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Assessment of Determinants of Domestic Water Demand in Rural Areas of Swaziland

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Abstract: This study is based on a study in which questionnaire interviews were administered to investigate the determinants of domestic water demand in rural areas of Swaziland. A total of 180 household heads were interviewed in Siphofaneni area to provide primary data for this study. The study discovered that average domestic water use per person per day was only 10 L and most households had unmet water demand for most domestic uses. The results suggest that income, household size and distance from homesteads to water sources are the major determinants of domestic water demand. Households with five or less people tend to collect small amounts of water (0-100 L/day) whereas larger households (greater than five) are likely to fetch larger quantities of water (more than 100 L/day). The chi-square test results reveal that there is a highly significant association between household size and amount of water collected, while the gamma value of 0.73 led to the conclusion that the association is strong and positive. The chi-square test results also show that there is a strong positive relationship between household income and amount of water collected that was significant at 1% level of significance. There is also a strong positive relationship between amount of water collected and household monthly income with the gamma value of 0.44 being significant at 1% level. The chi-square test results show that there is no association between distance travelled to water sources and amount of water collected at $p<0.05$ significance level. However, gamma values show a negative moderate association between distance travelled to water sources and amount of water collected at $p<0.05$ significance level.

Key words: Domestic water use, households, Siphofaneni, Swaziland, water sources

INTRODUCTION

Recent scholarship on rural water development in Africa has focused attention on domestic water demand (Mbata, 2006; Whittington *et al.*, 1998) and supply issues (Peter, 2009; Manyatsi and Mwendera, 2007; Matondo and Msibi, 2010). However, in southern Africa there is lack of information on the factors that determine domestic water demand in rural areas where rivers, springs, dams, wells and boreholes are the main water sources. Generally rural water supply strategies by governments in the region have been supply-driven and as a result demand issues have tended to receive insufficient attention in the development of water supply policies. Water demand studies reveal that socio-economic factors (such as education and income of the household head) and spatial factors (such as distance of the water source from the homestead) are key determinants of rural domestic water demand in other developing regions (Movik and Mehta, 2009; Sandiford *et al.*, 1990). A study by Whittington *et al*. (1998) done in Kenya highlights the need to include social characteristics of households in water demand analysis. A more recent study done by Kanyoka (2008) on water value and demand in rural areas of South Africa reveals that the determinants of water demand include type of water source, water quality, price of water, distance from existing sources, educational level, age and gender of household head. In Swaziland basic information on the determinants of water demand has been a missing link yet this information is necessary in order to develop appropriate water supply programmes that are aimed at meeting the rising demand. The aim of the study was to assess the main determinants of domestic water demand in rural areas of Swaziland using Siphofaneni *inkhundla* (administrative area) as a case in point.

METHODOLOGY

Description of the study area: Siphofaneni *inkhundla* (administrative area), which is situated in the Lubombo region of Swaziland, was considered ideal for the study because it is a rural area that is representative of many

