

Supporting Information to “Using treated wastewater for non-potable household uses in peri-urban India: Is it affordable for the users?” by Norbert Brunner, Sukanya Das, Anju Singh, and Markus Starkl

In 2023, 305 households from peri-urban areas of Bhubaneswar, Cuttack, and Jatni in Odisha state and of Kharagpur, and Midnapore Sadar in West Bengal state were selected at random to take part in a survey (see Figure 1). Responses from 281 households were suitable for further analysis. Below we summarize the questionnaire.

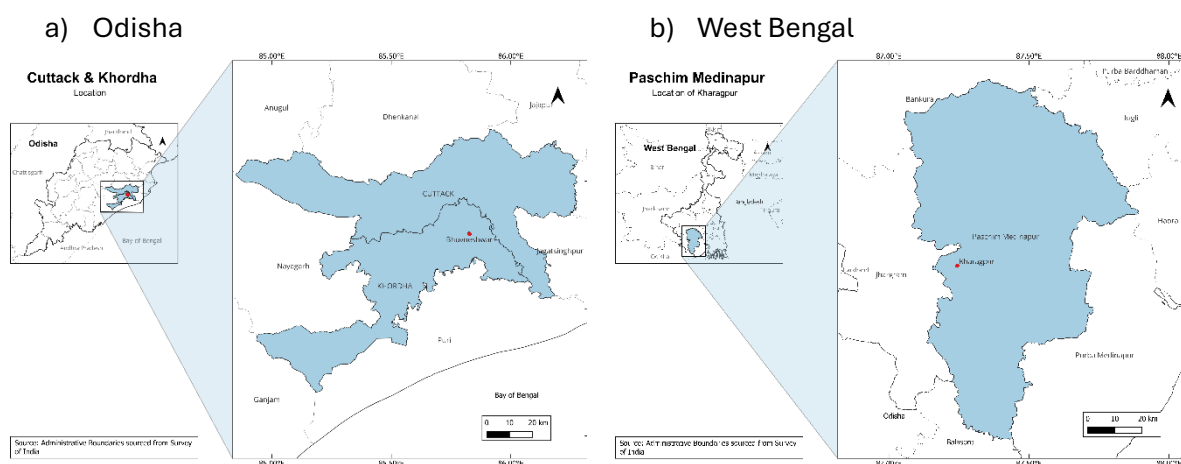


Figure 1. Map of the surveyed districts

Questionnaire:

Introduction with general explanations. [...]

HOUSEHOLD PROFILE: Name and address of respondent (not kept in the file)

Sex of the respondent (Code a: 1=Male ; 2= Female; 3= Other)

Age of the respondent : in years

Education of the respondent: (Code: 1=Illiterate; 2=Read & Write (Non formal Education); 3=Primary (1st -7th); 4=Secondary School (8th– 12th) or Diploma/ ITI; 5=Graduate; 6=Post Graduate & above)

Main Occupation of the respondent (Code: 1=Regular Salaried Employee; 2=Self-Employed/Business; 3=Casual/Daily wage Worker; 4=Housewife/Student/Retired; 5=Unemployed)

Household background [by selection, all were peri-urban]

Household size: how many members in your household (including you)?

Number of children (Less than 15 years old)

Which class best describes your monthly total household income? Below INR 25,000, INR 25,001- 50,000, INR 50,000-1,00,000, INR 1,00,001- 1,50,000, 1,50,001- 2,00,000, Above 2,00,000

DWELLING CHARACTERISTICS

Do you own or rent your home? (Code: 0=Rent; 1=Own)

What is the characteristic of the building? (Code: 1=Individual House; 2=Apartment/Floor system;3=Attached/Semi-attached quarter)

Do you have access to sanitary latrine facility at your accommodation? (Code: 1=Yes; 0=No)

Does your house have a proper sewage pipeline/ sewer connection facility for waste disposal? (Code: 1=Yes; 0=No)

Do you have availability of municipal disposal facilities for household solid waste

disposal on a regular basis? (Code: 1=Yes; 0=No)

Presence of garbage dumps (which are not regularly disposed off) in the immediate neighborhood of the house? (Code: 1=Yes; 0=No)

What are the main sources of water supply in your household? (Check all that applies) (Code: 1=Yes; 0=No): Municipal Water Supply, Groundwater/ Bore wells/ Tube wells/ Hand pump, Recycled water/Rainwater Harvesting, Tanker water supply, Bottled/canned water, Supply through Private water companies

