



Citizens' Perceptions & Opinions: Survey Results

An Overview of Survey Approach, and Citizens' Perceptions and Opinions on Challenges and Opportunities Facing Sustainable Water Resources Management in Udaipur City.

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Welcome

Vidya Bhawan Society, Udaipur in partnership with reputed national and international research organizations is conducting a research study on Ayar River; in which we wish to partner with the citizens of Udaipur to harness your collective spirit in sustainably managing our urban water resources. Udaipur city's water resources are facing serious man-made and climatic problems, and only through our combined efforts, we can improve their status.

Since we believe local people know best about their environmental issues, citizens like you are therefore uniquely positioned to help us secure a better understanding on local issues - what works and what does not. This survey is designed accordingly to capture your perspectives and opinions on some of the key challenges and opportunities with respect to improving water resources management in Udaipur.

The survey results will inform our research team in identifying areas which requires immediate attention based on citizens' opinions. Issues which will get rated highly will be later pursued under subsequent stages of research, also in partnership with citizens like you.



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Summary

Udaipur is richly endowed with a network of lakes and rivers that has been oiling the engines of growth for centuries. With the advent of modern era, however, these resources are facing a multitude of challenges owing to climatic and man-made factors. While plethora of solutions have been introduced, they mostly remain technical and followed an exclusionary approach limiting the involvement of local citizens in co-designing these solutions. It is not unnatural then that many of these panaceas are failing to allay the growing burden of challenges facing sustainable water resources management in Udaipur.

Against this background, Vidya Bhawan Society, Udaipur in partnership with the University of Copenhagen, Denmark, Geological Survey of Denmark and Greenland, DHI, and Development Alternatives, New Delhi has been developing strategies to facilitate a culture of public participation in science and policy making arenas in Udaipur. This research initiative is sourcing its inspiration from the evolving tenets of civic environmentalism, in general, and recent developments in the theories and praxis of 'Citizen Science', in specific, to accelerate a practice of collaborative enquiry with the citizens of Udaipur where they can join the research team as co-researchers and identify issues, challenges, and co-produce findings and results that can bring about improvement in water resources management.

Following an extensive literature review on the subject matter, this survey exercise has been introduced with an objective to gather a systematic

understanding of citizens' collective concerns and hopes regarding how water resources are currently being managed and should be managed. The experimental survey was developed using a psychometric analysis tool which lends an objective manner to ascertain citizen's perceptions, feelings and thinking regarding some of the critical elements concerning water resources management, viz. their functions in supporting diverse activities in Udaipur, extant challenges and nature of contributory factors, opportunities for improvement, etc.

This report starts with an overview of the approach, covering the elements of survey design and sampling approach. It also provides an overview of the respondents' profile in terms of their age, education background, profession, sources of water supply, and wastewater disposal arrangements. Thereafter, the report discusses how citizens perceive the importance of water resources and the challenges they are facing. Citizens were also asked to share their perception on some of the key interventions that could improve the current situation. Following this, the report discusses citizens' opinions (how they think) about the overall nature of problem (technical and governance related) and specific factors contributing to the outcome challenges with respect to water supply and sanitation, climate change, drainage and flooding, and declining water quantity and quality. The report also provides information on what citizens' think about the extant arrangements that are limiting public engagement in policy making spaces. The report concludes with some recommendations for future studies.

The findings from this survey can be said to have improved the understanding of research team on the common concerns and hopes of citizens, in addition to providing an insight into their culture and motivations for participating in science-policy domains. It has emerged that 'surface water pollution' is a key issue from citizens' perspective and 'untreated discharge of wastewater therein' is a key contributory factor for this said issue. Building upon the findings of this survey, the team will subsequently design a 'community action research' where local community members will be invited to develop and participate in a pilot data collection activity to map and report on the conditions of open drains discharging wastewater in the selected stretch of lakes and rivers in Udaipur.

Majority of Citizen Science projects have remained 'contributory' in nature, which means they only engage community members for collecting data to support the scientific enquiries. On the other hand, conclusion of this survey in Udaipur provides a testimony to research team's commitment to make this project a more 'co-created' type. The survey has, in summary, scripted a novel approach that provides a lesson on the means and value of engaging the citizens in formulating the problem statement. Now, with citizens shaping the overall research agenda, the research team is confident to continue developing strategies for engaging citizens in the subsequent stages of knowledge production which would involve: data collection, results analysis and communication.



Introduction

Developing a Citizen Science project in Udaipur entailed a thorough consultation with the citizens of Udaipur to gauge their perceptives, feelings and opinions regarding issues and opportunities facing water resources management in the city. This report outlines the steps that were involved in and the results transpiring from this process of public consultation. In the traditional parlance of Citizen Science, such exercises are a part of 'Issue Scoping' stage where project developers discuss with local community members their concerns over critical problems and, as an outcome, formulate a shared understanding of local challenges and priorities. This, additionally, also informs about the culture and motivations of citizens, which is useful for designing further steps to successfully implement the community action research projects.

In our case, faced with strict lockdown conditions in Udaipur owing to a second surge in COVID-19 pandemic between April 2021 and June 2021, we could not organize a physical consultation and/or focused group workshop with the members of public. Rather, an online survey was deployed where research team had made attempts to invite local community members to respond to a given set of questions.

Survey Design

The survey questions were designed using a 'Likert Scale' approach to assess the subjective perspective, feelings and opinions of individual citizens. Every citizen has a rich lived experience and ensuing personal connection with the waterscape of Udaipur; and this individual experience, together with social interactions and influences, must have formed a subjective construct of reality in their minds with respect to:

- a) What are the important functions of water resources?
- b) What are the existing challenges facing water resources management?
- c) What are the immediate steps that must be taken to allay the growing problems?
- d) Why public participation is limited in water resources management? and
- e) Degree of influence Governance Mechanisms and Technological Applications have on the success (or failure) of water resources management.

To tap into these individual constructs, or in other words, to understand citizens' subjective understanding of how Udaipur's water resources and incidental services are managed (or not managed), a psychometric technique was used (Likert Scale). This approach was tailored to help ascertain citizen's preferential thinking, feelings and opinions that are generally based on a collection of enduring values and beliefs that the individual holds in his/her mind. Thus, for we were desirous of sensing citizens individual beliefs and values regarding water resources, namely, their functions, challenges, solutions, etc., we developed:

- a) Rating type (and scale) questions that allowed citizens to venture response along a continuum of (adjective based) options to indicate their *opinions* (how they think?) to specific topics; and

- b) Ranking scale questions that allowed citizens to rank options reflecting their *perspective* (what they think?) on given topics.

These responses were then combined to understand a collective position (beliefs and values) of citizens on the topic of water resources management in Udaipur.

Rating scale technique is used which, as Larossi (2009)¹ p.59 defines, is “[o]ne of the most popular ways of asking subjective questions.....a single, well-defined continuum in which the answer is expected to be placed.” Current body of knowledge and practice in this domain enunciates that choosing scale categories and words or numbers associated with each scale categories are the two most prominent issues. While majority of researchers maintain that it is preferable to use 5 to 9 categories (Cox 1980²; Finn 1972³; Leigh and Martin 1987⁴; Miller 1956⁵); we have used a 4-point scale with verbal stimuli, as shown below:

Influence Stimuli⁶

To a great extent	Somewhat	Very little	Not at all
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Choice of scale frequency depends largely on the analytical purpose of research, the way response is being solicited, and the ability of respondents to understand the questions. The survey used a 4-point scale to ensure, therefore, that large number of people understand and respond to the survey. Also, the survey did not use a midpoint or “neutral and “opt out” categories for these types of question. Firstly, with respect to midpoint, the research community do not have any strong opinion as to whether the presence or exclusion of midpoint improves the quality of data (Andrews 1984⁷). Furthermore, Nemoto & Beglar (2013)⁸ p. 5 opined that midpoints a) distort statistical analysis, and b) if a Likert scale is developed like any physical measurement system, say a ruler, then there should not be any neutral category as “no point in the ruler has a “no length” or “neutral length””.

Secondly, the “opt out” option is also not included. While this option response helps remove bias in responses by allowing respondents to ‘opt out’ when they lack sufficient information to respond on any subject matter, it is posited that the topic under investigation in this study is fairly known to all the citizens as it concerns their own physical

¹ Larossi, G. (2006). *The Power of Survey Design*. The World Bank. Washington D.C.

² Cox, E. P. 1980. The Optimal Number of Response Alternatives for a Scale: a Review. *Journal of Marketing Research* 17(November): 407–22.

³ Finn, R. H. 1972. Effects of Some Variations in Rating Scale Characteristics on the Means and Reliabilities of Ratings. *Educational and Psychological Measurement* 32: 255–65.

⁴ Leigh, J. H., and C. R. Martin. 1987. Don’t Know Item Nonresponse in a Telephone Survey: Effects of Question Form and Respondent Characteristics. *Journal of Marketing Research* 24: 418–24.

⁵ Miller, G. A. 1956. The Magical Number Seven, Plus or Minus Two: Some Limits on Our capacity for Processing Information. *The Psychological Review* 63: 81–97.

⁶ Peterson, Robert A. 2000. *Constructing Effective Questionnaires*. Thousand Oaks, CA: Sage Publications

⁷ Andrews, F. M. 1984. “Construct Validity and Error Components of Survey Measures: A Structural Modeling Approach.” *Public Opinion Quarterly* 48 (2): 409–42.

⁸ Nemoto, T., & Beglar, D. (2014). Developing Likert-scale questionnaires. In N. Sonda & A. Krause (Eds.), *JALT2013 Conference Proceedings*. Tokyo: JALT.

and social well-being, and the topics discussed in the survey are covering elements which citizens normally interact with (directly or indirectly) in their routine lives.

Sample Size and Distribution: Process Evolution

To gauge public opinion and perspective, an adequate base of sample had to be identified to ensure that the results obtained are reliable for representing the overall mood of the community in the City of Udaipur. The sample size was calculated using Cochran's Formulae as given below:

$$n_0 = \frac{Z^2 pq}{e^2}$$

Where,

p is the proportion of population having the desired attribute;

e is the margin of error (or desired level of precision);

q is 1-p; and

z corresponds to the level of confidence sought in the results.

