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Drinking water and its Related Health Hazards in Patna Municipal Corporation Area

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Abstract : *Pure clean water is vital to all life. Pollution of this basic resource leads to various water borne diseases and hampers human growth. Besides, availability of this precious resource is dwindling over time, due to misuse and overuse. India has 18% of the world population and 4% of water resources of the world. The annual per capita availability of water decreased from 6,045 cubic meters in 1947 to 1,545 cubic meters in 2011. 90% of the waste water discharged in rivers does not meet environmental norms. As per a recent report, the country has 75.8 million people without access to clean drinking water. A majority of these people come from an impoverished background. Bihar, one of the poorest states in the country, faces tremendous challenges in ensuring access to safe water for its population. There are frequent breakdowns due to poor material and workmanship of old assets, lack of repairs and maintenance and irregular water supply. Several districts have reported contamination of groundwater with fluoride, arsenic, bacteria and iron. The state capital Patna is also facing the problem of availability of pure drinking water to all segments of the population. The high surface water potential of the Ganga is unutilized in Patna leading to over exploitation of groundwater, on account of good aquifers at adequate depth. The ground water source is much more economical than the surface water. The Bihar Rajya Jal Parishad is responsible for supply of drinking water in the capital and the Patna Jal Parishad is responsible for operation and maintenance of water supply network. The ground water is depleting in Patna due to excessive withdrawal and the worst thing is that there is no hope of a solution to the problem any time soon. The falling ground water level leads to muddy water or no water coming from the pumps. Even the public water supply system fails and results in immense difficulty to the residents. The water of Patna is polluted with hundreds of pollutants and impurities due to bad maintenance of infrastructures and non-functional nature of Government water purification system and percolation of sewerage water to ground water especially during the rainy season. Water poor communities are typically economically poor as well; the poor residents are trapped in an ongoing cycle of poverty due to exposure to waterborne diseases and loss of health and money due to that.*

Key Words: *Water pollution, Water borne diseases, Water purification.*

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Introduction :

India has the World's highest number of people without access to clean water, resulting a financial burden to the country's poorest people for its use. As a consequence of using dirty water, countless water borne diseases occur. Bihar, one of the poorest states in the country, faces tremendous challenges in ensuring access to safe water for its population. Several districts have reported contamination of groundwater with fluoride, arsenic, bacteria and iron. The state capital, Patna, is also facing the problem of availability of pure drinking water to all segments of the population. The high surface water potential of Ganga is unutilized in Patna, leading to over-exploitation of groundwater and consequently mixing of dirt, mud and arsenic with groundwater. The main problem with the existing system is non-uniform supply and contamination due to poor and old supply network. The sewerage system is inadequate leading to spillage and collection in low lying areas. In many colonies drinking water and sewerage pipelines touch each other, with sewer line on the top of water line increasing the possibility of contamination (CDP 2010). The presence of contaminants in water leads to diseases like jaundice, typhoid, and cholera among the residents.

With this background, the current study has been done to fulfil the following objectives.

Objectives :

- To study the sources of drinking water among cross sections of the population of Patna Municipal Corporation area and its related infrastructure.
- To analyse the drinking water quality of the city.
- To identify water borne diseases of the residents of Patna.
- To study the measures taken by the government and inhabitants to purify drinking water to combat the situation.

Hypotheses :

- Drinking water quality of Patna is not satisfactory.
- Mixing up of sewerage water and drinking water leads to contamination.
- Use of contaminated water leads to water borne diseases, and loss of health.

Database and Methodology :

The study is based mainly on stratified random sample survey of 105 households from four circles of Patna M.C. Thirty sample families from New Capital Circle and Twenty-five each from Kankarbagh, Bankipur and Patna City Circles have been selected from a cross section of population. Data has been generated from the feedback of these families, with the help of a questionnaire survey. To supplement the work, Ground Water analysis data from Pollution Control Board, Central Pollution Control Board, Centre for Science and Environment and water analysis of A.N. College have been used.

