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DETERMINING THE ROLE OF DIFFERENT STAKEHOLDERS TOWARDS SUSTAINABLE WATER MANAGEMENT WITHIN BHOPAL, MADHYA PRADESH

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ABSTRACT

The present study thus focuses on water management strategy carried out in the Indian city of Bhopal whose, surging topography is spotted with a big quantity of large number lentic water bodies. Presently, the city is at risk, and requires urgent implementation of an integrated urban water management system. To understand the existing scenario of the water management system carried out by both government and other responsible bodies, quantitative analysis has been sought based on survey mode of data collection carried out on 5000 residents residing in the Kolar Road and Old Bhopal of the capital city.

The role of various stakeholders in water management in Bhopal is satisfactory in certain areas but adequate improvement in needed– such as, lack of awareness among residents in prevention of water wastage, lack of initiatives adapted by NGOs and civil agencies to educate the residents in managing water and thereby preventing its wastage.

There is need to strengthen its technological innovation. Also, private partnerships should be encouraged, along with more stringent government laws. Private water suppliers need to act more responsibly while distributing water. More effective participation of the NGOs in educating the masses of water management practices thereby developing the present loopholes is recommended.

KEYWORDS: Sustainable Development, Water Management, Stakeholders, Sustainable Water Management, Civil Agencies, Government, Ngos

INTRODUCTION

BACKGROUND OF THE RESEARCH

Conceptualization of Sustainable Water Management

"Sustainable water management includes the process of allocation of water between water sector demands while balancing the financial and social resources required for the maintenance of various water systems"(Russo et al. 2014). Water has always been a necessity for the existence of life on earth and it will continue to be. However, over the time due to scarcity of this resource, its significance has increased. It has gained momentum giving rise to the effects of competing demands between different uses and users. This has resulted in states proceeding in the direction of adopting water resource legislations to address the issues arising out of water scarcity and deteriorating quality of water resources.

The management of water demand basically includes twin elements of introducing technical efficiency of water use and efficient allocation of water among competing sectors. These strategies complemented with various other water management measures and program is thus identified as an area that requires further improvement (Dziegielewski 2003).

Stakeholders in Sustainable Water Management

Bhopal with itsincreasing population base of more than 2 million has adequate water sources, owing to sufficient amount of annual rainfall, thereby supplying potable water to its inhabitants. “Supplying potable water to the whole city is a never ending scuffle seeing that the populace of the city is on a steady rise, however the resources bearing water quality of potable sources are fast dwindling”(Jotwani et al. 2014). As a result, the sustainability of Bhopal city is at risk, and requires urgent implementation of an integrated and holistic urban water management system. Jotwani et al., (2014) further argued that the water supply in Bhopal, just like other Indian cities, is faced with ever increasing demands and dwindling availability, and therefore, it is required to keep a fine balance in demand and supply through integrated approach of urban water management. The need of the hours is integration among various stakeholders in sustainable water management in Bhopal which are Bhopal Municipal Corporation (BMC), Public Health Engineering Department (PHE), Town and Country Planning Organisation (TCPO), Private Water Suppliers and Civil Societies such as various Non-Governmental Organisations operating within Bhopal.

AIM AND OBJECTIVES OF THE STUDY

- To explore the system of sustainable water management in Bhopal, and role of various stakeholders in maintaining and sustaining the same.
- To study of the proportion of responsibilities shared and carried out by various stakeholders.

METHODOLOGY

The research design strategy enables to identify data collection means and procedure, and the data analysis techniques which are to be applied in the research. The research method is classified as descriptive (Saunders et al. 2009), as description of the views of the residents residing in Kolar Road and Old Bhopal has been carried out, in terms of their demographic profile and general background. Moreover, explanatory method has also been applied through explanation and accounting of the descriptive information (Gray 2013) collected from the residents.

