49284	48
13	Gopalganj	34337	13608	6885	10521	65351	4995	60356	31889	4102	35992	5993	22474	60
14	Jamui	26636	7699	6709	2242	43285	3459	39826	12312	2728	15041	5329	22185	38
15	Jehanabad	20501	6626	2897	1446	31471	2063	29408	17005	1812	18818	2801	9602	64
16	Katihar	63109	9108	15793	5689	93698	6796	86902	42846	4173	47019	7361	36695	54
17	Khagaria	46579	1417	6138	4462	58597	5476	53121	20860	2422	23282	3959	28302	44
18	Kishanga	60420	2330	14676	2881	80307	8031	72276	16682	2900	19582	4885	50709	27

	nj													
19	Lakhisarai	21184	4662	3119	1757	30722	2781	27941	10153	1566	11719	2100	15688	42
20	Madhepura	34529	9230	8510	5178	57448	5745	51703	25216	3022	28238	4801	21687	55
21	Madhubani	69157	9004	15264	4891	98316	7472	90844	27345	6483	33828	10006	53494	37
22	Munger	24811	4170	4019	1074	34074	3168	30907	6922	2046	8968	2888	21097	29
23	Muzaffarpur	72596	17624	11172	14987	116380	9327	107052	50152	7126	57277	10839	46061	54
24	Nalanda	50219	11542	7002	3303	72067	5872	66195	38547	4425	42972	5509	22139	65
25	Nawada	41977	5061	6829	1874	55741	4377	51364	18531	3592	22123	5807	27025	43
26	Patna	72339	15644	10352	7449	105784	9329	96455	44052	8708	52760	12859	39544	55
27	Purnea	68281	7244	18860	4538	98923	8856	90066	34240	4966	39207	8528	47298	44
28	Rohtas	77214	19381	10500	7946	115041	7988	107053	33870	4650	38519	7370	65814	36
29	Saharsa	37968	7502	8139	5074	58684	4108	54575	17278	2774	20052	4895	32402	37
30	Samastipur	74205	7463	10749	5496	97913	6577	91336	38389	6499	44888	12191	40756	49
31	Saran	50251	12024	8105	10351	80731	4285	76446	36798	6661	43459	9582	30066	57
32	Sheikhpura	12190	2761	2080	672	17703	1770	15933	7340	1071	8411	1390	7204	53
33	Sheohar	13491	2145	1892	976	18504	1730	16774	8665	1056	9721	1910	6199	58
34	Sitamarhi	58727	6848	9711	5008	80294	5229	75065	27967	5181	33148	8662	38435	44
35	Siwan	39980	19346	7263	15296	81885	7890	73995	37786	4873	42658	7402	28807	58
36	Supaul	49742	12616	11809	8198	82365	7846	74519	21804	2922	24726	5391	47324	33
37	Vaishali	49384	11328	7330	9846	77888	5936	71952	34729	5558	40288	8730	28493	56
38	W. Champaran	94993	24177	12402	25594	157166	15717	141450	30220	5744	35964	9275	101955	25
	State Total (ham)	1892376	392116	339621	238498	2862611	242034	2620577	979351	156253	1135604	256351	1384877	43
	State Total (bcm)	18.92	3.92	3.40	2.38	28.63	2.42	26.21	9.79	1.56	11.36	2.56	13.85	43

(Source: CGWB Patna)

ANNEXURE 7

DEPTH OF GROUND WATER TABLE AND AQUIFER RELATED INFORMATION

SL.No	District	Pre Monsoon depth (m. bgl) in 2008		Aquifer Related Information								Suitability of Groundwater structure	Pump Set
				Shallow Aquifer				Deep Aquifer					
				Shallow Aquifer depth range (m.bgl)		Yield Potential of Shallow Aquifer (m/hr)		Deep Aquifer depth range (m.bgl		Yield Potential of Deep Aquifer (m/hr)			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Araria	2.70	3.90	10	50	20	40	50	100	100	200	Shallow	
2	Arwal	4.11	6.50	30	50	15	20	97	140	77	77	Shallow	
3	Aurangabad	4.98	8.19	5	88							Shallow	
4	Jehanabad	3.27	10.86	30	50	15	20	97	140	77	77	Shallow	
5	Banka	3.68	6.35	16	51	60	107	50	105	100	130	Shallow	
										1	27	Deep	
6	Begusarai	5.10	9.26	40	60	25	50	114	257	125	137	Shallow	
7	Bhojpur	1.18	6.96	4	44	50	100	44	256	150	200	Shallow	
8	Buxar	4.31	9.50	20	60	30	50	46	246	100	200	Shallow	
9	Bhagalpur	3.50	8.56	25	51	20	50	51	285	50	200	Shallow	
10	Kaimur	4.00	7.00	10	50			50	200	100	200	Shallow	
11	Darbhanga	3.10	5.50	25	62	30	50	78	193	150	200	Shallow	
12	East Champaran	2.25	4.45	16	53	40	72	50	279	40	110	Shallow	
13	Gaya	2.30	12.99	6	90	4	36	21	74			Shallow	
14	Gopalganj	2.88	4.70	31	47	30	50	48	148	168	215	Shallow	
15	Jamui	5.00	12.95	12	180	18	75					Deep up to 140 m	

16	Katihar	4.04	7.49	5	45			45	100	100	200	Shallow	
17	Khagaria	5.30	8.63	3	19	30	50	50	141	150	200	Shallow	
18	Kishanganj	2.10	4.24	5	50			50	100	100	150	Shallow	
19	Lakhisarai	3.50	8.56	38	110	25	240					Deep	
20	Madhepura	2.95	5.15	5	50	20	40	50	100	100	200	Shallow	
21	Madhubani	2.18	6.37	10	50	10	10	79	314	180	180	Shallow & Deep	
22	Munger	2.11	10.86	12	114	15	160					Deep	
23	Muzaffarpur	3.78	5.70	12	52	41	50	64	103	49	93	Shallow	
24	Nalanda	2.56	10.22	27	53	30	50	46	208	30	188	Shallow	
25	Nawada	4.19	7.04	26	47	30	70	47	124	80	180	Shallow	
26	Patna	2.25	9.90	22	63	30	50	54	300	125	250	Shallow	
27	Purnia	2.75	4.85	10	50			60	100	100	150	Shallow	
28	Rohtas	4.90	10.51	2	80	100	150						
29	Saharsa	2.91	4.25	10	50	20	40	50	100	100	200	Shallow	
30	Samastipur	3.82	6.70	15	45	50	100	50	235	100	180	Shallow	
31	Saran	3.10	6.90	9	46	7	23	72	141	20	73	Shallow	
32	Sheikhpura	3.27	10.86	20	65	10	60	79	147	60	210	Shallow	
33	Sheohar	3.64	3.80	10	50			60	110	100	150	Shallow	
34	Sitamarhi	2.10	4.85	10	50			50	200	100	200	Shallow	
35	Siwan	2.75	8.72	50	50	30	50	41	189	161	195	Shallow	
36	Supaul	2.11	4.50	10	50	20	40	50	100	100	200	Shallow	
37	Vaishali	3.80	5.90	20	62	25	50	82	220	28	176	Shallow	
38	West Champaran	1.62	6.06	32	47	30	50	53	196	89	89	Shallow	