The research work is based on a distinct methodology which follows three stages –

- **Pre - field survey** – study of relevant literature, collection of materials, data and maps, government offices (PMC) and concerned websites, preparation of questionnaire.
- **Field survey -** scheduled survey of 105 sample families and generation of primary data.
- **Post field survey** – analysis of available data for quality of ground water, compilation, tabulation, cartographic representation of primary data and preparation of paper.

Study Area :

Patna is the capital city of Bihar located in the centre of the state crossing the co-ordinates of $25^{0}37^{'}$ N and $85^{0}13^{'}$E having, a population of over 1.8 million (2011 census) on an area about 110 sq km with an average density of 1132 persons per sq km. Patna Municipal Corporation is divided into 72 wards, which are further divided into 4 circles-New Capital Circle, Bankipur Circle, Kankarbagh Circle and Patna City Circle. The study has covered 105 residents of all four circles coming from different cross sections of the society.

Analysis:

Drinking Water is the essence of basic survival.

Without it, life on earth would cease to exist. Pure clean water is vital to all life. Pollution of drinking water leads to water borne diseases, hampers human growth and is a health hazard to the residents. The present study has analysed the status of drinking water in Patna and the related health hazards of sample population due to its consumption.

Demographic Profile and Socio-Economic Conditions of Sample families :

The study of the demographic profile and socio-economic conditions are important, as it helps to know the current situation and formulate plans for the future. From the sample survey of 105 households, it is clear that most of the families (65.7per cent) reside as nuclear families. The average age of the respondents is less than 40 years while in an average family of Patna, there are six members. A majority of the sample population belong to the middle income or higher income group, while about 30 per cent of them are either from lower income families or from BPL families. (**Table 1**) Among sample populations, 11.4 per cent are illiterate while the rest are literate, with the educational level varying from primary to post graduate. The residents who are educated up to Matric or above are aware of the problem of water pollution and are taking preventive measures to combat water borne diseases if possible.

The **social environment** of the residents of Patna is not very healthy. Water logging is a common problem in a majority of localities, especially during the rainy season. The Kankarbagh circle is worst affected due to its saucer shaped geological structure. In case of New Capital circle, roads are higher compared to adjacent localities due to faulty planning, resulting into water logging. On the contrary, since Patna City Circle is located on the levee of river Ganges, minimum water logging can be seen.

Mushrooming unplanned growth of a large number of new colonies, with minimum infrastructural facilities leads to poor social environment of the residents. 68 per cent of residents of Patna City Circle and 53 per cent in Kankarbagh dispose of their garbage on the road side. Also, 48 per cent of the residents of Bankipur and 46.7 per cent in New Capital Circle throw garbage on the roadside. The improper management of waste disposal leads to contamination of Ground Water. The wastes are often dumped directly into nalas, which ultimately meet the Ganga or percolate downward and mix with aquifers especially after the rainy season.

40 per cent of the sample population in Patna M.C. conveyed that slums are located within 1 km of the residence, while 60 per cent of them informed that slums are located more than 1 km from their residences. That shows preponderance of slums in Patna where unhygienic social environment is polluting the aquifer of that area as well as of nearby localities. Slums are more prevalent in Kankarbagh circle, where 60 per cent of the sample population agreed that slums lay within 1 km of their residence. Apart from that, accumulation of solid waste is very common in Patna, which is one of the dirtiest capitals of the country. About 83 per cent of the residents agreed that municipal waste is abundant in their locality, while 17 per cent identified accumulation of medical waste in their locality. Failure of the Patna Municipal Corporation and their frequent strikes, lead to accumulation of municipal and medical wastes. Kankarbagh circle and Patna City circle witness the largest accumulation of Municipal waste (88 per cent), followed by Bankipur (80 per cent) and Kankarbagh Circle (76.6per cent). The accumulation of solid wastes on the roads, 'nalas' and open spaces spoil the social environment of the city and contaminate drinking water.

