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HOUSEHOLD PERCEPTION ON WATER CONSUMPTION IN URBAN AREA: A CASE STUDY OF CUTTACK CITY, ODISHA INDIA

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Abstract

Perception is regarded as a driving force of decision making in household management of water quality for a good life. A negative perception of the existing water consumption will lead to adopting self-management by the household in its all concern. This paper aims to investigate the factors affecting the perception of the household towards quality water consumption through the determinants of adopting water quality management technology in urban area. In this regard, primary data has been collected through systematic sampling and analyzed by a logit model. The result shows that most of the households shows concerned about water quality supplied by public authority. The monthly income of the household, years of education ofthe family head, source of water, age of family head and location of the house are the significant factor in determining the perception to adopt a water quality management technique. A majority of the households doesn't have any knowledge regarding the chemical contamination of water. The slums regions are more prone to water-related issues.

Key Words: *Perception, management, water quality, consumption, adopt.*

Introduction

Water is a life-saving resource fundamental to support livelihood, food security and sustainable development for all. But the improper distribution of water resources across the region creates social unrest. This situation is so dense that around 0.7 billion people worldwide could be displaced by2030 because of acute water scarcity (Hameeteman, 2013).India is home to around 18 % of the world's population but constitutes only 4% of the world's consumable water resources (NWP-2012). This implies a scarcity of water in the country. A report published by Water Aid states that clean water is inaccessible to around

19.33% of the population. The overall water consumption in the country also increasing, Asian Development Research Institute (ADRI) reported thatdomestic water demand on average would rise from 85 litres per capita per day (lpcd) in 2000 to 125 lpcdby 2025 and 170 lpcd by 2050.

Besides the quantity of water, quality is also an important aspect of the present industrial and urbanised world. Due to various anthropogenic activities, water quality has been deteriorating and causes health as well as economic loss. Managing drinking water quality is especially very crucial for human survival. Because batter the quality of water, better will be the health of the society and less will be the economic burden on the family in terms of medical expenditure along with better economic productivity. The study says, out of 37 diseases 21 are caused by water (Ramachandraiah, 2001).As per the report of Deccan Herald India losses around 1 lakh lives each year due to poor quality of drinking water. Despite government active management of drinking water quality in the urban area, household needs to improve their water quality because of the threat of supply chain pollution problem. This paper is focused on how drinking water should be endogenously managed by the household for better quality consumption but this behaviour of households is depending upon their perception towards the existing water supplies because perception creates awareness among the people which can be altered by the personal, social and economic factors. Thus all actions taken by a household to improve the consumption of water quality and quantity is driven by its perception.

This study will add some exciting facts about human consumption behaviour especially on drinking water consumption in the existing literature. In the literature, we found most have focused on what is the perception of people about drinking water consumption but in this study, we will focus on what are the factors affecting the household perception to adopt a technique to manage the water quality by themselves especially in urban areas. Because urban areas are more vulnerable in accessing domestic water and quality of water is again a most crucial problem in most of the city. out of this problem some agents of the society underestimate the water quality consumption and also the conservation practice (Hassell and Cary, 2007; Dolnicar et al., 2012). This indents us to do a study on the household perception on water consumption.

In the present context, we have conducted a study on Cuttack city to determine the factor which is playing a crucial role in household perception to adopt a method for managing the

quality of water for self-consumption. Besides that, our study also shows the household water use behaviour in the city.

