

ASSESSMENT OF WATER SUPPLY AND ITS IMPLICATIONS ON HOUSEHOLD INCOME IN KABUKU NDANI WARD, HANDENI DISTRICT, TANZANIA

ABSTRACT

Aims: To assess the water supply and its implications on household income in Kabuku Ndani ward, Handeni district, Tanga Region.

Place and Duration of Study: A cross sectional design was conducted between November 2013 and January 2014 in Kabuku Ndani ward.

Methodology: Questionnaire related to water supply and household income was administered to 90 of respondents who were randomly selected. Interviews with five key informants explored issues related to water supply and its influence on household income. Highest proportion of the respondents falls between 26-56 years of age. About 42% of respondents did not attend any formal education while 59% had attended formal education.

Results: Marital status and occupation showed a significant influence on water supply ($P=0.036$ and 0.048 respectively). Logistic analysis showed that infrastructure, management, occupation, education and age were significant ($P=0.05$) predictors of household income. People perceived that there was a direct relationship between water supply and household income. Water was a big problem which was thought to be caused by unreliability of sources, obsolete water infrastructure, administration problems and climate changes. The available water supplies did not meet household requirements and the Kabuku Ndani residents stored water in different ways like the use of jerry cans. In addition long distances from settlements to water sources led people spend up to 30 minutes fetching 20 litres of water on foot. The water was of poor quality and it could have led to serious water-borne diseases such as typhoid fever. The costs for water were alarmingly high which amounted between TZS 36, 000 and 54, 000 per month per household depending on family size

Conclusion: The study concludes that water supply problem in Kabuku ward has influence on the limited available household income. Therefore addressing water shortage problems combined efforts at local and national levels are required.

Keywords: *Assessment, water supply, household income, Kabuku Ward*

1. INTRODUCTION

1.1 Background Information

Water is crucial for sustainable development however, limited access to clean and safe water associated with poor water supply, hygiene and sanitation at household level is widening the poverty gap, gender inequalities and the prevalence of water-borne diseases (1). Water is an essential resource for survival and a catalyst to the world socio-economic development (2). Water is required for various purposes ranging from domestic uses, industrial production, irrigation, hydropower production, navigation to recreational activities and tourism (3). Currently, over 768 million people face water scarcity, most of them are in sub-Saharan Africa representing one quarter of the global population that faces water scarcity (4).

Tanzania is among the few countries endowed with both surface and underground water resources to meet most of its present needs (5). Despite the vast amounts of freshwater available, many Tanzanians both in rural and urban areas are still faced with water shortages due to insufficient capacity of water resources management (2). Among the regions in Tanzania with diminishing

quantities of safe water is Tanga (6). The region has different types of sources of water supply including Charco dam, springs, rivers, shallow wells and boreholes; shallow wells being the leading water source. Some areas such as Korogwe, Muheza and Handeni are deprived of reliable water supply (7). Handeni is among the dry districts in Tanzania; it has neither a permanent river nor lake. Water supply is not adequate in the district since only 42% of the rural population is supplied with clean and safe water, while 58% of the urban population gets clean and safe water (8). The available water is from different sources such as Handeni Truck Main scheme, dams, ponds, shallow wells and boreholes (9).

Empirical observations of existing piped water systems in developing countries reveal that many of these systems are not functioning properly. In response to deficiencies in the piped water supply or availability, households invest in alternative supply sources. A household may choose different sources of water for different uses. The coping strategies adopted by households have important economic implications. Households incur high fixed costs, in the form of investment in alternative supply sources and storage facilities, and recurring costs, in the form of water purchases from vendors, when coping with water supply deficiencies. Moreover, they also incur indirect costs such as diversion of labour away from income-generating activities to coping activities of water supply deficiencies (4).

Both men and women lack access to clean and easily accessible water for domestic use and small production activities. They face increased drudgery due to increased waiting time at water points and increased walking distances and insecurity for the girls while fetching water; unimproved health and nutrition due to unclean water and poor sanitation and other hygiene practices (1). This plays a role in gender discrimination where women fail to engage in other income generation activities for increased disposable income at the household level as well as participation in other productive activities such as agriculture which would further contribute to the general well-being of the household. Also unimproved health and living conditions directly impact on economic security for the community by making difficult for men and women to undertake income generation activities, because of reduced time availability and unimproved health (African Development Fund, 2006). The evidence above gives an overview on the association of water supply and household income due to the fact that water shortage has similar impacts in different regions/places as with the case of Handeni District.

2. MATERIAL AND METHODS

2.1 Study Area

The study was conducted in Handeni District in Kabuku Ndani Ward (Figure 2) with the population of 15,551 people (7,787 males and 7,764 females (NBS, 2013). Handeni is one of the 8 districts in Tanga region. The district is located within the latitudes 40 55' and 60 04' S and longitudes 370 47' and 380 46' E. The district has 23 wards including Kabuku Ndani (2). Kabuku Ndani ward has a total of four administrative villages namely Majani Mapana, Kabuku Mjini, Chogo and Kabuku Ndani. Community living in Handeni district depends on different types of freshwater sources including Handeni Truck Main scheme, manmade dams, ponds, shallow wells and boreholes. Such sources of water are sometimes unreliable and people suffer from water shortage.

2.2 Justification for the Study Area

Handeni has several wards; Kan'gata, Mkata, and Kabuku Ndani to mention few. Kabuku Ndani was chosen from many other wards to be the case study area due to its logistical location and the fact that it experiences critical water shortages. Also several authors such as Tanga Region Socio-Economic Profile (10), Handeni District Profile (11), Handeni District Investment Profile (12) and EWURA (13) have documented the problem of water supply in Tanga region, Handeni district and Kabuku Ndani ward in particular.

2.3 Research Design

A cross-sectional research design was used whereby data were gathered at one point in time (14). Cross sectional design was used because it enable collection of information at one point in time. The study focused on all selected households within the sample villages. Both qualitative and quantitative data were collected.