For our case, since the overall theme of the project, of which this survey was part of, revolves around public participation, we had initially chosen to select population showing traits of active engagement in the civic affairs of Udaipur. One way to ascertain this trait included estimating the number of people who had participated in the latest municipal elections (held in November 2019). The voter-turnout was 58% (value of p in above equation). It's posited that people's turnout for voting in local elections provides an objective measure of their enthusiasm for participating in local socio-political affairs. Hence, only those people turning out to vote were planned for inclusion in the survey, and, consequently, the sample size was identified to be 369 (with 95% confidence level and 5% margin of error).

It was subsequently decided that this sample size will be divided amongst the 70 wards of the city proportional to the voter turnout data for individual wards. Given COVID-19 related restrictions, it was thought that people will be thereafter contacted from the voter list on random basis, and upon contact, will be asked to fill up the survey. The questionnaire would have been easily shared to the respondent via WhatsApp or Gmail.

However, the unprecedented second wave of COVID-19, that had swept the country from April 2021 to June 2021, had spoiled the very mood of the city by destroying local businesses and leaving many families bereaved from the untimely death of their loved ones. As per official sources, Udaipur was featuring among the top COVID-19 affected cities of Rajasthan. Being cognizant of these untoward conditions, a decision was taken to not call individual households randomly, as it would have been impolite to ask for a response in the wake of personal and economic toll being borne by many of these families (who were not known to the enumerator in any capacity). A moral revival of sampling strategy suiting the prevailing air of grief and misery was deemed necessary.

A second strategy was developed where heads of various institutions were contacted to ask for their help in filling the survey by spreading the online survey link to their employees. A minimum of five institutions were subjectively selected among private, public, media, academic and non-profit domains based on the strength of their employee-base and wider connections. This worked best as, firstly, it provided a representational view of public coming from various professional and working backgrounds, and secondly, it gave the institutional heads a fair amount of discretionary power to seek responses from only those individuals who were not gravely affected by COVID-19 and were, accordingly, willing to participate in the survey. Therefrom, the link was further circulated by individual employees to their personal networks - thus also meeting the objective of random sampling. Therefore, while a moderate level of subjective selection was applied by the survey team when selecting and contacting local institutions, it can be confidently argued that as long as the final selection of sample elements remain random and out of the control of survey team, the results remain scientifically valid (Hansen, Hurwitz, and Madow 1953⁹).

537 people had visited the online survey using the access link, however only 82 people fully completed the survey questionnaire; and the average completion time for these respondents was 20 minutes and 33 seconds. The poor completion rate can partly be attributed to the online mode of survey used, where people were expected to respond to the questionnaire independently without any supervision or aid from the survey team. Length of the questionnaire, complexity of topic, etc. might have additionally contributed to this limited and undulating interest among members of the public to complete the questionnaire. This exercise, in short, provided many lessons for the researchers on the topic of questionnaire design, sequence, layout, length and style, and on securing public motivation, sample representativeness, etcetera. And, any subsequent study should build further from the success and failures of this experimental survey. Some key recommendations have been mentioned at the end of this report.

Respondents' Profile

The respondents' base was diverse in terms of their professional background, age, and educational qualification. Figure 1 below shows the profession-wise classification of respondents, and figure 2 is showing the age group of respondent citizens. The age classification is adopted from the Indian National Statistic Commission which defines Youth within the range of 15-34, the Middle group to be between 35-59, and Old Group to consists of population including and above 60 years of age.

⁹ Hansen, M., W. Hurwitz, and W. Madow. 1953. *Sample Survey Methods and Theory*, vol. 1. New York: John Wiley and Sons

Profession-wise Classification

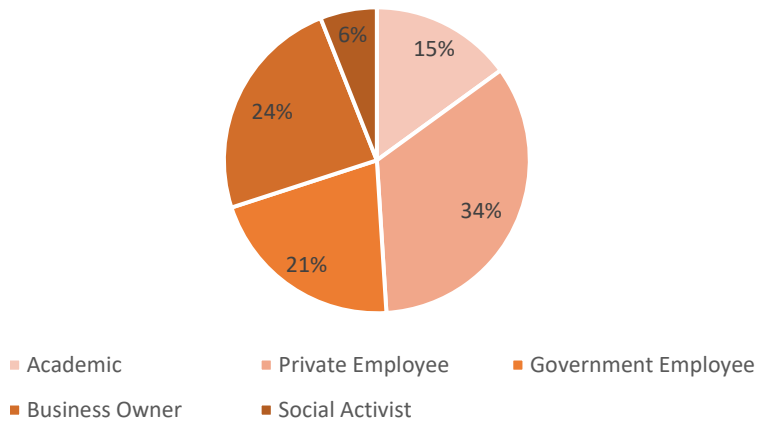


Figure 1 Profession of Citizens

Age-wise Classification

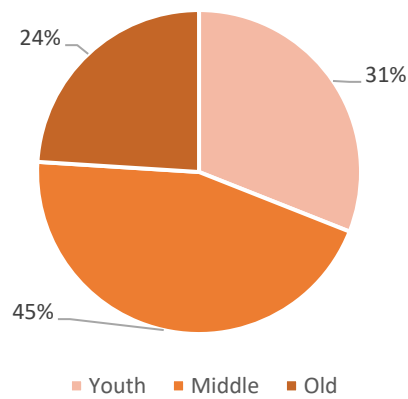


Figure 2 Age Classification of Citizens

Fig. 3 shows the educational background of respondents, and it comes out that almost 94% of the respondents have a professional degree obtained at the level of under-graduation and above.

Further, Fig. 4 shows the ward-wise distribution of survey respondents.

Education-wise Classification

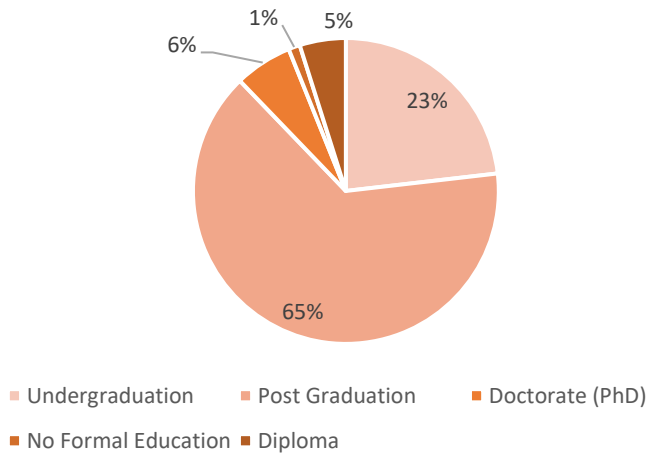


Figure 3 Educational Background of Citizens

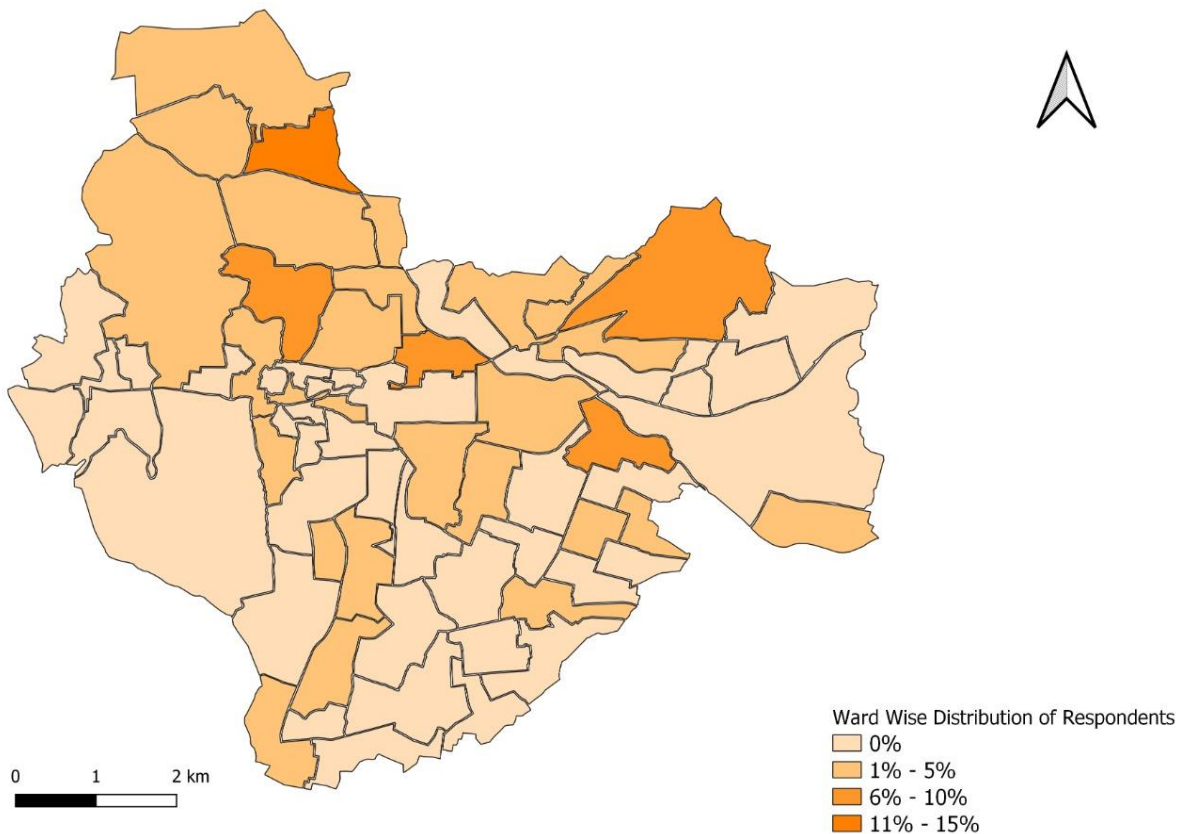


Figure 4 Ward-Wise Distribution of Survey Respondents

Water Supply

The survey had also asked people about their sources of water supply for both drinking and non-drinking uses. In Udaipur, official documents and a general interaction with the local community reveals five key sources of water, which are: Public Health and Engineering Department’s (PHED) Piped Water Supply, Private Ground Water Wells, Community Ground Water Wells, Private Tankers, and Bottled Water (appx. 5 - 10 litres Capacity). It should be noted that respondents were allowed to select multiple options, to

reflect the combination of arrangements that are usually present at the individual household level in the city for securing water supplies.