(Source: CGWB Patna)

ANNEXURE 8

BLOCK WISE STATUS OF DYNAMIC WATER RESOURCES IN 10 DISTRICTS IDENTIFIED FOR WORLD BANK PROJECT

West Champaran District

S. N.	Administrative Unit (block)	Recharge from Rainfall during monsoon season	Recharge from other sources during monsoon season	Recharge from Rainfall during non-monsoon season	Recharge from other sources during non-monsoon season	Total Annual Ground Water Recharge (3+4+5+6)	Provision for Natural Discharge	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground water Draft for Domestic and Industrial Water Supply	Existing Gross Ground Water Draft For all Uses (10+11)	Stage of Ground Water Development {(12/9)*100)] (%)	Category of block
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Bagaha-1	9717	2664	1269	3251	16901	1690	15211	2084	570	2653	17.4	Safe
2	Sidhaw	7260	3909	948	3884	16001	1600	14401	1857	426	2283	15.9	Safe
3	Bairia	5729	1123	748	1030	8629	863	7766	1621	287	1909	24.6	Safe
4	Bettiah	1512	294	197	359	2362	236	2126	364	337	701	33.0	Safe
5	Bhitaha	3456	328	451	112	4347	435	3912	1175	94	1268	32.4	Safe
6	Chanpatiya	6326	1869	826	1790	10812	1081	9731	2028	503	2530	26.0	Safe
7	Gaunaha	3595	1022	469	1435	6521	652	5869	789	284	1072	18.3	Safe
8	Jogapatti	5372	1613	701	1635	9320	932	8388	2075	333	2408	28.7	Safe
9	Lauria	4994	1488	652	1473	8607	861	7746	2249	323	2573	33.2	Safe
10	Madhubani	3448	358	450	122	4379	438	3941	1285	118	1403	35.6	Safe
11	Mainatanr	5752	1348	751	1968	9819	982	8837	1181	260	1440	16.3	Safe
12	Majhaulia	7021	2098	917	1828	11862	1186	10676	4240	457	4697	44.0	Safe
13	Narkatiaganj	8462	2171	1105	2752	14490	1449	13041	2341	527	2868	22.0	Safe

14	Nautan	4625	1256	604	1194	7678	768	6910	2676	316	2993	43.3	Safe
15	Piprasi	3931	143	513	49	4636	464	4173	514	57	571	13.7	Safe
16	Ramnagar	5457	1287	712	1495	8951	895	8056	1640	514	2155	26.7	Safe
17	Sikta	4804	1021	627	1154	7607	761	6846	1432	260	1693	24.7	Safe
18	Thakrahan	3532	187	461	64	4243	424	3819	669	79	748	19.6	Safe
	Total	94993	24177	12402	25594	157166	15717	141450	30220	5744	35964	25.4	Safe

Purnea District

S. N.	Administrative Unit (block)	Recharge from Rainfall during monsoon season	Recharge from other sources during monsoon season	Recharge from Rainfall during non-monsoon season	Recharge from other sources during non-monsoon season	Total Annual Ground Water Recharge (3+4+5+6)	Provision for Natural Discharge	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground water Draft for Domestic and Industrial Water Supply	Existing Gross Ground Water Draft For all Uses (10+11)	Stage of Ground Water Development {(12/9)*100)] (%)	Category of block
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Amaur	5380	534	1443	335	7692	385	7307	2525	411	2935	40.2	Safe
2	Baisa	4451	389	1221	244	6304	315	5989	1838	277	2115	35.3	Safe
3	Baisi	4602	561	1205	351	6720	336	6384	2652	314	2966	46.5	Safe
4	Banmankhi	7803	649	2172	407	11031	1103	9928	3070	634	3704	37.3	Safe
5	Baraharakothi	4860	500	1353	313	7026	703	6324	2366	310	2676	42.3	Safe
6	Bhawanipur	3398	399	946	250	4993	499	4493	1885	235	2120	47.2	Safe
7	Dagarua	4442	748	1236	469	6895	689	6205	3537	319	3856	62.1	Safe
8	Dhamdaha	7670	719	2135	451	10975	1097	9877	3401	432	3833	38.8	Safe
9	Jalalgarh	2395	259	667	162	3482	348	3134	1224	160	1384	44.1	Safe
10	K. Nagar	6023	598	1677	374	8672	867	7804	2825	325	3150	40.4	Safe
11	Kasba	3553	381	989	239	5162	516	4646	1792	385	2177	46.9	Safe

12	Purnea (E)	5443	589	1515	369	7916	792	7124	2785	665	3450	48.4	Safe
13	Rupauli	5254	590	1463	369	7676	768	6908	2788	349	3137	45.4	Safe
14	Srinagar	3008	328	838	206	4380	438	3942	1552	151	1703	43.2	Safe
	Total	68281	7244	18860	4538	98923	8856	90066	34240	4966	39207	43.5	Safe

Nalanda District

S. N.	Administrative Unit (block)	Recharge from Rainfall during monsoon season	Recharge from other sources during monsoon season	Recharge from Rainfall during non-monsoon season	Recharge from other sources during non-monsoon season	Total Annual Ground Water Recharge (3+4+5+6)	Provision for Natural Discharge	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground water Draft for Domestic and Industrial Water Supply	Existing Gross Ground Water Draft For all Uses (10+11)	Stage of Ground Water Development {(12/9)*100)] (%)	Category of block
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Asthawan	3282	699	428	200	4609	461	4148	2312	239	2551	61.5	Safe
2	Ben	2175	389	305	111	2980	149	2831	1295	120	1415	50.0	Safe
3	Biharsharif	4060	736	529	211	5535	554	4982	2459	664	3122	62.7	Safe
4	Bind	1685	326	219	93	2324	232	2091	1090	93	1183	56.6	Safe
5	Chandi	3042	576	396	165	4179	418	3762	1936	209	2145	57.0	Safe
6	Ekangarsarai	2743	663	406	190	4002	200	3802	2214	241	2455	64.6	Safe
7	Giriak	1878	566	245	162	2851	285	2566	1891	126	2017	78.6	Safe
8	Harnaut	4214	831	549	238	5831	583	5248	2781	239	3019	57.5	Safe
9	Hilsa	3347	934	436	267	4985	249	4735	3125	420	3545	74.9	Safe
10	Islampur	4982	995	671	285	6933	347	6586	3341	438	3779	57.4	Safe
11	Karai parsauni	1503	383	196	110	2191	219	1972	1288	100	1388	70.4	Safe

