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Attitudes and Adoption of Rainwater Harvesting: Influence of Gender, Awareness, and Social Status

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Abstract

Inadequate potable water often leads to hygiene-related infections while general lack of water for agriculture is a precursor to malnutrition in Sub-Saharan Africa. There is a widespread low adoption of rooftop rainwater harvesting in Kenya. Attitudes influence the level of farmers' participation in water harvesting. Literature on the influence of gender, level of education, and socioeconomic status (SES) on attitudes toward rainwater harvesting among smallholder farmers is inadequate. This study was conducted to fill that knowledge gap. The study was conducted in four sub-counties in Kenya. Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 20. Level of significance was set at $\alpha = .05$. Effect size was calculated and presented as Cohen's d for the independent t-tests and as omega squared (ω^2) for the one-way ANOVA. Post hoc tests were conducted using Gabriel's procedure. Results indicated that women had statistically significant better attitudes toward rainwater harvesting than men. Level of formal education among smallholder farmers did not indicate a statistically significant difference in attitudes. Comparisons across SES levels indicated a statistically significant difference in attitudes toward rainwater harvesting. Attitudes were determined to be a statistically significant predictor of adoption of rainwater harvesting. The researchers envision that these findings will be helpful to program planners, policy makers, agricultural educators, and curriculum designers in Kenya. The study expounded on knowledge on demographic-related attitudinal barriers to prioritization and adoption of rainwater harvesting. Recommendations to policy makers and educators on enhanced extension and outreach programs were proposed. Involvement of women as change agents was recommended. Further research on suitable and relevant extension methods was recommended.

Keywords: Adoption, attitudes, education, rainwater harvesting, socioeconomic status

Introduction

Studies have indicated that there is low adoption of rooftop rainwater harvesting in Kenya (Berger, 2011). The increase in human population has resulted in an unprecedented surge in the need for clean and safe water. Water has many purposes such as industrial, agricultural, home, and recreational uses. Natural ground water reservoirs are over-used, leading to lowering of water tables. Deforestation has seriously reduced recharge rate to the water table in many regions of the world (Mahe et al., 2013). Many rural households rely on natural ground water sources such as shallow wells, boreholes, dams, rivers, and lakes. Water conservation and utilization is fundamental in fostering local, regional, and international peace and development (Baguma, Hashim, Aljunid, & Loiskandl, 2013). According to Silali and Njambi (2014), about 37% of the total population in developing countries lack adequate access to clean and safe water. The problem is severe in Sub-Saharan African countries.

The struggle for access to available water in Sub-Saharan Africa is regarded among many as the most likely cause of intercommunity conflict in the region (Matiza, 2000). Domestic conflicts over access and use of water are constantly reported in many parts of the world (Baez, 2011). In April 1, 2014, Gerald Bwisa, an author with one of the largest and most respected newspapers in East Africa, *Daily Nation*, wrote a story about a domestic conflict resulting from scarcity of water. He narrated how an employer bit her house-help worker alleging misuse of water. The author quotes the house-help as saying; "I was washing utensils as usual when my employer came and questioned why I was misusing water. She slapped me twice and went ahead to biting me on my shoulder. Previously she had threatened to discipline me" (Bwisa, 2014, April 2, p. 1). Similar stories are told in many households across Kenya.

Theoretical Framework

This research was based on the Diffusion of Innovations Theory (Rogers, 2003). Rogers defines diffusion as the process by which an idea or innovation spreads through certain communication channels from the source to members of a social system over time. Adoption is the process that involves a series of stages that an individual undergoes from the time of first encounter with an idea to the point that it becomes a part of his/her life.

The stages of adoption are: 1) *awareness*; when an individual comes into contact with an innovation, 2) *interest*; when an individual develops liking for an innovation, 3) *evaluation*; in this stage, an individual seeks for rationale and judges the merits of an innovation, 4) *trial*; an individual puts the innovation into use in a small scale, and 5) *adoption*; the individual takes up the innovation and it becomes part of his life (Rogers, 2003).