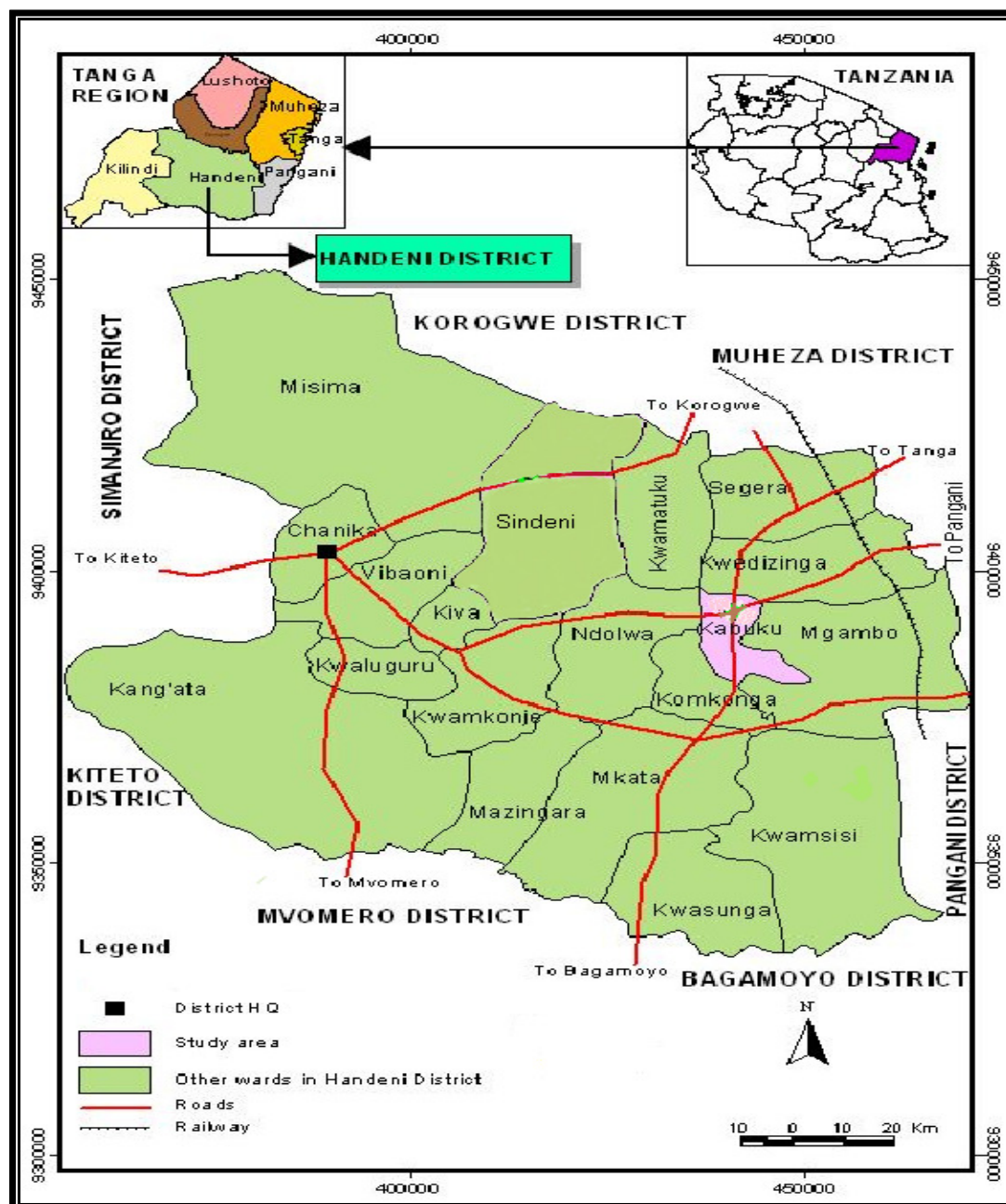


Figure 1: A map of Handeni District showing the study area (Kabuku) shaded with green colour. *Insert* is a map of Tanzania with purple paint indicating the location of Tanga region in which Handeni is one of the districts

2.4 Sampling Procedures

2.4.1 The study population

The sample was drawn from heads of households or adults in the household from the selected study villages. A household is defined as a person or group of persons, related or unrelated who live together and share a common source of food (15).

2.4.2 Sample size and unit of analysis

According to Bailey (16) regardless of the population size, a sample or sub sample of 30 cases is bare minimum for studies in which statistical data analysis can be done. The unit of analysis of this

study was the household. The formula used in calculating sample size was; $n = N / [1 + N (e^2)]$ whereby; n represents Sample size, N =Total population, e=10% Sample error (17).

Sample size calculation

Formula; $n = N / [1 + N (e^2)]$

Whereby; n = represents sample size

N = Total population

e = 10% Sample error (Bartlett *et al.*, 2001).

N = 15,551

e = 10% = 0.1

Then;

$n = N / [1 + N (e^2)]$

$$= \frac{15,551}{1 + 15,551(0.1^2)}$$

$$= \frac{15,551}{1 + 15,551 \times 0.01}$$

$$= \frac{15,551}{1 + 155.51}$$

$$= \frac{15,551}{156.51}$$

$$= 99.361$$

Therefore, sample size for this study was supposed to be 99 respondents but 90 respondents were selected due to low and fixed cost.

In addition in-depth interviews were carried out with 5 key informants. Key informants included District Executive Director, District Water Engineer, Ward Councillor, Ward Executive Officer and Village Executive Officer.

2.4.3 Sampling technique

Purposive sampling was used to select the villages from Kabuku Ndani ward. Selection based on the villages which were mostly affected by water shortages in the ward and also easy accessibility during data collection. In this case Majani Mapana, Chogo and Kabuku Ndani were selected as study villages. Simple random sampling was used in selecting households from different villages. Respondents were selected through the village register books from the village executive officers (VEOs) offices. The process of selecting the study household by simple random sampling involved first to list all the names of household heads in the selected villages and then recorded them on small pieces of papers, folded, shuffled and picked the folded papers at random. The names of the households that were picked through this method were written in a sheet of paper. In each village, an equal number of respondents i.e. 30 respondents were randomly selected for the study. A few people (<5%) who hesitated to participate in the interview on different grounds were replaced by other households who were randomly selected from the list.

