Average Expenditure Incurred and the Perception of Safe Drinking Water in a CKDu Affected Area: A Case Study in Madawachchiya, Anuradhapura

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Abstract

Water is non marketed environmental resource, which was available in excess in the past, but now a day's water is known as a scares resource. Therefore, safe drinking water has become a marketable commodity mainly in Chronic Kidney Disease Uncertain etiology (CKDu) affected areas of Sri Lanka as some past empirical studies have explained that prolonged consumption of drinking water with high contents of ionicity affects the kidney membrane adversely. Majority of Sri Lankans are not willing to pay for drinking water due to low family income and low level of awareness regarding the benefits of safe drinking water. However, the situation is somewhat different in CKDu affected areas because purified drinking water has been delivered to their doorstep by many government and non-government organizations at a subsidized price. Therefore, this study aimed to determine the average cost incurred by a household to purchase drinking water and factors affecting the Expenditure in getting access to safe drinking water in a selected CKDu affected area. This study was conducted in Madawachchiya Divisional Secretariat in Anuradhapura District. Data were collected from a random sample of 50 households in every three regions (urban, semi-urban and rural) using a structured questionnaire and analyzed using both descriptive and using multiple regression. Average monthly Expenditure on good quality drinking water incurred by a family unit in urban, semi-urban and rural were Rs.1075.35, Rs. 939.90, and Rs.893.30. respectively. According to the multiple regression analysis, household size was the most influencing factor in spending on safe drinking water. According to the questionnaire survey, 87 % people of the studied sample have started to consume water purified by Reverse Osmosis (RO) techniques due to the low quality of water they consumed in the past and impact of awareness programs on the benefits of safe drinking water. However, 10% of people are still using water from shallow dug wells and the remaining of the population use water from pipe borne with some averting measures such as boiling and filtering. Though people have to pay for drinking the sufficiency of water usage was very high water due to prevailing dry weather conditions in the study area. Results of this study suggest that the local authorities should take immediate steps to provide water purification filters to the areas where there are no such facilities. Further studies are needed to assess the average provincial expenditure for NCP since the price is the variable factor among rural and urban areas.

Keywords: *Safe drinking water, average monthly Expenditure, RO water, CKDu Introduction*

1. Introduction

Water is the most crucial factor for the existence and the maintenance of life on the earth. Everyone has the right to sufficient, continuous, safe, acceptable, physically accessible, and affordable water for personal and domestic use (World Health Organization, 2017). Water was considered as a non-marketed environmental resource since it was abundantly available in excess in the past. However, currently, water is known as a scarce resource as a result of the rapid increase in birth rate and rapid depletion of this resource due to human behaviour. In developing countries, a smaller proportion of the population is paying for safe water due to several reasons such as low-income level and the awareness regarding the impacts of poor-quality water on human health, etc. (Parveen *et al.*, 2016). According to studies conducted by Aziz (2007), people must pay for quality drinking water and their perception of that is different from one to another. Many environmental economists have studied averting expenditures to measure how much people value environmental goods and services such as clean drinking water. Around the world, communities are involved in debates over the price of drinking water, which can be expensive to treat and provide but is a basic need for human life. (Rice *et al*., 2012).

The endemic occurrence of chronic kidney disease of unknown etiology (CKDu) was first observed in the 1990s, and over the past 15 years, the prevalence of the disease within certain geographical locations has increased dramatically (Noble *et al*, .2014). The WHO led a study to find the prevalence of CKDu among the 15–70-year-olds to be at 15.1% in Anuradhapura and 20.6% in the Polonnaruwa, the two districts of the NCP.

North Central province (NCP) in Sri Lanka is largely overlapped with the region affected by Chronic Kidney Disease of uncertain etiology (CKDu). Currently, the main cause of CKDu is being under investigation (Gunatilake *et al.*, 2014). Past empirical studies have explained that prolonged consumption of drinking water with high contents of ionicity affects the kidney membrane adversely (Dharmawardana *et al.*, 2014). Male paddy farmer who uses agrochemicals and drinks water with high hardness has been identified as the category that is highly affected for CKDu. Phosphate fertilizer is also can be a main source of arsenic in areas affected with CKDuin Sri Lanka (Jayasumana, 2012). In Sri Lanka, some Government, Non-Government Organizations (NGOs), and private sector institutes are providing purified drinking water to communities in CKDu affected areas at a subsidized price. Consequently, people have started to use safe drinking water to control CKDu up to some extent.