12	Katrisarai	981	184	128	53	1345	134	1210	554	63	617	51.0	Safe
13	Nagarnausa	1659	733	228	210	2830	142	2689	2470	120	2590	96.3	Semi-critical
14	Noorsarai	2897	668	377	191	4134	413	3721	2190	228	2417	65.0	Safe
15	Parwalpur	1076	338	190	97	1701	85	1616	1138	97	1235	76.5	Safe
16	Rahui	2824	551	368	158	3900	390	3510	1834	212	2047	58.3	Safe
17	Rajgir	2107	601	392	172	3272	164	3108	2024	315	2339	75.2	Semi-critical
18	Sarmera	2871	456	374	130	3831	383	3448	1531	130	1661	48.2	Safe
19	Silao	1924	607	376	174	3081	308	2773	2045	284	2329	84.0	Safe
20	Tharthari	971	306	190	88	1554	155	1398	1030	86	1116	79.8	Safe
	Total	50219	11542	7002	3303	72067	5872	66195	38547	4425	42972	64.9	Safe

Begusarai District

S. N.	Administrative Unit (block)	Recharge from Rainfall during monsoon season	Recharge from other sources during monsoon season	Recharge from Rainfall during non-monsoon season	Recharge from other sources during non-monsoon season	Total Annual Ground Water Recharge (3+4+5+6)	Provision for Natural Discharge	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground water Draft for Domestic and Industrial Water Supply	Existing Gross Ground Water Draft For all Uses (10+11)	Stage of Ground Water Development {(12/9)*100)] (%)	Category of block
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Bachhawara	3767	302	551	562	5181	518	4663	2910	288	3199	68.6	Safe
2	Bakhari	2009	120	294	223	2646	265	2381	1150	203	1354	56.8	Safe
3	Balia	3875	560	567	351	5352	535	4817	1810	278	2088	43.4	Safe
4	Barauni	3167	222	463	412	4264	426	3837	2133	428	2561	66.7	Safe
5	Begusarai	5782	740	845	759	8126	813	7313	3890	792	4682	64.0	Safe
6	Bhagwanpur	2952	184	432	342	3910	391	3519	1749	246	1995	56.7	Safe
7	Birpur	1344	148	197	274	1963	196	1766	1410	140	1550	87.7	Safe
8	Cheria Bariarpur	2704	188	395	350	3637	364	3273	1809	223	2031	62.1	Safe
9	Chhaurahi	2681	203	392	378	3653	365	3288	1942	169	2111	64.2	Safe
10	Dandari	1835	99	268	184	2386	239	2147	951	112	1063	49.5	Safe
11	Garhpura	1597	122	233	226	2178	218	1960	1160	157	1317	67.2	Safe
12	Khudabandpur	1219	254	180	215	1867	93	1774	1102	128	1229	69.3	Safe
13	Mansur Chowk	997	76	157	141	1371	69	1302	731	122	853	65.5	Safe
14	Matihani	4600	240	673	447	5960	596	5364	2294	238	2533	47.2	Safe
15	Naokothi	1371	124	201	230	1925	193	1733	1186	151	1337	77.2	Safe

16	Shamho	1712	51	250	95	2108	211	1897	492	51	543	28.6	Safe
17	Sahebpur Kamal	3758	500	550	502	5309	531	4778	2594	291	2885	60.4	Safe
18	Teghra	3767	148	551	276	4742	474	4268	1421	397	1818	42.6	Safe
	Total	49136	4279	7198	5966	66579	6496	60083	30735	4415	35150	58.5	Safe

Banka District

S. N.	Administrative Unit (block)	Recharge from Rainfall during monsoon season	Recharge from other sources during monsoon season	Recharge from Rainfall during non-monsoon season	Recharge from other sources during non-monsoon season	Total Annual Ground Water Recharge (3+4+5+6)	Provision for Natural Discharge	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground water Draft for Domestic and Industrial Water Supply	Existing Gross Ground Water Draft For all Uses (10+11)	Stage of Ground Water Development {(12/9)*100)] (%)	Category of block
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Amarpur	2803	873	760	199	4635	464	4172	1767	404	2172	52.1	Safe
2	Banka	2188	954	594	161	3897	390	3507	1151	442	1593	45.4	Safe
3	Barahat	1391	482	310	95	2279	114	2165	765	211	976	45.1	Safe
4	Bausi	1652	647	448	94	2842	284	2558	573	255	828	32.4	Safe
5	Belhar	1405	845	381	139	2771	277	2494	966	222	1188	47.7	Safe
6	Chandan	2235	1148	606	175	4165	416	3748	1122	218	1340	35.7	Safe
7	Dhuraiya	5029	843	910	177	6958	696	6262	1489	322	1811	28.9	Safe
8	Katoria	4202	1631	899	257	6990	349	6640	1715	253	1968	29.6	Safe
9	Phulidumar	918	492	249	68	1727	173	1554	389	163	552	35.5	Safe
10	Rajun	3565	739	791	158	5253	263	4990	1355	281	1636	32.8	Safe
11	Shambhuganj	3136	799	784	172	4892	245	4648	1483	245	1728	37.2	Safe
	Total	28525	9454	6732	1696	46408	3670	42738	12774	3017	15791	36.9	Safe

MUNGER DISTRICT

S. N.	Administrative Unit (block)	Recharge from Rainfall during monsoon season	Recharge from other sources during monsoon season	Recharge from Rainfall during non-monsoon season	Recharge from other sources during non-monsoon season	Total Annual Ground Water Recharge (3+4+5+6)	Provision for Natural Discharge	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground water Draft for Domestic and Industrial Water Supply	Existing Gross Ground Water Draft For all Uses (10+11)	Stage of Ground Water Development	Category of block
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1`	Asarganj	1492	253	233	49	2027	203	1824	532	123	655	35.9	Safe
2	Bariarpur	3535	630	553	83	5431	543	4078	334	159	494	12.1	Safe
3	Dharhara	5915	534	926	131	7506	751	6756	721	179	900	13.3	Safe
4	Jamalpur	1731	280	271	76	2358	236	2122	569	302	871	41.1	Safe
5	Kharagpur	3489	846	546	213	5094	509	4585	1277	411	1688	36.8	Safe
6	Munger	3776	629	591	153	5149	515	4635	797	491	1288	27.8	Safe
7	Sangrampur	1615	453	315	122	2506	125	2381	901	135	1036	43.5	Safe
8	Tarapur	1782	417	279	141	2618	262	2356	1049	146	1195	50.7	Safe
9	Tetia Bhamber	1476	398	305	106	2285	114	2170	742	100	842	38.8	Safe
	Total	**24811**	**4170**	**4019**	**1074**	**34074**	**3168**	**30907**	**6922**	**2046**	**8968**	**29.0**	Safe