As per the survey results, 57% of the citizens are using the water supplied by PHED for meeting their drinking water purposes (See fig. 5). And, 46% of the respondents said that they have private ground water sources for meeting their drinking water needs. It must be noted that since people could select multiple options, a detailed analysis revealed that there were 36% of respondents who were only using PHED supplies and 25% of respondents, on the other hand, who were dependent completely on the private ground water sources.

Further, Bottled Water has also appeared to be a preferred source of drinking water, with 9% of the survey respondents have said to be using it; and, furthermore, 6% of the citizens are completely dependent on this particular source of water and do not have/or use any other source(s) of drinking water for complementing their potable needs.

Moreover, about 8% of the citizens are using community wells for meeting their drinking water demands, and about 6% of the citizens do not have access to any other source except these community wells.

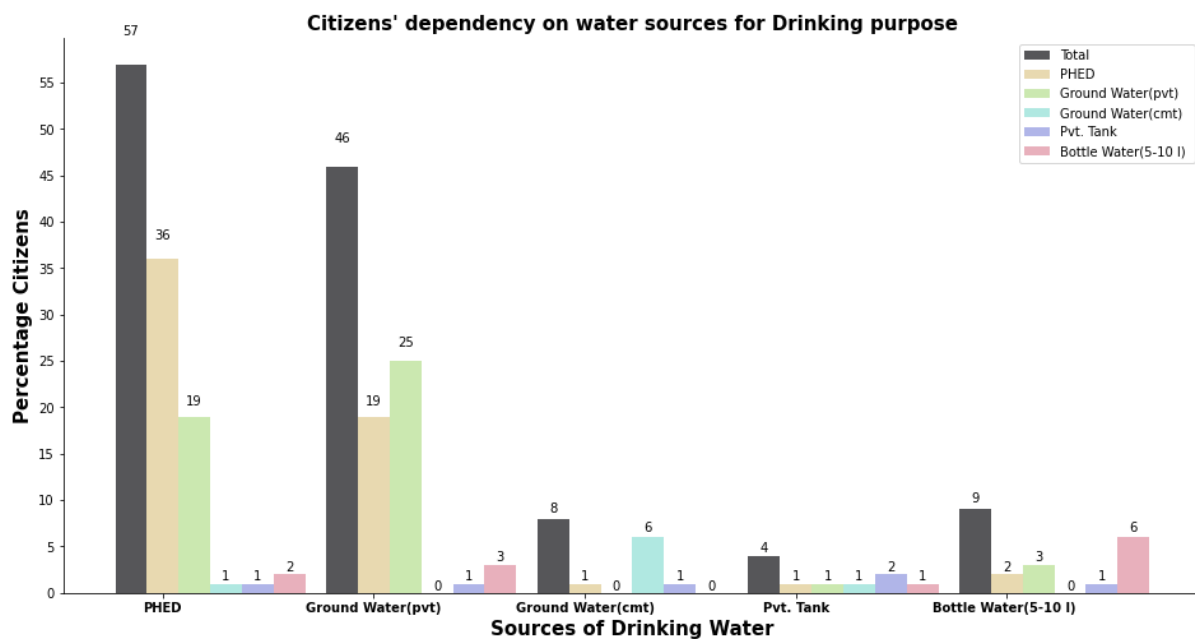


Figure 5 Citizen's dependency on various sources of meeting drinking water need

For meeting non-drinking water needs, the results show that (see fig. 6) 55% of the citizens are dependent on PHED supplies followed by private ground water sources as the second most preferred source.

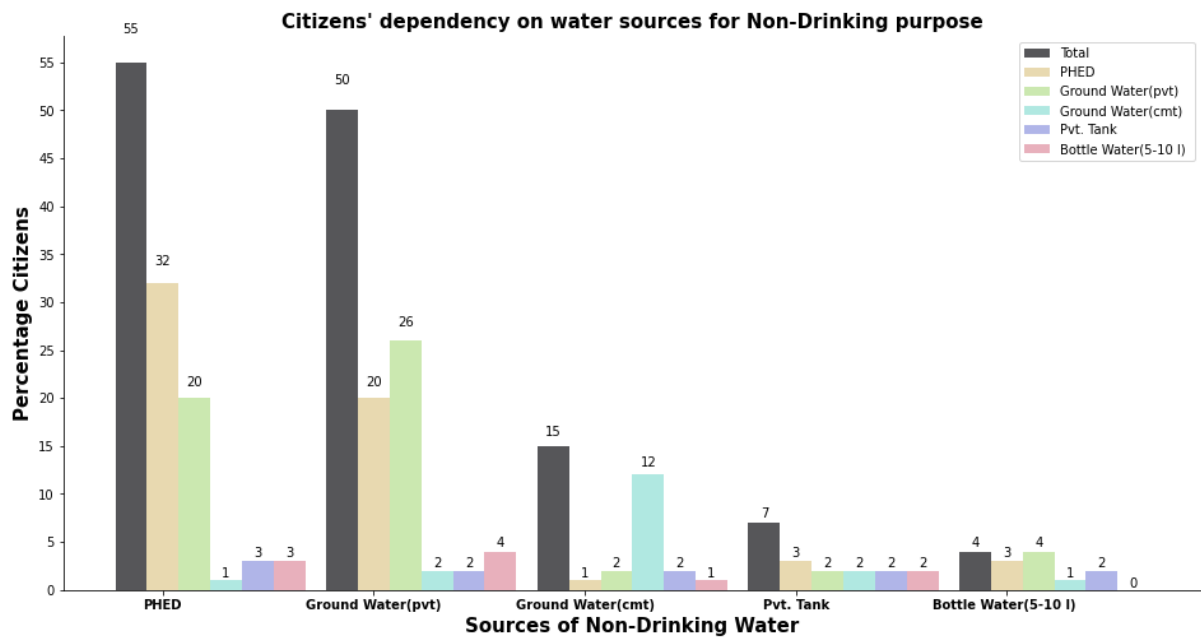


Figure 6 Citizen's dependency on various sources of meeting non-drinking water needs

Interestingly, asking separate responses allowed us to capture how citizen's preference/dependency shifts when using water for either drinking or non-drinking purposes. The fig. 7 below this shift in dependency on various sources of water supply when citizens switch between meeting drinking and non-drinking needs.

It is learned that while citizens tend to use marginally less water from PHED supplies and Bottled Water sources for meeting non-drinking purposes as compared to drinking needs, there is almost a 100% increase in the use of community wells when it comes to meeting non-drinking needs. Similar trend is observed for Private Ground Water Wells and Private Tankers which are preferred to be used for non-drinking purposes. This analysis hints that higher value water sources, in terms of quality and, perhaps, cost of procuring, is preferred for meeting drinking water needs as compared to other sources, viz. ground water (private and community) and tanker water, which is preferred for meeting non-potable needs.

Wastewater Discharges

To capture wastewater discharge trends, the survey had asked citizens to identify the destination of their household-generated wastewater streams. The survey had not defined the wastewater type as sullage, sewage and septic tank effluent, believing that many citizens may not comprehend such classification. The results reveal that majority of people are having sewerage connection, in contradiction to the official data which posits that septic tank is the preferred choice for containing wastewater on-site in the city of Udaipur. This could imply many things, including, but not limited to, the fact that: a) either survey respondents were concentrated in areas having sewerage system; b) respondents were confused between having underground (closed) drainage connection with underground sewerage; c) respondents were hiding the true fate of wastewater streams on account of anticipative embarrassment; etc. The present works of laying sewerage lines as part of various government programmes, viz. AMRUT, SMART City Mission and ADB Project, could also account for this changing composition of wastewater management system at

household level with increasingly higher levels of sewerage connections getting introduced in the city in lieu of septic tanks and/or pit latrines.

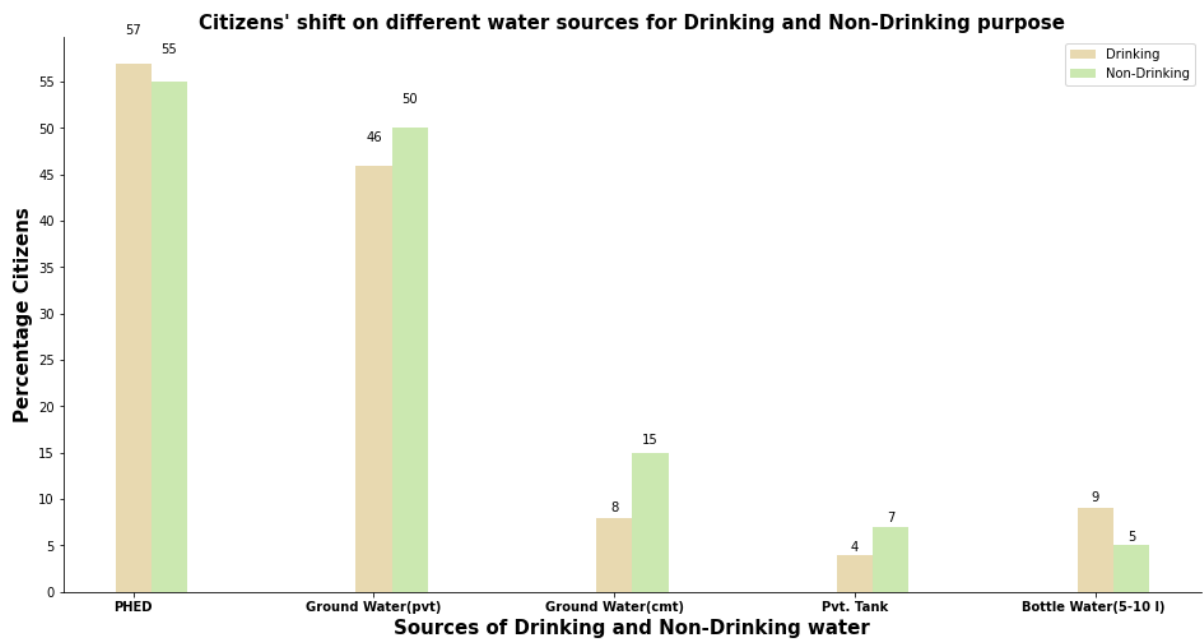


Figure 7 Shift in water sources for meeting different water needs

Confusion or selective misrepresentation nonetheless, the responses revealed that wastewater streams from their citizens' houses still end up in open lands (8%), open drains (28%) and/or nearby water bodies (3%). Thereby, boldly suggesting that the current arrangements of wastewater management (coverage, operations, planning, etc.) continue to remain insufficient in meeting the growing demands for scientific wastewater management in the city.

