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## SOCIOLOGY | RESEARCH ARTICLE

# Factors explaining household payment for potable water in South Africa

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**Abstract:** The critical role of clean water for sustaining life is enshrined in the Sustainable Development Goals 2030. However, water scarcity currently affects more than 40% of people globally and by 2030, demand for water is expected to grow by 50%. Maintaining current water usage in South Africa is anticipated to result in 17% water deficit in 2030 and this is expected to be exacerbated by climate change. Hence, this study seeks to explain factors influencing household payment for potable water utilizing the recently released South African Living Conditions Survey 2014/2015. The data was analyzed using descriptive statistics and probit model. Results reveal that 83% of the respondents received water from municipal water supplier while only 35% pay for water usage. The empirical result shows that socioeconomic characteristics of household head like gender, age and income positively influence payment for water while municipal water interruption for more than two days, black South Africans, keeping of livestock and involvement in agriculture negatively influence payment for water. Based on these findings, we recommend that South African water policy should address income inequality, encourage gender sensitive water management education and create awareness for prompt water tariff payment to promote sustainable water supply in South Africa.

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### PUBLIC INTEREST STATEMENT

South Africa is regarded as a water scarce country. The Western Cape Province where the city of Cape Town is located currently faces a serious drought and has been declared as a disaster area. Hence, Day Zero—the day Cape Town runs out of water as of January 26, 2018 sits at April 12, 2018. A veritable way to ensuring sustainable water supply in South Africa is to ensure prompt payment of water bills. Hence, this study seeks to explain factors influencing household payment for potable water in South Africa. Findings from this study indicate that 83% of participants in the study received water from municipal water supplier while only 35% pay for water usage. The empirical result shows that socioeconomic characteristics of household head positively influence payment for water while municipal water interruption for more than two days, and involvement in agriculture negatively influence payment for water.

**Subjects: Water Quality; Economics and Development; Economics; Environmental Economics**

**Keywords: household; payment; probit; water; South Africa**

### 1. Introduction

The critical role of clean water for sustaining life is enshrined in the recently released Sustainable Development Goals 2030, which affirms to “ensure availability and sustainable management of water and sanitation for all”. As it stands, water scarcity currently affects more than 40% of people around the world, and by 2030, global demand for energy and water is expected to grow by 40 and 50%, respectively (UN-HABITAT, 2016). These anticipated shortfalls in water supply constitute threats to water’s crucial role in supporting life, and have elevated water scarcity and security as a major global environmental problem of the twenty-first century (Jury & Vaux, 2005; Vörösmarty et al., 2010). At the onset of the century, the Earth and its diverse life forms, including over six billion humans, is facing a monumental water crisis (UNESCO, 2003). More worrisome is the fact that as global population is projected to increase by three billion or more over the next 50–75 years, and most of this population growth will likely occur in the developing countries where water supply is already critically short and many of the residents are impoverished (Jury & Vaux, 2005). Moreover, if the current trend continues unabated, by 2050 at least one in four people are likely to be affected by recurring water shortages (UNDP, n.d.).

Furthermore, decrease in availability, decline in quality, and increasing demand for water are creating significant challenges to businesses and investors globally. Inadequate drinking water constitutes a significant part of these challenges. Scarcity of drinking water results in more sickness and death and also causes higher health costs, low work productivity, lower school enrolment, and finally leads to poverty (Ahmad & Sattar, 2010). Polluted drinking water is also considered as a major health hazard in developing countries and most of the fatal diseases are associated with it. According to the World Health Organisation WHO (2004) estimates cited in Ahmad and Sattar (2010), 1.8 million people die every year from diarrhea and cholera. In addition, 88% of the cases of diarrhea disease are attributed to unsafe water supply, inadequate sanitation and hygiene. Hence, safe drinking water is an essential component of primary health care and is imperative for poverty alleviation. All these have culminated in an increasing global awareness of the importance of water, sanitation and hygiene to alleviate poverty across the globe.

It is widely acknowledged that the provision of potable water and hygienic sanitation is necessary to sustain human life and to ensure good health and human dignity. This facilitates fairer, more productive and healthier communities. With improved water access, we are able to stop the spread of deadly diseases and improve people’s health and living conditions. Therefore, enhancing water accessibility is an essential component of an integrated approach to tackling poverty, hunger, health and inequality (WaterAid, 2017). This integration encompasses the survival and productivity of all life and all ecosystems, which include agro-ecosystems—and therefore all ecosystem services for people (Merrey, 2015). The water challenge is equally a food production challenge as well as a challenge for meeting other social goals. For instance, the agricultural sector is responsible for 70% of water abstractions (World Water Development Report, 2017), which support the livelihoods of some of the poorest subsistence farmers worldwide. This challenge is acute in Africa where fourteen countries are already experiencing water stress; another eleven countries are expected to join them by 2025 by which time nearly 50 per cent of Africa’s predicted population of 1.45 billion will face water stress or scarcity (World Wide Fund, 2012).