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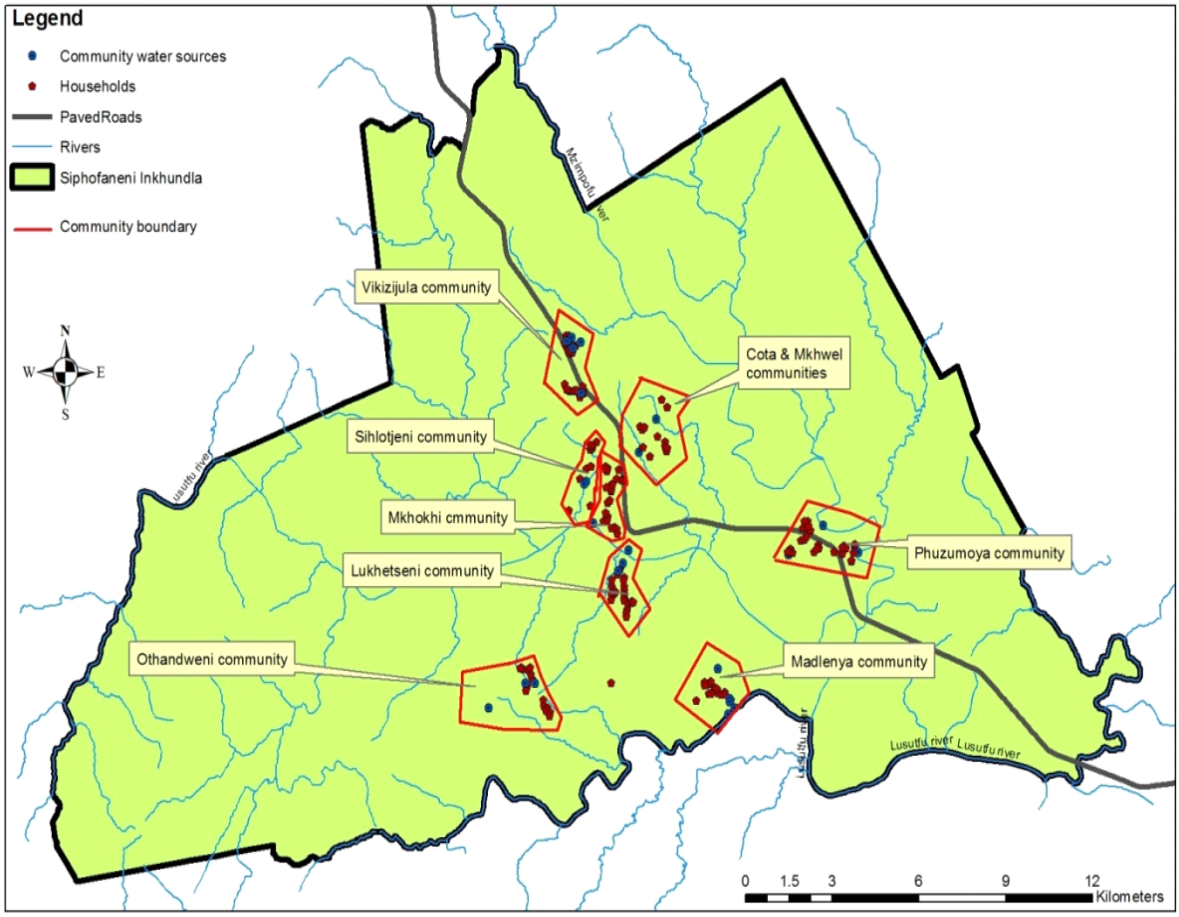

Fig. 1: Map of Siphofaneni area showing the sampled households and their domestic water sources

low rainfall and water scarce parts of the country. The *inkhundla* has ten chiefdoms and four of these, with a total of about 1800 households, were selected as representative of the ten chiefdoms (Central Statistical Office, 2007). Furthermore, the choice of the four chiefdoms was based on the availability of a wide range of water sources within a relatively small area and also taking into consideration time and budget constraints. All the chiefdoms fall under the Swazi Nation Land (SNL) (communal land) and its major economic activity is subsistence agriculture. Homesteads in the area generally form clusters, especially close to water sources or arable land. The main sources of ground water in the area include springs, hot springs, boreholes, rivers (e.g., Great Usuthu and Mhlatuzane rivers) and seasonal streams (e.g., Mtimpofu and Mshumpula streams) and dams (e.g., Lubovane Dam). The main domestic water uses in the area include cooking, washing, bathing and drinking.

Data collection and presentation: Primary data for this study were collected from a household survey conducted between November 2010 and January 2011. Eight localities (communities) in Siphofaneni *inkhundla* were selected from four chiefdoms (Mkhweli, Vikizijula, Maphilingo and Madlenya) using a designed questionnaire. Figure 1 shows the locations of the sampled households in the eight communities that were surveyed. The questionnaire was pilot tested to ascertain its validity and adequacy of the sampling variability within the population to be surveyed. Information regarding household composition, size, income, water sources, distance to water sources and access control measures to water sources was obtained from household heads.