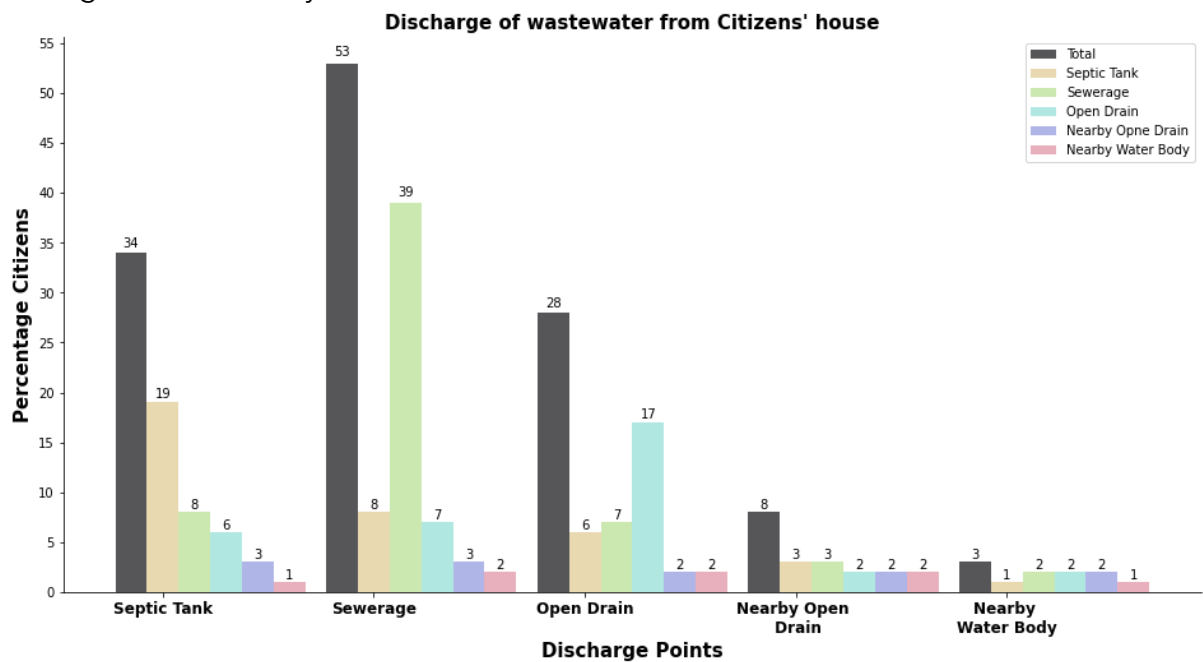


Figure 8 Fate of wastewater streams originating from domestic uses land

Open Drains Discharging Wastewater in Open Lands



Citizens' Perceptions on the Value of Multiple Functions of Water Resources in Udaipur

Water resources play a multiple role from providing drinking water, boosting economic growth, feeding crops, etc. The survey had identified five key functions of water resources and asked citizens to rank these functions based on their perception in terms of what they think is the most important value of water resources. The question asked was:

'Water resources play multiple roles from meeting our drinking water, food, industrial, and energy needs to nourishing a variety of ecosystems. Which of these following functions of water resources holds the most important value according to you?'

The functions identified as options are also acknowledged by the UNESCO's 2021 World Water Development Report titled 'Valuing Water'. The report had posited 'Infrastructural arrangements' as an additional value/function which water resources has/or perform. However, this has been removed from this survey because this particular function can already be considered part of other functions, for example, provisioning of WASH services depends on the technical rituals of infrastructure planning, designing, operations and

financing, all which, if done in a scientific, planned and periodic manner, can subsequently contribute to a safe and sustainable WASH service ecosystem.

The results are shown in figure 9 below, and these functions are summarized in Annexure 1. Based on citizens' response, the order of Value of Water Resources in Udaipur comes out to be as follows:

1. Water Supply for Drinking, Sanitation and Hygiene (WASH)
2. Food Production and Agriculture growth
3. Ecological health and services (e.g. Biodiversity)
4. Industrial production and economic growth
5. Culture, peace, and harmony

In conclusion, citizens have unequivocally ranked WASH services as the most important value that they derive from the water resources. On other note, Culture, Peace and Harmony has been ranked last by majority of the citizens (29% as compared to other option responses) suggesting, for example, a) a gap in understanding how water supports Culture and Peace; b) lack of negative triggers¹⁰ in past (like transboundary water sharing problems, etc.) that could inform citizens about the importance of this particular function of water resources.

On a more encouraging note, the 'Ecological Health and Services' was ranked considerably higher, implying a growing recognition amongst the citizens about the importance of conserving water resources for safeguarding ecological integrity in the region.

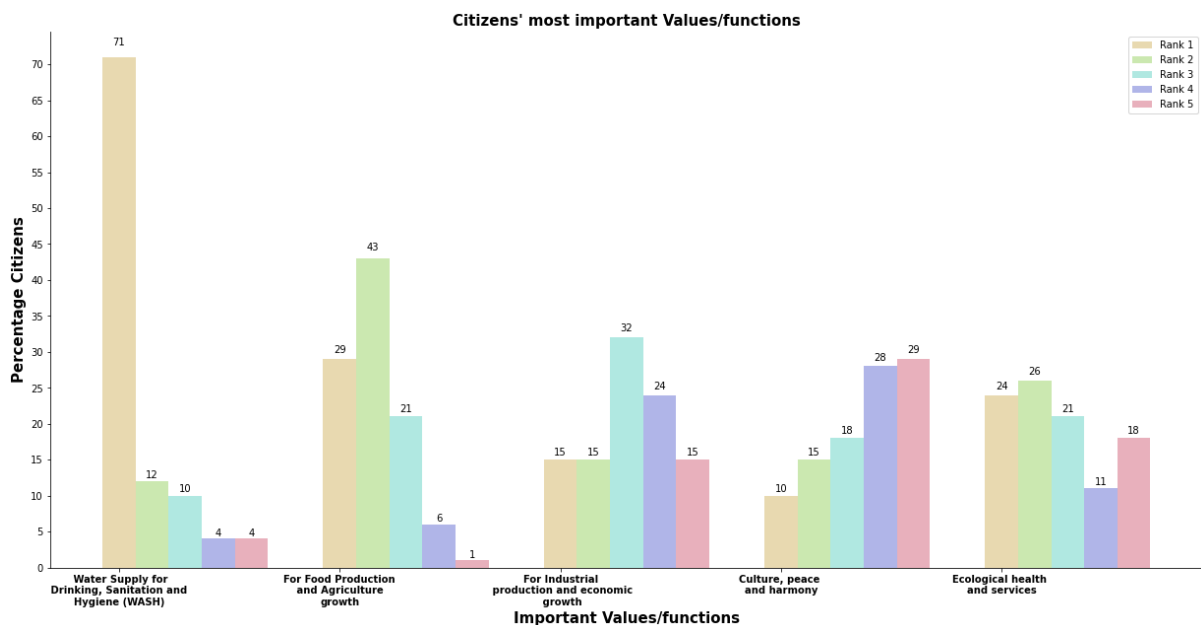


Figure 9 How Citizens Value the important functions of water resources in Udaipur

¹⁰ Positive triggers are already present. Like water being featuring prominently in poems, art work, music, and all other forms of cultural respites. However, strangely, people have not given this function of water a higher rank.

Do Citizens Really Value Water Supply and Sanitation Services?

One way to assess the true value that citizens place on water and sanitation services they enjoy on account of abundant water resources in Udaipur is by gauging whether they are paying a price/money or not for procuring these services and, additionally, will they be paying more money in return for better services. In Udaipur City, sewerage charges are a constituent part of the overall water bill which is collected by the PHED department. And, many people are not usually aware of this cost breakup, assuming that their bills are only reflecting the cost of water supply provisioning. Accordingly, the survey had asked people to only provide information on the status of their water supply pricing, viz.:

“Do you pay for your water supplies?”; and

“Would you pay more if you get better water supply services?”

Figure 10 below present this information. A detailed survey may be prudent in future capturing how water prices varies across different sources, and how this is disproportionately affecting the poor and marginalized who, as innumerable researches maintains, tend to pay far more per litre of water as compared to those who have access to piped water supply services.

Paying and Non-Paying Citizens

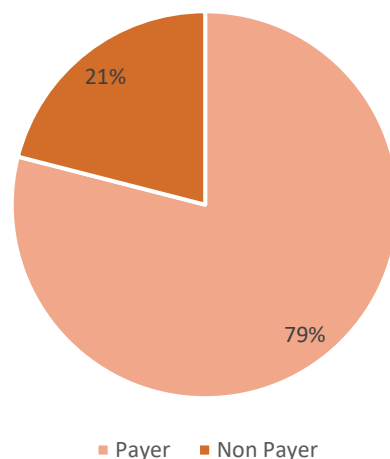


Figure 10 Citizens Paying and Not-Paying for their water supplies

Further, on asking whether they will pay more or not, astonishingly a large majority of citizens, from both the groups of existing paying and non-paying population, expressed willingness to pay more price for a better service in return (see fig. 11). This shows two things: a) majority of people are not satisfied with the level of service they are getting and want improvement; and b) there is an understanding amongst citizens to pay higher water prices for supporting the corresponding delivery of improved water and sanitation services. This is most pertinent for Udaipur where low and flat-water pricing, combined with poor accounting and metering, limit the revenue of water supply department (PHED), who, in turn, fails to appropriately fund the planning and operation protocols of the water supply infrastructure so as to synch infrastructure performance with the growing water consumption demands and lifestyle changes of the city’s residents.