MUZAFFARPUR DISTRICT

Block wise status of Dynamic water resources in 10 districts identified for World Bank Project

S. N.	Administrative Unit (block)	Recharge from Rainfall during monsoon season	Recharge from other sources during monsoon season	Recharge from Rainfall during non-monsoon season	Recharge from other sources during non-monsoon season	Total Annual Ground Water Recharge (3+4+5+6)	Provision for Natural Discharge	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground water Draft for Domestic and Industrial Water Supply	Existing Gross Ground Water Draft For all Uses (10+11)	Stage of Ground Water Development	Category of block
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Aurai	5368	474	715	430	6987	699	6288	2772	409	3180	50.6	Safe
2	Bandra	3046	322	406	292	4066	203	3863	1876	188	2065	53.4	Safe
3	Baruraj (Motipur)	6257	833	1151	930	9171	459	8713	4206	629	4835	55.5	Safe
4	Bochaha	4176	544	592	493	5805	290	5515	3179	324	3504	63.5	Safe
5	Gaighat	5793	595	772	539	7700	770	6930	3476	357	3833	55.3	Safe
6	Kanti	3090	3026	617	1593	8272	827	7445	2453	461	2915	39.2	Safe
7	Katra	5213	412	695	374	6693	669	6024	2406	336	2742	45.5	Safe
8	Kurahni	6982	2294	956	1873	12104	605	11499	5605	605	6210	54.0	Safe
9	Minapur	6521	808	869	732	8929	893	8036	4723	455	5178	64.4	Safe
10	Moraul (Dholi)	1726	192	230	174	2322	232	2089	1109	131	1240	59.3	Safe
11	Marwan	2728	287	423	1066	4504	225	4279	1679	218	1897	44.3	Safe
12	Mushari	3307	395	441	358	4500	450	4050	2259	1345	3603	89.0	Safe
13	Paru	5357	2906	1070	1804	11137	1114	10023	3929	482	4411	44.0	Safe

14	Sakra	4821	576	642	522	6562	656	5906	3310	426	3736	63.3	Safe
15	Saraia	4771	2227	906	2656	10560	528	10032	3792	437	4229	42.2	Safe
16	Shahebganj	3440	1735	687	1205	7067	707	6360	3378	322	3700	58.2	Safe
	Total	**72596**	**17624**	**11172**	**14987**	**116380**	**9327**	**107052**	**50152**	**7126**	**57277**	**53.5**	Safe

NAWADA DISTRICT

Block wise status of Dynamic water resources in 10 districts identified for World Bank Project

S. N.	Administrative Unit (block)	Recharge from Rainfall during monsoon season	Recharge from other sources during monsoon season	Recharge from Rainfall during non-monsoon season	Recharge from other sources during non-monsoon season	Total Annual Ground Water Recharge (3+4+5+6)	Provision for Natural Discharge	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground water Draft for Domestic and Industrial Water Supply	Existing Gross Ground Water Draft For all Uses (10+11)	Stage of Ground Water Development	Category of block
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Akbarpur	4706	675	682	250	6313	631	5681	2498	336	2834	49.9	Safe
2	Govindpur	2687	291	390	108	3476	348	3129	1079	142	1221	39.0	Safe
3	Hisua	2961	730	429	271	4391	439	3952	2705	334	3039	76.9	Safe
4	Kasichak	1427	206	287	76	1997	100	1897	628	119	747	39.4	Safe
5	Kawakol	5347	271	775	100	6493	649	5844	1003	235	1238	21.2	Safe
6	Meskaur	1069	234	155	87	1545	155	1391	868	168	1036	74.5	Semi-critical
7	Nardiganj	1997	363	356	135	2852	143	2709	1345	176	1522	56.2	Safe
8	Narhat	1564	87	227	32	1910	191	1719	322	156	478	27.8	Safe
9	Nawada	3430	538	623	199	4790	240	4551	1958	486	2443	53.7	Safe

10	Pakribarwan	3612	246	703	91	4652	233	4420	906	272	1178	26.6	Safe
11	Rajauli	4202	591	613	219	5625	281	5344	2189	250	2439	45.6	Safe
12	Roh	3958	153	574	57	4742	474	4268	568	232	800	18.8	Safe
13	Sirdala	2078	289	452	107	2926	293	2634	1071	248	1319	50.1	Safe
14	Warsaliganj	2939	385	563	143	4029	201	3828	1390	438	1828	47.8	Safe
	Total	**41977**	**5061**	**6829**	**1874**	**55741**	**4377**	**51364**	**18531**	**3592**	**22123**	**43.1**	Safe

PATNA DISTRICT

S. N.	Administrative Unit (block)	Recharge from Rainfall during monsoon season	Recharge from other sources during monsoon season	Recharge from Rainfall during non-monsoon season	Recharge from other sources during non-monsoon season	Total Annual Ground Water Recharge (3+4+5+6)	Provision for Natural Discharge	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground water Draft for Domestic and Industrial Water Supply	Existing Gross Ground Water Draft For all Uses (10+11)	Stage of Ground Water Development	Category of block
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Athmalgola	986	232	130	79	1427	143	1284	799	118	917	71.4	Safe
2	Bakhtiapur	4822	467	637	159	6085	608	5476	1642	453	2095	38.3	Safe
3	Barh	2685	361	354	123	3523	352	3171	1286	290	1576	49.7	Safe
4	Belchi	1682	163	222	56	2123	212	1911	581	83	663	34.7	Safe
5	Bihta	4138	911	627	310	5986	299	5687	3160	359	3519	61.9	Safe
6	Bikram	2657	635	479	883	4653	233	4421	2263	237	2500	56.5	Safe
7	Danapur	3049	358	403	122	3932	393	3539	1284	614	1898	53.6	Safe
8	Daniawan	1595	263	211	90	2159	216	1943	944	102	1046	53.8	Safe
9	Dhanarua	4130	1163	600	396	6289	314	5974	4152	298	4450	74.5	Safe