The target population was all the households in the four chiefdoms, namely Mkhweli chiefdom (268), Vikizijula (188), Maphilingo (594) and Madlenya (745). A list of households in the four chiefdoms was obtained from the Rural Development Area office at Siphofaneni. A stratified random sample of 180 households was drawn (i.e., 10% of the target population of 1800 households). In order to ensure that there was meaningful representation,

10% of the households in each of the four chiefdoms were included in the sample. Simple random sampling procedure was then used to determine the household heads who were interviewed in the eight communities within the four chiefdoms. The names of the household heads were captured on excel spreadsheet and names for inclusion in the sample were obtained according to the random numbers generated by Excel formula.

A Statistical Package for Social Sciences (SPSS version 18) was engaged to create a dictionary for data entry and analysis. The collected data were cleaned, recoded and analysed using cross tabulations and descriptive statistics. Cross tabulations were done to identify significant variables, which had an influence on water demand. The chi-square values were used to assess a significant relationship ($p<0.05$) of explanatory variables. A gamma test was conducted to determine the direction and strength of association between water demand and the explanatory variables. The findings of the study were summarised in figures and tables.

RESULTS AND DISCUSSION

Water sources and domestic water demand: As many as 35.4% of the households had rivers as their main source of water for domestic use; another 22.5% had protected wells or canals as their main source of water while 17.4% had unprotected wells as the main source. Only 5.6% of the households reported that communal standpipes were the main source while just 1.7% had personal standpipes as their main source. This finding is consistent with a general observation by Matondo and Msibi (2010) that groundwater is the main source of potable water in the rural areas of Swaziland.

Demand for domestic water was determined through soliciting views of the respondents on whether the water collected by the household was adequate for domestic use. The study discovered that average domestic water use per person per day is only 10 L which is considerably lower than the WHO suggested minimum of 20 L per person per day. Not surprisingly, 56.9% of the respondents mentioned that most of the times the amount was not adequate to meet the daily requirements of the households while 84.3% stated that water shortages were only seasonal, particularly during the dry winter months from May to July when the water table is low. The few (15.7%) households that had not experienced any water scarcity challenges either had piped water on their premises or had some better means of water conveyance like cars or tractors which enabled them to collect the required amounts of water from various sources. As many as 43.9% of the households collected water by head or carried it by hands from the water sources while 24.4% households used wheelbarrows and

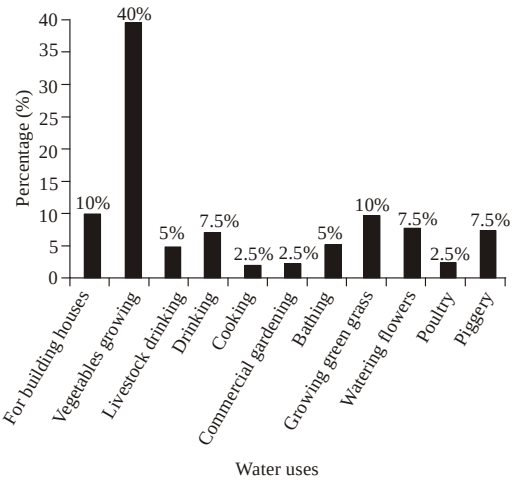

Fig. 2: Uses for which water demand has not been met

7.2% used a hired tanker. Only 1% of the households collected water using the family car or oxen drawn carts. Households used various containers, with the 20 and 25 L water pails being used by 35.8 and 40.5% of the households, respectively.

Worth noting is that domestic water use in the study area is hampered by water shortages. Figure 2 shows the various uses where water demand is unmet due to lack of water or capacity to collect the required water. As many as 40% of the households had unmet water demand for vegetable growing while unmet water demand for most domestic uses was 10% or less (Fig. 2).

Determinants of domestic water demand:

Distance to water sources and amount of water collected: The study sought to establish whether or not distance between homesteads and water sources was a determinant of water demand. Household heads were asked to specify the distance travelled by household members to the water sources and the amount of water collected per day. A majority (63.3%) of households stated that they collected water from sources that were beyond 200 m away from the homesteads. Table 1 shows that households which were more than 200 m away from the water source (73.3%) tended to collect less water (less than 100 L) a day whereas the households close to water sources (0 to 200 m) generally collected larger amounts of water (greater than 100 L). The measure of strength of association, gamma, shows a negative moderate relationship between distance travelled to water source and water demand. However, the chi-square value of 4.54 shows that there is no association between distance travelled and water demand at 5% level of significance but the gamma value of -0.30 is significant at $p<0.05$. This shows that distance is a weak determinant of domestic water demand in Siphofaneni rural area of Swaziland.