Rogers (2003) describes five important, systematic, and logical steps of the innovation-decision process. These are: 1) knowledge, 2) persuasion or conviction that results in attitude formation, 3) decision or making a choice to either accept and try out or reject the innovation, 4) implementation or execution which involves putting the idea into practice, and, finally, 5) confirmation which involves seeking more ideas and resources to support the progress of the decision made.

Ganpat, Harder, and Moore (2014) indicated that agricultural extension systems usually use collaborative strategies in the decision making process aimed for a larger program. The decision-making process among smallholder farmers is related to characteristics of an innovation: 1) relative advantage of the innovation, 2) trialability or

the propensity to put the innovation into practical use, 3) compatibility with present farming activities, 4) complexity or easiness to adopt, and 5) observability or the possibility of observable positive outcomes because of adopting the innovation (Rogers, 2003).

According to Rogers (2003), five distinct categories of adopters exist. Each category has certain unique characteristics but the boundary between categories is often blurred. Since this categorization is rate based, time is a common factor. He assigned specific percentages to each category: (1) innovators; 2.5%, (2) early adopters; 13.5%, (3) early majority; 34%, (4) late majority; 34%, and (5) laggards; 16%.

In their research on goal-directed behavior, Ajzen and Madden (1986) argued that beliefs and attitudes toward an innovation are associated with the expected behavior or practice. Ajzen (1991) explains that normative beliefs, attitudes, and subjective norms are common factors that lead to certain observable actions/behavior among people. In his ground-breaking study, *Theory of Planned Behavior* (TPB), Ajzen asserts that intentions are guided by attitudes and that they represent the conscious motivation to a behavior. Previous studies indicate that low adoption of rainwater harvesting in developing countries is mainly due to low prioritization, and thus, farmers allocate little income from their savings to the activity (Lourete, Tsukada, & Lehmann, 2009). The construction of the research instruments was guided by Ajzen and Rogers works.

Purpose and Objectives

The purpose of this study was two-fold: one, to develop an understanding of how gender, level of education, and socioeconomic status (SES) related to the attitudes toward prioritization and adoption of rainwater harvesting among smallholder farmers, and two, to investigate whether attitudes, socioeconomic status, and awareness are related to adoption of rainwater harvesting. The following objectives guided the study:

1. Determine whether small holder farmers' attitudes toward rainwater harvesting vary with their gender.
2. Determine whether small holder farmers' attitudes toward rainwater harvesting vary with their levels of education.
3. Determine whether small holder farmers' attitudes toward rainwater harvesting vary with their socio-economic status.
4. Determine whether adoption is related to attitudes, awareness, and socioeconomic status.

Methods

Participants in this study were smallholder farmers drawn from four sub-counties: Meru South and Maara in Tharaka-Nithi county and Bahati and Subukia in Nakuru county. A majority of rural dwellers in both counties are predominantly farmers. An ex-post facto design was used in this study. In an ex-post facto design, independent variables are studied after their effects have occurred (Ary, Jacobs, & Razavieh, 2009). The researchers investigated independent variables in retrospect for possible connectedness and influence on the dependent variables (Cohen, Manion, & Morrison, 2000).

Simple random sampling was used in selecting participants for inclusion in the study. The recommendation for getting a sample size by Mugenda and Mugenda (1999) was used. The sampling frame comprised 1638 households. The sample size for this study was 310 participants where one adult participant represented a household. This initial selection was done

on household basis. To have parity in gender representation, a simple random selection of households was adopted where male and female participants were alternated in the list of households. In social science research where quantitative type of data are collected, a sample size of more than 30 participants can be considered adequate to provide basis for inference (Hinkle, Wiersma, & Jurs, 2003). Borg and Gall (1979) suggested that in survey research, a sample size of not less than 100 participants in each major grouping and between 20 and 50 participants in a minor subgroup should be ensured. The primary variables of interest, namely, level of education and SES, were considered the major groupings and mutually exclusive. A researcher-designed questionnaire was used. Validity informs that the instrument is measuring what it ought to measure (Field, 2013). Validity of each scale on the instrument was established by a panel of four experts comprised of faculty members. Cronbach reliability coefficient was established for the two sets of questions that represented attitudes and awareness. An alpha level of .70 and .72 was established for attitudes and awareness, respectively. Awareness was determined by knowledge-based questions.