2.5 Data Collection Procedures

2.5.1 Pre-testing and recruitment of research assistant

2.5.1.1 Pretesting of the research tools

Before pre-testing of the questionnaire, the revised version of the questionnaire was translated into 'Kiswahili', the national language understood by majority of Tanzanians for easy communication. Pre-testing of the questionnaire was done in order to assure their clarity and relevance. Questionnaires for pre-testing were administered to 10 respondents drawn from the population with similar characteristics to the respondents. Respondents who were used during pre-testing were not included in the research. Questionnaires were modified accordingly to incorporate lessons drawn from the pre-testing.

2.5.2 Primary data

2.5.2.1 Structured interview

Both quantitative and qualitative data collection methods were used to obtain primary data. The main tool for quantitative data collection was a structured questionnaire containing both closed and open-ended questions (Appendix 2). The questionnaires consisted of various aspects related to water supply and household income. These included determining the sources of water available in the research area and their reliability; accessibility to water supply in terms of distance, time and the price; identification of water related activities in the area; gender role in water supply and other factors causing water shortages. The questionnaires were administered by hand delivery to the respondents in their households.

2.5.2.2 Key informants interviews

This involved the use of checklist of questions (Appendix 3) to gather official technical data from five key informants. The key informants include: the District Executive Director, District Water Engineer, Ward councilor, Ward Executive Officer and Village Executive Officer who gave detailed information on water supply in the District. Key informants were selected because they had first-hand knowledge about the community, residents and issues being investigated. Also they were mixed to ensure a variety of perspectives. The information was collected through note books whereby each interview took an average duration of 25 minutes. The interviews were conducted in the office of each respective informant. The key information collected include water sources, amount of water available per person per day, current users of the water sources, sufficiency of the available water for short and long time and water sources quality.

2.5.2.3 Physical field observation

This offered an opportunity for objective assessments of on-site situations of members and further probing of issues that were not covered in the structured questionnaire and checklist. For instance water sources and means of transport were observed as well as the distance from most households to water sources. This also enabled the researcher to estimate the possible time that may be spent per one trip of fetching water from the source on foot.

2.6 Data Processing and Analysis

2.6.1 Quantitative data

Quantitative data were analysed using the Statistical Package for Social Sciences (SPSS). One-Way ANOVA was used to measure the significance differences on water supply across demographic factors for objective two. For objective three, percentages and cross tabulations were used to assess the magnitudes of relationships using Chi-Square Test at a critical probability of $P < 0.05$ at 95% confidence intervals. Also Binary Logistic Regression was used to analyse the maximum likelihood estimates for household income. Moreover, Chi-Square test was used in examining the significance of relationships between household income of people in Kabuku Ndani ward and water supply.

Also the standard residual to critical value that corresponds to an alpha of 0.05 was set. For research hypotheses, if the probability of the test statistic is less than or equal to the probability of the alpha error rate, the null hypothesis is rejected and conclude that the data supports the research hypothesis. This signifies that there is a relationship between the variables and if the probability of the test statistic is greater than the probability of the alpha error rate, the null hypothesis is not rejected. Therefore the conclusion is drawn that there is no relationship between the variables.

2.6.1.1 Regression analysis

An index on variables that influence household income was developed. Binary logistic regression analysis for hypothesis one was used to examine relationship between water supply and household income. It was made using sets of statements which were included in the questionnaire administered to selected respondents. Setting of such statements was necessary because it was not easy to solicit information for such variables by asking one question to a respondent. Answers from those statements were entered into factor analysis to determine the most important among the sets of statements determining each index variable.

2.6.1.2 Specification of the logistic regression model

The logistic regression model was run to establish the relationship between the dependent (household income) and independent variables. The model was presented as follows;

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon$$

$Y = \alpha + \beta_1$ age + β_2 sex + β_3 occupation + β_4 education level + β_5 marital status + β_6 household size + β_7 infrastructure + β_8 water sources + β_9 management + β_{10} rules, norms and/ or beliefs.

Y = Dependent variable (household income).

Age = Age of respondent in years.

Sex = 1 if member is a male, 0 if otherwise.

Occupation = 1 if crop producer, 0 if otherwise.

Education level = Education attained by household member in ears of schooling.

Marital status = 1 if married, 0 if otherwise.

Household size = Number of household members.

Infrastructure = 1 if functioning, 0 if not functioning.

Water sources = 1 if reliable, 0 if not reliable.

Management = Institutional arrangement for water sources management.

Rules, norms and/or beliefs = Traditional practices pertaining to water supply.

ε = An error term.

α = Constant term

$\beta_1, \beta_2, \beta_3, \dots, \beta_{10}$ are coefficients for variables.

2.6.2 Qualitative data

The transcript from focus group discussions and key informant interviews were analyzed using thematic analysis, a flexible qualitative method of analysis used for identifying themes within the collected data (18).

The data were analysed manually, in which transcripts were read several times to become familiar with the whole data and to get a general overview. Key informants transcripts were also reviewed to identify meaningful concepts. After the data was read from all gathered notes, different themes were established. The aim of content analysis in this study was to reduce the total content of qualitative information into a series of variables. Verbal discussion held with the selected government officials representatives were broken down into meaningfully information using content analysis in order to ascertain values and attitudes of respondents.

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Background characteristics of the respondents

The background characteristics considered in the study included age, sex, marital status, education level, occupation, household size and length of stay in the ward (Table 1). The study assessed whether these parameters had any influence on the household income. Demographic characteristics of the respondents showed that more than three quarters of those interviewed were above 26 years of age. The result consistently shows that the highest proportion of the respondents falls between the ages of 26-56 years. Large number of respondents was males. Assessment of level of education indicated that about (41.2%) of the respondents did not attend any formal education while (58.8%) attended formal education. Four kinds of marital characteristics were observed to the study participants being dominated by those who were married. The others were divorced, separated, widowed and unmarried. The religion of the respondents indicated that Muslims were the dominant while the common ethnic groups were Zigua followed by the Sambaa.

The distribution of respondents among the various occupation groups in the communities studied show that there are more farmers than any other group. This distribution is not interesting because it shows, among other implications that, in rural areas the non-farm informal sector is not growing. The lengths of stay of the respondent in the ward varied whereby majority stayed in the ward for more than 14 years. It was also established that more than half of the respondents have between 5 and 8 members in their households suggestive of extended family.