The research comprised of quantitative analysis, with a deductive approach through which a survey method was adopted by the researcher to collect the responses, administered through close ended questionnaire. The survey consisted of probability sampling, as each respondent was approached through simple random sampling method. The questionnaire was administered to nearly 8000 residents out of whom 5000 (i.e. 63%) responded. The statistical data was analysed using SPSS 21.0, whose validity has been pilot tested on 100 initial residents. The reliability of the data tested through Cronbach’ Alpha projects a higher value of 0.876. The study furthermore comply with the ethical issues by justifying the research objectives formulated, maintaining confidentiality of the residents and transparency of the study through checking plagiarism level.

The research analysis and its findings were based on the following questions:

- What is Government’s (BMC, PHE and TCPO) impact in sustainable water management system?
- What is the impact of private water suppliers in sustainable urban water management?
- What is the impact of civil societies in sustainable urban water management?

FINDINGS

RQ1: What is the Government's Impact in Sustainable Water Management System?

Quantitative data collected from the responses of the residents of Bhopal were analysed using statistical tool of correlation and regression through SPSS 21.0, where the role of these authorities (BMC/Kolar Road Municipality, PHE[1] and TCPO[2]) were taken as dependent variable against the various initiatives[3] as the independent ones. The correlation analysis projected a strong positive correlation between the role played by these authorities in carrying out the various responsibilities towards water supply and its management. Though some of the initiatives such as, tackling of the water problem in affected areas by the PHE, removal of open defecation and manual scavenging by the TCPO, still lingers heavily in the city. Besides, analysis also project an ineffective and inadequate water supply and management carried out by the Municipality of Kolar Road, where most of the residents are slum dwellers and resort to tube wells and bore wells for their daily supply of water.

The regression analysis furthermore justifies the results of correlation testing by projecting the value of adjusted R2 at.907, asserting that the role of these agencies are influenced by 90.7% variance in the initiatives level.

RQ2: What is the Impact of Private Water Suppliers in Sustainable Urban Water Management?

Private water suppliers[4] play a significant role in areas where water supply by responsible authorities is scarce. It is especially observed in slum dwellings of Old Bhopal and Kolar Road where, most of the slum dwellers are inter-state migrant workers and live in scanty quarters. The correlation analysis project a significantly positive value with most of the variables, barring few such as, development of infrastructure to minimalize water leakage and ensuring steps for rain water harvesting, where negative correlation is reflected with significance level being 0.00. Regression analysis justifies the correlation results, with the value of adjusted R^2 being.918 and ANOVA being at f= 7979.637; p=.000, suggesting that 91.8 variance is detected in the influence exerted by various independent variables over the dependent variable i.e. the impact of private water suppliers.

From both the analysis it is inferred that private players' initiatives are significant in carrying out water management, though efficient handling of the initiatives are lacking, affecting the sustainability of the management.

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[1] The independent variables of PHE were, full coverage of both rural and urban population with safe drinking water supply facilities; coverage of urban and rural population with sanitation up to the limit determined by the GOI, 1981; ensuring as well as maintenance of sustainability of the systems and sources of water; tackling the problem of water quality in affected habitations; preservation of quality of water by institutionalizing water quality monitoring and surveillance through a Catchment Area Approach and; undertaking measures to educate masses on the importance of sanitation and sustainability of water sources.

[2] Independent Variables of TCPO include: operation and maintenance of three important benchmarks identified by the GOI— water supply, sanitation and solid waste management; contribution in eliminating key areas like open defecation and manual scavenging; conducting regular field visits to understand the development taking place and the actual scenario and; regular maintenance of technical options of water supply and management like, small bore sewerage, simplified sewerage with decentralized wastewater treatment and mixed sanitation.

[3] Independent variables of BMC/Municipality of Kolar Road were— ensuring the provision of pure drinking water with appropriate pressure, controlling scarce water resources, adequate water supply for domestic use, construction of irrigation structures, appropriate water allocation to each household, construction of water treatment plant, increased productive efficiency related to water usages and infrastructure development (rainwater harvesting, prevention of flood, etc.).