10	Dulhinbazar	2712	406	358	630	4106	411	3695	1454	176	1630	44.1	Safe
11	Fathua	2456	615	409	209	3688	184	3504	2203	272	2475	70.6	Safe
12	Ghoshwari	3426	343	452	117	4338	434	3904	1230	97	1327	34.0	Safe
13	Khusrupur	1504	128	199	43	1874	187	1686	458	197	655	38.8	Safe
14	Maner	4182	473	552	161	5369	537	4832	1676	491	2167	44.9	Safe
15	Masuarhi	4959	1460	655	472	7546	755	6791	4946	568	5514	81.2	Safe
16	Mokama	4687	357	619	122	5785	578	5206	1281	564	1845	35.4	Safe
17	Naubatpur	2740	1690	542	1206	6177	618	5560	3100	291	3390	61.0	Safe
18	Paliganj	3883	2254	769	1068	7974	797	7177	1585	363	1948	27.1	Safe
19	Pandarak	5020	637	663	217	6536	654	5883	2276	210	2486	42.3	Safe
20	Patna Sadar	3838	340	507	116	4801	480	4321	1216	2008	3225	74.6	Safe
21	Phulwarisarif	2608	1185	344	461	4598	460	4138	2279	588	2867	69.3	Safe
22	Punpun	2980	740	410	252	4381	219	4162	2624	198	2822	67.8	Safe
23	Sampatchak	1601	464	211	158	2434	243	2191	1615	130	1745	79.6	Safe
	Total	72339	15644	10352	7449	105784	9329	96455	44052	8708	52760	54.7	Safe

SARAN DISTRICT

S. N.	Administrative Unit (block)	Recharge from Rainfall during monsoon season	Recharge from other sources during monsoon season	Recharge from Rainfall during non-monsoon season	Recharge from other sources during non-monsoon season	Total Annual Ground Water Recharge (3+4+5+6)	Provision for Natural Discharge	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground water Draft for Domestic and Industrial Water Supply	Existing Gross Ground Water Draft For all Uses (10+11)	Stage of Ground Water Development	Category of block
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Amnaur	2206.9	191	388.3	158.0	2943.9	147	2797	375	295	670	24.0	Safe
2	Baniapur	3446.1	960	523.8	791.1	5721.1	286	5435	2711	380	3092	56.9	Safe
3	Chapra	3738.5	517	569.8	489.3	5315.0	266	5049	2082	592	2674	53.0	Safe
4	Dariapur	4271.7	560	695.7	631.3	6158.4	308	5850	3769	400	4169	71.3	Safe
5	Dighwara	1653.0	206	274.0	233.0	2365.9	118	2248	1387	278	1665	74.1	Safe
6	Ekma	3051.2	903	463.7	794.0	5212.2	261	4952	3247	318	3564	72.0	Safe
7	Garakha	3473.5	649	530.2	607.8	5260.5	263	4997	2685	387	3073	61.5	Safe
8	Ishupur	2059.0	536	308.4	478.5	3381.8	169	3213	2117	212	2329	72.5	Safe
9	Jalalpur	2054.4	937	368.4	764.9	4124.8	206	3919	1975	241	2216	56.6	Safe
10	Lahladpur	974.5	433	164.5	326.4	1897.9	95	1803	836	123	959	53.2	Safe
11	Maker	1237.7	458	228.4	399.0	2323.3	116	2207	504	133	638	28.9	Safe
12	Manjhi	4144.1	475	654.7	328.1	5601.9	280	5322	540	394	935	17.6	Safe
13	Marhaura	2985.0	1034	472.9	935.0	5426.9	271	5156	3089	455	3544	68.7	Safe
14	Masharakh	2137.9	1415	416.5	1003.2	4972.9	497	4476	1955	274	2230	49.8	Safe
15	Nagra	1060.1	366	165.9	325.0	1916.5	96	1821	1164	169	1333	73.2	Safe
16	Panapur	1882.3	757	347.4	580.0	3567.3	178	3389	1597	176	1773	52.3	Safe
17	Parasa	2337.3	542	320.7	540.3	3740.8	187	3554	2513	219	2732	76.9	Safe

18	Revelganj	2714.5	179	380.7	202.1	3476.4	174	3303	1206	285	1491	45.1	Safe
19	Sonpur	3017.0	149	517.5	168.1	3851.5	193	3659	1003	495	1498	40.9	Safe
20	Tariya	1806.3	756	313.4	595.8	3471.6	174	3298	2039	207	2246	68.1	Safe
	Total	50251	12024	8105	10351	80731	4285	76466	36798	6661	43459	56.8	Safe

(Source: CGWB Patna)

ANNEXURE 9

SALIENT FEATURES OF VARIOUS RESERVOIRS SITUATED IN BIHAR

SI. No.	Name of Dam	Year of Completion	River	Nearest City	Type	Height above lowest foundation	Length of dam	Gross storage capacity	Reservoir area	Effective storage capacity	Designed spillway capacity
						(m)	(m)	(10^3m^3)	(10^3m^3)	(10^3m^3)	(m^3/sec)
1	Kharagpur Lake	1876	Mani	Munger	Earth	26.53	221.04	12460	3840		850
2	Nagi	1968	Nagi	Munger	Earth	23.39	1884	10800	4250		283.28
3	Kohira	1962	Kohira	Bhabua	Earth	15	85.7	28330	5510		736
4	Amrity	1965	Amrity	Jamui	Earth	16.65	166.16	4920		3350	
5	Badua	1965	Badua	Bhagalpur	Earth	56.66	457.32	128340	1133	109830	2834
6	Srikhandi	1965	Srikhandi	Jamui	Earth	16.65	205.8	4920		3350	
7	Kolmahadeo	1966	Kolmahade	Nawada	Earth	19.2	157	5700		4700	128
8	Chandan	1968	Chandan	Baunsi	Earth	49.38	1554	157230	10810	135740	3113
9	Jalkund	1968	Jalkund	Munger	Earth	15.99	631.1	3080	690	2770	149
10	Morway	1969	Morway	Munger	Earth	25.56	533.53	14570		12370	709
11	Satgharwa (N.F.)	1976	Morway	Munger	Earth	19.21	266.72	1800	360		106
12	Job	1977	Job	Nawada	Earth	18.9	1616	12000			425
13	Kailash Ghati	1980	Kailash Ghati	Jamui	Earth	25.2	286	3571	1235	3152	127.18
14	Nakti	1980	Nakti	Munger	Earth	23.61	990.85	13970	3640	12870	490.25
15	Tarakol (N.F.)	1980	Tarakol	Jamui	Earth	16.83	102.13	980	190	911	70.17
16	Baskund	1984	Baskund	Jamui	Earth	17.68	67.07	1230	600		231
17	Upper Badua	1985	Badua	Banka	Earth	16.92	1745	4520			200