Currently, nearly 51 per cent equivalent to 300 million people in sub-Saharan countries lack access to a supply of safe water and 41 per cent lack adequate sanitation. Part of these people are resident in South Africa, which is a semi-arid country with average rainfall of 450 mm per annum which is well below the world average of 860 mm per annum thus ranking her as the 30th driest country in the world (Department of Water & Sanitation, 2015a). Based on current usage trends, South Africa

is expected to face a water deficit of 17% by 2030, and this shortage will only be worsened by climate change (WWF-SA, 2017). In terms of access to piped borne water, 44.4, 30.0, 15.5 and 10.1% have access to water inside the dwelling, inside the yard, access point outside the yard and no access to piped water respectively (Statistics South Africa, 2016b), while diarrhoeal ranks third among the cause of death killing 10,786 equivalent to 10.2% death among children under the age of 5 in South Africa (Harrison, 2009).

To ensure water secured South Africa, a well-articulated water legislation with strong emphasis on the entire water cycle in accordance with people and the environment fundamental right to water has been put in place (WWF-SA, 2016). One of the pathway proposed by the Department of Water Affairs and Forestry (DWAF) for achieving this entails the implementation of holistic water-resource management fee in the water tariff charged to consumers. These water charges include a charge for control of invasive alien plants as well as charges for activities such as planning and implementation, pollution control, demand management, water management and water use control (Turpie, Marais, & Blignaut, 2008). Past water management relied on cost recovery policies premised on believe that neither rural nor peri-urban communities could afford to pay for water services have now been dominated by a view that is currently recognized as outdated. In line with this, South Africa's white paper on water supply and sanitation policy recommends that payment for water by its user is a central principle to ensure sustainable and equitable development, as well as efficient and effective management (Department of Water Affairs & Forestry, 1994).

A key element influencing a household's willingness to pay for an improved water supply is the households' sense of entitlement to Government services and their attitude toward Government policy regarding water supply and sanitation (Mugabi, Kayaga, Smout, & Njiru, 2010). In general, communities are reluctant to involve themselves in countries where the perception prevails that it is the Government's responsibility to provide services. In parts of South Africa where consumers have enjoyed free supplies of water, the costs have been borne by the State usually through the now defunct homeland administrations. This was often because of the over-riding political environment and because of administrative and management inadequacies. Information are limited on the reasons for not paying for water in these areas and factors explaining reasons for paying are scanty. In the light of the aforementioned, it is very germane, to understand the drivers of household payment for water supply to ensure continuous flow of income to ensure sustainable water supply. This study therefore investigated factors explaining household payment for water across South Africa using South Africa Living Conditions Survey data.

## 2. Methodology

### 2.1 Data and sampling procedure

This study used South African Living Conditions Survey 2014/2015 data collected by Statistics South Africa. Details of the sampling procedures had been explained by Statistics South Africa (Statistics South Africa (StatSA), 2015). The data was collected using a well-designed survey questionnaire. Trained enumerators administered the questionnaires. In all, 30, 818 dwelling units were sampled across the country during the survey. Thirty-two thousand nine hundred and six (32,906) households were identified by the survey (Statistics South Africa (StatSA), 2015). From these, there was a sample realization of 27,527 (83.65%) households, with the remaining 5,379 (16.35%) households being classified as out-of-scope due to number of reasons, such as listing error, vacant/unoccupied dwelling. Sampled households participated in the survey for a period of four weeks, and the survey was conducted over a period of one year between 13 October 2014 and 25 October 2015. However, for this study, 23 330 households with complete information on payment for water across the nine provinces in South Africa were analyzed.

### 2.2. Conceptual framework

Several factors can influence decision to pay or not to pay for water. For instance, Olajuyigbe and Fasakin (2010) identified access to improved source of water, distance from main source of water to dwelling, average time spent to fetch water, adequacy of supply, quantity of water used per person

per day, quantity of water purchased per day, incidence of water borne diseases, performance of water providing institution and average amount spent on water during the dry season as main factors influencing household's willingness to pay for water. Whereas adequacy of water supply, large volume of water use per day and incidence of water borne disease can increase payment for potable water. Moreover, irregular or frequent water interruption can also discourage payment for water. It is also expected that large households will use more water and therefore derive more utility from paying for water.

Similarly, several studies have established relationships between willingness to pay for water and the socio-economic characteristics of household head such as age, level of education, income and gender (Addo-yobo, Njiru, & Sohail, 2006; Alhaji, Mohd, & Yacob, 2015; Mezgebo & Ewnetu, 2015; Mugabi et al., 2010). For example, Mugabi et al. (2010) investigated the determinants of customers decision to pay utility water bills promptly in Uganda. Findings from the study revealed that customer attitude towards prompt payment, perceived ease or difficulty of paying on time (perceived control), as well as social pressure, strongly influence intentions to pay, which in turn directly affects actual prompt bill payment behaviour. The study further showed that attitudes towards prompt payment are informed by perceptions of benefits and sacrifices associated with the behaviour.

Moreover, Mezgebo and Ewnetu (2015) study on households willingness to pay for improved water services in urban areas in Ethiopia using probit model further confirmed several socio-economic factors that explained household's willingness to pay for improved water services. Among these factors are water supply interruption, delay in maintenance, irregular/erratic availability of the public water supply, the price charged per unit, the unequal treatment households face while collecting water at the public supply. Descriptive analysis result from Mezgebo and Ewnetu (2015) study showed that 96% of the households were willing to pay for the provision of improved water service. Whereas the result from the probit model showed that income, main water source distance to household dwelling, expense on water, proposed bid, and educational attainment, level of existing water satisfaction, marital status and sex were associated with households' willingness to pay for the provision of improved water services.