Review of literature

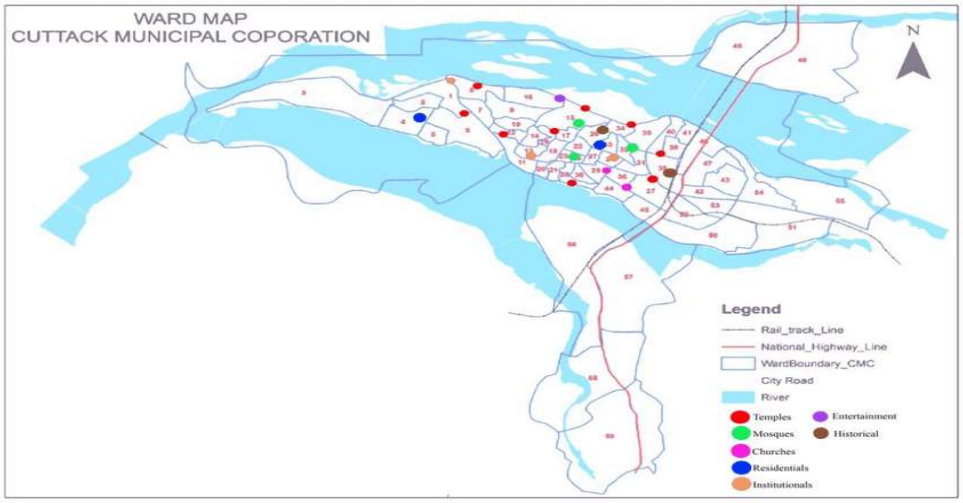
Water consumption in Indian urban areas is far lower than the standards laid by the Bureau of Indian Standards because the water supply is not copping with population growth (Shaban and Sharma, 2007).A projection on the Middle East countries shows that per household demand for domestic water consumption is 75 % higher than the per person demand for domestic water (Martin, 1999). The quantity of per capita water consumption is also reducing due to an increase in family size (Aitken et al., 1994). Immigration also has a certain impact on the distribution of water (Darr et al.,1975) which creates inequality among the stakeholder of the society. To increase the standard of water consumption many infrastructures have been made but the water supply infrastructure has been seen as biased towards the elite persons of the society which creates inequality among the stakeholder of the society regarding the distribution of water-poor and socially backwards people are not allowed to collect water where rich people are collecting water (Kanmony, 2003; Ramachandraiah, 2001). Similarly, the higher-income group in urban society have been taking advantage of getting more water consumption than the poorer one (Jethoo and Poonia, 2011; Bajpai and Bhandari, 2001; Harlan et al., 2009) and also the government servants use much more lpcd than the slums peoples (Kanmony, 2003). There might have the probability that the reduction in household size may affect the demand for domestic water in the future, this is because of household economies of scale and suppression in the investment on batter water-saving measures effectively. Political unwillingness also causes unequal distribution and commercialization of water resources (Ramchandraiah, 2001).

Water quality is also a matter of concern for good health and prosperity, but in cities, most of the people are dependent upon the public supplies for their household needs but this supplied water as Bedi et al. (2015) found that it is getting degraded during its transmission to the end-users. The water quality is also getting degraded by climate change, especially low precipitation and various anthropogenic activity (He et al. 2019). Which have adverse health impacts by increasing the morbidity rate among low-quality water users (Srinivasan and Reddy, 2009). Similarly, Adimalla (2018) and He & Wu (2019) in a similar type of study in India and China respectively found that children are more acute to drinking water impurity. Water has the potential power to alter the economic values of goods. For example, Talun et

al. (2012) had found that improvement in the water quality raises the property value in the IzmitBay coastal of Turkey. Because an improvement in the quality of water may reduce the mortality rate (Boberg, 2005) and this will create a positive work environment in the economy. Studies on perception on water availability and quality say that people are less informed about groundwater so they perceive that groundwater is good in quality (Lee, 2009). But Jones et al. (2006) conducted a study in Ontario, Canada and shown that people have a positive perception of the water quality and they are well informed about it. Now the question arises how water quality could be managed? As Li & Wu (2019) suggested the use of filtered water and the adoption of adequate technology by households can reduce the low-quality water problem. Thus households should manage the water quantity as well as quality by themselves for stable and sustainable consumption.

Methodology and study area

Study area: This study is conducted in Cuttack city of Odisha. The reason behind selecting Odisha is that being it is a mineral-rich state in India it comes 20th rank in the access to safe drinking water as per the census 2011. Besides that, Odisha also performing low in the Composite water management index published by NITI Ayog. Cuttack is a more than 1000 years old and varied socio-cultural city in Odisha. This city is treated as the commercial capital of the state and comprises 116820 households (HHs) out of which 50170 HHs have direct water supply connection and 66650 number of HHs doesn't have a direct water supply connection[1].



Source: Cuttack Municipal Corporation.

[1]Information is taken from the Service level implementation plan of AMRUT scheme 2015 report on Cuttack city.