273 **Table 1: Demographic characteristics of respondents (n=90)**

Variable	Category	Number of respondents	Percentage
Age (years)	15 – 25	8	8.9
	26 – 55	58	64.4
	Above 55	24	26.7
Sex	Male	52	57.8
	Female	38	42.2
Marital status	Married	69	76.7
	Divorced	6	6.7
	Separated	6	6.7
	Widowed	3	3.3
	Unmarried	6	6.7
Education level	No formal education	5	5.6
	Adult education	9	10.0
	Madrasa	23	25.6
	Primary education	23	25.6
	Secondary education	11	12.2
Religion	College education	19	21.1
	Muslims	60	66.7
	Christians	30	33.3
Ethnic groups	Zigua	38	42.2
	Sambaa	15	16.7
	Others	37	41.1
Occupations	Crop production	52	57.8
	Employment	31	34.4
	Business	5	5.6
	Pastoralists	1	1.1
	Crop and livestock production	1	1.1
Length of stay in the ward (years)	4 – 14	33	36.7
	15 – 44	31	34.5
	45 – 74	21	23.4
	Above 75	5	5.6
Household size	1-4	9	10.0
	5-8	60	66.7
	9-12	14	15.6
	Above 12	7	7.8

274 3.2 Significant Differences on Water Supply across Demographic Characteristics of 275 Respondents

276 The significance differences on water supply to household income across demographic factors
277 showed that, with exception of marital status and occupation other demographic factors were not
278 statistically significant (Table 2). Therefore, these factors have no significant influence on water supply
279 to household income. Marital status shows a significant influence on water supply ($P=0.036$) which
280 implies that marriage determines different modes of water availability of a particular household.
281 Occupation of the respondents was also a significant factor to water supply ($P= 0.048$) which implies
282 that the source of income which determines financial status of a particular household has a significant
283 influence on the mode of accessing water for day-to-day uses.
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294 **Table 2: Significance differences on water supply across demographic factors (n=90)**

Respondent variables		Sum of Squares	df	Mean Square	F	P value
Age	Between groups	29.179	1	29.179	0.085	0.772
	Within groups	29938.102	87	344.116		
Sex	Between groups	0.008	1	0.008	0.034	0.854
	Within groups	21.947	88	0.249		
Marital status	Between groups	6.058	1	6.058	4.516	0.036*
	Within groups	118.042	88	1.341		
Education level	Between groups	0.805	1	0.805	0.373	0.543
	Within groups	189.651	88	2.155		
Occupation	Between groups	18.305	1	18.305	4.006	0.048*
	Within groups	402.095	88	4.569		
Household size	Between groups	0.240	1	0.240	0.441	0.508
	Within groups	83.399	153	0.545		

*Statistically significant P <0.05 at 95% level of significant

3.3 Respondents perception on the implication of water supply on household income

This was developed to measure the level on how people in the study area perceived the relationship between water supply and household income (Table 3). The study came up with different perceptions of people in different households. The average score shows that (61.1%) strongly agreed, (17.2%) agreed, (3.9%) undecided, (11%) disagreed and (6.8%) strongly disagreed with all the statements.

Table 3: Perception levels on the implication of water supply on household income

Statement	Strongly agree (%)	Agree (%)	Undecided (%)	Disagree (%)	Strongly disagree (%)
There is no relationship between water supply and household income	7.8	12.2	2.2	63.4	14.4
Utilization of water resources maximizes economic growth	66.7	26.7	2.2	2.2	2.2
The current conservation measures are not efficient	58.9	25.6	8.9	3.3	3.3
Poor water supply leads to poor sanitation	66.7	17.8	3.3	7.8	4.4
Long distances to water points delays other economic activities	83.3	10.1	2.2	3.3	1.1
Women and vulnerable groups are highly affected by poor water supply	78.9	11.1	5.6	2.2	2.2
Women and young girls play a great role in searching water	57.8	16.7	3.3	4.4	17.8
Water searching is done	68.9	17.8	3.3	1.1	8.9

by both males and
females

Average scores	61.1	17.2	3.9	11	6.8
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3.4 Water Sources, Uses and Reliability

This section describes water sources, uses and problems which household confront in obtaining water for domestic use. The critical problems confronting household in obtaining water for domestic uses were mainly time and distance (Table 4)..

3.4.1 Sources of water

Large portion of the population in the ward use tap water under the Handeni Trunk Main (HTM) project and bore holes for drinking, cooking, washing and other household activities as their main sources. In addition to tap water and bore holes, the community members have also access to shallow wells and rain water (Table 4, Plate 1). Rainwater runoff from roofs can be collected and stored for drinking and other household activities. Unless the rain water is contaminated during collection, it is believed to be of good quality and the only source of contamination may be airborne microbes and chemicals that may be in form of smokes. Likewise, in the community the rain water is perceived to be the cleanest water. However, the results on reasons for choice of a certain type of water source show that (74.4%) of the population interviewed indicated that it was controlled by cheapness and reliability.



Plate 1: Bore hole (A) and rain water harvest (B) as sources of water in Kabuku Ndani ward

3.4.2 Reliability of water sources

On reliability of water sources at Kabuku Ndani ward, the findings show that (51.1%) of the respondents argued that water is not reliable (Table 4) below the water supply continuity standard of 24 hours per day. According to the respondents, the unreliability of water sources is due to the following factors: frequent electricity power supply cut off, leakages in pipes and valves due to wear, rusting and vandalism; aging of pumping units; leakage of storage tanks; improper laying of pipes to some of the places; insufficient communication system and climatic condition. This entails that water is still not sufficiently available to the whole community. It also means that certain group of people has adequate access to water while others do not.

3.4.3 Water storage facilities

Following the unreliability of water sources, large number of the population possesses many water storage facilities at their households (Table 4). The common methods of storing water that respondents currently use in the study area include jerrycans (33.3%) and tanks (32.2%) while others use buckets, clay pots and drums.