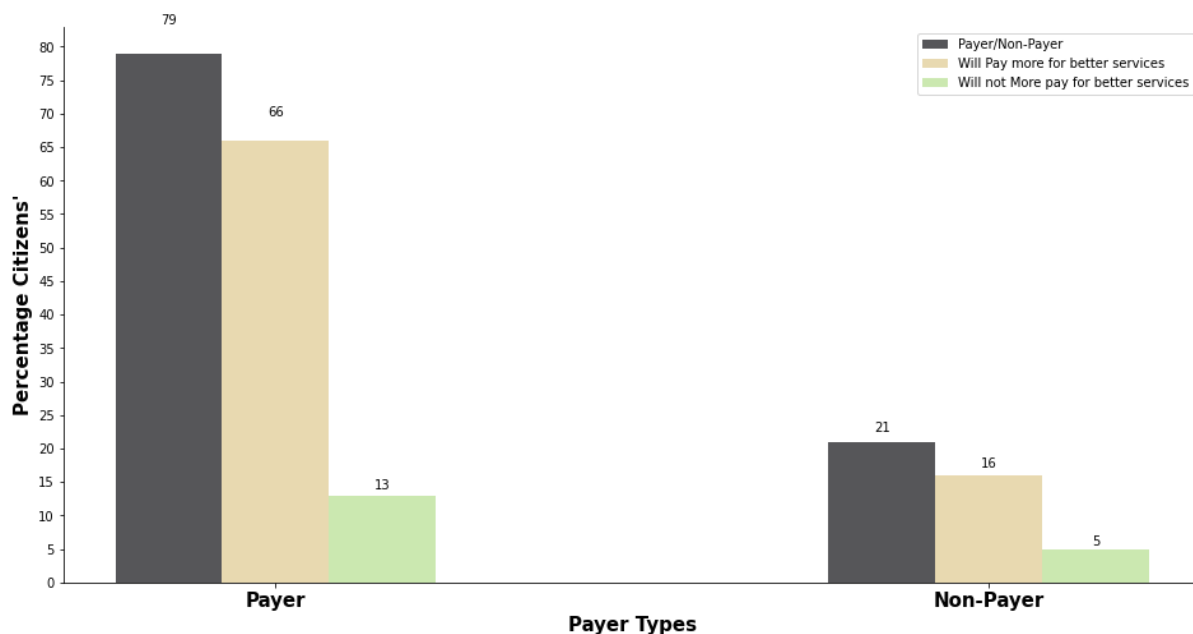


Figure 11 Willingness to Pay (between paying and non-paying population groups)

Citizens' Perceptions on Key Outcome Challenges Facing Water Resources Management

Integrated approach to water resources management requires that we first understand how water resources are plagued by multiple challenges cutting across the domains of resources availability and distribution, multiple users and their impacts on water, resources planning and management, etc. In Udaipur, water resources are threatened by a combination of factors, man-made and natural, and the survey had attempted to gather information on public's understanding of these challenges. The first question was designed to ascertain how citizens ranked some of the critical issues that are emerging as an outcome of failing water resources management approach in the City (Hereafter called 'Outcome Challenges'). In the second question, Citizens were asked to identify areas which require immediate intervention to allay these outcome challenges. Thus, the second question delved into the inputs that citizens perceived as urgently required for bringing a better outcome result.

It must be noted that the choice of option responses that were provided were not comprehensive in nature, and their inclusion in survey was informed by the overall Citizen Science project imperatives which demanded that an action research project is developed following the survey. For example, the survey could have asked citizens to rank poor construction/ workmanship of, say, sewerage system as one of the contributory factors for the outcome challenge of polluted surface and ground water resources. However, while adding this would have given a greater understanding of the problems (and where people think, in turn, actions are required) across the various dimensions of water resources management, it would have been constraining for the research team to develop a research project where citizens would have been then expected to participate in collecting data on structural faults of underground sewer networks.



Leaking In-Lake Sewerage Line

The first question under this theme was:

'Udaipur's water resources are currently depleted from excessive human use and changes in climate. Which among the following issues do you believe are some of the most critical and thus require greater priority for management? '

The results are shown in figure 12 below and the final rank is presented¹¹ below in descending order of preference:

1. Pollution of surface water resources (lakes and ponds)
2. Pollution of groundwater resources
3. Poor drainage and frequent flooding
4. Falling groundwater level (availability)
5. Climate change and changing hydrology
6. Limited surface water quantity (availability)
7. Less reliable water supply and sanitation services

¹¹ First and second rank scores (higher end of the continuum) were combined for each option responses to give a final ranking order. The same approach is adopted for presenting results from all other ranking questions.

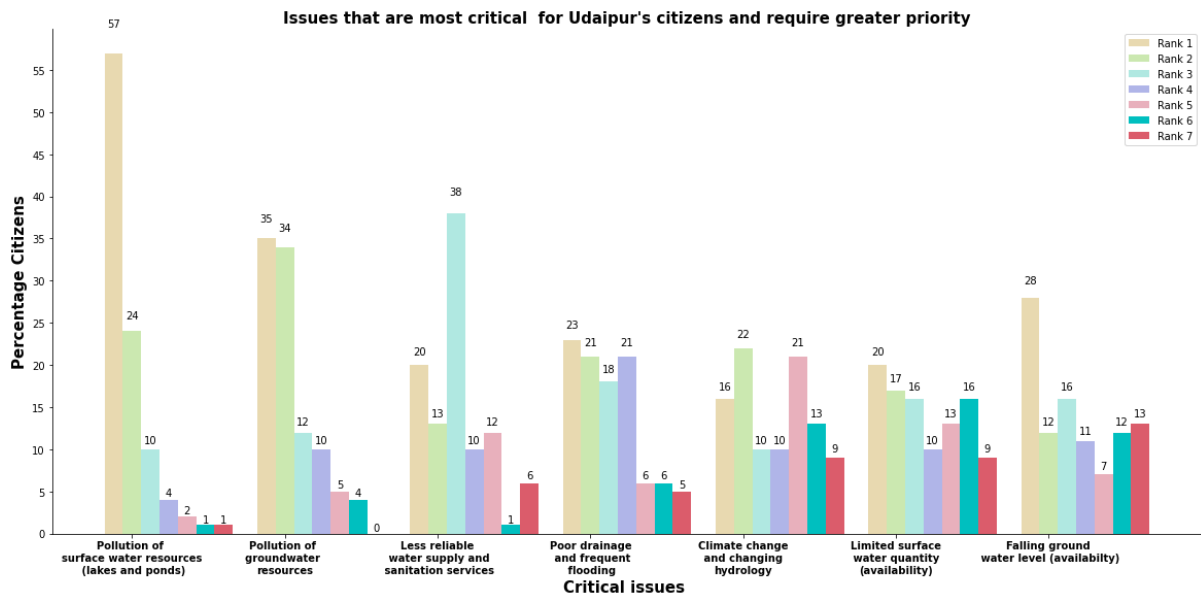


Figure 12 Citizens' response to Key Challenges facing Udaipur's Water Resources Management

The second question had asked:

'Which of the following areas do you believe requires immediate attention (interventions) on priority?'¹²

The results are shown in figure 13 below and final ranking is summarized as under:

1. Improving drinking water quality monitoring and surveillance - public water supply system
2. Improving water use efficiency at the level of public water supply
3. Improving source water quality monitoring and surveillance - lakes, rivers, ponds and groundwater
4. Preservation of traditional water bodies, such as bawdies, stepwells and commonly found traditional water harvesting practices and structures in the region
5. Improving public engagement in decision making/planning process
6. Ensuring that sufficient water flows (quantity) are maintained in surface and ground water resources
7. Adequate pricing and billing of water related services reflecting real costs of service provision

¹² The question has consciously precluded 'improvement of sewerage system' as an option for solving pollution issues, as this is something commonly debated in the city, and has traditionally received preferential treatment from policy makers and citizens combined – and rightly so. That is the reason why development of sewerage system has continued to receive greater funding in all the government schemes since 1984. Its removal from this survey was intended to 'force' citizens to provide a perception on other options, viz. 'water quality monitoring regimes' and 'adequate pricing' that could also directly and indirectly aid in pollution abatement.