Data: A primary survey is being carried out in the city and the sample data are being collected from two areas of the city one part from a relatively higher income area that is CDA Sector-7 which is a planned area developed by the Cuttack Development Authority (CDA) and another part from a low-level income area that is Dash-Sahi slum near Ranihat which is considered as a big slump in the city. The reason behind the selection of these two areas for this study is that any city has two sides one is where relatively well established or socially standard population lives and on the other side where socially backward and poor families who are mainly migrated from villages in search of income source, who lives in the slum areas due to financial constraints. So considering a slum area and a non-slum area would provide us with a better picture of the urban water problem. So from the personal interaction with the resident of these areas, it is come to know that there is a massive water quality problem of the public supplies faced by the resident. The distinction of low-level income and high level of income area is done by looking at the housing condition of the resident of the survey area. The survey was conducted in July 2019 through a structured schedule. The study collects data on the water using appliances of the survey households along with it households have been asked whether they practice any water quality improvement method, types of water-related disease that happened within six months and what type of drinking water-related issues they face in the city. A systematic sampling technique is used to identify the sample household, so the sample unit here is household. From both of these areas, 70 households each had been surveyed. Which comprises a total of 140 households, which are analyzed for this paper?

Methodology: A water consumption study by Lin et al. (2010) to see the impact of the household socioeconomic condition on the water consumption had used a multivariate regression technique. Similarly, Darr et al. (1975) to understand the carried out a study with the same objective in Israel with a Willingness to Pay (WTP) approach. Whereas some studies with a special focus on water quality have used different methods like Gartin et al. (2010) used a least square regression model whereas Tolun et al. (2012) used a Hedonic Pricing Approach (HPA) method. Studies on perception of water availability by Patel et al. (2010) have used a Cohen's K approach using qualitative data, on the other hand, Lee (2009) and Jones et al. (2006) have used descriptive method with their survey data to analyze the public perception on drinking water. A work on demand for water quality by Roy et al. (2004) in Kolkata WTP method through Averting Expenditure (AE) technique. Triplett et al.

(2019) have done an extensive survey and used the multivariate probit model to show the role of quality perception on the use of three modes of water use. Audeogum et al. (2008) have used logit model to determine the adoption decision of farmers in Nigeria. Similarly, Lwayo&Maritim (2003) have used logit model to study the factor affecting the decision making of farmers in Kenya.

Considering the above studies, we employed descriptive statistics for analyzing household water consumption characteristics. A logistic regression model has been used to analyze the factor affecting HHs perception to adopt a water quality improvement technique. The logistic regression model is a traditional method used in agriculture economics (Yatribi, 2020; Audeogun et al., 2008; Wondale et al., 2016), transportation economics (Mohammadian&Kanaroglou, 2003) to analyze the adaptability and discrete choice problem. The variable used in this model has been listed in Table-1. The variables are selected based on the work of Li & Wu (2019); Triplett et al. (2019); March et al. (2020). According to these papers, the listed variables have a certain impact on the decision making of household water consumption.

Table-1: Variable Description

Variable name	Description	Unit of measurement
Dependent variable: AWPM (Y_i)	Adopting a water Purification method	1: Yes 0: No
Independent Variables: Education (*edu*)	Education of Family head	No. of years of formal education
Age	Age of the head of household	Years
Log Family Income (*fi*)	Log of Monthly income of the family	Rupees/Month
Household Size (*hs*)	No. of people staying in the household	n
Source of water (*sw*)	Major source of household water	1-if Private supply 0- If Public supply
Location (*loc*)	Residential Location of the household	1- If slum area 0- Non-slum area

Here the dependent variable adopting a water purification method means using Aqua guard, RO, water filter, chlorine tablets provided by the municipality, boiling of water etc. if any of the methods is used by the household is considered as adopting of a purification method. The source of water variable is considered public supplies which are supplied by Public Health Engineering Department (PHED) and community tube wells whereas private supplies are households own bore well and bottled water.

Based on the above methodology the logit model is applied as described below.

$$Y_i = g^z$$

$$Z = \beta_0 + \beta_1 edu + \beta_2 age + \beta_3 fi + \beta_4 hs + \beta_5 sw + \beta_6 loc + \varepsilon_i$$

The logit model assumes Z is a stimulus that can predict the probability of the household perception toward adopting a purified method or not.

$$P_i = \frac{e^z}{1+e^z}$$

To simplify the above equation, we take the log and make the probability equation linear

$$\text{Logit (P)} = \ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 edu + \beta_2 age + \beta_3 fi + \beta_4 hs + \beta_5 sw + \beta_6 loc + \varepsilon_i$$