[4] The independent variables of Private Water Suppliers are, frequent requirement of its service by the residents, provision of adequate water supply to each household, even distribution of water among all the residents, address of water leakage by the organization, awareness among the stakeholders of water resource management, development of infrastructure or technical solution to ensure minimal leakage of water during distribution and ensuring steps to harvest rain water

RQ3: What is the Impact of Civil Societies in Sustainable Urban Water Management?

It is where the responsible authorities as well as the private water suppliers lack in maintaining efficient water supply among all the households and in the sustainable management of water, that the civil societies come to save the situation. Survey data and its quantitative analysis project that the role played by the civil societies such as the NGO5 exerts strong positive correlation values with the efforts carried out by them. It is significant to note that, these organizations act significantly in spreading awareness among the residents and educating them about the importance of water management, it necessity in the long run and various individual initiatives which will contribute in efficient water management. The regression analysis justifies the correlation established between the dependent and independent variable with significance value being.000, adjusted R2 at.865 and ANOVA being f= 5341.394. Such values imply that the independent variables are exerting a strong influence on the dependent variable, with 86.5% variance among them.

DISCUSSIONS AND CONCLUSIONS

From the quantitative analysis carried out with the residents of Kolar Road and Old Bhopal area of Bhopal city, it is inferred that all the responsible stakeholders involved in sustainable water management play a significant role through their individual efforts. The Government authorities have actively participated in waste water management, storm water management and rain water harvesting programs. Also, civil societies such as, domestic and international NGOs are indulged in educational campaigns, awareness and individual level programs. Even though the United Nations (UN-HABITAT to be precise) and the Asian Development Bank has monetarily assisted agencies to continue as per what is planned, still these enterprises have to go a very long way to set up the technical equipment like meters, energy auditing, water auditing, etc. in every household and their maintenance for smooth operation, so as to measure the demands and supply of water and the amount of loss as well. Besides, there is a need to adopt effective measures to amend the water scarcity in Kolar road area, providing the residents minimum amenities of a healthy life style, i.e. smooth water and its management. Thus, for effective and sustainable water management in Bhopal, certain key areas need improvement like technical innovation, public-private partnership, awareness programs among the masses and more research programs by civil societies to develop proper management practices.

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[5] Independent variables of NGOs include, imparting practical knowledge about local situations related to water, developing the experience on independent research of local water and health problems, informing the locals about water related problems and water resource management, imparting technical solutions and alternatives to improve the situation, developing expertise on implementation of low cost, environmentally sustainable and efficient technologies and empowering women to act for improving the access to safe water and manage water resources.

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APPENDICES

TABLES OF STATISTICAL ANALYSIS

Role of BMC/Kolar Road Municipality

Correlation Table

Table 1: Model Summary and ANOVA Values of the Impact of BMC

Variables		Role of Bhopal Municipal Corporation
Role of Bhopal Municipal Corporation	Pearson Correlation	1
	Sig. (2-tailed)	
	N	5000
Ensures the provision of pure water (drinking purposes) with appropriate flow pressure	Pearson Correlation	.722**
	Sig. (2-tailed)	0.000
	N	5000
Control the scarce water resources	Pearson Correlation	.909**
	Sig. (2-tailed)	0.000
	N	5000
Ensure adequate water supply for domestic use	Pearson Correlation	.423**
	Sig. (2-tailed)	.000
	N	5000
Construction of irrigation structures in irrigation areas	Pearson Correlation	.876**
	Sig. (2-tailed)	0.000
	N	5000
Appropriate water allocation to each household in the locale	Pearson Correlation	.264**
	Sig. (2-tailed)	.000
	N	5000
Construction of water treatment plant	Pearson Correlation	.872**
	Sig. (2-tailed)	0.000
	N	5000
Increased productive efficiency related to water usages (e.g. agriculture, irrigation)	Pearson Correlation	.553**
	Sig. (2-tailed)	0.000
	N	5000
Infrastructure development (rainwater harvesting, prevention of flood, for example)	Pearson Correlation	.596**
	Sig. (2-tailed)	0.000
	N	5000
**. Correlation is significant at the 0.01 level (2-tailed).		