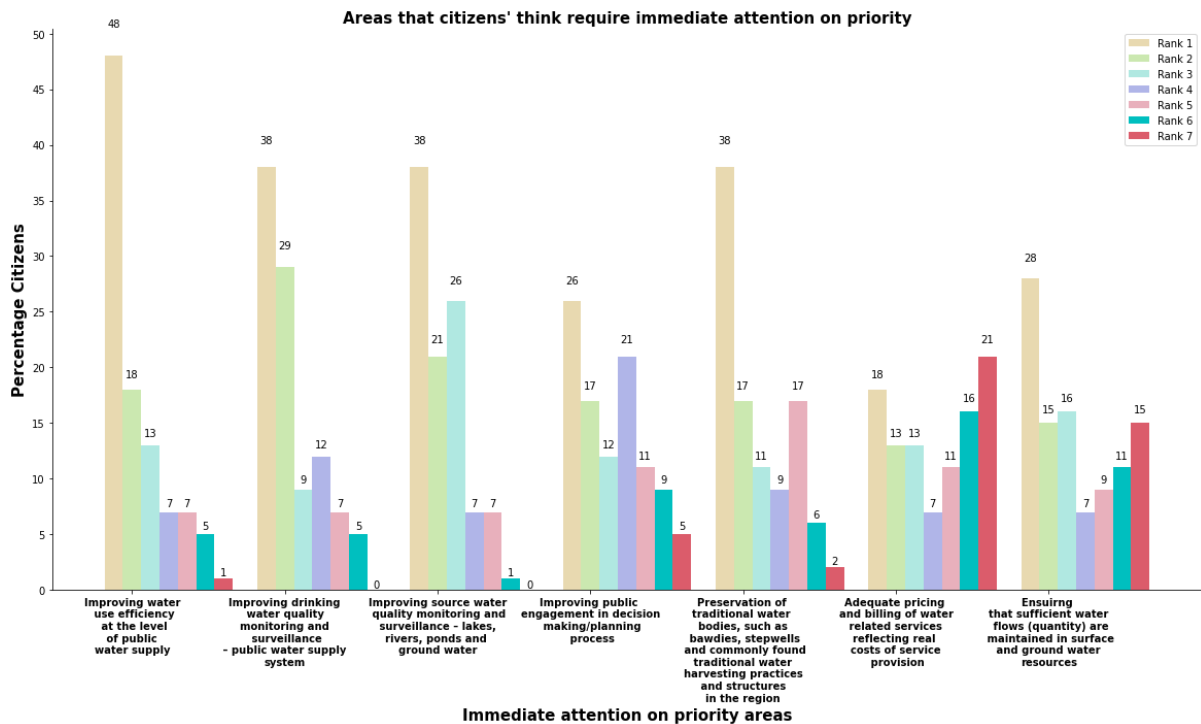


Figure 13 Citizens' Response on Key Interventions for Improving Water Resources Management in Udaipur

On overview, it appears that the public has given contradictory responses, highlighting pollution of surface and ground water resources as the most critical challenges that are visible at the outcome level, however, suggesting interventions with respect to drinking water quality and use-efficiency improvements on priority. This also does not correspond to the low rank they have given to the outcome challenge of 'less reliable water supply and sanitation services.' On the other hand, interventions that could reduce pollution, viz. improving source water quality monitoring and preservation of traditional water bodies, were given medium ranks in the second question.

Strangely, public do not perceive limited water quantity as a major challenge. This could be attributed to having adequate rainfall in recent years which might be supporting the formation of this perspective. While falling ground water levels were given a moderate rank, public believe that surface water quantity is not an issue in Udaipur, and hence, furthermore, do not feel the need to prioritizing measures for ensuring that sufficient water flows are maintained in the rivers and lakes; which has a direct bearing on the water availability and distribution in the ground water resources.

Citizens' Opinions on factors Contributing to the Growing Challenge of Water Resources (Ground and Surface) Pollution

Following an assessment of citizens' perceptions on key outcome challenges that Udaipur's water resources are seen facing, a set of questions were asked using a Rating-type approach which had aimed to ascertain citizens' opinions (how people think) about the factors that can contribute towards the development of each of the 'outcome



*Manual means of sewerage lines maintenance:
Removal of Silt from Chocked Line*

challenges' which people had ranked previously. In this report, responses for 'factors contributing to the problems of growing pollution of surface and ground water resources' are shown, as this has been ranked by citizens as the top outcome challenge the city of Udaipur is currently facing. Based on this analysis, future citizen science project will be developed under subsequent stages.

For a detailed overview of the factors considered under each of the outcome challenges, see Annexure 2. Given that the factors that are contributing to the outcome challenges of declining ground water quantity and surface water quantity are same, these two outcome

challenges were grouped to get a combined response from the respondents on the factors contributing thereto. For example, excessive withdrawal of water for meeting, say, domestic needs impacts both the sources given how public depend on both surface and ground water resources for meeting their water demands. Hence, no sperate questions were asked in this case. For same reasons, outcome challenges of surface water pollution and ground water pollution were also clubbed to get a combined opinion of public with respect to the factors producing these outcome results.

The results are shown in figure 14 below for the outcome challenge of 'surface and ground water pollution', and citizens identify 'too much discharge of wastewater into the lakes and groundwater' to be contributing 'to a great extent' in increasing the problem of (surface and ground) water resources pollution in Udaipur. Interestingly, citizens show that they do not feel 'limited financial capacity at government level' is contributing significantly to the problem of water pollution, because 16% (maximum vote in comparison to all other option responses) have described it to be contributing 'not at all' in causing the growth of water pollution challenges in Udaipur City.

Government's nonchalant attitude towards polluters was voted as the second most important factor contributing 'to a great extent' in polluting the water resources. Disposal of solid wastes (including plastic) into lakes was voted third most critical contributory factor.

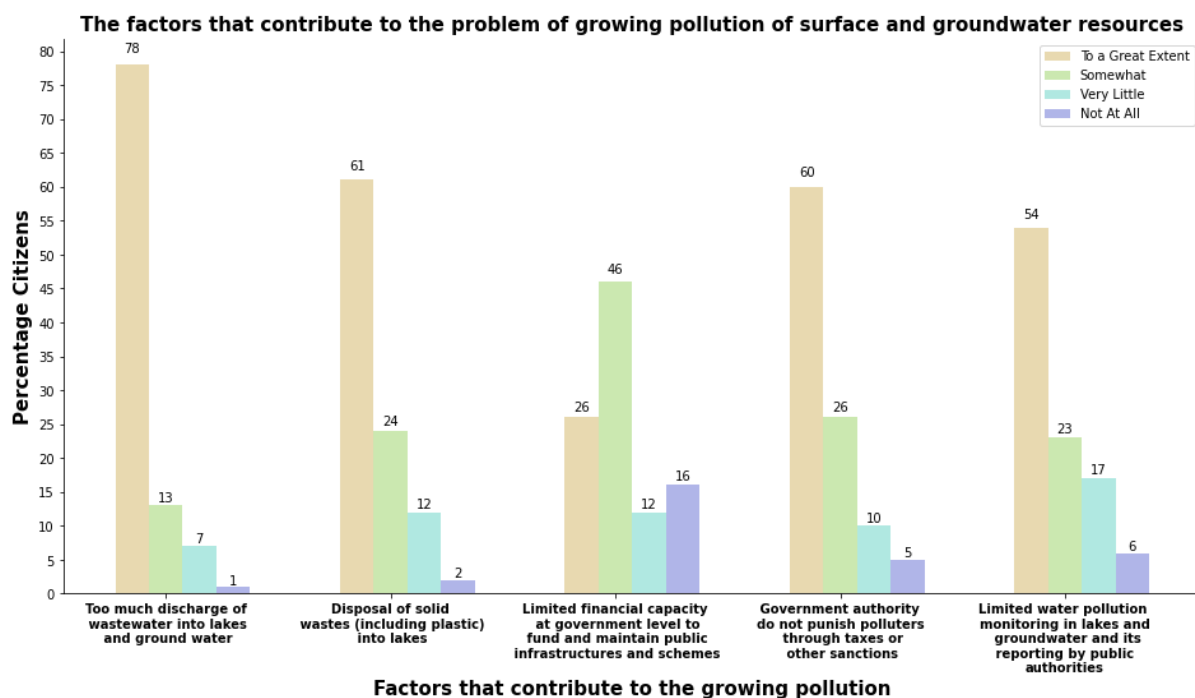


Figure 14 Citizen's response on the factors that contributes to the problems of water resources pollution

Citizens' Opinions on the Nature of Problems: Governance VS Technology

Annexure 2 provides information on all the factors that were considered under each of the outcome challenges as contributing thereto. Each of these specific factors were further codified as pertaining to either the Governance or the Infrastructure Performance related themes.

The Governance performance (GP) theme provides a measure of how decisions are made related to public engagement, planning and prioritization of schemes and regulation of incentives for promoting water-right behaviours through framing of public laws, policies, institutions, and other guiding frameworks.

The Infrastructural Performance (IP) theme incorporates measures that have a bearing on the physical performance of public infrastructure, and, accordingly, include aspects of regular and scientific maintenance, adequate pricing and revenue collection methods for financial viability of operations, periodic auditing for monitoring water use efficiency, wastewater conveyance and treatment, etc.

This categorization was used to draw broader conclusions over the nature (governance vs infrastructure) of problems that people collectively opined to be contributing 'to a great extent'. The results are shown in figure 15 below. It emerged from this analysis that, for the citizens, the importance of infrastructure/ technology performance and adequate governance mechanisms are comparable, and thus suggesting their equal relevance for improving the management of water resources in Udaipur. This sends a strong signal to the current cohort of policy makers and planners in Udaipur and State of Rajasthan who have an unjustified penchant for pushing for high-tech technological solutions at the expense of fragile governance arrangements for managing local water resources.

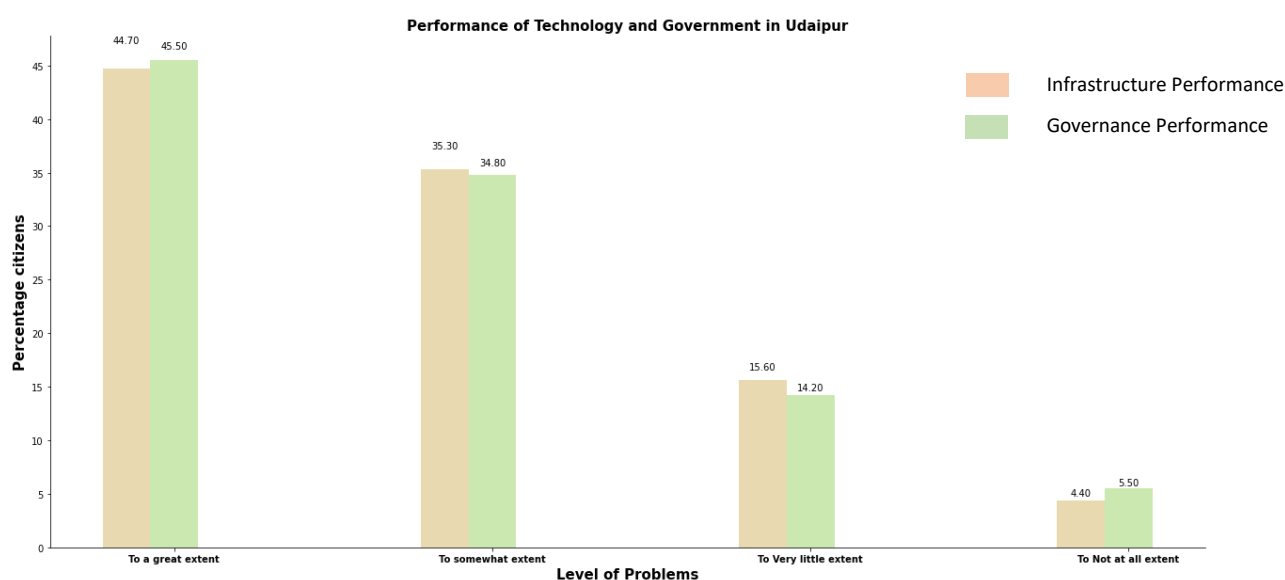


Figure 15 Citizens Response on the nature of problem: Infrastructure VS Governance

Citizens' Perceptions on Public Participation

As the underlying theme of this survey and ensuing steps is to ensure active public participation in this research project, the survey used this opportunity to ask citizens about their perceptions on extant participatory arrangements in Udaipur, specifically the factors they think are limiting their participation in local science-policy domains/spaces.