$\left(\frac{P_i}{1-P_i}\right)$ is the odds ratio, which explains if the expected β value will be >1 then it will have an impact on the first factor (household will adopt a purification method) otherwise if the value of the expected β will be <1 then this will have an impact on the second factor (household is not adopting any method)

Socio-economic characteristics

The area covered under the sample shows that around 49 percent of the household belongs to the general category, around 30 percent belongs to the Scheduled Caste (SC) category and the rest are belonging to Scheduled Tribes (ST) and Other Backward Class (OBC). Similarly, around 46 percent belongs to Below Poverty Line (BPL) category. As the study area covers both Non-slum and slum areas, it has been seen that there is more illiterate in the slum area while more graduates are in the non-slum area. There is more number of the daily wage earner in the slum area while in the non-slum area most are engaged in the private service and business. From the sampled household around 72% are having their own home and the rest are staying in a rented home. There is around 64% of households having one or two bathrooms and only a few are there that have more than two bathrooms present in the house. Around 27% of the household doesn't have a bathroom facility and they are mainly belonging to the slum area, they are using the community bathroom at a consolidated price. Similarly, around 27% household doesn't have toilet facility whereas around 73% has a toilet facility in their houses. Out of the total toilet user, only a few are using western-style toilets whereas Indian style with the flush is more than that of Indian style without flush which accounts for 34% and 21% respectively. All of them who have a bathroom are using two to three taps in their bathroom and two taps in their kitchen. This information is relevant as it gives a clear

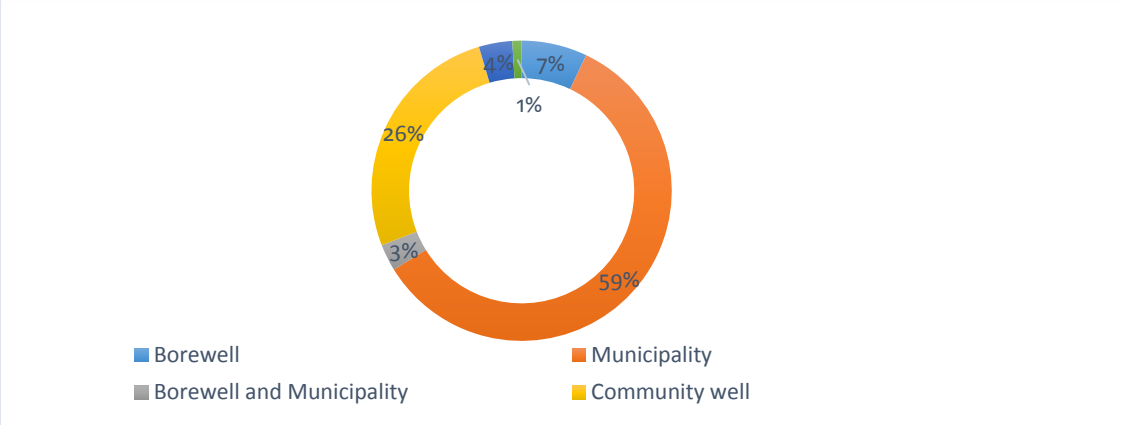
picture of the household consciousness about water use because as the number of taps increases the water consumption for these purposes also increases.

The analysis is being done based on water consumption which includes the source of water to the household and quantity consumption of water for different purposes of the household, quality of water consumption and methods adopted to improve it by the household.

Water use patterns for different purposes.

The Public Health EngineeringDepartment (PHED)supply is the major source of water to the household in the city. Which covers around 60% of the household followed by community well and individual bore well. Community well is the major source of water for slum dwellers. The below figure shows detail about the source of water as a whole.

Figure- 1: Source of water supply to the household



Source: Primary data

Water used for different purposes of the household reveals that slum dwellers average consumption is more than the non-slum dwellers with a larger standard deviation. This is similar in each case except for drinking water shown in table-2.