Type of water availability? (Code: 1=Continuous (24 Hours); 0=Irregular (Specify hours))

How often do you suffer from water scarcity for meeting your household needs? (Code: 1=Always; 2=Sometimes; 3=Rarely; 4=Never)

Are you facing any of the below mentioned water related problems? (Code: 1=Yes; 0=No): Infrastructural faults (Faulty pipelines/leakages), Receiving foul smelling water through the water lines (contaminated water), Hard water, Any other (Please specify)

Do you pay your water bill? (Code: 1=Yes; 0=No)

Type of water bill payment? (Code: 1= Monthly; 2= Quarterly; 3= Half-yearly; 4= Yearly; 5= Any other (Please Specify))

How much is your average monthly household water bill? Below INR 20, INR 21 – INR 40, INR 41 – INR 60, Above INR 60

Could you please provide an estimate of your household's monthly expenditure on essential goods and services (groceries, rent, utilities, transportation, healthcare, education, and other basic necessities), excluding water-related expenses? Below INR 5,000, INR 5,001 – INR 10,000, INR 10,001 – INR 15,000, INR 15,001 – INR 20,000, INR 20,001 – INR 25,000, INR 25,001 – INR 30,000, INR 30,001 – INR 35,000, Above INR 35,000

How frequently do you engage in water conservation methods (such as Installing low-flow fixtures; fixing leaks promptly; watering plants efficiently; shorter showers etc.) in your daily life? (Code: 1=Always; 2=Sometimes; 3=Rarely; 4=Never)

HEALTH ASPECTS, only insofar analyzed in the paper, as it was related to water quality

Do you think that the quality of water in your surroundings has an impact on your health? (Code: 1=Yes; 2=No; 3=Maybe; 4=Can't Say)

Do you feel that the water supplied at your house (for potable & non-potable purposes) is not entirely free from disease-causing contaminants (Presence of foul smell/ unusual taste etc.)? (Code: 1=Yes; 0=No)

Do you practice any type of water storage (such as in water coolers/canisters /buckets etc.) before using/consuming water? (Code: 1=Yes; 0=No)

If answer to the above question is yes then, how often are the storage facilities cleaned? (Code: 1= Daily; 2= Weekly; 3= Every fortnight; 4=Monthly; 5= Any other (Please Specify))

What water purification method do you follow in your household to ensure safe drinking water? (Code: 1=Water Purifier/ RO system; 2=Boiling & Cooling (Batch Method); 3= Chlorination; 4=Already use purified (Canned/Bottled) water; 5= Any other (Please Specify); 6= Does not follow any method to purify water)

Please fill in the costs (if any) and other relevant information associated with the water purification method that you follow: Initial installation cost (such as in case of water purifier), Average yearly maintenance costs, Other costs (such as cost of chlorination tablets), Cost of canned/bottled water consumed, Average quantity of water purified in a day

Do you regularly practice hygiene norms such as washing of hands after defecation and before preparation & consumption of meals? (Code: 1=Yes; 0=No)

Did you or any member of your household experience these diseases linked to water pollution in the past three months (recall) for which you required treatment? Please provide

information in the table below. First column person number, second column disease: Diarrhea (passage of loose, liquid, or watery stools more than 3 times a day.), Vomiting, Abdominal pain, Fever, Any Other (Specify), third column: days of illness, fourth column workdays lost (Office, School, daily routine, sick days, restlessness etc.), fifth column Total cost associated with medical consultation (Travelling & Doctor Fees). Sixth column Total cost associated with medicines (All days)

AWARENESS & OPINION ABOUT WASTEWATER REUSE

Do you know where the wastewater generated by your household is being disposed? (Code: 1=Central/Municipal Sewage system; 2=Septic system/ On-site treatment plant; 3=Surface water discharge; 4= Any other (specify); 5= Don't know)

Do you know what a sewage treatment plant (STP) is? (Code: 1=Yes, 0= No)

Are you aware of the existence of any STP (Sewage Treatment Plant) to treat wastewater in your locality? (Code: 1=Yes; 0=No); If yes, distance from your household to wastewater disposal facility? (in km)