The level of adoption of rainwater harvesting was determined by scores obtained from questions that sought data on the quantity of water reservoir in relation to perceived income. The participants' scores on this variable constituted their level of adoption of rainwater harvesting. A summated composite score was computed using SPSS. Attitudes toward rainwater harvesting were determined using 14 items; 13 of the items were measured on a five-point scale with responses as strongly agree, agree, undecided, disagree, and strongly disagree; and one item was measured on a three-point scale. This one question stated that, "How interested are you in obtaining more information about rain water harvesting? (*Check (√) one answer*) (a)Very Interested (b) Slightly Interested (c) Not Interested." The maximum attainable score was 68 points. A higher score indicated a higher positive attitude.

Socioeconomic status was measured on a nominal scale using the researcher developed questionnaire. Indicators for socio-economic status included, types of house, owning and operating bank account, owning a car, ability to own a car, owning cattle, sheep, and/or goats. A composite score was computed from the six questions. The computed composite score was recomputed to ordinal level yielding a new variable with five levels of socioeconomic category. The five socioeconomic status groups were labelled as *very low*, *low*, *middle*, *above average*, and *high* (Antonovsky, 1967). Social economic status is a rather complex phenomenon and has no single agreed upon way of measuring. It depends on several factors and context of the research (Meyer et al., 2014).

Descriptive statistics used in data analysis included frequencies, means, and standard deviations. Inferential statistics that were used to explain the data included Pearson's product moment correlation (*r*), independent samples *t*-test, linear multiple regression, and one-way analysis of variance (ANOVA). Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 20. Significance level was set at $\alpha = .05$ (Hinkle, et al., 2003).

Results

Objective one was to determine whether small holder farmers' attitudes toward rainwater harvesting varied with gender. A gender comparison of attitudes toward rainwater harvesting indicated that women participants scored an average of 73.2% ($M = 49.79$, $SD = 6.55$, $n = 175$) while their male counterparts had an average

of 70.4% (*M* = 47.87, *SD* = 5.61, *n* = 135). Although the male and female numbers were expected to be the same, it was difficult finding male household heads in some households as they were out for work. In such a case, a female acting as the household head was interviewed.

A comparison by gender was conducted using an independent samples *t*-test. Table 1 presents results of the independent samples *t*-test between attitudes' scores of male and female smallholder farmers (*N* = 310). Results indicated a statistically significant difference, *t* (308) = -2.72, *p* = .007, *d* = 0.34. The effect size, Cohen's *d* = 0.34, was small according to Cohen (1988).

Table 1
Independent Sample t-test on Attitude Scores of Rainwater Harvesting by Gender

Gender	*n*	*M*	*SD*	*df*	*t*	*p*	*d*
Males	135	47.87	5.61	308	-2.72	.007	0.34
Females	175	49.79	6.55				

Note. *N* = 310, p < .05

Objective two was to describe the influence of the level of formal education on participants' attitudes toward rainwater harvesting. Participants were classified into five categories as follows; 1) not literate, 2) elementary/primary level, 3) secondary/high school level, 4) middle level/community college, and 5) university level. The indicated the highest attitudinal score (*M* = 49.79, *SD* = 6.32, *n* = 131) while those not literate had the lowest attitudinal score (*M* = 47.15, *SD* = 5.84, *n* = 39). Table 2 shows descriptive results of attitudes' score based on smallholder farmers' level of formal education.

Table 2
Participants' Attitudes Scores by Level of Formal Education

Education level	*M*	*SD*	*n*
Not literate	47.15	5.84	39
Primary/elementary	49.79	6.32	131
Secondary/High school	48.46	6.32	100
College	49.61	6.08	28
University	48.25	4.94	12
Total	48.95	6.22	310

Note. *N* = 310

primary/elementary school category

A one-way ANOVA test indicated that there was no significant difference in the group means. *F*(4, 305) = 1.69, *p* = .15, ω = .09. Effect size measured as omega squared indicated negligible practical significance, ($\omega^2 = 0.008$). Table 3 shows a summary of the results.