Table -2: Daily water consumption detail

	Non-Slum Area		Slum Area		Total	
	Mean	S.D	Mean	S.D	Mean	S.D
Total water consumption	120.18	52.26	149.17	61.33	134.67	58.61
Drinking	17.48	8.39	16.64	9.59	17.05	8.98
Bathing	90.97	43.07	117.50	52.50	104.23	49.66
Other domestic	11.51	10.32	15.02	8.28	13.27	9.49

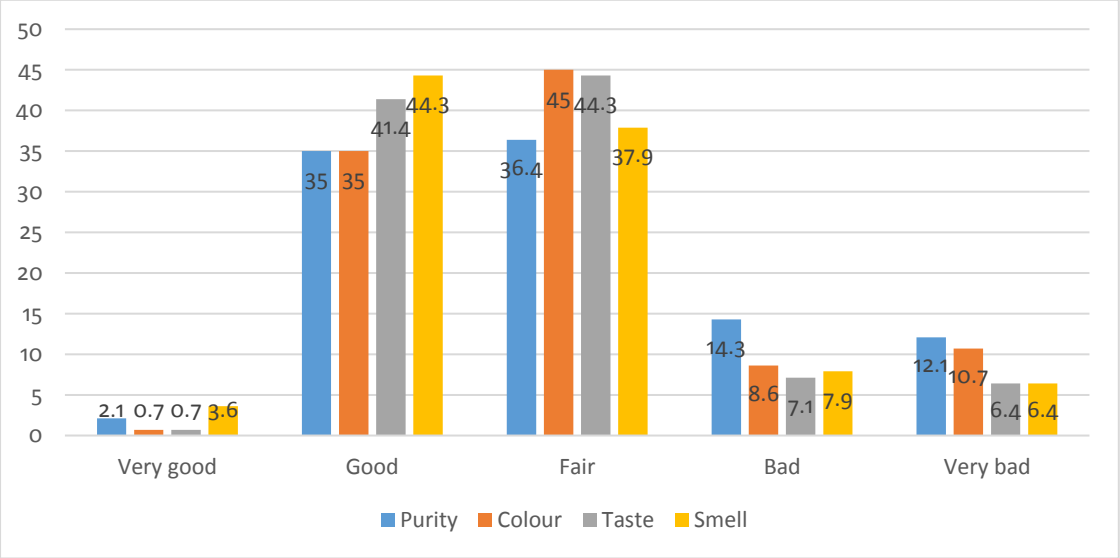
Source: Calculated from primary data.

The highest water spending habit is bathing in the slum area than that of the non-slum area. This is because of the irrational behaviour of the slum people towards water use as they primarily take water from the community tube-well or use the nearby river for their bathing purpose, another cause would be the larger family size have increased their average water consumption.

Satisfaction with water delivery services

The water services on different parameters are assessed by giving an option to the households to rate the current public water supply service based on four-parameter of water – purity, colour, taste and smell (Figure – 2).

Figure-2: Rating of the current public water service in the city



Source: Primary data

The figure above tells that the maximum number of people are rating their preference as good and fair in all cases. The city dwellers are neither happy nor worse off by these four parameters. Hence their rate of satisfaction on a different aspect of water supply was measured (Table -3).

Table-3: Rating of Satisfaction of different aspects of the water supply. (in %)

	Highly dissatisfied	**Dissatisfied**	**Neither satisfied nor dissatisfied**	**Satisfied**	**Highly satisfied**
Overall satisfaction	2.1	14.3	19.3	47.1	17.1

Hours of Supply	0.7	12.1	12.9	56.4	17.9
Reliability of Supply	1.4	7.9	29.3	47.8	13.6
Distribution	2.9	8.6	30.00	46.4	12.1
Reported treating water	3.6	7.9	32.9	43.6	12.1
Satisfaction from the current piped water supply	2.1	8.6	32.1	45.7	11.4
Adequacy	3.6	10	26.4	48.6	11.4
Quality	4.3	32.1	27.1	36.4	0
Dependability	2.1	17.1	28.6	40	11.4

Source: *Primary data*

The table shows that less than 50 % are satisfied in every case except hours of supply as it differs in sampled houses because of the maintenance problem in the connected pipes. In terms of quality, people are dissatisfied in CDA and Satisfied in slums and 27 % is neither satisfied nor dissatisfied. The adequacy was rated as satisfied more than dissatisfied. The overall satisfaction is rated as 47.1 % as satisfied and 17.1 % highly satisfied and the dissatisfied rating only comes in one part of the slum area because of connection problem before few months. The most important rating is how many persons are gone for reporting to authority to maintain water quality and the feedback they got is important and on that matter, people are rated 43.6 % are satisfied, 11.4 are highly satisfied, 32.1 % are neither satisfied nor dissatisfied and the rest are dissatisfied. That means authorities are well addressing the common people.