In South Africa, a couple of empirical studies have been implemented to investigate willingness to pay for water among household and farmers across the country (Kanyoka, Farolfi, & Morardet, 2008; Speelman, D'Haese, Frijia, Farolfi, & D'Haese, 2009; Turpie et al., 2008). For instance, Kanyoka et al. (2008) investigated South African households' preferences and willingness to pay for multiple use water services in rural areas using choice modelling approach. The study was carried out in Sekororo-Letsoalo area in the Limpopo Province. Findings from the study revealed that households in the rural areas are willing to pay for improvements in water services. The limitation of this study is however methodological and contextual. First, the methodological limitation anchors on the fact that choice modelling measures willingness to pay using hypothetically simulated which may not follow conventional market realities. Second, the study was conducted Sekororo-Letsoalo area in Limpopo, which is one of the nine provinces in the country; hence, findings from the study may not be representative of the entire South Africa.

Furthermore, Speelman et al. (2009) conducted a study on willingness to pay for water and water rights definition among irrigators in Limpopo Province, South Africa. The study also proposed contingent ranking which is another variant of stated preference method of willingness to pay, to investigate smallholder irrigators WTP for changes in water right system. Results from the study indicated that smallholders are prepared to pay considerably higher water prices if these prices are connected with advancements in the water right system. The findings from this study may also be limited and relevant to smallholders that share similar characteristics to Limpopo smallholders. In similar vein, Makaudze (2016) measures the willingness to pay for water and sanitation by people living with HIV and AIDs in South Africa. The study was based on 485 HIV and AIDs individuals drawn from three types of settlements (rural, peri-urban and urban slums) sampled from three selected provincial districts of Khayelitsha (Western Cape), Ukhahlamba (Eastern Cape) and Groblersdal (Limpopo). The

results from the study indicates that PLWHA have higher WTP for sanitation of ZAR448.40/month compared to ZAR428.60/month for water.

The present study however, distinguishes itself from previous studies on payment for water in South Africa in two ways. First, the study utilized large data-set containing 23 380 households across the nine South Africa provinces unlike other previous studies (Kanyoka et al., 2008; Speelman et al., 2009) that only looked at a particular area within the country. Two, payment for water data collected in the Living Conditions Survey utilized revealed preference method by eliciting respondents' actual payment for water compared to previous studies that utilized stated preference method of WTP. Moreover, as far as we know, we are not aware of any empirical studies that have empirically investigated drivers of household payment for water in South Africa. Based on the aforementioned, we are of the opinion that the current study is relevant and that the findings from the study will contribute to the formulation of policies on payment for water in South Africa

### 2.2.1. Analytical framework for household payment for water in South Africa

From the conceptual framework, household decision to pay for water depends on several variables such as age, level of education, income, gender, access to improved source of water, distance from main source of water to dwelling, average time spent to fetch water, adequacy of supply, quantity of water used per person per day (Addo-yobo et al., 2006; Alhaji et al., 2015; Mezgebo & Ewnetu, 2015; Mugabi et al., 2010) and unobservable factors explained by the stochastic term,  $\varepsilon$ . Although this study adopted the probit model to assess factors explaining payment for water in South Africa, result from logit model is also included for the purpose of comparison since the two models are closely similar but different in the distribution of their error components.

We assumed *a priori* that household pays for water based on benefit derived from water use. Benefits derived from access to clean water may include reduction of water-borne diseases, free-up time for education and other productive activities, as well as increase in the productivities of the labour force. Other benefits from water may however be under-estimated because of the fact that these benefits are non-economic in nature. These non-economic water benefits are of high value to individual concerned in terms of dignity, social status, cleanliness and overall well-being. Hence, all things being equal, households will pay for water if the net benefits are positive.

We assumed a latent variable  $Y_i^*$  representing payment or non-payment. Where payment indicates that the household is paying for water that is being used. Independent variables  $X_i$  are regarded as factors that explains payment for water and  $\beta$  are  $K$ -vector of parameters. Then the decision to pay for water can be specified as follows:

$$Y_i^* = \beta X_i + \varepsilon_i \tag{1}$$

where:

We observe  $Y_i = 1$  if  $Y_i^* > 0$  and  $Y_i = 0$  if otherwise.

$Y = 1$  if the household pays for water and  $Y = 0$  if the household decides otherwise.

$$\text{In the case } \text{Prob}(Y = 1/X) = F(X, \beta) \tag{2}$$

$$\text{Prob}(Y = 0/X) = 1 - F(X, \beta) \tag{3}$$

Then  $F(X, \beta) = X\beta$

Limiting  $X\beta$  to (0, 1)