Table 4: Water sources and use in Kabuku Ndani ward (n=90)

Category	Frequency	Percentage
Sources of water		
Tap water	39	43.3
Bore holes	31	34.4
Shallow wells	10	11.1
Rain water	5	5.6
Others	5	5.6
Reason for choice of the sources		
Cheap and always available	67	74.4
Distance to other water sources	22	24.4
Water quality issues	1	1.1
Reliability of the sources		
Reliable	46	48.9
Not reliable	44	51.1
Alternative sources of water		
Searching far from households	32	35.6
Buying from private sources	34	37.8
Buying from streets	19	21.1
Using rain water	5	5.6
Storage facilities		
Jerry cans	30	33.3
Drums	7	7.8
Tanks	29	32.2
Buckets	19	21.1
Clay pots	5	5.6

3.4.4 Distance from households to water sources

According to the findings, majority of the respondents (34.4%) reported that the distance from the source of water supply to households is less than 1 kilometre, but greater than 400 metres. Again another high proportion of the respondents (33.3%) claimed that the distance to main water sources is between 2 and 5 kilometres. This result is not surprising considering the fact that Kabuku Ndani is a linear settlement. The distance between the two ends of the settlement is about 7 kilometres.

3.4.5 Time spent in fetching water

The length of time spent in fetching water varies from season to season, being highest during dry season. The results obtained from this study reveal that the highest proportion of respondents (54.4%) spends more than 30 minutes from their households to the water sources. Only a small proportion of respondents (17.8%) spend less than 30 minutes to reach water sources. There is therefore a lot of pressure on the few boreholes that are provided in the community.

3.4.6 Means of transport used in fetching water

The means of transport used by individuals is among others one of the necessary factors fostering accessibility to water supply. From the findings, it indicates that the highest proportion of respondents (50.0%) use bicycles in transporting water from the sources (Plate 4). Another means commonly used by respondents (28.9%) is carrying on the head while the use of motorbikes and other means like vehicles is not common in the study area (Plate 4).



Plate 2: Photos (A and B) show some of the means of transports used in the study area

3.4.7 Frequency of fetching water

According to the results it was observed that (25.6%) of the respondents fetch water twice a day while (14.4%) fetch water thrice a day. This means that more than 4 hours are spent per day per person just for fetching water.

3.4.8 Adequacy of water at household level

The results show that (83.3%) of the respondents argued that water is not adequate to meet all the needs for the household especially for domestic uses. Conversely, (16.7%) of the respondents said that water is adequate. The average amount of water used per day is less than 40 litres which is the consumption standard of a person per day. However, (73.0%) of the respondents use less than 20 litres of water per day. This is caused by several factors mainly poor and obsolete water supply infrastructure and climate changes are also among other contributing factors.

3.4.9 Household members involved in fetching water

The results show that individuals responsible for fetching water at household levels include women, men and children. Among the three categories, men are found to be the most responsible for fetching water in households being (72.2%) of the total respondents. The others participated in fetching water but at minimal levels were children (16.7%) and women (11.1%).

3.4.10 Quality of water and treatment methods

According to the results of this research, it was observed that (90.0%) of the population interviewed indicated to be dissatisfied with the quality of water in Kabuku Ndani while only 10% were satisfied with the quality of water. The respondents reported that the quality of water is not satisfactory because of the contamination with mud and other dirty which acted as pollutants. Indeed, up to (49.9%) of the water sources in Kabuku Ndani are saline (hard water) including that from the tap. Moreover, (92.2%) of the respondents treat drinking water by use of different methods including boiling, filtering and using water guard (Figure 2). Boiling and filtering were the commonest methods used as they are easy and cheap to apply whereas the use of water guard scored least due to its cost implications. Boiling method was also able to make saline water to be relatively normal especially if the water hardness was temporary (that caused by magnesium or calcium carbonate).

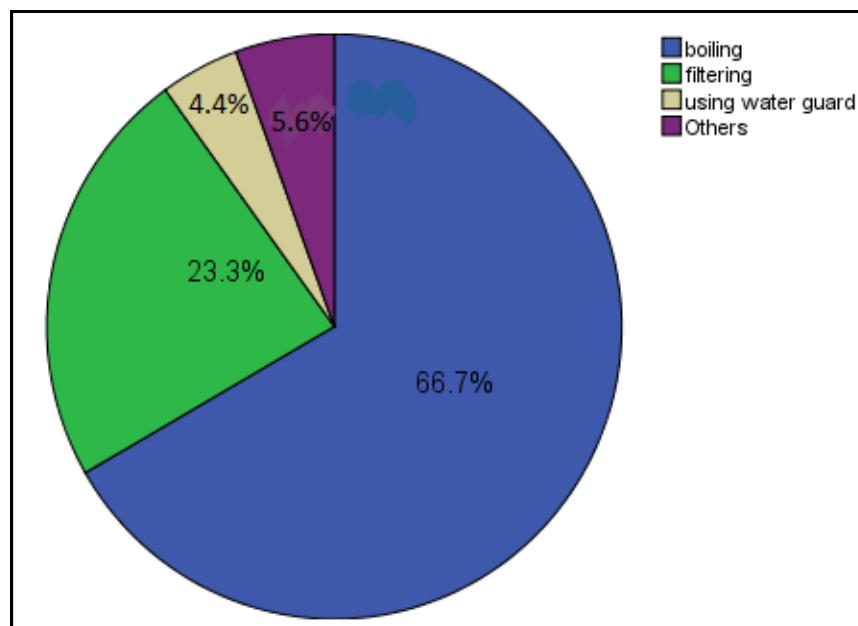


Figure 2: Water treatment methods in used in Kabuku Ndani ward

3.4.11 Water related health problems

A number of water-borne health problems were reported by the respondents in Kabuku Ndani ward. These problems included waterborne diseases like diarrhoea, typhoid, helminths, amoeba and cholera. These diseases were linked with drinking contaminated water. The most dominant disease was diarrhoea as reported by majority of respondents (Table 5).