Perception on water quality

Water quality is an important segment of quality of life. Inaccessibility to good quality water can lead to serious health problems. Hence some key issues are taken into consideration which is faced by the residents of the city to observe their management of the situation. It was seen that brown water is a big problem in the non-slum area while it is less in the slum, around 74% of households reported this case in non-slum and only 22.9% reported in the slum area. Lather content is a major problem accounting for 28% as it is not good for external use of water like- washing, floor moping while 72% said no contamination. This is similar to the case of brown water, non-slum dwellers reported more and slum dwellers reported less.

To know the individual knowledge on the water components respondents were asked about the various components present in their water. Most of the households don't have knowledge about Ammonia, Arsenic, Nitrate, and Salinity which accounts for around 90-95% which is obvious as these are purely scientific measurements and could not be said without testing the water whereas the majority of the households reported contamination of Iron which can be felt without testing. Chlorine contamination also comes out as not present in the water supplied to them. Only 35% admitted that they are getting chlorine in their water and on the other form of chemical contamination they said: "We can't say". So it needs proper testing of these components so that they have the information on the merit and demerits of these contaminations. The most important is that the slum dwellers lack knowledge about these contaminations. Therefore, they are affected by several diseases in the last six months than non-slum dwellers (Table-4).

Table-4: Cases of different types of disease (in %)

Name of the Disease	Non-slum Area	Slum Area	Total
Diarrhoea	4.3	10	7.1
Vomiting	8.6	4.3	6.4
Malaria	4.3	8.6	6.4
Typhoid	1.4	2.9	2.1
Others	1.4	5.7	3.6

Source: Primary data

This table shows that the slum people are more affected by the water-related disease than the other part of the city. Only vomiting is more in the case of non-slum people. The case of diarrhoea, malaria, and cold fever is more in the slum area, this is because of their lifestyle in the slum. Their environment situation is very much unconditional to live. While they are asked about the purification method, only 11.4 % of the slum dwellers are using the purification method that is using government-supplied quinine (10 %) and boiling method (1.4 %). While on the other side the non-slum dwellers are very much conscious about the water quality and most of them (94 %) are using the purification method. While asked about the reason for not having a purification method 64 percent said that water is clean whereas 28 % are unable to buy a purifier and they also don't have that much time to boil the water and the rest are - do not know any water purification method.

Determinants of adoption of purification technique

A logit model helps us to understand the factor which is affecting a household perception for adopting a purification technique such as using RO, Aqua guard, Filter, chlorine tablet distributed by the municipality. The model fitted shows Nagelkerke R^2 of 0.621 and the individual effect of independent variables are presented inTable-5.

Table-5: Logit model result.

Name of the Variable	β	S.E	Wald	df	Sig.	Odds ratio
Education	0.161	0.075	4.638	1	0.031	1.174
Age	0.36	0.021	2.977	1	0.084	1.036
Log of Family income	-0.615	0.312	3.900	1	0.048	0.540
Household size	-0.168	0.180	0.879	1	0.348	0.845
Source of water (1)	-2.00	0.854	0.194	1	0.018	0.125
Location (1)	-5.536	1.394	15.773	1	0.000	0.004
Constant	5.372	2.806	3.666	1	0.056	215.207

Source: Authors calculation estimated from primary data.

The table shows that education, age, monthly family income has a significant effect on the household perception of the adoption of the purification technique. Similarly, the source of the household water supply and location of the house plays an important role to decide on adopting the purification technique of the household. If we talk about the magnitude of the variables impact on the categorical variable shows a year change in education and age will change the household perception to adopt a purification method by 16% and 36 % respectively. The odds ratio of these two variables is>1 which indicates that there is a probability that if we change education and age by one unit that they will have an impact on the first factor that is the decision to adopt the purification method. The income of the family has negative relation with the dependent variable. The result defines that adoption of a quality improvement method is less likely to occur with a decline of the income level. On the other hand, the two categorical explanatory variable- the source of water and location of the house in the city has a significant relation with preference to adopt quality improvement method. There is less probability that a household will perceive the practice of a purification method if the source of water is from private sources like own bore well and use of bottled water. In the same way, if the house is situated in a slum then there is less probability that the household will adopt a method to maintain its water quality. Out of the above considered variable

household size comes out as ineffective. The overall prediction of the model can be seen from the classification table below.