	(N.F.)										
18	Belharna	1987	Belharna	Bhagalpur	Earth	30.1	411.58	15560	2680	14570	425
19	Phulwaria	1988	Tilaya	Nawada	Earth	32.98	1135	59340	9530	50740	1135
20	Anjan	1989	Anjan	Jamui	Earth	39.02	518.3	26680	3440	24710	878
21	Batane	1990	Batane	Chhattarpur	Earth	24.08	2012.2	67870	13360	59970	2692
22	Orhani	1998	Orhni	Banka	Earth	32	686	51560	9550		1167
23	Bilasi	2001	Bilasi	Banka	Earth	20.06	168.3	32570	5830	28870	492
24	Barnar	U/C	Barnar	Jamui	Gavity / Masonry	76.75	282.7	80210	3750	70770	3256
25	Durgawati	U/C	Durgawati	Bhabua	Earth	46.3	1915.4	28770	23370	25750	4249
26	North Koel	U/C	North Koel	Daltonganj	Earth / Gravity / Masonry	67.86	342.75	1170000	71200	960000	16000
27	Sindhwarni	U/C	Mani	Munger	Earth	21.34	125.76	58600	7000	42800	609
28	Upper Kiul	U/C	Kivi	Jamui	Earth	30	3673	98100	12300	84530	3401

(Source: Water Resource Development Dept. Govt. of Bihar)

ANNEXURE 10

DISTRICT WISE ANNUAL AVERAGE RAINY DAYS AND ACTUAL RAINFALL

(In M.M)

SI. No.	Name of District	2007		2008		2009		2010		2011	
		Average No. of Rainy Days	Actual Rainfall	Average No. of Rainy Days	Actual Rainfall	Average No. of Rainy Days	Actual Rainfall	Average No. of Rainy Days	Actual Rainfall	Average No. of Rainy Days	Actual Rainfall
1	2	3	4	5	6	7	8	9	10	11	12
1.	Patna	51.9	1492.5	62.1	1284.5	39.6	733.8	31.2	573.8	44.9	1011.2
2.	Nalanda	50.1	1257.6	52.6	1150.7	35.6	592.9	35.8	598.5	46.1	1164.8
3.	Bhojpur	47.3	1377.6	61.8	1321.5	33.4	683.2	32.7	623.1	44.1	955.9
4.	Buxar	43.2	944.0	49.7	1355.6	28.6	562.7	28.3	579.2	45.1	1003.6
5.	Rohtas	39.3	977.1	58.4	1133.3	33.1	811.0	23.4	419.6	42.0	1057.5
6.	Kaimur	44.2	1045.6	48.1	902.6	23.5	490.5	40.8	713.0	44.8	946
7.	Gaya	51.0	1133.4	54.9	1025.8	35.6	702.8	40.9	366.3	41.1	754.3
8.	Jehanabad	46.3	1288.5	53	1263.0	31.8	626.8	31.3	587.5	47.8	1280.1
9.	Arwal	53.7	1345.9	55.9	1364.5	40.4	828.6	25.9	532.9	50.4	1153
10.	Nawada	54.1	1167.5	57.6	1201.3	53.2	796.4	33.7	642.7	46.8	979.4
11.	Aurangabad	43.0	1092.7	50.3	1108.0	32.2	752.0	29.5	505.5	43.3	916.7
12.	Saran	56.9	1602.8	59.2	1448.0	36.3	782.0	26.1	673.1	50.4	1105.7
13.	Siwan	52.7	1386.1	38.7	1359.7	25.4	478.6	35.3	835.6	45.5	821.5
14.	Gopalganj	55.5	1822.3	57.6	1273.0	37.3	882.6	35.0	806.3	50.2	1082.2
15.	Muzaffarpur	67.1	2295.5	59.5	1359.7	37.3	761.0	38.3	671.8	46.9	1240.9
16.	Vaishali	56.3	1737.7	52.1	1479.3	37.8	747.5	32.1	575.3	45.3	1096
17.	Sitamarhi	47.7	1723.1	48.5	758.6	43	916.8	27.7	642.8	43.1	1287.9
18.	Sheohar	49.3	1605.4	64.0	1224.0	33	661.4	23.6	613.3	51.4	1210.7
19.	East Champaran	61.9	2042.3	53.8	1330.0	39.9	900.6	36.3	743.3	58.3	1315.4

20.	West Champaran	63.9	2085.5	61.9	1534.8	38.7	1144.1	48.7	1180.9	46.0	1074.2
21.	Darbhanga	51.9	1610.7	38.9	759.4	40.7	1040.0	30.2	492.0	54.2	997.8
22.	Samastipur	57.7	1795.4	47.7	1123.4	42.7	798.1	29.9	525.5	43.7	1141.2
23.	Madhubani	52.4	1805.2	40.4	845.4	38.4	1239.3	34.3	857.9	41.4	928.6
24.	Munger	56.8	1609.4	48.7	1297.2	40.0	1063.6	35.4	651.2	46.6	787.1
25.	Begusarai	54.7	1612.2	52.1	1138.4	23.3	464.2	30.4	499.6	48.5	966.2
26.	Lakhisarai	51.8	1449.8	62.5	1261.3	40.3	859.9	44.6	768.8	46.3	1175.7
27.	Sheikhpura	50	1255.9	55.5	998.7	43.5	1044.2	38.8	764.2	46.3	752.1
28.	Jamui	52.2	1228.8	45.1	663.7	40.1	686.1	31.0	729.9	49.7	925.8
29.	Khagaria	49.5	1542.2	46.5	989.5	38.0	1025.3	13.0	182.0	59.8	1214.3
30.	Bhagalpur	51.1	1248.4	54.7	915.4	42.2	1018.8	36.2	475.0	56.4	998.1
31.	Banka	63	1616.8	53.5	896.7	39.1	796.6	39.4	673.2	60.4	1083.4
32.	Saharsa	51.6	1270.7	48.8	1146.5	37.7	896.6	33.0	392.7	48.2	800.8
33.	Supaul	70.5	1450.1	52.0	1040.9	33.4	691.4	19.6	602.3	61.9	1386.2
34.	Madhepura	56.2	1359.0	43.4	1094.3	46.0	1356.7	40.4	909.6	58.6	1226.07
35.	Purnea	60.9	1407.7	54.0	1413.5	52.1	1495.6	43.5	952.1	61.2	1844.5
36.	Araria	66.4	1713	73.2	1657.7	47.4	1298.4	37.5	1193.4	59.5	1640.3
37.	Kishanganj	64.9	2175.5	73.1	2193.3	45	1457.5	70.1	1993.8	60.2	1952.5
38.	Katihar	55.6	1233.7	58.7	1133.9	44.9	1022.3	39.1	565.9	58.7	1264

(Source: Directorate of Economics & Statistics Bihar, Patna)