Respondents were further asked to provide their perception on the reasons that will motivate them the most to participate in a community research program that will be developed as an outcome of this survey. The results are, therefore, not only important to identify the problems impeding public's active engagement in science-policy arenas, but also provides information on some of the critical ingredients whose inclusion will help the research team to design the next steps in such a manner so that they can ensure public enthusiastically participate in activities to follow. The latter also gives an overview of factors that citizens generally consider for giving their volunteer inputs, and any volunteer programs, accordingly, should attempt to include these as prompts for ensuring a motivated base of volunteer participants. Figure 16 below shows how public has ranked various factors which they think are contributing to the problem of limited public engagement water resources science and policy. The ranking is as follows:

1. Public do not know the importance of their participation for water management, and hence stay aloof from development planning processes
2. Limited avenues for public to participate in government schemes and programmes
3. Lack of public availability of data and information Processes of scientific enquiries and policy making is not easy to understand and participate in for the common public
4. It is the duty of government alone to contribute to betterment of water resources, and other social objectives in general



Figure 16 Citizens' response on factors impeding their participation in managing water resources in Udaipur

One of the most fascinating results of this survey is respondents' self-acknowledgement of a prevailing lacuna in their own understanding of the importance of public participation for strengthening the science-policy processes - in this case, for sustainable water resources management. Ranking 'limited avenues for participation' second, only goes to show how these two are mutually co-producing a weak participatory environment in Udaipur. Whereas lack of participatory avenues contributes to sustain this limiting understanding among citizens as to how important their role is for improving water resources management in Udaipur, this limited knowledge, and therefore a limited motivation, further fails, in turn, to put any pressure among policy makers and scientists to open up the traditionally closed doors of knowledge production and decision making.

Moreover, citizens have also highlighted that having limited availability of data and information in public domain also impedes their active participation. Thus, suggesting that to improve the practice of democratic engagement of citizens in co-managing their local water resources, the first step could be (perhaps initiated by local scientists and government officials) to collect and put the data in public domain. To ensure that public is digesting these data sets, transmedia platforms can be used to disseminate information using story telling or creative visualization tools.

Lastly, and importantly, citizens are also showing that they do not feel that managing water resources is government's duty alone (34% respondents have given it rank 5). This is a positive indicator and can be used to build further participatory programs in Udaipur.

*Surface Water Pollution
(Source: Udaipur Times, 2017)*



Figure 17 below, furthermore, show citizens' responses on the factors that motivates them to participate in managing the local water resources. The final ranks are as follows:

1. Having an opportunity to contribute to the management of water resources through better data and information
2. Having an opportunity to learn and discover something new
3. Have a personal interest in the topic of water resources management
4. Having an opportunity to socialize with likeminded people
5. Having an opportunity to gain self-reputation and improve career prospects by volunteering in science project

A clear enunciation of this rank order is suggesting to tap into the 'altruistic' and 'inquisitive' characteristics of citizens while designing the citizen science projects. However, it should also be understood that respondents might have wanted to project this image about themselves, and thus ranked opportunity to make 'social contribution' and satiate personal 'desire for knowledge as the key factors that might be influencing their participation. Because, on practical note, many citizen/or voluntarily based project have found it difficult to grapple with the high attrition rates. Thus, it should not be easily concluded that citizens will participate out of their 'love for collective growth and self-learning' only, and project team must develop additional incentives, such as certificates for school children, (market) redemption points for common members of community, a chance of having their names in scientific reports, awards and recognition schemes, etcetera.

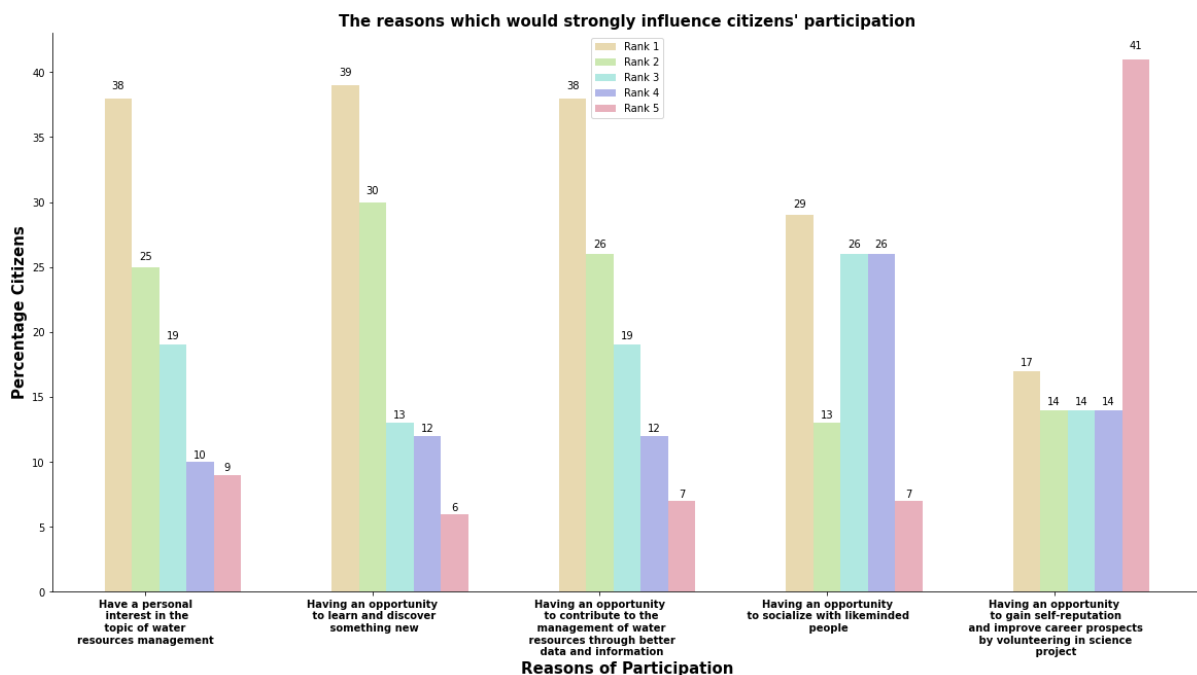


Figure 17 Citizens' response on the factors that would influence their participation

Where to Start?

While this Citizen Science project intends to build a culture of public engagement in managing civic affairs, particularly for democratizing the management of water resources system in Udaipur, it must be understood that the right behaviours should be nurtured at

the individual level, preferably those that can be performed at the level of individual houses. There are many activities that a citizen can perform to conserve water at home and encouraging these behaviours will provide a starting point for introducing a water-wise behaviour among citizens - which can be then channelized later towards supporting a more city-wide culture of participation for achieving a co-managed system for sustainable water resources. The survey had, accordingly, asked respondents using a 'frequency' based verbal stimuli (Peterson 2000) to venture response about the frequency with which they perform certain activities at the household level for water conservation, and the results are shown in fig. 18 below.

The results expound that for only three activities, viz. 'immediately repairing leakages in taps', 'turning off taps while brushing', and 'turning off taps while shaving', 50% of the citizens have said that they perform them 'Always'.

However, this do not imply a negative trend at the household level, and the results are still encouraging to allow researchers and policy makers to draw upon this existing base of 'active'¹³ citizens for building a growing momentum of public participation for water resources management in Udaipur.