Therefore, people tend to pay for drinking water, and this research attempts to estimate the average cost incurred by a household per month in getting access to safe drinking water, to identify factors that determine the amount of money spent on safe drinking water and, to assess the sufficiency of use of safe drinking water by a family unit in Madawachchiya Area.

2. Methodology

This study was conducted in *Madawachchiya* divisional secretariat area in *Anuradhapura* district, North Central Province of Sri Lanka. The study area was divided into 3 regions: urban, semi-urban and rural areas. The urban area was the area falls within a radius of 1 km from the centre of *Medawachchiya* town. The semi-urban area was an area located between 1km and 2 km outside of the city limits and the rural area was remote locations where more than 2 km away from *Madawachchiya* town. A random sample of 50 households were selected from each of the above studied three different populations. Primary data was

collected through a field survey using a structured questionnaire. Family information, socio-economic factors, water, monthly average income, water consumption information, information on current drinking water facilities and information related to health condition were gathered from the questionnaire. Calculating means & averages, and multiple linear regression analyses were employed using MS Excel and SAS computer package respectively. Descriptive analyses involved the use of means, percentages and averages. Multiple regression analysis was used to establish the statistical relationship between the monthly average Expenditure and household size, the average income of the respondent, distance to a safe drinking water source, education level of the household head and the number of CKDu patients of a family.

1. ***Average monthly Expenditure by a family unit (Rs.)***

$$= \frac{Q * D * P}{N} \quad \text{……..…….(1)}$$

Where,

Q = Amount of water consumed per family per day (L/day)

D = Number of days in the month

P = Unit Price (Rs /L)

N = Number of family units

2. ***Water use sufficiency***

$$= \frac{Q_C}{Q_R} \text{ …….(2)}$$

Where,
Q_R = Amount of water consumed (L/day/person)
Q_C = MRI recommendation (L/day/person)

3. ***Factors affecting on the average Expenditure***

Following regression equation was used to identify factors affecting on average Expenditure.

$$Y=\beta_1+\beta_2 D_1+\beta_3 D_2+\beta_4 X_1+\beta_5 X_2+\beta_6 X_4+\beta_7 X_5 \text{ ……..……(3)}$$

Where:

Y = Average monthly expenditure for safe drinking water by a family unit (Rs)

D_1 = Area dummy, D1=1 if urban, 0 otherwise

D_2 = Area dummy, D2=1 if semi urban.0 otherwise

X_1 = Family size (number of individuals)

X_2 = Monthly family income (Rs)

X_3 = Distance to the safe water source (m)

X_4 =Number of CKDu patients in a family (Number)

X_5 = Level of education of household head (years)

3. Results and Discussion

3.1 Characteristics of the Sample

Table 4.1 shows the gender composition of the respondents in urban, semi-urban and rural regions of the study area. According to the table, the majority of the respondents were male, and the decision-maker of the family is the male. And the results indicate that the majority of the people in the urban area is over 50 years of age while the age of the majority of semi-urban and rural areas is less than 50 years. The young and adult population are equally distributed in the rural area.

Table 3.1 Gender and Age Composition of the Respondents

		Urban		Semi-urban		Rural	
		No.	%	No.	%	No.	%
Gender	Male	37	74	44	88	32	64
	Female	13	26	6	12	18	36
Age	< 25	3	6	2	4	1	2
	25-50	18	36	29	58	24	48
	50 <	29	58	19	38	25	50

There was no wide variation in family size in all three locations and it is around 4 members in all three locations. Majority of the respondents have spent at least 10 years for formal education. Thus, it is possible to state that the respondents have recovered a sufficient level of education to understand the benefits of consuming safe drinking water. When the total sample was considered, the majority is males, less than 50 years of age with a sufficient level of formal education.

When considering the income level, the average monthly income of the urban sample was higher than the average monthly income of the semi-urban and rural samples. Relatively higher access to non-farm and off-farm employments and higher wages offered in the urban area might be the main reason for the higher income level.

3.2 Sources of Safe Drinking Water

Figure 3.1 shows the past and the present drinking water sources used by the respondents of all three locations studied in the Medawachchiya area. Even though the majority of urban dwellers have access to the pipe born water they have started to use Reverse Osmosis (RO) water due to the bad flavour of the pipe born water and the awareness on the benefits of using safe drinking water. Urban people who used water of deep wells have begun to consume RO water as the water of deep wells are no longer safe to drink. People in semi-

urban areas had used shallow dug wells as the main source of drinking water in the past and at present, the majority of semi-urban dwellers has started to use RO water (figure 3.1 c & d)). However, some people are still using shallow dug well water as the source of drinking water in semi-urban areas. About 70% of people live in semi-urban areas had used shallow dug wells as the source of drinking water in the past and at present, the majority (80 %) of semi-urban dwellers has started using RO water (figure 3.1 e & f). However, a considerable proportion of the rural population is still using shallow dug wells to fulfil their drinking water demand.