ANNEXURE 11

THE WATER QUALITY STATUS OF VARIOUS RIVERS IN BIHAR

SI. No.	Sampling Station	Year	PH	DO (mg/I)	BOD (mg/I)	TC (MPN/100 ml)	FC (MPN/100 ml)	Designated best use classification of surface water
1	2	3	4	5	6	7	8	9
1	Ganga at Chausa, Buxar	2005-06	8.14	8.04	2.13	18133	7883	Class - C
		2006-07	8.23	8.3	2.1	30491	15263	
		2007-08	8.23	8.27	2.16	13909	5354	
		2008-09	8.2	8.69	2.55	11083	5567	
		2009-10	8.26	8.25	2.8	6275	2033	
		2010-11	7.95	8.58	2.76	5750	2383	
		2011-12	8.1	8.5	2.7	5900	2733	
2	Ganga at Ramrekhaghat, Buxar	2010-11	7.88	8.43	2.95	22000	8083	Not Suitable
		2011-12	8.12	8.4	2.9	22667	7000	
3	Ganga at D/S Buxar near Ganga Bridge	2011-12	7.79	8.8	2.7	7000	2566	Not Suitable
4	Ganga at the confluence of	2010-11	8.27	8.4	2.8	3533	1566	Class – C

	Sone River, Doriganj, Chhapra	2011-12	7.85	8.4	2.7	3783	1716	
5	Ganga at Kurji, Patna	2005-06	8.04	8.3	2.04	19892	7517	Class – C
		2006-07	8.06	8.1	2.1	30083	13566	
		2007-08	8.15	8.2	2.15	13250	4908	
		2008-09	8.17	8.38	2.54	8866	4516	
		2009-10	8.14	8.09	2.7	3983	1808	
		2010-11	8.31	8.57	2.74	4216	2075	
		2011-12	8.19	8.5	2.7	5966	2383	
6	Ganga at Darbhangaghat, Patna	2010-11	8.21	8.4	2.9	22083	8083	Not Suitable
7	Ganga at Sultanganj	2010-11	7.88	8.2	2.74	4690	2260	Class – C
	Ganga at Sultanganj	2011-12	7.9	7.9	2.7	3654	1972	
8	Ganga at U/S Sultanganj	2011-12	8.0	8.2	2.3	2666	1133	Class – C
9	Ganga at Gaighat, Patna	2005-06	8.08	8.25	2.2	38292	10458	Not Suitable
		2006-07	8.08	8	2.3	51833	20416	
		2007-08	8.16	8.2	2.26	33666	14083	
		2008-09	8.15	8.29	2.7	30416	12333	
		2009-10	8.18	8.02	2.89	18833	5433	
		2010-11	8.16	8.38	2.89	15583	5700	

		2011-12	8.27	8.4	2.9	17500	5167	
10	Ganga at Malsalami, Patna City	2011-12	8.26	8.6	2.8	3600	1800	Class – C
11	Ganga at Barh	2011-12	7.9	8.2	2.5	-	-	Class – C
12	Ganga at U/S Mokama	2005-06	7.95	8	2.06	14540	7310	Class – C
		2006-07	8.04	8.2	2.1	20727	8818	
		2007-08	8.1	8.2	2.1	13090	5336	
		2008-09	8.12	8.54	2.48	10492	4750	
		2009-10	8.15	8.18	2.7	5758	1800	
		2010-11	7.95	8.3	2.75	4309	2136	
		2011-12	8.04	8.06	2.68	5518	2109	
13	Ganga at D/S Mokama	2005-06	8.02	7.9	2.3	45000	15900	Not Suitable
		2006-07	7.99	7.4	2.3	42000	14545	
		2007-08	8.05	7.9	2.32	35636	15445	
		2008-09	8.09	8.33	2.69	15333	12900	
		2009-10	8.21	8.02	2.9	17333	5525	
		2010-11	7.91	8.04	2.92	16273	6473	
		2011-12	7.95	7.9	3.0	21090	6736	
14	Ganga at Munger	2005-06	8.03	8.2	1.9	10133	5400	Class – C
		2006-07	8.27	8.15	2	26600	9675	

		2007-08	8.31	8.5	2.05	5500	2275	
		2008-09	8.22	8.7	2.4	8750	4050	
		2009-10	8.09	8.5	2.67	6350	2225	
		2010-11	7.98	8.32	2.76	3560	1540	
		2011-12	8.65	7.9	2.7	4425	1942	
15	Ganga at Bhagalpur	2005-06	7.83	8.2	2.06	15900	7700	
		2006-07	8.24	8.2	2.15	21000	8100	
		2007-08	8.28	8.22	2.15	11500	4350	
		2008-09	8.23	8.8	2.5	12750	5300	Not Suitable
		2009-10	8.18	8.15	2.8	4625	1825	
		2010-11	7.90	8.5	2.8	7466	2800	
		2011-12	7.9	7.8	2.8	9020	1710	
16	Ganga at Khalgaon	2005-06	7.92	8.08	2.14	22875	9733	
		2006-07	7.9	8.2	2.2	24909	12035	
		2007-08	8.21	8.3	2.18	22083	8450	
		2008-09	8.24	8.7	2.55	16416	6250	Not Suitable
		2009-10	8.23	8.06	2.8	8416	2733	
		2010-11	7.96	8.27	2.8	7500	3000	
		2011-12	7.9	8.0	2.8	9583	3012	

17	Ganga at Kewalaghat, Fatuha	2011-12	8.3	8.4	2.7	5875	2175	Class – C
18	Ganga at U/S Munger (near Intake well of Ganga)	2011-12	7.9	8.2	2.5	2800	1233	Class – C
19	Sone at Koelwar	2005-06	7.9	7.9	1.8	7542	3525	Class – C
		2006-07	8.26	8.3	1.9	3509	1545	
		2007-08	7.82	8.25	1.95	1542	733	
		2008-09	7.98	8.23	2.27	1242	658	
		2009-10	8.1	8	2.4	1416	675	
		2011-12	7.75	8.2	2.6	2058	942	
20	Sone at Bahiyara	2011-12	8.3	8.0	2.6	1366	500	Class – C
21	Sone at Banzari	2011-12	8.1	8.2	2.2	1700	733	Class – C
22	Sone at Indrapuri Dam Dehri –on-Sone	2011-12	7.84	8.3	2.6	2072	1036	Class – C
23	Sone at Nasiriganj Dam	2011-12	8.16	8.03	2.6	1333	566	Class – C
24	Ghaghara at Chhapra	2005-06	7.98	8.02	1.83	3708	1867	Class – C
		2006-07	8.2	8.2	1.9	3258	1316	
		2007-08	7.97	8.23	2	1908	942	
		2008-09	7.73	8.33	2.31	1400	780	
		2009-10	7.61	8.15	2.5	2208	950	
		2011-12	7.85	8.6	2.6	2275	1050	