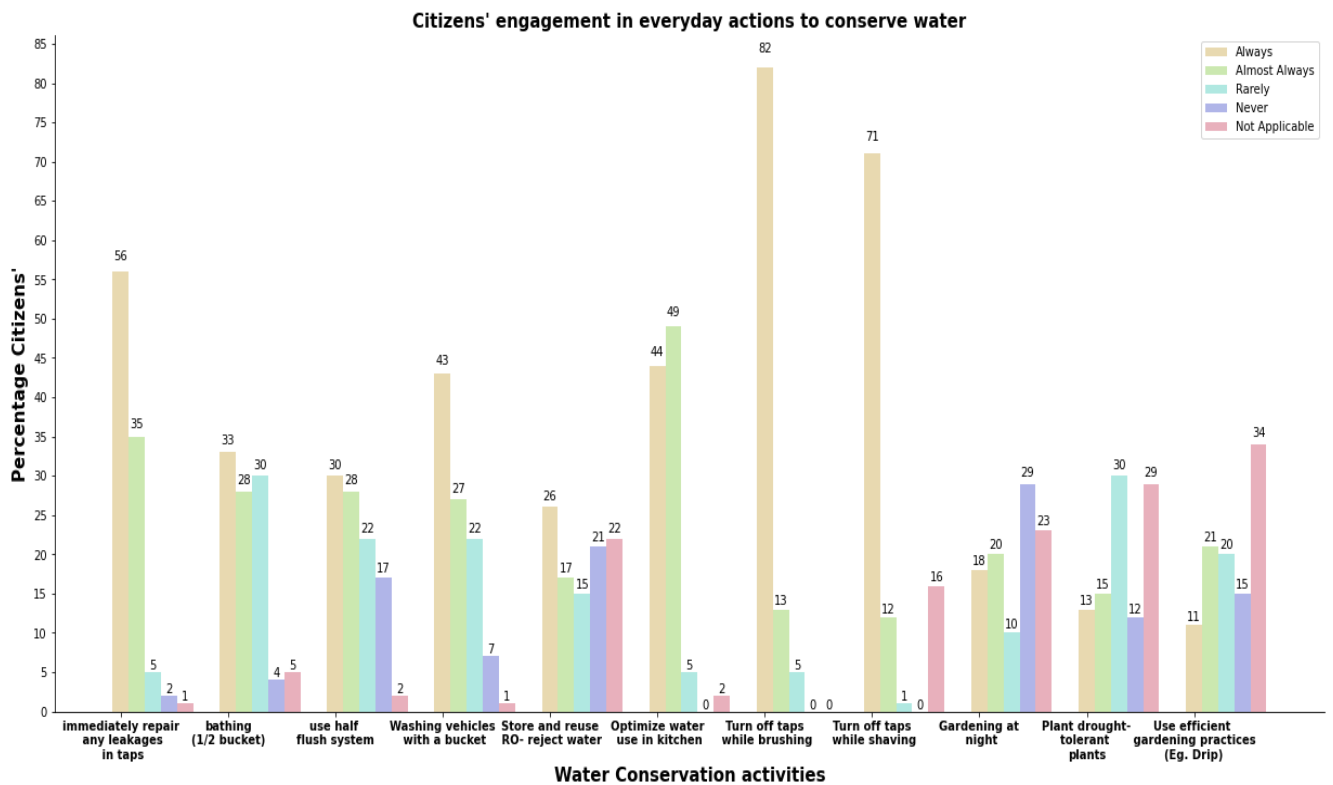


Figure 18 Citizens' response on the various water conservation activities they perform at home

¹³ Active is defined here as citizens practicing one or more than one water conservation activities at home 'Always' and/or 'Almost Always'.



*Citizen Volunteers Cleaning
Pichhola Lake*

Recommendations For Future Studies

- To capture response from a wider base of community members representing the socio-economic, demographic and even faith-based diversities, further research into this matter should apply a mix methods approach, combining physical household surveys, online survey forms, webinars, roundtable discussions and focused group discussions targeting diverse community groups for seeking their responses. Special efforts must be made to solicit the views of people marginalized on the grounds of caste, gender, economic status, religion, etc.
- As learned through this survey experience that it is challenging to keep public sufficiently motivated to fill the complete online survey form, future surveys can be divided into various parts to cover different topics once at a time to keep the questionnaire length simple and the overall format arousing enough for the public to enthusiastically respond to. However, the engendering results from these disparate survey cycles should be constituting a flow of information that is congruent and logically feeding the overall objective/theme of these surveys.
- Adequate consideration should also be given to the questionnaire layout and option response sequencing to avoid inviting 'acquiescence bias' where respondents tend to indiscriminately agree to the research statement and fail to make critical distinctions between response options that could have reflected their true personal position. In this survey, for example, it was observed that the majority of people have ranked initial option responses highly (i.e. Rank 1 and Rank 2) given that they appear first among the order of options. This shows respondents' tendency to take mental shortcuts on account of lack of time, lengthy questionnaire, limited motivation, etc.
- The designing of this survey was limited by the need to develop a subsequent community action research project necessitating public's participation in data collection and analysis (For explanation, see para 2 at page no. 13). A more comprehensive survey can be developed to capture various possible dimensions as they relate to water resources management in Udaipur.
- Once the survey methodologies and questions are standardized for undertaking a comprehensive study, these surveys should be organized periodically for the years to come. This will result in a longitudinal study that would help establish how citizen's values and beliefs have changed in terms of magnitude and direction.

Annexure 1

Multiple Functions of Water Resources in Udaipur

1. Water Supply, Sanitation and Hygiene (WASH)

WASH services are known to play a fundamental role in meeting Udaipur's drinking water needs, sanitation and hygiene maintenance, and overall environmental and human health. We have all seen the importance of hand washing as a first line of defence in protecting us from COVID-19. However, despite its importance, many households, schools and health facilities lack WASH services. It is said that the benefits of universal coverage of WASH extends to better education opportunities and work force productivity and a life of dignity and equality (especially for women and poor urban residents). Noting above, how do you see the importance of WASH in supporting the holistic growth of Udaipur City?

2. Food and Agriculture

Growing demand for food from urban residents in Udaipur is placing high pressure on our water resources. Agriculture is the largest consumer of water, and water is used inefficiently for food production - leading to lot of wastage, ecological destruction and limited returns to farmers. As competition for water use increases from other sectors like domestic and industries, it is important that water is used judiciously for food production. Some of the methods include drip irrigation, organic farming, farmers participation in water resources management and scientific crop plantation and marketing. How important do you think availability of good quantity and quality of water is for meeting our urban food and nutritional needs?

3. Industrial, energy and economic growth

Water is key input for industrial growth, energy production and supporting businesses. However, poor water management, especially in the plant operations and waste management cycle, combined with water scarcity and climate change risks, will lead to lower returns, supply chain disruptions, tight regulatory sanctions, falling brand reputation, etc. It is now increasingly recognized that industries should strive for increasing their water use efficiency and progress towards reuse of water again and again such that water becomes part of the infrastructure rather than a consumable resources. How do you see the value of water in sustaining economic growth and productivity, and the lifestyle, reputational and livelihood benefits we all derive from an economically strong city?

4. Culture, peace, and harmony

Majority of Udaipurite may hold a deep cultural and spiritual connection with water, passed down through the reverential treatment of water resources by our great rulers of Mewar - who had built water storage and conservation structures in great quantity. While some may see water as a form of divine itself as narrated in our puranic and Vedic stories, others may rejoice the scenic beauty and recreational opportunities it offers. It is said that healthy water ecosystems provide more than just physical needs of Udaipurites, and offers mental peace, emotional balance and happiness. Water scarcity often brings conflicting situations among many users; however, it also provides for an opportunity to build trust and dialogues among disparate communities of users through providing avenues for co-

management and joint conservation. How do you feel about the value of water in supporting peace, reducing economic and social tensions and conflicts, and promoting a thriving local culture with an international appeal?

5. Ecological health and services

Increasing human consumption of water is putting pressure on the ecological systems connected with our local water resources. Many wild animals, including migratory birds, rely on the availability of freshwater of good quality and quantity. However, our policy processes do not pay enough attention to protect water flows and quality for the environment itself, and rather continues to propagate extractive and polluting human practices. How do you recognize the value of water in supporting the ecological health of our local environment?

Annexure 2

Factors Contributing to Various Water Resources-Related Outcome Challenges in Udaipur

1. Factors contributing to the problem of growing pollution of surface and groundwater resources:
 - Too much discharge of wastewater into lakes and ground water (IP¹⁴)
 - Disposal of solid wastes (including plastic) into lakes (IP)
 - Limited financial capacity at government level to fund and maintain public infrastructures and schemes (GP¹⁵)
 - Government authority do not punish polluters through taxes or other sanctions (GP)
 - Limited water pollution monitoring in lakes and groundwater and its reporting by public authorities (GP)

2. Factors contributing to the problem of less reliable water supply, sanitation and hygiene services (WASH)
 - Water supply timings are not reliable (IP)
 - Poor quality of water supplied (IP)
 - Municipal water is not priced/billed effectively (GP)
 - Irregular and poor maintenance of infrastructures (GP)
 - Unsatisfactory management of public's grievances (GP)
 - Limited technical capacity of public officers in planning for water supply and sewerage services using scientific and modern tools (GP)
 - High incidences of leakages in public water supply lines (IP)
 - Water supply quantity is not sufficient (IP)
 - Limited arrangements for septic tank waste collection (IP)
 - High incidences of leakage in sewerage lines (IP)

3. Factors contributing to the problem of poor drainage and flooding
 - Infrequent maintenance of drains by public authorities (GP)
 - Limited coverage of drainage system (IP)
 - Poor flood detection and warning system (IP)
 - Unplanned construction/encroachment with disregard to natural drainage pattern, especially on flood plains and low-lying areas (GP)

4. Factors contributing to the problem of changing climate
 - Current policies do not help make Udaipur resilient to changing climate (GP)
 - Government officers do not have the necessary skills to scientifically manage climate change issues (GP)
 - There is limited information as to how climate change will affect us (GP)

¹⁴ Infrastructure Performance

¹⁵ Governance Performance

- Weak (social and physical) infrastructure for protecting from the extreme shocks and stresses of climate change such as heatwaves, extreme floods, recurrent drought, etc. (IP)
5. Factors contributing to the problem of declining water quantity
- Obstruction of channels/streams carrying water to lakes and ponds (IP)
 - Lack of water quantity monitoring and modelling (GP)
 - Excessive withdrawal for domestic consumption (GP)
 - Excessive withdrawal for agriculture production (GP)
 - Excessive withdrawal for industrial production (GP)
 - Less rainfall in the region
 - Less water storage structure in the catchment area (e.g. Check Dam) (IP)
 - Poor health of the larger catchment (by deforestation, mining, construction, etc.) (GP)



The survey concludes the 'Issue Scoping' Stage of Citizen Science Pilot Demonstration. As **Next Steps**, researchers will develop a web-integrated mobile application to allow citizen volunteers to 'map open drains' discharging wastewater into a selected stretch of Lake and/or River. The app will include options that will allow citizens to report physical conditions of drains, take photo observations, identify pollution hotspots, and mark elevations for supporting the development of a DEM Model of the pilot area. This work will be strongly supported by a 'Commons Mapping' exercise, where extant volunteer groups and individual influencers will be identified to take stock of the resources and support they can provide to make this pilot a successful campaign by engaging themselves and also mobilizing a large number of inspired citizen volunteers for mapping open drains.

Project Partners