Regression: Model Summary, ANOVA, Coefficients

Model Summary				
Model	Correlation coefficients (R)	R Square	Adjusted R Square	Std. Error of the Estimate
1	.952[a]	.907	.907	.389

ANOVA						
Model		Sum of Squares	Degrees of Freedom (df)	Mean Square	F	Sig.
1	Regression	7389.614	8	923.702	6099.065	.000[b]
	Residual	755.886	4991	.151		
	Total	8145.500	4999			

Source: Compiled by researcher

Table 2: Coefficient Values of Various Responsibilities Carried Out by the BMC towards Sustainability

Coefficients[*]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.183	.025		-7.357	.000
	Ensures the provision of pure water (drinking purposes) with appropriate flow pressure	.138	.012	.166	11.911	.000
	Control the scarce water resources	.237	.018	.199	13.250	.000
	Ensure adequate water supply for domestic use	-.035	.010	-.032	-3.415	.001
	Construction of irrigation structures in irrigation areas	.372	.016	.299	23.605	.000
	Appropriate water allocation to each household in the locale	-.181	.008	-.167	-21.620	.000
	Construction of water treatment plant	.379	.011	.288	33.695	.000
	Increased productive efficiency related to water usages (e.g. agriculture, irrigation)	.104	.010	.112	10.469	.000
	Infrastructure development (rainwater harvesting, prevention of flood, for example)	.272	.010	.151	25.999	.000
[*]Dependent Variable: Role of Bhopal Municipal Corporation						

Source: Compiled by researcher

Role of Public Health Engineering Department (PHE) Correlation

Table 3: Correlation Values Projecting Various Responsibilities of Public Health Engineering Department

Variables		Role of Public Health Engineering Department in Water Supply and Management
Role of Public Health Engineering Department in Water supply and management	Pearson Correlation	1
	Sig. (2-tailed)	
	N	5000
Full coverage of both rural and urban population with safe drinking water supply facilities	Pearson Correlation	.913**
	Sig. (2-tailed)	0.000
	N	5000
Coverage of urban and rural population with sanitation, up to the limit determined by the GOI, 1981	Pearson Correlation	-.869**
	Sig. (2-tailed)	0.000
	N	5000
Ensuring as well as maintenance of sustainability of the systems and sources of water	Pearson Correlation	.684**
	Sig. (2-tailed)	0.000
	N	5000
Tackling the problem of water quality in affected habitations	Pearson Correlation	-.869**
	Sig. (2-tailed)	0.000
	N	5000
Preservation of quality of water by institutionalizing water quality monitoring and surveillance through a Catchment Area Approach	Pearson Correlation	.666**
	Sig. (2-tailed)	0.000
	N	5000
Undertaking measures to educate masses on the importance of sanitation and sustainability of water sources	Pearson Correlation	.566**
	Sig. (2-tailed)	0.000
	N	5000
**. Correlation is significant at the 0.01 level (2-tailed).		

Source: Compiled by researcher

Regression

Table 4: Model Summary and ANOVA Values of the Impact of PHE

Model Summary				
Model	Correlation Coefficients (R)	R Square	Adjusted R Square	Std. Error of the Estimate
1	.914[a]	.836	.836	.416

ANOVA[a]						
Model		Sum of Squares	Degrees of freedom (df)	Mean Square	F	Sig.
1	Regression	4403.215	5	880.643	5100.320	.000[b]
	Residual	862.285	4994	.173		
	Total	**5265.500**	**4999**			

Source: Compiled by researcher

Table 5: Coefficient Values of Various Responsibilities Carried Out by the PHE towards Sustainability