Sources of Drinking Water :

Groundwater is the most preferred source of water for drinking in Patna Municipal Corporation Area. The easy availability of fresh drinking water in Patna M.C. has prompted 60 per cent middle and higher income group residents to have their own boring. 8 per cent of the residents of Patna M.C. have their own well or hand pump at home, while 27per cent have Government pipeline supply at home. Only 3 per cent of the poor residents are dependent on a tube well outside their premises, while Public Stand Posts have become a rare affair.

Fig 1 shows circle wise distribution of various sources of drinking water in Patna Municipal Corporation area. 70 per cent of the population of New Capital Circle, 64 per cent of Kankarbagh, 56 per cent in Bankipur and 44 per cent in Patna City Circle have their own boring. Corresponding to this, about 20 per cent of the families in the New Capital Circle use their private well / hand pumps in their home. 24per cent of Kankarbagh people, 28 per cent people of Bankipur

circle and 56 per cent in Patna City Circle use the same source of drinking water.

Depth of Boring- A large number of people of the four circles under Patna MC get their drinking water through boring. Among them, about 36 per cent have agreed that the depth of their boring is 200 feet and above, 25 per cent of the residents have a depth of boring of 150-200 feet, about 30 per cent of them get it from the aquifer level of 100-150 feet, while 9.37 per cent get it from a depth of 50-100 feet (**Fig 2**). During summer months, the aquifer level declines, leading to intermixing of mud with water or no water at all in many residences.

Duration of Municipal supply - Regular supply of clean drinking water is one of the primary responsibilities of the Government. 4.87 per cent of the residents of Patna M.C. dependent on municipal supply get water less than 2 hours and sometimes no supply at all. 34.15 per cent of the residents, who are dependent on municipal supply, generally get water for 4 to 8 hours. 31.7 per cent of them are getting it upto 8 to10 hours, while 6 per cent of them get it upto 10 hours.

The dependence of citizens of Patna on Government supply has declined considering. Among them, most of the people are getting water supply for 4 to 8 hours in New Capital Circle, Kankarbagh and Bankipur circle. Patna City Circle residents are lucky to get supply water for 8 to10 hours duration. Among four functional tanks in Patna M.C., three are located in Patna City. Operational nature of the overhead tanks might have helped the authority to supply water for 8 to10 hours. The duration of government water supply is satisfactory for those who are depending on it.

Status of Government supply of water- Regular supply of clean water that can be used for drinking purposes is an indicator of good governance. Lack of regular supply of water in many localities and ill maintenance of pipes has led residents to think about alternatives. Most of the residents have their own boring, hence, they do not complain about supply.

Quality of Ground Water in Patna M.C. -The pH of the water in Patna ranged from 7.42 to 7.68 which shows the alkalinity of the drinking water. pH usually has direct effects on biotic environment. For satisfactory water disinfection and clarification at all stages, the control of pH is very necessary. Effective disinfection with chlorine the pH should preferably be less than 8. pH of all the circles of PMC Area was found within the range of Indian Standards(6.5-8.5). The Total Dissolved Solids (T.D.S) of the water ranged from 244mg/ltr to 298 mg/Ltr. The Total Dissolved Solids of the four circles were less than the Indian Standard (500 mg/L.tr). The total hardness of the samples has a wide range (208-278 mg/Ltr). The total hardness is an important parameter of water quality, whether it is to be used for domestic, industrial or agricultural purposes. Total hardness of the four circles was above the Indian Standards of drinking water. The Calcium ranged from 10-24 mg/Ltr. The calcium concentration in the four circles was found less than the standards. In case of Magnesium, three circles (National Capital Circle, and Bankipur) have equal amount of magnesium concentration. In Patna City the amount of magnesium concentration is high. The chloride and sulphate concentration of the four circles were found at a low level of Indian Standards (200 mg/Ltr) and the Fluoride concentration in the circles of PMC area was below the Indian Standard (1.0 mg/Ltr.) Thus, it appears that the quality of ground water is satisfactory in Patna M.C. (**Table 2**) Even then, the residents of Patna are not satisfied with the quality of drinking water in Patna, mainly because of ill maintenance of supply pipes, non-functional tanks and mixing of supply water with sewerage water due to leakage in pipes and irregular cleaning of tanks in most households.