**Table 1. Descriptions of explanatory variables in the model for determinants of payment for water**

Variables	Variable type	Description of variables
<i>Demographic characteristics</i>		
SexofHead ( $X_1$ )	Dummy	1 if male, 0 female
Ageofhead ( $X_2$ )	Discrete	Age of household head in years as at 2015
Hhsize ( $X_3$ )	Discrete	Number of persons living in the household
Income ( $X_4$ )	Continuous	Monthly income of household in Rand
BLACKAF ( $X_5$ )	Dummy	1 if black South African, 0 otherwise
INDIGENT ( $X_6$ )	Dummy	1 if registered on indigent register, 0 otherwise
<i>Water related</i>		
LONGTWO ( $X_7$ )	Dummy	1 if municipal water interrupted more than two days, 0 otherwise
DRINKM ( $X_8$ )	Dummy	1 if main source of drinking water is tap, 0 otherwise
<i>Agriculture &amp; production</i>		
OWNPROD ( $X_9$ )	Dummy	1 if engaged in own production/keeping livestock, 0 otherwise
INVOLVED ( $X_{10}$ )	Dummy	1 if involve in food production or other agric. products, 0 otherwise
<i>Provincial variables</i>		
Western Cape ( $X_{11}$ )	Dummy	1 if resident in the Western Cape, 0 otherwise
Northern Cape ( $X_{12}$ )	Dummy	1 if resident in the Northern Cape, 0 otherwise
Free State ( $X_{13}$ )	Dummy	1 if resident in the Free State, 0 otherwise
Kwazulu Natal ( $X_{14}$ )	Dummy	1 if resident in the KwaZulu Natal, 0 otherwise
North West ( $X_{15}$ )	Dummy	1 if resident in the North West, 0 otherwise
Gauteng ( $X_{16}$ )	Dummy	1 if resident in the Gauteng, 0 otherwise
Mpumalanga ( $X_{17}$ )	Dummy	1 if resident in the Mpumalanga, 0 otherwise

$$\text{Prob}(Y = 1/X) = \int_{-\infty}^{X\beta} \Phi(t)dt = \Phi(X\beta) \tag{4}$$

$$\text{Such that Prob}(Y = 1) = \Phi(\beta X) \tag{5}$$

where  $\Phi(.)$  is function of standard normal distribution function (Table 1).

### 3. Results and discussions

#### 3.1. Socio-economic profile of the respondents

The socioeconomic characteristics of the respondents across South African nine provinces is presented in Table 2. It shows that 55.22% of the respondents are headed by male. Gauteng and Western Cape Provinces have the highest number of male headed households of 64.61 and 64.28 respectively, while lowest male headed households of 45.95 was reported in Limpopo Province. It indicates that majority of the household heads in Limpopo Province are female. This finding may explain why poverty is pervasive in the province, since the recently released Statistics South Africa report on poverty showed that women and children below the age 17 years are more susceptible to the incidence of poverty in South Africa than men, and that poverty is more pervasive in Limpopo, Eastern Cape and KwaZulu Natal provinces.

It is further revealed that average household head in the pooled data was 49.22 years old. The highest average age of 52.25 years was recorded in the Eastern Cape Province, while Gauteng Province reported the least average age of 46.68 years. According to Burger, Steenekamp, Van Der



**Table 2. Descriptive statistics of household heads' selected socioeconomic characteristics**

Province	Western Cape	Eastern Cape	Northern Cape	Free State	KwaZulu Natal	North West	Gauteng	Mpumalanga	Limpopo	All
Male	64.28	49.06	56.86	56.64	50.99	55.56	64.61	55.17	45.95	55.22
Age (Years)	48.87	52.25	49.25	47.42	48.84	49.87	46.68	48.70	51.04	49.22
Household size	3.72	3.85	3.82	3.38	4.18	3.67	3.46	3.91	4.02	3.80
Income (Rand)	11,385.9	8,163.75	9,658.12	8,771.33	3,734.39	6,232.23	10,195.8	8,843.49	6,504.64	5,114.95
Indigent	20.88	26.09	31.02	23.52	12.88	16.91	43.09	21.45	15.34	23.16

Source: Author's computations from South African's Living Conditions Survey (LCS) 2014/2015.

Berg, & Zoch (2014), households in the middle class are emerging due to the recently implemented economic reforms. Similarly, comprehending the dynamism of marital relationships within South Africa may shed light on the result (Pettifor, Rees, Steffenson, Hlongwa-Madikizela, & MacPhail, 2004). Prevalence of marriage dissolution and continual refusal of young people that are eligible to marry to accept family responsibilities frequently confer household's headship on young women. Endemics of HIV and AIDS and its attendant consequences such as the subjection of young children and women to take up household head's role and responsibility (Leclerc-Madlala, 2008).

Moreover, the results shows that the average household size in South Africa is 3.80. Household size greater than four (4) members were recorded in Kwa Zulu Natal and Limpopo Provinces, while Gauteng reported the least household size of 3.46. Although the overall average household size of 3.80 reported in this study is higher than the 3.3 reported in the community survey report 2016 (Statistics South Africa, 2016a), there is a noticeable similarities in the distribution of household size across provinces. Similar to what our finding in this study, the community survey reported highest average household size of 3.9 in Eastern Cape, whereas the smallest household size of 2.7 was reported in Gauteng province.

Furthermore, mean monthly income for all the households was R5114.95. Western Cape and Gauteng had the highest monthly income of R11385.9 and R10195.8 respectively, whereas North West (R6232.23) and Limpopo (R6504.64) had the lowest. Several studies have established the strong positive association between income and payment for water(Edward Nketiah-Amponsah, 2009). Needless to say that this relationship brings about bidirectional fortification between income and payment for water. For instance, in Niger, Bardasi and Wodon (2008) observed that the rich household are more likely to be connected to piped water in residence and that households connected to piped water pay less relative to the poor who utilize alternative sources. Likewise, Asante (2003) found a significant statistical relationship between income and access to safe/potable water. This finding is also consistent with Iskandarani (2002) who reported that household income is a significant predictor of per capita water demand.