Table 1: Perceived distance traveled to the water source and amount of water collected

Amount of water collected (L)	Perceived distance travelled, metres (m) 0-200	>200	Total
0-100	57.4	73.3	67.5
101-200	19.7	11.4	14.5
>200	23.0	15.2	18.1
Total	61	105	166
Chi-square, p-value	4.54	0.103	
Gamma, p-value	-0.30*	0.047	

*: Significant at p<0.05

Table 2: Household size and amount of water collected per day

Amount of water collected (L)	Household size 1-5	>5	Total
0-100	85.5	50.6	67.1
101-200	14.5	23.4	19.2
>200	0.0	26.0	13.7
Total	69	77	146
Chi-square, p-value	26.01***	0.000	
Gamma, p-value	0.73***	0.000	

***: Significant at p<0.001

Table 3: Monthly income and amount of water collected per day

Amount of water collected (L)	Monthly income, Emalangeni (E) 0-1500	>1500	Total
0-100	75.0	55.1	65.7
101-200	15.9	12.8	14.5
>200	9.1	32.1	19.9
Total	88	78	166
Chi-square, p-value	13.73***	0.001	
Gamma, p-value	0.44***	0.001	

***: Significant at p<0.001; 1USD: E7.6 at the time of the survey

Household size and amount of water collected: The chi-square value of 26.01 in Table 2 led to the conclusion that there is a highly significant association ($p \leq 0.000$) between water demand and household size. The gamma value of 0.73 led to the conclusion that there is a strong positive association between amount of water collected and household size. Households with five or less people tended to collect small amounts of water (0-100 L/day whereas larger households (greater than five) fetched larger quantities of water (more than 100 L/day). Generally, the larger the household the more likely it is to collect large amounts of water per day while the smaller the household the more likely it is to collect small amounts of water per day.

For example, a cross tabulation of household size and the amount of water collected indicated that 43% of the households with 0-5 members, used less than 50 L/day, 16% used 51-100 L/day, 4% uses 101-150 L/day and 6% of these households used 151-200 L/day. On the other hand, only 23% of the households with 6-10 people collected less than 50 L/day, while 30% collected 51-100 L/day, 11% collected 101-150 L/day and only 14% collected above 200 L/day.

Income and amount of water collected: Considering the amount of water collected by the households across various income levels from less than E300 to more than E1900/month, the study revealed that households with heads that earned a high income tended to consume more water. This may be attributable to the fact that most of these had access to tractors, family cars and hired tankers which they used to collect water. Also these were mostly the households which had private standpipes in their homesteads. The chi-square test results show that the relationship between income and amount of water collected was significant at 1% level of significance (Table 3). There is also a strong positive relationship between amount of water collected and monthly income. The gamma value of 0.44 was significant at 1% level. Households with low income (less than E1500 or USD200) are likely to collect less amount of water (less than 200 L/day) whereas those with high income tend to fetch larger amounts of water (more than 200 L/day).

CONCLUSION AND RECOMMENDATIONS

The study examined the determinants of domestic water demand in four rural chiefdoms in Swaziland. The findings revealed that most households in the study area still used unprotected water sources for domestic purposes due to lack of alternative good quality water sources. The study discovered that several factors tend to determine domestic water demand and these include household size, income and distance of water sources from homesteads. Generally, large households with more than five people or those with heads earning more than E1500/month (USD200), had a higher water demand, while households that were more than 200 m away from water sources tended to use less amounts of water than households that were less than 200 m from water sources. The statistical results reveal that there is a highly significant and positive association between household size and amount of water collected and that a strong positive relationship also exists between household income and amount of water collected. However, while the chi-square test results show that there is no association between distance travelled to water sources and amount of water collected at p<0.05 significance level, the gamma values show a negative moderate association at p<0.05 significance level between distance travelled to water sources and amount of water collected. A policy recommendation seems plausible from the study findings. Since there is a strong positive relationship between monthly income and the amount of water collected there is need for further studies which focus on determining willingness to pay for improved water supplies in rural areas.

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