Physical Condition of Supply pipes and Sewerage pipes- "The city water pipeline system is approximately 700 km in length, of which nearly 300 km requires immediate replacement to stop high leakages", as according to Public Health Institute, Patna. In New Capital Circle, 70 per cent and Patna City 56 per cent of the supply and sewerage pipes are satisfactory while 52 per cent in Kankarbagh and 56 per cent in Bankipur, residents are not satisfied with the condition of the pipe lines especially joints, which may be due to the poor maintenance or the residents have not complained against their pipe condition. (**fig 3**)

Maintenance of supply pipes and sewerage pipes- The main problem with the existing system is non uniform supply in different areas and contamination due to various leakages. The underground flow water loss is above 40 per cent due to poor and old supply networks. The pipes are not easily accessed due to heavy traffic.

Thus, poor maintenance leads to a loss of carrying capacity, contamination of water, repair and maintenance problem. In many colonies in Patna the drinking water and sewerage pipe line intercept with each other, with the sewer line on top of the water line increasing the possibility of contamination. According to 50 per cent residents of New Capital Circle, 56 per cent in Bankipur, 64 per cent in Patna City, the maintenance of supply of sewerage pipes is irregular. 48 per cent residents in Kankarbagh and 36 per cent in Patna City have complained about no maintenance at all (Table 3). The government officials are not prompt in maintaining the pipes and joints condition. This is the reason why they are irregularly maintained. Further, heavy traffic congestion on the roads makes the maintenance work really difficult. Ill maintenance of pipes leads to contamination of water and pollution of drinking water. This satisfies the hypothesis too.

Drinking Water Pollution :

Drinking Water is the essence of basic survival. Without it life on earth would cease to exist. 'Water Pollution' can be defined as alteration in physical, chemical or biological characteristics of water through natural or human activities, making it unsuitable for its designated use.' (Anjaneyulu, 2004). Drinking water pollution is now a major problem throughout the World especially in developing countries. In Patna Municipal Corporation Area, due to absence of proper water supply and sewerage system, drinking water pollution is rampant. Water contamination can be attributed to infiltration, leaching and surface run-off through pastures, and leakage of sewerage disposal systems. Leakages in piped water supply network leads to contamination and water pollution.

From **fig 4**, it is clear that 22.9 per cent of sample population have complained about objectionable smell in drinking water. Their proportion varies from 36 per cent in Patna City area, 28 per cent in Kankarbagh, 24 per cent in Bankipur and 10 per cent in New Capital Circle. As the majority of New Capital Circle residents are dependent on deep boring, they do not experience smell in water. Contrary to that in Patna City and Kankarbagh circle, large numbers of residents are dependent on municipal supply and experience awful odour in water, especially after the rainy season.

Presence of visible particles indicates gross failure of the administration to provide clean water to its citizens. 24 per cent of respondents in Kankarbagh circle, 20 per cent each in Bankipur and New Capital Circle and 16 per cent in Patna City circle have complained about existence of visible particles in water which clearly indicate the **pollution of drinking water in Patna**. The colour of water changes after the rainy season. It becomes dark and muddy, which clearly indicates lack of maintenance of pipes and overhead tanks. 10 per cent of the residents of New Capital Circle complained about non-transparency of water, while their proportion is 8 per cent in Kankarbagh and Bankipur. 20 per cent Patna city residents have complained about deposition of oily layer if kept for long, while 12 per cent of residents in Bankipur circle and 3.3 per cent of residents in New Capital Circle have similar complaints which clearly indicate percolation of petroleum products in ground water. Heavy movement of trucks and heavy vehicles in the city area, and seepage and mixing of pollutants with aquifers are responsible for this phenomenon.