The results further shows that 23.16% of all the households are registered as indigent. Almost half of the respondents interviewed in Gauteng were affirmative when asked if they were registered on the Municipal indigent register (43.09%). Households on municipality indigent register are regarded as vulnerable households that may require state support and subventions. Most of these households may lack the ability to pay for social infrastructural services provided by either government or other service providers. Hence, this category of household may need state support to be water secured.

### 3.2. Main source of water for drinking among households in South Africa Provinces

The distribution of main sources of drinking water among South African households is presented on Table 3. It indicates that above 70% received tap water either within or outside the yard. Although some households still receive water from wells, streams, spring and river but such cases are very negligible. Over 92% of households in Western Cape received water from the tap, whereas only 34% received tap water in Limpopo thus leaving 66% households with no access to tap water in the

province. Twenty-six and twenty-four percent received water from public/communal source in Eastern Cape and Limpopo respectively whereas only 5.86 and 3.46% use public/communal water sources in the predominantly urban provinces of Western Cape and Gauteng. The result further indicates that 2.56% of the respondent still use flowing water/stream/river as main source of drinking water. This is more prevalent among the provinces where majority of the population still live in the former homelands such Eastern Cape (8.97%), KwaZulu Natal (5.30%) and Limpopo (4.10%). This finding aligns with the study of Ramathuba (2009) which reported that waterborne diseases were in all cases predominant among poor households in rural areas that use unsafe water supply (borehole/river or spring untreated water) as the main source of drinking water.

### **3.3. Drinking water suppliers and distance from dwelling to main source of drinking water among households in South Africa**

Presented in Table 4 is the distribution of the supplier of drinking water and distance from dwelling to main source of drinking water across South Africa. The result shows that majority of the household represented by 83% received water from the municipal water service provider. Across the province, virtually all of the households in Western Cape (96%) and Gauteng (95%) received water from the municipality, whereas 66% and 71% received water from municipality in Limpopo and Eastern Cape provinces respectively. Very few households were supplied by other water schemes. This suggest that the municipal water scheme is till effective in meeting water demand in South Africa unlike what obtains in other African countries where government water schemes are either non-existing or moribund. In terms of distance of dwelling to main source of drinking, majority of the household responded “not applicable” because source is located within the house or yard, hence, the issue of distance does not applies to them. However, 12.28, 6.61 and 3.89% draw water from distance of 200metre or less, 201 to 500metre and 501 to 1 kilometre respectively. Only 1.11% had to travel more than 1 kilometre to get their drinking water.

### **3.4. Payment for water and reasons for non-payment for water in South Africa**

Responses to payment for water and reasons for non-payment across South African nine provinces is presented in Table 5. When asked if household were paying for water, 34% responded affirmatively yes while 66% responded No. At least 50% of respondents were paying for water in Western Cape (58.01%), Gauteng (49.66%) and Northern Cape (50.37%) provinces. Whereas, less than 30% pay for water in Eastern Cape (25.81%), Free State (26.73%), Mpumalanga (26.76%) and Limpopo (19.71%) provinces. Limpopo and Eastern Cape Province that was reported by Kavese (2017) to have consistently been the two provinces with the highest levels of poverty between 2006 and 2015 show lowest incidences of payment for potable water of 19.71 and 25.81% respectively in this study. This suggest that payment for water in some provinces in South Africa is dismally low compared to other developed countries where payment are strictly enforced.

Of the 66% that responded “No” when asked if they were paying for water, follow-up questions were asked to elicit information on reasons for not paying for potable water. Various reason cited include use of own source of water, use of free water, paying directly to landlord as part of rent, payment included in level, permission from municipality not to pay. As shown in Table 5, the four most cited reasons for not paying for potable water are *use a free water source* (18.87%), *pay directly to landlord as part of rent* (8.44%), *permission from municipality not to pay* (8.22%), and *Do not have water meter* (6.63%). Those that *use a free water source* (18.87%) and granted *permission from municipality not to pay* (8.22%) benefit from South Africa’s legislation on provision of water to households that are registered on indigent register who receive water supply through a communal water services (Department of Water & Sanitation, 2015b).

Whereas, households that *pay directly to landlord as part of rent* (8.44%) still bear the cost of water used, hence, they are paying for potable water indirectly. However, households that are not paying because they *do not have water meter* (6.63%) are taking advantage of the laxity in water supply services in the country and this constitute leakage to water revenue receive by Municipal government that supplies water to the household. However, households that use own source of water incur