Table-6: Classification Table

Observed			Predicted		
			Do you use a purification method?		
			Yes	No	
Step 1	Do you use a purification water	Yes	70	16	81.4
		No	6	48	88.9
Overall percentage					84.3

Source: Authors estimation from the primary data

The classification table shows that our observed variable predicts around 84.3% correctness of values of the variable used in the model and that's a good result. Thus we could say that our observations are giving a near true value to our prediction and our result comes out significant for that reason only. The logistic model gives a significant result to predict the household perception towards adopting a purification method or not which will benefit the household.

Findings

Water is considered a major resource for all the stakeholders of society. The water quantity in Cuttack city is not a considering problem rather water quality is the main problem in the city. As there is a consolidated tariff system adopted by PHED there is no relation between the water tariff and its consumption. Water tariff is less in the slum than that of non-slum areas, so the slum people are consuming more than that of non-slum people (Lins et al., 2010). Because the non-slum households are more rational than the slum household. The source of water to the household sector is mainly from the municipality which is about 59% is lesser than the estimate of 70% by Bajpai and Bhandari (2001). People are considering more water quality than the water tariff, so there is a positive perception among the household situated in non-slum areas (Tolun et al., 2012) because of the favourable socio-economic condition. The water quality is rated as not good therefore the households are using the purification method for maintaining the good quality water (Jones et al., 2006) but there is a difference in the non-slum and slum areas. Water supplied by the public authority is highly rated as good in its smell and taste while on the other side purity and colour are rated as fair and some rated it as bad. The maximum number of people considered themselves less knowledgeable about the

information of water quality and the chemical contamination in case of both groundwater and PHED supplies (Lee, 2009; Jones et al., 2012). The relatively higher income group people can install a purifier than the lower income group (slum people) which causing them more prone to diseases than the higher income group in the urban area (Bedi et al., 2015). Regarding the access to water in the different caste groups, it's found to be opposite of the Kanmony (2003) study where he found there is high caste biasedness in accession of water in the urban area. The perception of household on water quality to adopt water quality improvement method shows that the income has a significant role in determining whether a household adopts a purifier or use tape water similar to the result of Roy et al. (2004), education of the household increases the probability to consume good quality water (Roy, et al., 2004; Darr et al., 1975). Because as the education level increases the perception to consume good quality water also increases. The size of the family is not significant in the case of our study to determine the perception of the household regarding the water quality which refuses the result of some previous studies DeHaven, (1963), Aitken et al.(1994) and Triplett et al. (2019). The major driver of household perception towards adopting purified water for consumptionin the city is the source of water supplies and the location of the house. We found that households that are mainly dependent on public supplies are more perceived to adopt a purification method as their perception of public water supply is very bad. The location of the house such as slum and non-slum also plays a significant role in the determination of the public perception to adopt a purification technique. The household situated in slum areas is less likely to have a purification technique than the non-slum household.

Conclusion and policy implications

Water quality is regarded as an important factor in determining the quality of life of human beings. Consumption of good quality water reduces the loss of human resources and wastage of economic resources. The maintenance of good quality water is solely responsible for households and for which they implement the various method. Household decision to adopt any method for water quality improvement is solely determined by their perception of the existing water services which helps them to decide against it. So in this study, we have investigated the influencing factor which affects the household perception to use a quality improvement method or not. We have done a primary survey on Cuttack city of Odisha on the various socio-economic conditions which are the deciding factor of the household

decision-making process and their behaviour on water consumption and knowledge about existing water-related problems. Based on the survey data we have analysed the household perception of existing water quality, conservation practice and the important factor which influence their decision-making practices.

The households are beware of the water quality and most of the households has a bad perception about the water quality supplied by the PHED. Though they are aware of it, their income level becomes a constraint to adopt a purification technology other than that source of water and the household location (i.e. slum and non-slum) also plays a significant role in their perception to take the decision. Education and age are quite influencing factors except for all restrictions. There is also present asymmetric information regarding the water quality and quantity.

The policymaker should give subsidised water treatment devices to the needy along with that proper information-rich system should be developed to counter the asymmetric information between the household and water supplying authorities related to water quantity and quality. However, education related to efficient use of water and technique of water conservation should be availed in the public domain so that the household gets knowledge about water and optimise their consumption.

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