According to the results of this field survey, the majority of the people in the study area are satisfied with the current source of drinking water irrespective of the location of their residence. About 41% of the studied population in the urban area claimed that the present drinking water is "Very Good2 whereas the other 57% said it is "Good". Nearly 32% and 16 % of people lived in semi-urban and rural areas respectively were highly satisfied with the current water source while 60% and 74% of the studied sample of semi-urban areas stated that their new water source is "Good". There were no respondents in any of the areas who are unhappy with the present drinking water.

3.3 Sufficiency of safe drinking water usage

The amount of water that one person consumed per day was presented as a percentage of the amount of water that one person should drink per day to assess the sufficiency in water use. There is a standard amount of water required for a person per day for the proper functioning of activities in the human body. Therefore, a sufficient amount of water should be consumed. The average amounts of water consumed by a household per day in each area are presented in table 3.2. Highest and the lowest sufficiency are associated with urban and rural communities.

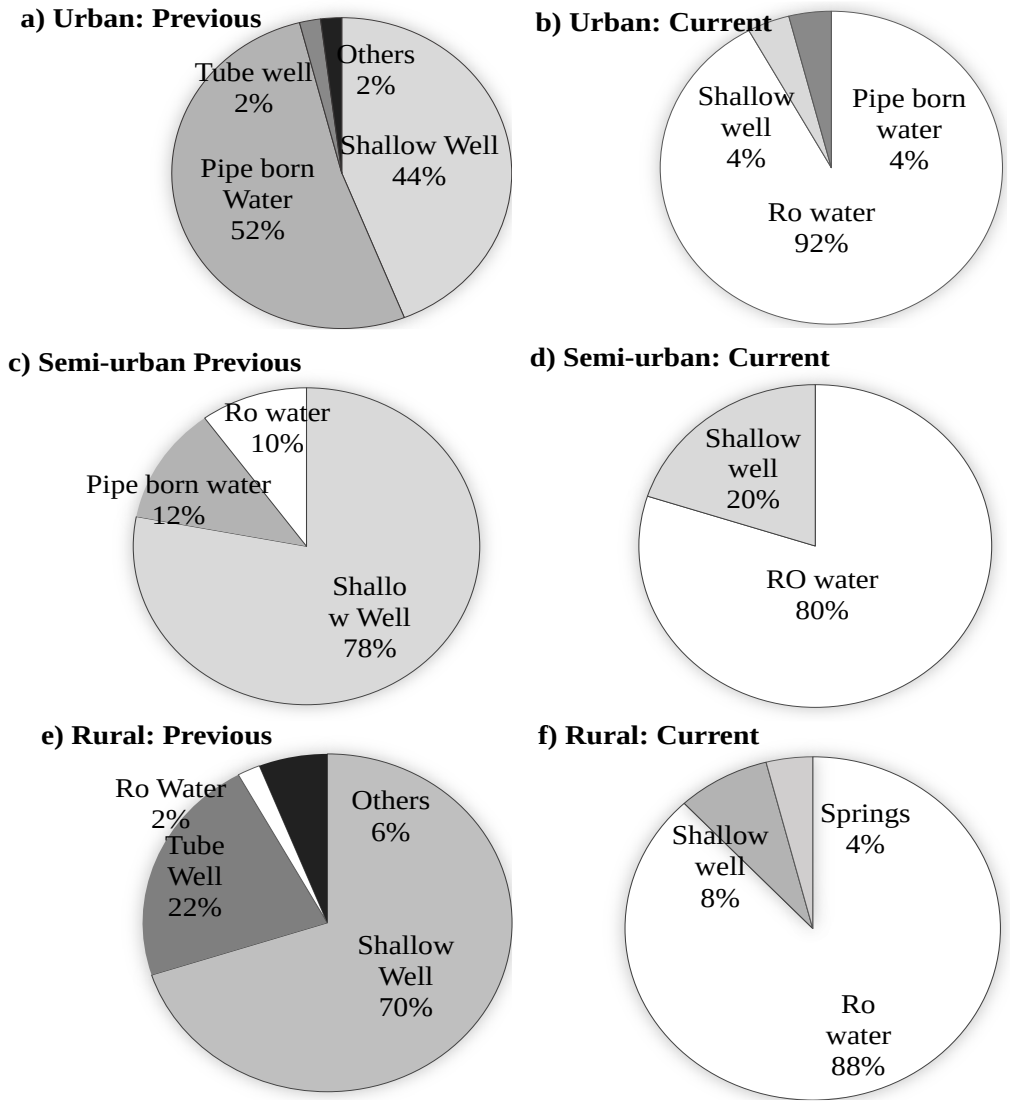

Figure 3.1: Previous (a) and Current (b) Drinking Water Sources of Respondents

Table 3.2 Sufficiency of water usage

Area	Daily Water Consumption (L)	Sufficiency (%)
Urban Area	4.7	157
Semi-urban Area	4.6	153
Rural Area	4.3	143