50 per cent of the respondents of New Capital Circle have observed that the drinking water they get is odourless. In general, they are staying in apartments, where source of water is deep boring and overhead tanks are cleaned regularly. Even then, they use various purification methods to avoid water borne diseases. The same is the case in 40 per cent of residents in Kankarbagh and 36 per cent of residents in Bankipur but this percentage decreases to 24 per cent in Patna City area, where apartment culture is not so prevalent and people are dependent mostly on supply water.

Cleaning of Water Tanks- If water tanks are not being cleaned or disinfected for a long time, the physical, chemical and biological contaminants result in mudding, shedding, rusting, odour and bacterial formation in the water. This situation destroys the portability and the usability properties of the water. Since water is used for so many different things, it is vital that the source through which the water flows is clean and well maintained, to avoid water borne illnesses.

It was found, on examination that most respondents cleaned their water tank monthly. However, equal cases of bi monthly cleaning and those who never got their tank cleaned was also observed. Very few of them opted for weekly cleaning.

Water borne Diseases- Water borne disease is transmitted or spread through contaminated water. Pathogenic microbes and some parasitic organisms are responsible for various diseases. Such infectious pathogens survive and spread in the environment using various strategies. The main source of spread is through water. Diarrheal diseases, in particular, are carried through the medium of water. The lack of knowledge and awareness regarding hygiene and health issues has generally exposed the population in different areas of Patna to various diseases related to water and sanitation.

Type of water borne diseases :

Water Borne Diseases like cholera, diarrhoea, typhoid, jaundice, B-Coli, E Coli erupt every year during summer and rainy seasons in Patna, due to poor quality of drinking water supply and sanitation. Water related diseases have plagued many people. The health burden of poor water quality is enormous.

There is some variation in the dominance of a particular kind of water borne disease in the four circles(**Table 4**). In the National Capital Circle, diseases typhoid, jaundice, B-Coli and E-Coli are more dominant, as is clear from the table. In Kankerbaghs most of the population was affected by typhoid (64 per cent) followed by jaundice and diarrhoea (52%) each, B-Coli (24%). The Bankipur circle showed much variation.The common types were typhoid (32%), malaria (24%), diarrhoea (24%), cholera (20%), B-Coli (12%), E-Coli. Jaundice was the most common disease affecting more than half of the population in Kankarbagh and Patna City (Fig 5). A large number of residents in Patna City are dependent on Government water supply and the residents of Patna City have observed oily layer in their drinking water when kept for long. This might be the reason behind Jaundice. In case of Kankarbagh, intermixing of sewerage water with drinking water might be the reason for jaundice especially during the rainy season after water logging.

In case of illness, private clinics were the choice of a major proportion of the population in National Capital Circle, Kankarbagh, Bankipur, followed by hospitals, health care units and medical shops. The population of Kankarbagh visited only private clinics, hospitals and health centres . Patna city showed a little deviation from the above trends. Its population mostly visited hospitals, followed by private clinics and health centres and medical shops.

Water borne diseases can have a significant impact on the economy. People who are infected by water borne diseases are usually confronted with related costs and often with a huge financial burden. The financial losses are mostly caused by costs for medical treatment and medication, cost for transport, special food and by the loss of man power.

Water borne diseases can prove to be fatal. Every year they cause a large number of deaths. Kankarbagh and Bankipur showed highest death percentage, 24 per cent each, while their proportion in New Capital Circle was 13.3 per cent and 12 per cent in Patna City. The deaths were mostly observed in the very low income groups, mainly due to lack of proper treatment of the diseases. The upper income group also showed some deaths but it was negligible compared to the poor sections.