**Table 3. Percentage distribution of main source of water for drinking among households in South Africa Provinces**

Province	Western Cape	Eastern Cape	Northern Cape	Free State	KwaZulu Natal	North West	Gauteng	Mpumalanga	Limpopo	All
Piped (tap) water in the dwelling/house	80.78	29.15	49.48	39.91	34.19	23.67	64.69	27.18	10.88	40.06
Piped (tap) water in the yard	12.43	17.21	31.27	52.95	31.57	41.85	29.37	44.24	33.44	31.61
Borehole in yard	0.07	0.57	1.18	0.83	0.24	4.24	0.90	2.75	7.96	2.01
Rain-water tank in yard	0.11	7.89	0.15	0.09	0.90	0.15	0.12	0.34	0.07	1.25
Neighbor's tap	0.37	1.48	1.84	1.20	2.37	5.23	0.40	7.07	8.69	3.12
Public/communal tap	5.86	25.94	13.50	2.40	16.67	16.69	3.46	8.00	24.09	13.30
Water-carrier/tanker	0.04	0.71	0.37	0.51	2.96	2.34	0.37	4.45	2.88	1.69
Borehole outside yard	0.04	0.40	0.29	0.28	2.53	4.73	0.31	1.95	4.59	1.71
Flowing water/stream/river	0.00	8.97	0.15	0.05	5.30	0.05	0.03	0.59	4.10	2.56
Stagnant water/dam/pool	0.04	0.17	0.15	0.00	0.46	0.20	0.00	0.04	0.42	0.18
Well	0.00	0.40	0.29	0.00	1.17	0.05	0.06	1.69	1.29	0.60
Spring	0.00	0.58	0.07	0.09	1.25	0.00	0.00	1.06	0.45	1.21
Other	0.22	0.30	0.03	1.57	0.19	0.70	0.12	0.64	1.01	0.57
Missing	0.04	0.20	0.22	0.14	0.19	0.10	0.19	0.00	0.14	0.14

Source: Author's computations from South Africa's Living Conditions Survey (LCS) 2014/2015.

cost either through sinking their own boreholes and other means of meeting their water demand. *do not have water meter* (10.95%) and *use own source of water*. Less than ten percent (i.e. 7%) cited “cannot afford to pay” as reason for non-payment. This suggest that vast majority of South Africans actually have the means to pay for water. Leakage for non-payment include reasons related to either meter is not working, absent or not receiving water bills

### **3.5. Empirical findings of factors explaining payment for water in South Africa**

For comparison purpose, both probit and logit regression models were implemented and the results of the two models are presented in Table 6. In implementing these models, we tested for presence of multicollinearity among the variables identified from the literature that may explain payment for water in the first stage. Some variables that failed the collinearity test were dropped at this stage. In addition, we examine the tolerance level of each variable to decide on the relevance of their inclusion in the model. The tolerance levels of included variables are presented in the last column of Table 6 and the average variance inflation factor (VIF) for the model was 1.36. This depicts an overall tolerance of about 73.52% which clearly indicates that multicollinearity pose no problem to both model. Both the probit and logit model estimates indicated a good fit for the data deducing from the statistical significance of the Prob.  $\chi^2$  statistics ( $p < 0.01$ ). The Pseudo  $R^2$  of 0.2857 for probit and 0.2879 for logit show that 28.5 and 28.7% variation in the outcome variable (i.e. payment for water) was explained by the independent variables included in the two models.

The log likelihood and the coefficient estimates from both the probit and logit models are closely similar in magnitudes and signs indicating that the relationships between the explanatory variables and the probability are indistinguishable and negligible. Despite the similarity in the probit and logit model results, it can however, be misleading to compare coefficients across the two models since the variance of the underlying latent variable (i.e. payment for water) may not be identified and can differ substantially across these models (Williams, 2012). Hence, the result of the probit regression model and its average marginal effects are discussed and the logit model result is included for the sake of comparison.

From the variables that were included in the model, income parameters (*Income*) are statistically significant at 1% level. The marginal effect at mean result indicates that if other variables are held at their means, probability of household payment for water significantly increase by less than 1% with R1 increase in the monthly income of the household. This result was anticipated a priori based on previous studies on willingness to pay for water, since household with high income tend to have more disposable income with which payment can be made for social amenities such as water, waste disposal and other taxable expenditure (Oyekale, 2015). Likewise, the parameters of age (*Age of head*) of the household head in the model has positive sign and statistically significant at 1% level. The marginal effect at the mean indicates that a unit increase in age of the household head increase the probability of payment for water by less than 1%. This finding may be due to prevalence of unemployment among youths in South Africa, which may make payment for water difficult for younger household heads in the country.

Furthermore, the parameter of the sex of the household head (*Sex of Head*) is positive and statistically significant at 5% level. The marginal effect at the mean shows that if other variables are held at their means, male household heads are 6% more likely to pay for water than their female counterparts. This finding may not be far-fetched as previous studies (Casale & Posel, 2011; Orr & Van Meelis, 2014) have also established gender wage gap in favour of men in South Africa which often limit the purchasing power of the women. Moreover, the parameters of Black South African population groups (*BLACKAF*) is statistically significant at 1% level. The marginal effect at mean indicates that if all other variables are held at their means, the probability of black South African household heads paying for water are 28% less than other population groups within the country. This may not be unconnected with the pervasiveness of poverty among these population groups when compared with white and coloured population groups.

**Table 4. Percentage distribution of supplier and distance from dwelling to main source of drinking water among households in South Africa**

Province	Western Cape	Eastern Cape	Northern Cape	Free State	KwaZulu Natal	North West	Gauteng	Mpumalanga	Limpopo	All
<i>Supplier of water</i>										
Municipality	96.16	71.36	83.85	94.61	82.65	74.64	95.89	82.39	66.91	83.13
Other water scheme	3.02	3.68	10.10	1.20	4.03	8.12	1.30	4.57	6.57	4.30
Not supplied by water scheme	0.63	24.63	5.31	4.06	12.16	15.55	1.64	11.43	24.71	11.57
Do Not Know	0.00	0.17	0.74	0.14	0.84	1.69	0.86	1.57	1.74	0.85
Missing	0.19	0.17	0.00	0.00	0.33	0.00	0.31	0.04	0.07	0.15
<i>Distance to main source of water</i>										
200 metres or less	5.49	19.64	12.61	3.27	13.41	16.44	2.90	11.47	24.54	12.28
201 to 500 metres	0.56	14.27	3.17	0.51	9.27	6.98	1.14	8.21	11.78	6.61
501 metres to 1 kilometre	0.04	8.03	0.29	0.46	7.70	4.68	0.28	3.18	6.74	3.89
More than 1 kilometre	0.00	2.36	0.00	0.00	2.07	0.75	0.00	0.89	2.64	1.11
Do Not Know	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.13	0.10	0.03
Not Applicable	93.62	55.13	83.11	95.35	67.09	70.60	95.18	75.15	53.35	75.50
Missing	0.30	0.57	0.81	0.41	0.46	0.45	0.49	0.97	0.83	0.57