25	Gandak at Sonpur	2005-06	7.94	8.01	1.7	4100	1948	Class – C
		2006-07	8.22	8.3	1.81	1758	1008	
		2007-08	7.68	8.3	1.9	1316	691	
		2008-09	7.68	8.45	2.18	1075	671	
		2009-10	7.48	8.12	2.35	1633	717	
		2011-12	7.87	8.5	2.5	1708	783	
26	Gandak at Rewaghat, Vaishali	2011-12	8.24	8.4	2.5	1150	500	Class – C
27	Gandak at Samastipur Road Bridge	2011-12	7.71	8.18	2.4	2520	960	Class – C
28	Gandak at Dumaria Ghat Gopalganj – Piprakothi Road Bridge	2011-12	7.84	8.8	2.4	1366	500	Class – C
29	Burhi Gandak at Akharagaht, Muzaffarpur	2010-11	7.78	8.9	2.3	2400	900	Class – C
		2011-12	8.08	8.6	2.7	2420	900	
30	Burhi Gandak at NH, Muzaffarpur Road Bridge	2011-12	7.78	8.9	2.3	2400	900	Class – C
31	Sikrahna at Chanpatia	2005-06	7.53	6.3	2.1	2050	900	Class – C
		2006-07	8.08	7	3.5	7125	3050	
		2007-08	7.67	7.8	2.14	2550	1325	

		2008-09	7.75	7.8	2.3	2225	1075	
		2009-10	7.71	8.35	2.57	1950	925	
		2011-12	7.95	7.8	2.7	2666	1250	
32	Sikrahna River at Lauria – Harinagar Road Bridge	2011-12	7.25	7.9	2.7	2733	1533	Class – C
33	Sikrahna River at Lalparsa, Sugauli – Raxual Road Bridge	2011-12	7.92	8.0	2.7	2800	1316	Class – C
34	Daha at Siwan	2005-06	8.02	8.6	1.96	1500	767	Class – C
		2006-07	8.28	8.6	2.02	2025	1000	
		2007-08	7.97	10.3	2	3200	1194	
		2008-09	7.8	8.1	2.5	1875	800	
		2009-10	7.99	7.8	2.75	2825	1100	
		2011-12	7.79	7.8	2.6	2380	840	
35	Daha River at Itwa Bridge, Meerganj	2011-12	7.99	7.9	2.7	2383	1575	Class – C
36	Daha River at Meerganj	2011-12	7.91	7.9	2.7	2200	800	Class – C
37	D/S Daha River at Sasamusa	2011-12	8.75	8.7	2.9	6833	2816	Not Suitable
38	Dhos at Madhubani	2005-06	8.03	7.96	1.73	643	407	Class – C
		2006-07	7.68	7.95	2.02	1500	825	

		2007-08	7.96	7.83	2	1250	700	
		2008-09	8.25	7.6	2.4	2000	975	
		2009-10	8.09	6.9	2.83	2166	1133	
		2011-12	7.81	7.4	2.7	3950	1650	
39	Sirsia at Raxaul	2005-06	7.04	6.4	2	2733	2100	Not Suitable
		2006-07	7.87	6.47	2.05	7325	1925	
		2007-08	7.66	7.05	2.17	3025	1475	
		2008-09	7.6	6.9	2.5	2700	1325	
		2009-10	7.27	6.8	3	2425	1150	
		2011-12	7.75	0.8	10.0	21333	6660	
40	Sirsia River at Koeria tola near Temple, Raxaul	2011-12	7.96	Nil	12.0	24000	6333	Not Suitable
41	Parmar at Jogwani	2005-06	8.04	8.1	1.73	667	433	Class – C
		2006-07	8.17	8.22	1.92	1450	750	
		2007-08	8.02	8.3	2.05	1567	800	
		2008-09	8.05	8.2	2.3	1450	875	
		2009-10	7.39	7.75	2.62	1525	725	
		2011-12	7.7	7.5	2.9	3183	1550	
42	Mahananda at Thakurganj Kishanganj Road	2011-12	7.8	7.5	2.6	2583	1200	Class – C

43	Mahananda River at Thakurganj – Kishanganj Road Bridge	2011-12	7.8	7.5	2.6	2583	1200	Class – C
44	Punpun at Patna Fatuha Road	2011-12	7.86	7.4	2.7	3366	1458	Class – C
45	Punpun River at Punpun Rail Bridge	2011-12	8.23	7.7	2.2	1866	900	Class – C
46	Punpun River at Kinze near Road Bridge	2011-12	8.2	8.3	2.0	1933	800	Class – C
47	Koshi at Kurshela Bridge, Katihar	2011-12	7.7	7.12	2.5	2325	820	Class – C
48	Koshi River at Kurshela Bridge, Katihar	2011-12	7.7	7.12	2.5	2325	820	Class – C
49	Koshi River at Madhepura	2011-12	7.71	7.3	2.6	2283	1166	Class – C
50	Koshi River at Beerpur	2011-12	7.8	7.45	2.65	1550	700	Class – C
51	Kamla at Benipati, Madhubani	2011-12	7.91	8.06	2.6	1600	700	Class – C
52	Kamla River at Darbhanga at Gausa ghat	2011-12	7.83	7.8	2.5	2160	920	Class – C
53	Kamla River at Jaynagar	2011-12	8.22	9.0	2.5	1800	700	Class – C
54	Bagmati at Muzaffarpur	2011-12	7.75	8.86	2.5	1366	566	Class – C

	Sitamarhi Road Bridge							
55	Bagmati River at Samastipur – Darbhanga Road Bridge	2011-12	8.09	8.7	2.5	1466	566	Class – C
56	U/S Harbora River at Narkatiaganj	2011-12	7.81	7.9	2.4	1600	800	Class – C
57	D/S Harbora River at Narkatiaganj	2011-12	7.64	5.8	4.46	9533	2816	Not Suitable
58	U/S Ramrekha River at Harinagar	2011-12	7.22	7.9	2.5	1366	666	Class – C
59	D/S Ramrekha River at Harinagar	2011-12	7.68	5.03	5.26	10000	4000	Not Suitable
60	U/S Manusmar River at Riga	2011-12	7.8	7.4	2.6	2033	766	Class – C
61	D/S Manusmar River at Riga	2011-12	7.78	5.8	4.0	4416	1400	Class – C
62	Motijheel Lake at Motihari	2011-12	7.72	7.7	3.0	10333	3516	Not Suitable
63	Dighi Talab at Gaya	2011-12	7.43	7.0	2.8	10500	3467	Not Suitable
64	Surajkund Talab at Gaya	2011-12	7.6	7.0	2.6	9633	2950	Not Suitable
65	Kawar Lake at Manghol, Begusarai	2011-12	7.8	6.8	2.9	3571	1900	Class – C

(Source: Bihar State Pollution Control Board, Patna and Bihar Statistical Hand Book 2012)