Table 3
A One-Way ANOVA on Attitudes of Participants by the Level of Formal Education

Source	*SS*	*df*	*MS*	*F*	*p*	ω
Between	259.41	4	64.85	1.69	.15	.09
Within	11704.86	305	38.38			
Total	11964.27	309				

Note. $N = 310$, $p < .05$

Objective three was to determine whether small holder farmers' attitudes toward rainwater harvesting vary with their socio-economic status. Five socioeconomic status groups--*very low*, *low*, *middle*, *above average*, and *high* were compared on the mean score of their attitudes towards rainwater harvesting. The *low* group had the most positive attitudes with the highest attitudes score ($M = 50.04$, SD 5.86, $n = 112$), while *high* socioeconomic status group had the lowest positive attitudes as expressed in the scores ($M = 45.14$, SD 5.52, $n = 14$). Table 4 shows descriptive analysis of participants' attitudes towards rainwater harvesting based on the socioeconomic categories.

Table 4
Smallholder Farmers' Attitudes Scores by Socioeconomic Category

Socioeconomic category	*M*	*SD*	*n*
Very low	48.11	7.26	47
Low	50.04	5.86	112
Middle	48.62	5.84	100
Above average	49.05	6.61	37
High	45.14	5.52	14
Total	48.95	6.22	310

Note. $N = 310$

The attitudes mean scores for the five socioeconomic categories were compared using one-way ANOVA. Results showed that there was a statistically significant difference between the means of at least two groups, $F(4, 305) = 2.51$, $p = .04$, $\omega = .14$. Table 5 provides results of the one-way ANOVA.

Table 5
A One-Way ANOVA on Attitudes of Participants Based on Socioeconomic Category

Source	*SS*	*df*	*MS*	*F*	*p*	ω
Between	381.86	4	95.47	2.51	.04	.14
Within	11582.41	305	37.98			
Total	11964.27	309				

Note. $N = 310$, $p < .05$

Since the overall *F*-test yielded significant results, (p = .04), follow up post hoc tests were conducted for multiple comparison of the attitudes means for the five socioeconomic categories. Gabriel's post hoc procedure was used due to varying small group sizes. There were two groups that were statistically significantly different, *low* (M = 50.04, SD 5.86, n = 112), and *high* (M = 45.14, SD 5.52, n = 14), p = .02.

Objective four was to determine whether adoption is related to attitudes, awareness, and socioeconomic status. The tank size was used as a determinant of participant's level of adoption in relation to their income and family size. Equitable tank size for an average family of five members was scored highest in a five-point scale. Pearson's product moment correlation (r) procedure was conducted to determine the nature of relationship between adoption, awareness, attitudes, and SES index (Field, 2013). Davis (1971) adjectives were used to describe the magnitude of Pearson's product moment correlations (r).

Results indicated negligible positive correlation (r = .03) between adoption (M = 5.41, SD = 2.08) and SES index (M = 13.17, SD = 2.91). A negligible negative correlation (r = -.08) was indicated between adoption (M = 5.41, SD = 2.08) and awareness (M = 21.81, SD = 2.95). Analysis indicated low positive correlation (r = .23) between adoption (M = 5.41, SD = 2.08) and attitudes (M = 48.95, SD = 6.22). This correlation was statistically significant. Table 6 provides summarized results of the analysis.

Table 6
Pearson's Product-Moment Correlations Between Adoption, Awareness, SES Index and Attitudes

Variables	*Y*	X_1	X_2	X_3	*M*	*SD*
Adoption (*Y*)	–	-.08	.23	.03	5.41	2.08
Awareness (X_1)		–	.02	.13	21.81	2.95
Attitude (X_2)			–	-.05	48.95	6.22
SES index (X_3)				–	13.17	2.91

Note: N = 310

Conclusions and Implications

Objective one was to determine whether small holder farmers' attitudes toward rainwater harvesting vary with gender. To get a deeper understanding of how attitudes influence decision making, the researchers investigated how attitudes towards rainwater harvesting varied across various levels of selected demographics. Variation in attitudes across these levels was used as implicative predictor of how demographics influence prioritization of rainwater harvesting (Little, 2013).