Conclusion :

Clean water is a pre-requisite for reducing the spread of water-borne disease. It is well recognised that the prevalence of water-borne disease can be greatly reduced by the provision of clean drinking water and safe disposal of faeces. Ensuring poor people's access to safe drinking water and encouraging personal, domestic, and community sanitation and hygiene will improve the quality of life for millions of individuals.

Ground water is the main source of drinking water in Patna. Bihar Rajya Jal Parishad is responsible for operation and maintenance of public water supply. It comprises 98 tube wells (11 non Functional) that pump water directly to the distribution Mains. The Distribution System includes 23 overhead reservoirs, of which Agamkuan, Gulzarbagh, Guru Govind Singh Hospital and High Court are functional (CDP 2010). Government drinking water supply in Patna City circle is best because of operative reservoirs. But iron content in Patna City circle is above the Indian Standard on account of old infrastructure. Ground water is supplied after pumping through a piped distribution network. A lot of it is contaminated through leakage points in the pipelines that are already old and on the verge of collapse. Dumping of solid and liquid waste have further degraded the quality of water. Further, 'overutilization of groundwater through bore wells leads to water scarcity,

pollution and arsenic pollution' (Ghosh 2007). Drinking water quality in Kankarbagh and New Capital Circle is the worst due to waterlogging, nearness to slums and percolation of polluted water to groundwater. According to the centre for Science and Environment, more than 50 per cent of samples taken in the State capital have been found water unfit for consumption due to serious bacterial contamination (Chaudhury 2012). The ground water from fourteen stations were analysed by Central Pollution Control Board. Even though the water quality index put the water into good category, none of the samples were found suitable, because all of them were found with high concentration of faecal and total coli forms. Alkalinity, total dissolved solids and nitrate concentrations in some stations were found above the drinking water standards (Sukumaran et al 2015). More than **62 per cent of sample population have reported about bad odour, mud, solid matter and oily substance in their drinking water. Thus, it satisfies the first hypothesis that drinking water quality in Patna is not satisfactory.**

Less than 16 per cent of the city's population is connected to a sewage network, which means 84 per cent of the city's excreta is discharged into open drains and eventually into the same river. From the drain, it also percolates into the ground water, which is pumped by Patna Municipal Corporation and supplied to houses. Intermixing of the sewer water and drinking water due to leakage in pipes (as per city Development Plan) and percolation of sewer water to aquifers (as per Centre for Science and Environment) leads to contamination. 60 per cent of the sample population also reported this problem. Hence, the second hypothesis that "**Mixing of sewerage water and drinking water leads to contamination"** is satisfied.

Jaundice, Typhoid, B Coli, E Coli are very common among the residents, especially in Kankarbagh, Patna City and New Capital Circle, as per sample survey. More than 65 per cent of the family members of the respondents have suffered from waterborne diseases. The study further shows that 18 to 50 age group is the most vulnerable to waterborne diseases due to day-to-day interaction with impure water and consumption of street food. **42 per cent sample population agreed about monetary loss and 91 per cent agreed about loss of health as a result of waterborne diseases**. Thus, it satisfies the third hypothesis **that 'Use of contaminated water leads to waterborne diseases and loss of health of the residents.'**

The only method of water purification by Government is online electroclorination. Residents are either boiling water or using mainly Aquaguard or RO purifiers to get clean drinking water. But it depends on the affordability of the residents.

Government started a magnificent project to supply drinking water to its residents under JNNURM. However, it was a complete failure thereby risking the lives of the residents and making them vulnerable to various types of water borne diseases.

Suggestions :

- Proper maintenance of infrastructure both by the households and the Government.
- Proper construction of soak pits and septic tanks.
- Regular cleaning of tanks, both by the Government and private operators,
- Revamping of the drainage system of the city and cleaning of sewerage water before mixing with Ganga water.
- To prevent overutilization of groundwater, use of Ganga water in nearby localities after purification.
- Coordination of different agencies responsible for water supply to improve the drinking water quality of the city.