Source: Author's computations from South Africa's Living Conditions Survey (LCS) 2014/2015.

**Table 5. Percentage distribution of respondents based on paying and reasons for not paying for water across the Provinces in South Africa**

Province	Western Cape	Eastern Cape	Northern Cape	Free State	KwaZulu Natal	North West	Gauteng	Mpumalanga	Limpopo	All
<i>Paying</i>										
Yes	58.01	25.81	50.37	26.73	28.23	35.92	49.66	26.76	19.71	34.92
No	41.99	74.19	49.63	73.27	71.77	64.08	50.34	73.24	80.29	65.08
<i>Reasons for not paying</i>										
Use own source of water	0.19	5.53	2.14	1.24	2.56	4.78	1.14	4.06	10.29	3.62
Use a free water source	7.99	43.25	14.09	2.40	20.42	16.94	3.34	24.77	30.55	18.87
Pay directly to landlord as part of rent	15.94	4.08	6.12	10.97	5.66	7.67	13.90	7.66	3.72	8.44
Payment included in levy	1.12	1.21	0.29	0.65	0.41	0.90	1.70	1.31	0.28	0.90
Permission from municipality not to pay	2.50	9.01	5.31	5.81	19.28	6.13	3.68	3.01	13.42	8.32
Do not have water meter	0.71	4.45	1.25	9.26	8.84	3.89	6.33	10.75	10.95	6.63
Water meter not working or broken	0.04	0.37	0.07	0.46	0.65	0.30	1.42	1.14	0.66	0.62
Do not receive water bill	2.72	0.98	2.06	8.11	7.10	7.17	2.32	8.47	1.77	4.44
Community decision not to pay	0.22	0.34	1.40	1.52	1.69	3.54	3.80	1.99	5.35	2.25
Cannot afford to pay	6.38	2.23	12.24	27.51	1.66	9.12	7.54	5.67	1.04	7.08
Water supply irregular	0.04	0.03	0.00	0.46	0.16	0.50	0.28	0.25	0.17	0.21
Water supply has been stopped	0.11	0.03	0.00	0.05	0.46	0.15	0.00	0.17	0.28	0.16
Other	2.91	0.98	2.14	3.23	1.12	2.44	2.59	2.46	1.11	2.01
Missing	1.12	1.69	2.51	1.61	1.77	0.55	2.32	1.52	0.70	1.53

Source: Author's computations from South Africa's Living Conditions Survey (LCS) 2014/2015.

**Table 6. Estimates from probit and logit regression model result**

Variables	Probit model			Average marginal effects			Logit model			Average marginal effects			
	Coeff.	Std. error	p-value	Coeff.	Std. error	p-value	Coeff.	Std. error	p-value	Coeff.	Std. error	p-value	Tolerance
SexofHead	0.0689	0.0289	0.017	0.0186	0.0095	0.052	0.0991	0.0503	0.049	0.0188	0.0095	0.049	0.9289
Ageofhead	0.0083	0.0009	0.000	0.0028	0.0003	0.000	0.0149	0.0016	0.000	0.0028	0.0003	0.000	0.8696
Hhsize	0.0009	0.0059	0.948	-0.0002	0.0019	0.888	-0.0023	0.0102	0.820	-0.0004	0.0019	0.820	0.8971
Income	0.0000003	0.0000001	0.000	0.0000001	0.000000001	0.000	0.0000005	0.00000002	0.000	0.0000001	0.000000005	0.000	0.8392
LONGTWO	-0.3196	0.0304	0.000	-0.1055	0.0099	0.000	-0.5777	0.0519	0.000	-0.1100	0.0099	0.000	0.7979
BLACKAF	-0.8914	0.0489	0.000	-0.2815	0.0167	0.000	-1.4953	0.0843	0.000	-0.2849	0.0167	0.000	0.7002
INDIGENT	0.2632	0.0318	0.000	0.08455	0.0104	0.000	0.4707	0.0540	0.000	0.0897	0.0103	0.000	0.9159
DRINKM	0.9554	0.0477	0.000	0.3473	0.0166	0.000	1.8154	0.0977	0.000	0.3459	0.0166	0.000	0.7863
OWNPROD	-0.2161	0.0505	0.000	-0.0740	0.0171	0.000	-0.3871	0.0898	0.000	-0.0737	0.0171	0.000	0.6373
INVOLVED	-0.3024	0.0502	0.000	-0.1063	0.0171	0.000	-0.5593	0.0903	0.000	-0.1065	0.0171	0.000	0.6130
Western Cape	-0.1921	0.0729	0.008	-0.0519	0.0204	0.011	-0.3092	0.1272	0.015	-0.0589	0.0242	0.015	0.6693
Northern Cape	0.4139	0.0711	0.000	0.1503	0.0279	0.000	0.7060	0.1239	0.000	0.1345	0.0236	0.000	0.7703
Free State	-0.1375	0.0501	0.006	-0.0413	0.0150	0.006	-0.2415	0.0880	0.006	-0.0460	0.0168	0.006	0.6362
Kwazulu Natal	0.0600	0.0478	0.210	0.0153	0.0158	0.333	0.0822	0.0848	0.333	0.0156	0.0161	0.332	0.6492
North West	0.2672	0.0564	0.000	0.0902	0.0204	0.000	0.4452	0.0982	0.000	0.0848	0.0186	0.000	0.7603
Gauteng	0.1739	0.0524	0.001	0.0573	0.0178	0.001	0.2921	0.0901	0.001	0.0556	0.0171	0.001	0.6166
Mpumalanga	0.0543	0.0517	0.293	0.0209	0.0170	0.219	0.1114	0.0903	0.217	0.0212	0.0171	0.217	0.7004
Constant	-1.3623	0.0933	0.000				-2.2195	0.1670	0.000				
Observation	11, 838						11,838						Mean VIF = 1.36
Prob. > $\chi^2$	0.0000						0.0000						
Pseudo R <sup>2</sup>	0.2857						0.2879						
Log likelihood		-5,258.5382						-5,242.0851					