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.915	.089		10.343	.000
	Full coverage of both rural and urban population with safe drinking water supply facilities	.758	.017	.809	44.217	.000
	Ensuring as well as maintenance of sustainability of the systems and sources of water	.005	.022	.007	.240	.810
	Tackling the problem of water quality in affected habitations	-.121	.013	-.153	-9.025	.000
	Preservation of quality of water by institutionalizing water quality monitoring and surveillance through a Catchment Area Approach	-.011	.023	-.013	-.479	.632
	Undertaking measures to educate masses on the importance of sanitation and sustainability of water sources	-.042	.007	-.054	-5.796	.000
a. Dependent Variable: Role of Public Health Engineering Department in Water supply and management						

Source: Compiled by researcher

Role of Department of Town and Country Planning Organisation (TCPO)

Correlation

Table 6: Correlation Values Projecting Various Responsibilities of the Department of Town and Country Planning Organisation

Variables		Role of Town and Country Planning Department in Water Resource Management
Role of Town and Country Planning Department in water resource management	Pearson Correlation	1
	Sig. (2-tailed)	
	N	5000
Operation and maintenance of three important benchmarks identified by the GOI— water supply, sanitation and solid waste management	Pearson Correlation	.637**
	Sig. (2-tailed)	0.000
	N	5000
Contribution in eliminating key areas like open defecation and manual scavenging	Pearson Correlation	-.821**
	Sig. (2-tailed)	0.000
	N	5000
Conducting regular field visits to understand the development taking place and the actual scenario	Pearson Correlation	.385**
	Sig. (2-tailed)	.000
	N	5000
Regular maintenance of technical options of water supply and management like, small bore sewerage, Simplified sewerage with decentralized wastewater treatment and mixed sanitation	Pearson Correlation	.367**
	Sig. (2-tailed)	.000
	N	5000

**. Correlation is significant at the 0.01 level (2-tailed).

Source: Compiled by researcher

Regression

Table 7: Model Summary and ANOVA Values of the Impact of TCPO

Model Summary				
Model	**Correlation Coefficients (R)**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.866[a]	.751	.750	.513

ANOVA						
Model		**Sum of Squares**	**Degrees of freedom (df)**	**Mean Square**	**F**	**Sig.**
1	Regression	3952.394	4	988.098	3758.684	.000[b]
	Residual	1313.106	4995	.263		
	Total	**5265.500**	**4999**			

Source: Compiled by researcher

Table 8: Coefficient Values of Various Responsibilities Carried Out by the TCPO towards Sustainability

Coefficients*						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	4.933	.067		73.588	.000
	Operation and maintenance of three important benchmarks identified by the GOI— water supply, sanitation and solid waste management	-.291	.010	-.438	-28.570	.000
	Contribution in eliminating key areas like open defecation and manual scavenging	-.847	.011	-1.141	-79.512	.000
	Conducting regular field visits to understand the development taking place and the actual scenario	.028	.036	.035	.784	.433
	Regular maintenance of technical options of water supply and management like, small bore sewerage, Simplified sewerage with decentralized wastewater treatment and mixed sanitation	.180	.035	.218	5.061	.000
*Dependent Variable: Role of Town and Country Planning Department in water resource management						

Source: Compiled by researcher

Role of Private Players

Correlation

Table 9: Correlation Values Projecting Various Responsibilities of Private Stakeholders

Variables		Role of Private Water Suppliers
Role of Private Water Suppliers	Pearson Correlation	1
	Sig. (2-tailed)	
	N	5000
Does it's service is required frequently by the residents?	Pearson Correlation	.942**
	Sig. (2-tailed)	0.000
	N	5000
Does it provide adequate supply of water to each household?	Pearson Correlation	.430**
	Sig. (2-tailed)	.000
	N	5000
Even distribution of water among all the residents	Pearson Correlation	.300**
	Sig. (2-tailed)	.000
	N	5000
Does the organization address water leakage, if any?	Pearson Correlation	.332**
	Sig. (2-tailed)	.000
	N	5000
Is the organization aware of water resource management?	Pearson Correlation	.798**
	Sig. (2-tailed)	0.000
	N	5000
Does the organization develop infrastructure or technical solution to ensure minimal leakage of water during distribution?	Pearson Correlation	-.710**
	Sig. (2-tailed)	0.000
	N	5000
Does the organization ensure steps to harvest rain water?	Pearson Correlation	-.389**
	Sig. (2-tailed)	.000
	N	5000
**. Correlation is significant at the 0.01 level (2-tailed).		