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Table 1. Average income of sample families in Patna Municipal Corporation Area*

Locality	<5000		5000-25000		25000-50000		>50000	
	No.	%	No.	%	No.	%	No.	%
New Capital Circle	3	10	9	30	9	30	9	30
Kankerbagh	3	12	6	24	10	40	16	24
Bankipur	1	4	6	24	5	20	13	52
Patna City	8	32	4	16	8	32	5	20

*Based on sample survey, 2016.

Table 2. Physical and Chemical composition of sample water

Circles	Temp.	pH	T.D.S mg/Ltr	C.O.D mg/Ltr	PO_4 mg/Ltr	T.F.S mg/Ltr	K mg/Ltr	T.S.S mg/Ltr	Ca mg/Ltr	Mg mg/Ltr	Cl mg/Ltr	Alk^n mg/Ltr	SO_4 mg/Ltr	Nam mg/Ltr	F mg/Ltr	T-H/ mg/Ltr
New Capital Circle	35/27	7.42	244	4	0.06	72	2.2	12	33.66	30.21	16	194	14	22	0.8	208
Kankerbagh	34/29	7.52	258	4	0.08	68	2.4	10	62.52	22.85	20	220	16	24	0.9	250
Bankipur	34/27	7.68	298	4	0.04	72	2.6	12	34.46	30.21	10	186	12	26	0.8	210
Patna City	33/31	7.49	248	4	0.08	120	2.6	12	25.65	32.18	24	228	16	26	0.6	278

Source: Bihar State Pollution Control Board, Water Quality Status, April 2016.

Table 3. Maintenance of Pipes in Patna M.C.*

Locality	Regular		Irregular		No Maintenance	
	No.	%	No.	%	No.	%
New Capital Circle	7	23.3	15	50	8	26.6
Kankerbagh	5	20	8	32	12	48
Bankipur	4	16	14	56	7	28
Patna City	0	0	16	64	9	36
Patna M C	16	15.2	53	50.5	36	34.3

*Based on sample survey, 2016

Table 4. Type of water borne disease in Patna MC Area*

Circles	Cholera		Typhoid		Jaundice		Diarrhoea		B Coli		E Coli		Others	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
New Capital Circle	0	0	8	26.6	7	23.3	5	16.6	1	3.3	3	10	15	50
Kankerbagh	3	12	16	64	13	52	13	52	4	16	6	24	5	20
Bankipur	5	20	8	32	3	12	6	24	3	12	6	24	7	28
Patna city	3	12	7	28	13	52	6	24	4	16	1	4	12	48
Patna MC		10.5	39	37.1	36	34.3	30	28.6	12	11.4	16	15.2	39	37.1

*Based on sample survey, 2016

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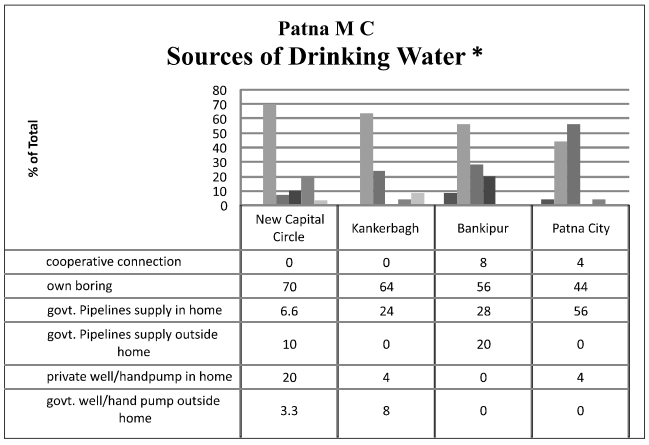
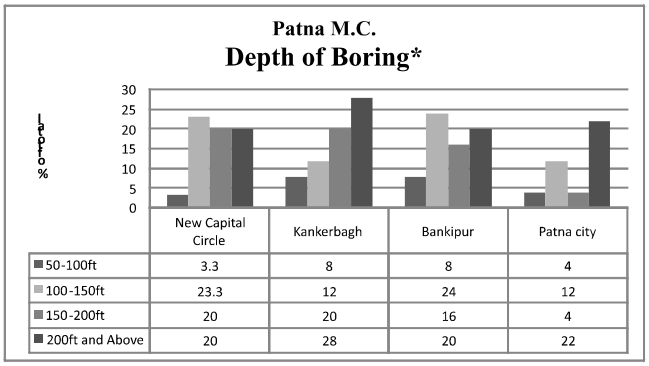