Source: Author's computations from South Africa's Living Conditions Survey (LCS) 2014/2015.



As expected, the parameter of households that use tap water as main source of drinking water (*DRINKM*) is also statistically significant at 1% level. The mean marginal effect result reveals that households that use tap water as their main source of drinking water are 34% more likely to pay for water than those that use alternative sources like borehole, tanker services, well and others. Counterintuitively, households that are registered on indigent register (*INDIGENT*) are 8% more likely to pay for water than those that are not listed on indigent register, whereas engagement in agricultural and food production, livestock production or own production activities that were anticipated a priori to encourage payment for water discourage payment for water by 7% and 10% respectively. This result is counterintuitive because households on indigent register are generally considered as poor and often need government social security support, hence, they may not be able to pay for various social amenities like electricity, water and waste disposal. In like manner, households that use water for agricultural and food production, livestock production or own production activities should be willing to pay since water is critical to their production process. In addition, the parameters of water interruption for more than two days (*LONGTWO*) shows statistical significance at 1% level. The coefficient of the marginal effect at the mean indicates that if other variables are at their means, water interruption for more than two days will reduce the probability of payment for water by 10.5%. This was anticipated a priori because water interruption for longer period will reduce utility derived from paying for water and hence discourage payment for water.

The provincial polychotomous dummy variable adopted Eastern Cape and Limpopo as the reference category because both provinces have consistently shown highest levels of poverty between 2006 and 2015 in South Africa (Kavese, 2017). All the provincial variables included in the model are statistically significant at 1% level except KwaZulu Natal and Mpumalanga province. This implies that if all other variables are held at their averages, households in Northern Cape (0.4139), North West (0.2672) and Gauteng (0.1739) have higher probabilities of paying for water when compared to those in Eastern Cape and Limpopo Provinces, which are regarded as the poorest provinces by the recent released reports, by Statistics South Africa. Whereas households in Western Cape (-0.1921) and Free State (-0.1375) shows lesser probabilities of paying for water when compared to the households in these two poor provinces. The results of the marginal effects the significant provincial variables indicates that Northern Cape, North West and Gauteng provinces households are 15.03, 9.02 and 5.73% more likely to pay for water respectively. However, surprisingly, households in Western Cape and Free State are 5.19 and 4.13% respectively less likely to pay for water compared to Eastern Cape and Limpopo provinces.

#### 4. Conclusions

This study investigated payment for water, which is necessary for ensuring sustainable water management and mitigating drought in South Africa. Findings emanating from the study indicates that a dismally low 35% of South African households were paying for water in 2014. The lowest level of payment of 19.71 and 25.81% were identified among households residing in Limpopo and Eastern Cape provinces. Among the major reasons cited for not paying for water across South Africa provinces include use of free water source (18.87), permission from municipality not to pay (8.32%), lack of water meter (6.63%), do not receive water bill (4.44%) and cannot afford to pay (7.08%) among others. These findings emphasize the need for more proactive water billing system that address water revenue leakages and formulation of policies that will enhance purchasing power of South Africans which will enable them to pay for social amenities such as water. In similar vein, addressing all the reasons cited due to poor water management such as not receiving bills for water use and using water without water meter will eventually lead to high water revenue in the country.

Behavioral reorientation has been regarded as strategic to addressing issue of water conservation in developing countries. In this study, households with higher income were more involved in paying for water. Hence, addressing the issue of poverty in South Africa may be very critical to promoting payment for water and ensuring sustainable water management in the country. This recommendation can be reinforced further from the findings that indicated low probabilities of paying for water by black household heads population among whom there is pervasiveness of poverty. Emphasizing

collective and individual responsibilities of safeguarding water conservation through some media and sensitization programs would go a long way in strengthening water conservation in South Africa. Periodic public lecture should also be provided on water conservation and the need to desist from water wastage and recognition of other citizen rights to clean and uncontaminated water.

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#### Competing interest

The authors declare no competing interest.

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