How familiar are you with the concept of reuse of treated wastewater? (Code: 1=Very Familiar; 2=Familiar; 3=Somewhat Familiar; 4=Not Familiar)

What is your perception about the idea of using treated wastewater obtained from wastewater treatment plants? (Code: 1= I fully support the idea of using treated wastewater; 2= I'm hesitant about using treated wastewater; 3= I strongly oppose the use of treated wastewater; 4=I have no strong opinion either way about using treated wastewater)

If you support the idea of wastewater reuse, reason(s) for it? (Check all that apply: Code: 1=Yes; 0=No): There is scarcity of water in your area; To recharge/ replenish water bodies: To help in environmental conservation by reducing over exploitation of fresh water sources; Because it is more environmentally sustainable than continuing to discharge untreated wastewater into streams and lakes; Because it allows for the beneficial recycling of water and nutrients; Other reasons (specify)

If you do not support the idea of wastewater reuse, reasons for it? (Check all that apply, Code: 1=Yes; 0=No): Availability of water from other sources; Religious Reasons; Absence of proper wastewater treatment technology; Content of the wastewater is harmful even after treatment; Wastewater treatment and reuse are not economical; Health-related concerns; Other reasons (specify)

How important are each of the following to you? (Code: 1= Most Important; 2=Somewhat Important; 3=Less Important; 4=Not Important): Need justification for reusing purified water; Knowledge about the potential reuse possibilities of treated wastewater; A complete description of the system of wastewater treatment and reuse; Implementation and degree of success in other places; Costs and benefits of the scheme; Human and environmental health risks; Monitoring/Inspection systems

Are you aware that wastewater can be treated and reused for non-potable uses such as Landscaping (watering gardens/parks/domestic plants); toilet flushing; household cleaning; vehicle washing etc.? (Code: 1=Yes, 0= No)

Are you aware that sludge obtained during the wastewater purification process can be used as manure/fertilizer for gardening, land-filling and other agricultural purposes? (Code: 1=Yes, 0= No)

ACCEPTABLE & NON-ACCEPTABLE USES OF TREATED WASTEWATER

Please state your preference for use of purified water from sewage treatment plants. (Code: 1=Acceptable; 2=Maybe; 3=Not Acceptable; 4=Can't Say/No Opinion):

Treated wastewater for Irrigation: of Non-Food Crops; Food Crops; Recreational Public Parks/Lawns; Domestic Plantations/Gardens

Treated wastewater for Household uses: Toilet Flushing; Vehicle Washing; Domestic Cleaning; Dish Washing; Other

Treated wastewater for Aquaculture/Fisheries management

Digested Sludge as fertilizer for: Non-food Crops, Food Crops, Plantations (Public parks/gardens etc.) or for Biogas digestion

What is your opinion about irrigation/landscaping with treated wastewater? (Tick all that applies: Code: 1=Yes, 0=No): Threat to the health of farmers/gardeners and workers; Threat to the health of consumers of the products; Threat to the environment (contaminates the soil, groundwater etc.); Degrade the quality of the agricultural produce; Enhance agriculture production; Increase the quantities of nutrients in the soil

If a treated wastewater reuse project for irrigation/landscaping is developed in your city, will you be willing to contribute towards buying treated wastewater for irrigating your domestic plantations? (Code: 1=Yes, 0=No)

Would you prefer to go to recreational facilities such as public parks/gardens irrigated with treated wastewater? (Code: 1=Yes, 0=No)

Would you be willing to use products made of non-food crops (paper, plastic, rubber, fabric etc.) irrigated from safe treated waste water or for which sludge (by-product from waste water treatment) has been used as manure/fertilizer? (Code: 1=Yes, 0=No)

Would you be willing to consume food crops irrigated with safe treated waste water (properly treated with adherence to specified quality standards) or for which sludge (by-product from waste water treatment) has been used as manure/fertilizer? (Code: 1=Yes, 0=No)

What is your opinion about toilet flushing with treated wastewater? (Tick all that applies, Code: 1=Yes, 0=No): Can amount to significant freshwater saving; Can lead to foul-smelling toilets; Can lead to discoloration of the toilet bowl; Feeling of Disgust and poor Hygiene; Threat to health (UTI etc.)