	New Capital Circle	Kankerbagh	Bankipur	Patna City
cooperative connection	0	0	8	4
own boring	70	64	56	44
govt. Pipelines supply in home	6.6	24	28	56
govt. Pipelines supply outside home	10	0	20	0
private well/handpump in home	20	4	0	4
govt. well/hand pump outside home	3.3	8	0	0

*Based on sample survey, 2016

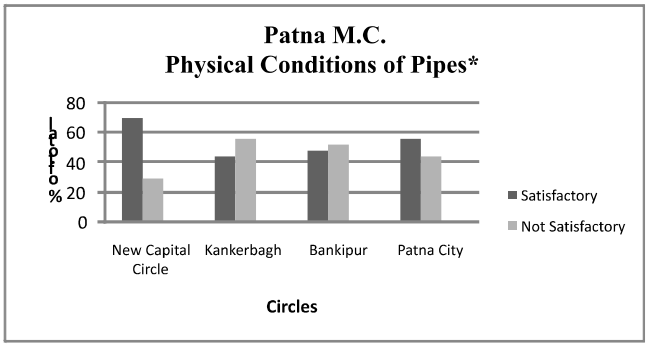
Fig. 1



	New Capital Circle	Kankerbagh	Bankipur	Patna city
50-100ft	3.3	8	8	4
100-150ft	23.3	12	24	12
150-200ft	20	20	16	4
200ft and Above	20	28	20	22

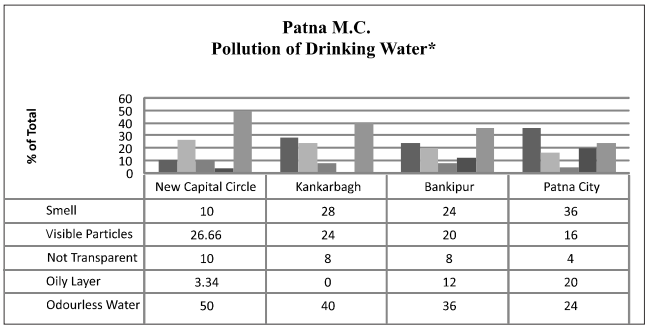
*Based on sample survey, 2016

Fig. 2



*Based on sample survey, 2016

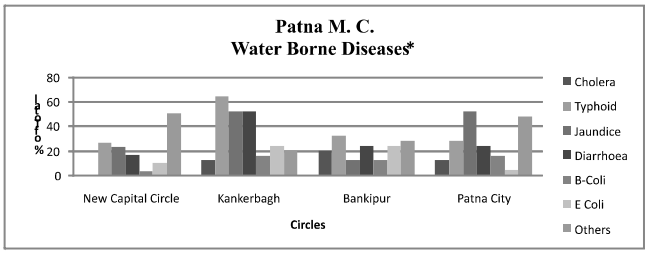
Fig. 3



	New Capital Circle	Kankarbagh	Bankipur	Patna City
Smell	10	28	24	36
Visible Particles	26.66	24	20	16
Not Transparent	10	8	8	4
Oily Layer	3.34	0	12	20
Odourless Water	50	40	36	24

*Based on sample survey, 2016

Fig. 4



*Based on sample survey 2016

Fig. 5

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