Table 5: Health related water-borne diseases reported by the respondents (n=90)

Disease	Frequency	Percentage
Diarrhoea	37	48.7
Typhoid	36	47.4
Amoeba	2	2.6
Cholera	1	1.3

3.4.12 Sources of income and household earnings

In Kabuku Ndani the community depends on different sources of income. Results show that agriculture (62.2%) is the major source of income to the households. Other sources of income are employment (32.2%) and others (5.6%) business and pastoralism. It was established that the earnings differ in accordance with the type of income source. Employees showed high income status than other sectors with an average of TZS 100 000 – 200 000 per month. The earnings in agriculture sector are in annual terms whereas the employment, business and other sources of income are termed in monthly basis (Table 6).

429 **Table 6: Income sources and household earnings (n=90)**

Source	Earning per year/month (TZS)	Frequency	Percentage
Agriculture	100 000 – 400 000	31	34.4
	500 000 – 1 000 000	13	14.4
	1 100 000 – 5 000 000	7	7.8
	Above 5 000 000	7	7.8
Employment	100 000 – 200 000	8	8.9
	300 000 – 400 000	4	4.4
	500 000 – 720 000	6	6.7
Business	150 000 – 200 000	4	4.4
	250 000 – 300 000	1	1.1
	350 000 – 500 000	5	5.6
Others	50 000 – 100 000	2	2.2
	150 000 – 200 000	2	2.2

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431 **3.4.13 Estimation of water pricing and affordability**

432 According to the results, (93.3%) of the respondents purchase water while only (6.7%) reported to get
433 water for free of charge. The price of water is not even. Moreover, research findings show that
434 (84.4%) of the respondents bought one bucket of water at the price ranging from TZS 100 to 500,
435 (10%) bought at the price of TZS 50 and only (2%) of the respondents reported to buy water at the
436 price exceeding TZS 500. By using the average price of TZS 300 per bucket, the following
437 calculations applied. The assumptions made here was that there is constant requirements of water in
438 all the 12 months in a year. The highest proportion of respondents reported to need up to 5 buckets
439 (100 more than litres) of water per day which costs TZS 1 500 and above (Table 7) per day. This
440 applied for the households with 5 members of the family meaning every person uses one bucket (20
441 litres) of water per day. For some families with 12 people in a house needed up to 240 litres of water
442 per day which costs TZS 3 600. The least proportion of interviewed households indicated to require
443 3.5 to 4 buckets (70 – 80 litres) of water per day which costs TZS 1 050 – 1 200 (Table 7). Therefore,
444 the first group of these households was expected to spend more than TZS 45 000 per month implying
445 that TZS 540 000 was spent per year as costs of buying water. The second group with 12 members in
446 the family spend TZS 108 000 per month (1 296 000 per year) while the third group with least
447 proportion of households spend an estimated TZS 31 500 – 36 000 per month (378 000 to 432 000).
448 However, these water requirements and the associated costs mainly depended to the size of the
449 households.

450
451 Apart from this tangible amount of money spent in buying water, there was issue of time spent which
452 was 30 minutes to fetch one bucket of water from the sources on foot. From the stated group of
453 households that need 5 buckets of water per day in the above section, the total time spent in fetching
454 such amount of water per day was more than 150 minutes (2.5 hours and above) per day. Also many
455 other factors like water treatment have a very big contribution on the costs of water (Table 7).
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469 **Table 7: Estimated water and time costs per day (n=90)**

Quantity of water required by household per day (litres/day)	Average time spent to fetch water (minutes)	Average cost (TZS)	Frequency	Percentage
20 – 40	30 – 60	300 – 600	13	14.4
50 – 60	75 – 90	750 – 900	26	28.9
70 – 80	105 – 120	1 050 – 1 200	12	13.3
> 100	> 150	> 1 500	39	43.3

470

471 *Note: The average time spent to fetch 1 bucket (20 litres) of water per household is 30 minutes.*

472

473 The percentage of household income spent on water per month in all income categories of
 474 respondents was averagely greater than the recommended standard of 3% of the total earnings
 475 (URT, 2002)(Table 8). In households which entirely depend on agriculture as source of income there
 476 was a high percentage of income commonly spent by households monthly on water averaged to TZS
 477 20 000 i.e. 225% (Table 8). For this case, one household requires a minimum of TZS 1 500 000 per
 478 month to spend the recommended (TZS 45 000) three percent on water, something which is mythical
 479 in rural areas like Kabuku Ndani.

480

481 **Table 8: Estimated percentages of household income spent on water per month (n=90)**

Occupation	Average household income per month (TZS)	Percentage of household income spent on water per month
Agriculture	20 000	225.0
	60 000	75.0
	250 000	18.0
	> 400 000	11.25
Employment	150 000	30.0
	350 000	12.9
	610 000	7.40
Business	175 000	25.7
	275 000	16.4
	425 000	10.6
Others	75 000	60.0
	175 000	25.7

482

NB: • TZS 45 000 is an average fixed cost deducted from each household income.

483

• Households should not spend more than 3% of their income on water (NAWAPO, 2002).

484

485 However, the price of water differs according to place and time. Up to 53.3% of the respondents said
 486 that the price of water differs especially during drought seasons. Also 28.9% of the respondents
 487 believe that the price of water differed due to the nature of the water sources particularly the
 488 ownership and 16.7% believed that accessibility was a cause of price differences.

489

490 According to the existing prices of water and income of the people, most of the households do not
 491 afford to purchase enough water to satisfy for domestic uses. Results showed that 83.3% of the
 492 respondents argued that they cannot afford buying water daily and only 16.7% were able to afford the
 493 costs of water.

494

495 **3.5 Economic Activities Involving the Use of Water**

496

497 The study findings identified different economic activities that were involved in the use of water in
 498 Kabuku Ndani ward. These activities included; irrigation farming, bricks making, cafes and water
 499 vending. The highest proportion of respondents indicated to be engaged in irrigation farming (10%)
 500 and cafe (8.9%) as their most preferred economic activities in the ward. Another high proportion of
 respondents were engaged in water vending. Bricks making was found to be the least economic

501 activity conducted in the study area. The group of those who were engaged in all activities constituted
 502 30% while the large group (70%) of respondents were not using water for any economic activity.