Institute of Medicine (IOM) has declared that 3L per day is the adequate water intake for a normal person. According to the results, the water intake of the people in this area is higher than the recommended level. This is an adventive condition due to existing dry weather condition in the study area in the study period and this situation can differ if the study is conducted in another period of the year. So, the findings are inconclusive.

3.5 Average Monthly Expenditure on Safe Drinking Water

The first objective of this study was to estimate the average monthly Expenditure on safe drinking water of a family unit. The average drinking water consumption and unit price of water were used to estimate the average Expenditure. According to the results, the average monthly Expenditure incurred by urban, semi-urban and rural family Rs.1075.35, Rs.893.30, and Rs.939.90 respectively.

Most of the people live in all three categories (urban, semi-urban and rural) of regions in Madawachchiya area have access to free or low-cost supply of safe drinking water since some government and non-governmental organizations have established RO water purification plants in those areas. As a result, the unit price of water varies from 50 cents to Rs. 2.50 across the study area. Results revealed that people in urban and semi-urban locations have incurred the highest and the lowest cost respectively.

3.6 Factors influencing average Expenditure on safe drinking water

Another objective of the study was to identify the determinants of average Expenditure incurred on safe drinking water. The multiple regression analysis was used for this purpose where the dependent variable was the average Expenditure and independent variables were the distance to the water source, education level of the respondent, area of residence, the average income of the respondent and the number of CKD patients in the family. According to literature, these factors are affecting significantly on average Expenditure on drinking water. However, this study showed slightly deviated results from the previous studies done. Table 3.3 shows the results of multiple regression analysis done in this study.

Table 3.3: Results of the Multiple Regression Analysis

Variable	Coefficient	Pr> |t|
Intercept	339.47	0.19
D1	10.7	0.91
D2	-135.78	0.14
Household size	159.81	<.0.01**
Education level	-19.16	0.41
Distance to the water source	49.61	0.37
The monthly average income of the respondent	0.00867	0.007**

The unit price of drinking water has shown a lesser variability in the study area and some people have access to free, clean and safe drinking water supplies. Safe drinking water has been delivered to the doorstep a subsidized price and thus the price variability was less. The unit price of water was not a constant value but, those are almost the same across the study area.

When the number of CKD patients has considered it was a negligible number because the majority of the patients had already died. Majority of respondents of the survey are middle-aged people and they are not affected from CKD because this generation is not highly engaged in farming activities and they use purified safe drinking water from their childhood due to CKD prevention awareness programs conducted in Madawachchiya area since previous years.

As a result, the education level of the respondents was also not a significant determinant of the Expenditure on water because the variability in the education level of the respondent was very low. This could be the impact of the free education policy of the government. Other than that, they all are aware and know the benefits of consuming safe drinking water, as a result of intensified awareness programs.

Distance to safe drinking source was another dependent variable that considered, and it was also not significant either because people have the access to safe drinking water installed in close proximities of their residence. At the same time, some organizations have delivered purified drinking water to doorsteps of the people. As a result, there is no considerable variation in the distance to the source of water. Therefore, this variable was not statistically significant.

Household size is hypothesized that it is positively associated with the average Expenditure incurred on safe drinking water. There is a natural tendency to demand more of safe drinking water by large family units.

Another dependent variable on average Expenditure was the average monthly income of the respondent. It was also significantly affected on average Expenditure on safe drinking water. According to the literature it was assumed that people with higher income levels spend more on safe drinking water.

4. Conclusions

The majority of the studied sample are consuming water purified by Reverse Osmosis (RO) techniques. Others are still using water from shallow dug wells. And pipe born water with some averting measures such as boiling and filtering. Household size and the average monthly income are significantly affecting the average Expenditure on safe drinking water.

Findings of this study can be used by local authorities to know how much money which public are willing to pay for drinking water and to establish relevant water supply schemes for people who are not access to clean and safe drinking water.

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