If authorities provide you with two kinds of water connections- one with potable water (for drinking) and the other with purified and treated waste water (for toilet flushing, vehicle washing, cleaning etc.), would it be acceptable to you? (Code: 1=Yes, 0=No)

Would you be willing to contribute towards the installation of the above mentioned set-up for using treated waste water for toilet flushing & other domestic purposes? (Code: 1=Yes, 0=No)

Studies in other jurisdictions have found that public acceptance of reusing treated wastewater is high when the following conditions exist. From your perspective, please mark to what extent do you agree or disagree with those conditions, as mentioned below. (Code: 1=Strongly Agree; 2=Agree; 3=Neither Agree nor Disagree; 4=Disagree; 5=Strongly Disagree): The degree of human contact is minimal, i.e. I don't have to drink it, wash in it, etc.; Protection of public health is clear; Protection of the environment is a clear benefit of reusing purified water; Promotion of water conservation is a clear benefit of reusing purified waste water; Cost of treatment and distribution technologies and systems is reasonable; Awareness of water supply problems in the community is high; Perception of the quality of reusing purified water is high; Confidence in local management of public utilities and technologies is high.

CONTINGENT VALUATION Lengthy introductory text to prepare two scenarios
SCENARIO A (Status Quo- Water use Restriction Programme) [...] residents are encouraged to prioritize essential water needs, such as drinking, cooking, and personal hygiene, while minimizing wasteful practices. To enforce the restrictions, local authorities have implemented regulations and guidelines that limit or prohibit non-essential water uses. Home gardens/private lawns could be watered every second day only (only during specified hours during late evening

or early morning). Public green spaces to be watered twice a week only, on specified days. Residents are required to refrain from car washing except at designated water-efficient car wash facilities. Furthermore, swimming pool maintenance, and other non-essential water-based recreational activities have been put on hold due to the limited water supply. Regular monitoring and enforcement mechanisms are put in place to ensure compliance with the water use restrictions. Residents who violate the guidelines may face penalties or fines, promoting a culture of responsible water use. [...] Wastewater is released into the environment without treatment and hence cannot be used as an alternate source for non-potable uses to augment the restricted supply of freshwater.

Would you like to continue to participate to scenario A (Current situation)? (Code: 1=Yes, 0=No) If no, for what reason?

SCENARIO B (Water Supply Augmentation Programme) In response to the situation of limited water supply, a water supply augmentation program has been implemented [...] Under this program, an improved and upgraded sewer infrastructure would be set up that would allow piping of treated and disinfected reclaimed waste water from decentralized treatment plants back to the households through a separate system to be used only for non-potable and non-essential purposes. The treated waste water would go through advanced quality checks to ensure health safety and would not look or smell different from the regular tap water. Use of treated waste water by implementing such a mechanism, for non-potable and non-essential uses augments the supply of the limited freshwater and is sufficient to obviate the need for any type of water use restriction programme. This program provides an effective solution to the limited water supply situation by utilizing treated wastewater as an alternate source for non-potable and non-essential water uses, ensuring a more sustainable and responsible approach to water management.

Would you like to move to Scenario B in the future years if it would involve paying additional monthly amounts on your household water bills? (Code: 1=Yes, 0= No)

If yes, are you willing to pay Rs. 25 over and above your regular water bill per month in order to achieve scenario B and avoid water use restrictions? (Code: 1=Yes, 2= No; If Yes- keep asking the above question with Rs.10 increments, until the answer is No; If No- keep asking the above question with Rs.10 reductions, until the answer is Yes; The lower bound (L) is defined as the highest amount accepted by the respondent and the upper bound (U) is defined as the lowest amount rejected by the respondent. [...] Please specify the Final Payment interval of the respondent [Y_{jL}, Y_{jU}])

If you are not willing to pay, please mark accordingly for the reasons mentioned below. (Code: 1=Strongly Agree; 2=Agree; 3=Neither Agree nor Disagree; 4=Disagree; 5=Strongly Disagree): The municipality should use existing funds and not hike tariffs ; I do not think the municipality will use the contributions wisely; I am not interested in wastewater management; I cannot afford an extra contribution; I think this problem is not a priority; Other reasons? (Please describe)

In your opinion, what are the challenges in promoting reuse of treated waste water? (Please mark all that apply) (Code: 1=Yes; 2=No): Cost; Water Quality; Technology; Public Policy; Public Perception/Acceptance; Health Concerns; Distrust on Authorities; Religious Reasons