Data analysis on attitudes toward rainwater harvesting indicated statistically significant difference between male and female participants. The effect size, Cohen's d, was small, $t(308) = -2.72$, p = .007, d = 0.34. These results led to the conclusion that women have more positive attitudes toward rainwater harvesting than men. These findings support results by Berger (2011) that indicated women have more positive attitudes toward water conservation at the family level. This implies that there is a need for enhanced extension programs that focus on rainwater harvesting among women.

Objective two was to determine whether small holder farmers' attitudes

toward rainwater harvesting vary with their levels of education. From the results, it was indicated that there was no statistically significant mean difference in attitudes toward rainwater harvesting across the five groups of participants based on their level of formal education. It was concluded that small farmers' attitudes toward rain water harvesting did not vary with their levels of education.

Objective three was to determine whether small holder farmers' attitudes toward rainwater harvesting vary with their socio-economic status. It can be concluded that smallholder farmers in the *low* socioeconomic status have better positive attitudes toward rainwater harvesting than those in higher socioeconomic status. These findings concur with results reported by Mwaniki (1986) who found that resource-limited smallholder farmers in Mbeere, Kenya, particularly women, have a lot of intrinsic motivation toward making their family lives better.

Objective four was to determine whether adoption is related to attitudes, awareness, and socioeconomic status. It was concluded that attitudes represented the only variable positively correlated with the adoption of rainwater harvesting. Conversely, SES is not likely to impact adoption. The theory of Planned Behavior provides important descriptions and explanation of the close relationship between expressed behavior of people and a combination of norms, beliefs, attitudes, and intentions (Ajzen, 1991).

A related study conducted in a developing country in Asia (Rezvanfar, Ghorbanian, & Shafiee, 2014) revealed that attitudes have greater influence on the decisions that are made by individuals regardless of the codified knowledge that is available to them. The findings by Rezvanfar et al. agree with the premise of the theory of planned behavior (TPB) that attitudes and beliefs have great influence on an individual's behavior (Munro, Lewin, Swart, & Volmink, 2007). It can be concluded that if the attitude toward rainwater harvesting is positive, then, there is a great tendency of adopting rainwater harvesting practice.

Recommendations for Practice

This research study investigated smallholder farmers' attitudes in relation to prioritizing and adopting rainwater harvesting. Based on prospect theory (Griesdorn, 2011), it can be argued that farmers are aversive to investing money for long term rainwater harvesting as they are not certain if the investment will pay off. It is therefore recommended that curriculum planners in agricultural education consider integrating attitudinal and economic aspects of rainwater harvesting in the curriculum.

Lourete et al. (2009) noted that although some studies indicate that inadequate resources among smallholder farmers negatively impact their decision-making process, many of the challenges in rainwater harvesting have been attributed to inadequate knowledge about economics of rainwater harvesting. It was therefore recommended that government extension agents and other institutions offering extension services make a deliberate effort to educate farmers on the economics of rainwater harvesting in relation to time saved in man-hours for other income generating activities.

Women indicated more positive attitudes toward rainwater harvesting than men. Based on these findings, we recommend that women involvement in outreach programs be enhanced. Also, curriculum developers and extension program planners should draw from the findings of this study to promote rainwater harvesting among women. This recommendation is augmented by the fact

that if the attitude toward rainwater harvesting is positive, then, there is a great tendency of adopting rainwater harvesting practice.

Recommendations for Research

Research should be conducted on extension methods that could enhance positive attitudes toward adoption of rainwater harvesting. Follow-up research should be conducted to ascertain actual cost of setting up a sustainable rainwater harvesting system that can satisfy water needs of an average family size of five members. The researchers recommend replicating this research in other regions of the country (Kenya) and comparing it to the findings of this research. Thus, generalization of the results in regions with similar geographic and socioeconomic characteristics will be more realistic and empirically tenable.

This study was primarily preliminary research and it specifically employed a classical quantitative approach (Ary et al., 2009). Integrating qualitative methods in quantitative research allows for thick and richer data (Guba, 1990). It is recommended that mixed method research be conducted to provide more insight on why prioritization of rainwater harvesting has generally remained low among smallholder farmers.

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