Source: Compiled by researcher

Regression

Table 10: Model Summary and ANOVA Values of the Impact of Pvt. Stakeholders

Model Summary				
Model	Correlation Coefficients (R)	R Square	Adjusted R Square	Std. Error of the Estimate
1	.958[a]	.918	.918	.294

ANOVA						
Model		Sum of Squares	Degrees of freedom (df)	Mean Square	F	Sig.
1	Regression	4833.526	7	690.504	7979.637	.000[b]
	Residual	431.974	4992	.087		
	Total	**5265.500**	**4999**			

Source: Compiled by researcher

Table 11: Coefficient Values of Various Responsibilities Carried Out by the Pvt. Players towards Sustainability

Coefficients*						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.462	.067		36.951	.000
	Does it's service is required frequently by the residents?	1.232	.013	1.053	96.967	.000
	Does it provide adequate supply of water to each household?	-.248	.009	-.327	-27.214	.000
	Even distribution of water among all the residents	-.484	.012	-.435	-40.001	.000
	Does the organization address water leakage, if any?	.024	.006	.028	3.944	.000
	Is the organization aware of water resource management?	.084	.007	.119	11.719	.000
	Does the organization develop infrastructure or technical solution to ensure minimal leakage of water during distribution?	-.167	.011	-.161	-14.719	.000
	Does the organization ensure steps to harvest rain water?	.043	.008	.055	5.200	.000
*Dependent Variable: Role of Private Water Suppliers						

Source: Compiled by researcher

Role of Civil Society

Correlation

Table 12: Correlation Values Projecting Various Responsibilities of Civil Societies Such as NGOs

Variables		Role of NGOs in the Area's Water Resource Management
Role of NGOs in the area's water resource management	Pearson Correlation	1
	Sig. (2-tailed)	
	N	5000
Imparting practical knowledge about local situations related to water	Pearson Correlation	.917**
	Sig. (2-tailed)	0.000
	N	5000
Have developed the experience on independent research of local water and health problems	Pearson Correlation	.393**
	Sig. (2-tailed)	.000
	N	5000
Inform the locals about water related problems and water resource management	Pearson Correlation	.757**
	Sig. (2-tailed)	0.000
	N	5000
Imparting technical solutions and alternatives to improve the situation	Pearson Correlation	.095**
	Sig. (2-tailed)	.000
	N	5000
Have developed expertise on implementation of low cost, environmentally sustainable, and efficient technologies	Pearson Correlation	.629**
	Sig. (2-tailed)	0.000
	N	5000
Empowering women to act for improving the access to safe water and manage water resources	Pearson Correlation	.760**
	Sig. (2-tailed)	0.000
	N	5000
**. Correlation is significant at the 0.01 level (2-tailed).		

Source: Compiled by researcher

Regression

Table 13: Model Summary and ANOVA Values of the Impact of NGOs

Model Summary				
Model	**Correlation Coefficients (R)**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.930[a]	.865	.865	.424

ANOVA						
Model		**Sum of Squares**	**Degrees of freedom (df)**	**Mean Square**	**F**	**Sig.**
1	Regression	5763.093	6	960.516	5341.394	.000[b]
	Residual	897.866	4993	.180		
	Total	**6660.959**	**4999**			

Source: Compiled by researcher

Table 14: Coefficient Values of Various Responsibilities Carried Out by the NGOs towards Sustainability