503

504 **Table 9: Economic activities involving the use water (n=90)**

Economic activity	Frequency	Percentage
Irrigation	9	10.0
Brick making	3	3.3
Cafe	8	8.9
Water vending	7	7.8
None	63	70.0

505

Table 10: Variability of responses by Age

Variables		Sum of Squares	df	Mean Square	F	P value
Major sources of water	Between Groups	71.256	46	1.549	1.135	0.339
	Within Groups	58.700	43	1.365		
Time taken to water source	Between Groups	251.818	46	5.474	0.935	0.589
	Within Groups	245.800	42	5.852		
Distance to water source	Between Groups	43.256	46	0.940	0.922	0.608
	Within Groups	43.867	43	1.020		
Responsibility in fetching water	Between Groups	123.956	46	2.695	0.861	0.691
	Within Groups	134.500	43	3.128		
Amount of money spent on water	Between Groups	3.687	46	0.080	0.475	0.992
	Within Groups	6.750	40	0.169		

3.6 Variability of Responses by the Selected Background Variables

Results from table 10 showed that the age of respondents was not a statistical significant predictor ($P < 0.05$) of major sources of water, time taken to water source, distance moved to water source, responsibility in fetching water and the amount of money spent on water despite the fact that it was a positive coefficient. There is no clear relationship between age and all the variables.

Table 11: Variability of responses by Sex

Variables		Sum of Squares	df	Mean Square	F	P value
Major sources of water	Between Groups	0.061	1	0.061	0.041	0.840
	Within Groups	129.895	88	1.476		
Time taken to water source	Between Groups	21.820	1	21.820	3.990	0.049
	Within Groups	475.798	87	5.469		
Distance to water source	Between Groups	1.372	1	1.372	1.408	0.239
	Within Groups	85.750	88	0.974		
Responsibility in fetching water	Between Groups	0.001	1	0.001	0.000	0.985
	Within Groups	258.454	88	2.937		
Amount of money spent on water	Between Groups	0.761	1	0.761	6.686	0.011
	Within Groups	9.676	85	0.114		

Results from table 11 showed that with exception of the time taken to water sources and the amount of money spent on water between groups, gender of respondents was not a statistical significant predictor ($P < 0.05$) of major sources of water, distance moved to water source and responsibility in fetching water. Moreover, the coefficients of all variables were positive. This implies that gender respondents have a clear relationship with such two variables stated above.

Table 12: Variability of responses by Occupation

Variables		Sum of Squares	df	Mean Square	F	P value
Major sources of water	Between Groups	13.136	7	1.877	1.317	0.253
	Within Groups	116.819	82	1.425		
Time taken to water source	Between Groups	64.475	7	9.211	1.722	0.115
	Within Groups	433.143	81	5.347		
Distance to water source	Between Groups	10.292	7	1.470	1.569	0.156
	Within Groups	76.830	82	0.937		
Responsibility in fetching water	Between Groups	13.445	7	1.921	0.643	0.719
	Within Groups	245.010	82	2.988		
Amount of money spent on water	Between Groups	.758	7	0.108	0.883	0.524
	Within Groups	9.679	79	0.123		

Like it was revealed in table 10, results from table 12 showed that occupation of respondents was not a statistical significant predictor ($P < 0.05$) of major sources of water, time taken to water source, distance moved to water source, responsibility in fetching water and the amount of money spent on water though all the variables showed positive coefficients. It indicates that there is no clear relationship between occupation and all variables in above.

3.7 Regression model estimation

In order to test how were demographic and other factors responsible for household income (when considered simultaneously), a logistic regression model was used. Results for logistic regression analysis were as presented in Table 13. The results showed that age, sex, education, occupation and infrastructure were significant ($P < 0.01$ and $P < 0.05$) predictors of household income. The rest of the variables like sex, marital status, household size, management, rules, norms and/or beliefs, and water sources showed to have no influence on household income.

Table 13: Analysis of Maximum Likelihood Estimates for household income

Parameter	df	Estimate	Standard Error	Chi-square	P value
Water supply infrastructure	4	3.311	0.644	11.454	0.022*
Management	4	1.290	0.366	6.423	0.170
Water sources	4	1.099	1.633	3.544	0.471
Rules, norms and /or beliefs	4	1.099	0.356	5.897	0.207
Age	47	0.405	1.115	83.37	0.001**
Sex	1	0.310	0.212	1.888	0.169
Marital status	4	1.872	0.410	6.963	0.138
Education	5	2.970	0.483	16.572	0.005**
Occupation	7	0.916	0.648	16.461	0.021*
Household size	3	0.268	2.067	7.357	0.061

Statistical test of the model			
Test	df	Chi-Square	P value
Likelihood Ratio	6	13.114	0.041*
Score	6	13.092	0.042*
Wald	1	6.101	0.014*

* $P < 0.05$, ** $P < 0.01$, df = degree of freedom

The probability of the Chi-Square test statistic (chi-square = 13.144) was $P = 0.041$, less than the alpha level of significance of 0.05. Therefore, the null hypothesis that household's expenditure on water supply does not significantly affect household income was rejected and hence the alternative hypothesis that household's expenditure on water supply significantly affects household income was accepted. This was evidenced by the calculations of water costs shown in 4.4.13 above.

3.8 Effects of individual factor on household income

3.8.1 Respondents' age and household income

In Table 13 it showed that the coefficient for age factor was positive. Also the respondents' age category (26 - 55) showed a statistical significance ($P = 0.001$) indicating that there was a clear relationship between the age of the respondents and their household income as it constitute the working force.

3.8.2 Sex of respondents and household income

The study also revealed that the coefficient for sex factor was positive but not statistically significant predictor of Kabuku Ndani ward's household income ($P > 0.05$). This implies that respondents' sex has no clear relationship with household income.

3.8.3 Marital status and household income

Results in Table 13 showed that the coefficient of marital status of respondents was positive indicating that marriage contributes to increase in household income. But marital status factor was not statistically significant predictor of household income in the ward ($P > 0.05$) showing that there was no direct relationship with household income.

3.8.4 Education of respondents and household income

The coefficient for education factor was positive meaning that as one advance in education level, the probability of rise in household income increases. This also implies that people with low level of education were likely to have low income. Indeed, the education factor was statistically significant predictor for household income ($P = 0.005$).

3.8.5 Occupation of respondent and household income

Table 13 shows that the coefficient for occupation factor was positive showing to have a favourable influence on respondents' household income since it determines the income of an individual. Also the findings of this study showed that occupation factor was a significant predictor of Kabuku Ndani ward households' income ($P = 0.021$).

3.8.6 Water supply infrastructure and household income

The coefficient for water supply infrastructure on household income was positive thus there was a clear relationship between infrastructure and household income. However, the findings in Table 9 show that infrastructure factor was a significant predictor of household income ($P = 0.022$). It means that the functionality of water supply infrastructure determines water supply continuity thus secures costs and time for other activities.

3.8.7 Water sources and household income

The study showed that, the coefficient factor for water sources was also positive. Its implication was that the sources of water have a great contribution to the household income in the community. But, it was not a significant predictor of household income as its value ($P > 0.05$).

3.8.8 Management of water sources and household income

The coefficient factor for management was revealed by the findings in Table 13 to be positive. This implied that if water sources were properly managed, water supply becomes reliable in the community and finally enhances income in households. But management factor was not statistical significant predictor of household income in Kabuku Ndani ward as its p-value was greater than 0.05.

3.8.9 Rules, norms and/or beliefs and household income

From Table 13 above, it was found that the coefficient factor for rules, norms and/or beliefs was positive as well. It means this factor influences households' income such that some of the community members have some traditional practices on water supply that secure water sources and ultimately help in economic growth. For example, people were restricted to step into water dams by their feet as it helped to prevent contaminations of water. But, according to the statistical test; rules, norms and/or beliefs were not significant predictors of household income ($P > 0.05$).

3.8.10 Household size and household income

The coefficient factor for household size was positive indicating that it influences household income in one way or another. Most of the respondents' households sizes range between 4 and 6 people thus there was a probability of having a remarkable productive working forces. However, the household size was not a significant predictor of household income ($P > 0.05$).

3.9 Factors prohibiting accessibility to potable water supply in Kabuku Ndani

he results generally found that water supply was a critical problem to the community in the study area. This was contributed by several factors including; water sources, obsolete water supply infrastructures, administration problems, insufficient resources, climate changes and the price of water as outlined in the subsequent sections 4.7.1 to 4.7.5 below.

3.9.1 Administration problems

Administration problems were identified as major challenge hindering access to potable water in the study area. Findings from key informants indicate that when they were responding on what were the reasons for poor water supply in their respective area, majority said *"These cases are contributed by some of the officials who lack integrity in handling projects especially projects that have direct benefits to the community"*.

Furthermore, few respondents added to this reason a justifying statement;

"There had been a households' contribution of money for drilling bore holes in the ward but unfortunately it was ended up by just identification of the site thus, nothing more has been done to date".

3.9.2 Water sources

The Handeni Trunk Main (HTM) project was the major source of water supply in the study area which was established in 1974 to serve the population in the study area. The project was currently overloaded due to increase of human population size which does not correspond with the capacity of the water source supply.

3.9.3 Obsolete water supply infrastructures

Findings from key informants indicated that poor and obsolete water supply infrastructures cause failure in sustainable water flow from the main intake to the distributive connections. Therefore, people do not meet the daily requirements for domestic uses as evidenced by water cuts for long periods of time that was being experienced. This was contributed by lack of regular maintenance and rehabilitation of the water system facilities.

3.9.4 Climate changes

According to the key informants' findings, it indicates that Handeni district was among the dry areas in Tanga Region. The seasonal arid climate makes the community suffer from lack of potable water especially during the dry season. The situation was caused by two phenomena which were environmental degradation and the global warming. Deforestation was among the factors that have led to degraded environment in the district mostly due to lack of knowledge by the people. The problem of cutting trees makes water sources vulnerable to drying out. On the other hand, global warming naturally brings about changes in rain formation and other climatic effects.

3.9.5 Water pricing

Chronic water shortage in the study area has led to people pay an increasing high price for even polluted water. According to the field study, it shows that the community members pay for water service despite the hardships of life they experience. Living expenses become high as water service integrates largely with other aspects such as sanitation which was very important for health security. High water prices arise as a result of the mode of water sources ownership and the season factor. Most of the water sources which at least provide reasonable service were privately owned thus the water charges peak up to TZS 500 per bucket. During dry season water supply became short conversely to the wet season whereby the availability of water was a relief to the community.

4. CONCLUSION

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

From the findings, it can be concluded that there were no permanent water sources that could have served the community throughout the year despite of the availability of the Handeni Trunk Main project. Most of these sources were found to be located at far distance from the households. In this case men are involved in fetching water for domestic uses. While women had to take care of their children and perform other domestic duties.

Domestic water supply has shown to have implications on households' income in Kabuku Ndani ward, Handeni. High expenditure on water services has kept reducing economy of most families and the community as a whole as most of the residents in the ward spent much on water supply than they could have spent on other responsibilities. The distress of searching and collecting water for household's uses widens a room for absolute poverty in the community.

4.2 Recommendations

In order to address the manifold problems, the following should be done;

- The government needs to expand, restructure, and rehabilitate public water supplies infrastructures. This improvement can only be achieved with assistance in terms of technical and financial assistance from aid agencies as most of people in the ward were poor. Moreover, there should be a shared responsibility between aid agencies and communities, that means the community members can contribute in maintenance of infrastructures.

- Reconstruction of traditional wells by protecting and fencing can greatly improve water quality and reduce the risk of accidents and water borne diseases. There is also a need of mobilizing and sensitizing the community to give their technical advice to the management teams and the entire community. Strengthening institutional arrangements will increase the continuous inspection of schemes for sustainable water supply.
- Cost subsidization: The government also needs to subsidize the price of water and make water affordable for the poor.
- Education to the community: Development partners i.e. NGOs; CBOs in collaboration with the Government should on the other hand inculcate community members on the importance of conserving water sources through seminars, meetings and workshops. As this will be one of the most effective ways of conserving water sources.
- Strengthening institutional framework: Because the government lacks the capacity to enforce its water pollution rules, it needs to work with customary institutions. The government should strengthen, recognize, and formalize customary laws for water management. Some combination of both customary and statutory institutions may potentially increase the efficient management of water sources.

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