Coefficients[*]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	.513	.029		17.948	.000
	Imparting practical knowledge about local situations related to water	1.036	.014	1.055	75.840	.000
	Have developed the experience on independent research of local water and health problems	.089	.008	.077	10.558	.000
	Inform the locals about water related problems and water resource management	-.320	.020	-.216	-15.590	.000
	Imparting technical solutions and alternatives to improve the situation	-.049	.007	-.057	-6.839	.000
	Have developed expertise on implementation of low cost, environmentally sustainable, and efficient technologies	-.037	.012	-.031	-3.066	.002
	Empowering women to act for improving the access to safe water and manage water resources	.094	.018	.075	5.228	.000

[*]Dependent Variable: Role of NGOs in the area's water resource management

Source: Compiled by researcher

QUANTITATIVE QUESTIONNAIRE

Section A: Role of Ngos in the Area's Water Resource Management

The following questions are based on 5-point Likert scale where **1** mean **strongly agree** and **5** means **strongly disagree**, with **3** being **No comments**.

	1	2	3	4	5
Imparting practical knowledge about local situations related to water					
Have developed the experience on independent research of local water and health problems					
Inform the locals about water related problems and water resource management					
Imparting technical solutions and alternatives to improve the situation					
Have developed expertise on implementation of low cost, environmentally sustainable, and efficient technologies					
Empowering women to act for improvement the access to safe water and manage water resources.					

Section B: Role of Bhopal Municipal Corporation

The following questions are based on 5-point Likert scale where **1** mean **strongly agree** and **5** means **strongly disagree**, with **3** being **No comments**.

	1	2	3	4	5
Ensures the provision of *pure* water (drinking purposes) with appropriate flow pressure					
Control the scarce water resources					
Ensure adequate water supply for domestic use					
Construction of irrigation structures in irrigation areas					
Appropriate water allocation to each household in the locale					
Construction of water treatment plant					
Increased productive efficiency related to water usages (e.g. agriculture, irrigation)					
Infrastructure development (rainwater harvesting, prevention of flood, for example)					

Section C: Role of Private Water Suppliers

The following questions are based on 5-point Likert scale where **1** mean **strongly agree** and **5** means **strongly disagree**, with **3** being **No comments**.

	1	2	3	4	5
Does its service is required frequently by the residents?					
Does it provide adequate supply of water to each household?					
Do you provide adequate supply of water to each household?					
Even distribution of water among all the residents					
Does your organization address water leakage, if any?					
Is your organization aware of water resource management?					
Does your organization develop infrastructure or technical solution to ensure minimal leakage of water during distribution?					
Does your organization ensure steps to harvest rain water?					

Section D: Role of Public Health Engineering Department in Water Supply and Management

The following questions are based on 5-point Likert scale where **1** mean **strongly agree** and **5** means **strongly disagree**, with **3** being **No comments**.

	1	2	3	4	5
Full coverage of both rural and urban population with safe drinking water supply facilities					
Coverage of urban and rural population with sanitation, up to the limit determined by the GOI, 1981					
Ensuring as well as maintenance of sustainability of the systems and sources of water.					
Tackling the problem of water quality in affected habitations					
Preservation of quality of water by institutionalizing water quality monitoring and surveillance through a Catchment Area Approach					
Undertaking measures to educate masses on the importance of sanitation and sustainability of water sources.					

Section E: Role of Town and Country Planning Department in Water Resource Management

The following questions are based on 5-point Likert scale where **1** mean **strongly agree** and **5** means **strongly disagree**, with **3** being **No comments**.

	1	2	3	4	5
Operation and maintenance of three important benchmarks identified by the GOI— water supply, sanitation and solid waste management					
Contribution in eliminating key areas like open defecation and manual scavenging					
Conducting regular field visits to understand the development taking place and the actual scenario					
Regular maintenance of technical options of water supply and management like, small bore sewerage, Simplified sewerage with decentralized wastewater treatment and mixed sanitation.					