Status on the Use of Improved Cooking Stoves in Rungwe District: A Case of Makandana Ward

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Isikiri

Utafiti huu ulilenga kuchunguza hali ya utumiaji wa majiko banifu katika kata ya Mkandama iliyopo katika wilaya ya Rungwe. Malengo mahsusi ya utafiti yalikuwa ni kubaini upatikanaji wa majiko banifu, kuchambua mambo yanayoathiri jamii kutumia majiko hayo na kubaini juhudi zilizotumika kuhamasisha wananchi kutumia majiko banifu. Ukusanyaji wa takwimu ulifanyika kwa njia ya usaili na udadisi. Dodoso zilitumika kukusanya taarifa za msingi kutoka kwa wasailiwa waliochaguliwa na takwimu za taarifa mbalimbali za kiupili zilikusanywa kwa maorodhesho kutoka kwa watu maalum waliochaguliwa. Uchakataji wa taarifa ulifanywa kwa kutumia mbinu ya takwimu maelezo (discriptive statistics) na mbinu ya uchambuzi wa kurudi nyuma katika hali ya ukosefu wa uhakika wa habari kamilifu (Logistic regression analysis). Matokeo ya utafiti huu yanaonesha kuwa asilimia thelathini na tisa (39%) tu walitumia majiko banifu. Kupitia mbinu ya uchambuzi wa kurudi nyuma katika hali ya ukosefu wa uhakika wa habari kamilifu, mambo yafuatavyo yana umuhimu wa pekee kwa kiwango cha $p<0.05$katika utumiaji wa majiko hayo;umri, kiwango cha elimu, uhimizaji wa matumizi yake, ladha ya chakula, upatikanaji na gharama. Uhamasishaji, bei punguzo, msaada wa kitaalamu na malighafi ni mikakati inayotumika kuhamasisha utumiaji. Hivyo, msaada wa kifedha na kiufundi na mikopo ya riba nafuu itasaidia kuzalisha majiko bora ya bei nafuu. Mafunzo, semina, warsha na mikutano, matangazo ya vyombo vya habari vitasaidia kuelimisha na kuhamasisha matumizi ya majiko banifu.

Abstract

The study assessed the status of using Improved Cooking Stoves (ICS) at Makandana ward in the Rungwe District. Specifically, it determined the availability of ICS, analysed the factors that influence the use of the improved cooking stoves and determined initiatives were taken to motivate the community to use ICS technology. Data were collected through focus group discussions, observations and interviews. While the questionnaire was used as a tool to collect primary data from respondents, the checklists were employed to solicit secondary information from key informants. Descriptive and Logistic regression analyses were used in the data analysis. Descriptive results reported that there were few users of improved cooking stoves by 39.0 percent. Logistic regression analysis showed that age, education level, costs of ICS, food taste, sensitization, availability of ICS and time consumption during cooking were statistically significant in the use of ICS at $p<0.05$. Dissemination of information (54.7 percent), promotion (52.0 percent) and technical training (37.3 percent) were the main initiatives to motivate the use of ICS. More financial, technical support and credit to youth groups are highly recommended to produce affordable ICS with good quality. Training, seminars, workshops, meetings and public media such as radios and cell phones (SMS) should enable the spreading of knowledge on the use of ICS.

Keywords: Deforestation, Climate change, Improved Cooking Stove, Energy source, Carbon sink

1.0. Introduction

Over the past few decades, improved firewood and charcoal cooking stoves have been tremendously distributed across the globe, mainly with the purpose of lessening fuelwood consumption among the rural communities (Adrianzén, 2013). Heavily relying on fuelwood as the main source of energy particularly in developing countries has been revealed to be a major and chronic source of forest degradation (Specht et al., 2015) particularly in sub-Saharan Africa (SSA) (Rudel, 2013). The SSA population is increasing at the fastest rate of any region: by 2100, the population of SSA is likely to quadruple to 4.2 billion (Gerland *etal*., 2014). Escalating population growth is associated with increased consumption of forest resources, thus threatening the existence of forests (Brandt et al., 2017).

Forests cover about 31 percent of the land area on the planet (WWF, 2021*)*. They help people to thrive and survive, for example, by purifying water and air and providing people with jobs. Approximately, 13.2 million people across the world work in the forest sector and another 41 million do work that is related to the sector (WWF, 2021*;* Salim and Ullsten, 1999*)*. Forests are home to more than three-quarters of the world's life on land including animals. Forests also play a critical role in mitigating climate change effects because they act as a carbon sink that soaks up carbon dioxide that would otherwise be free in the atmosphere and contribute to ongoing changes in climatic patterns (WWF, 2021*;* Salim and Ullsten, 1999*)*. Forests around the world, however, are under disappearance threat; jeopardizing these benefits and the life of more than 1.6 billion people who rely on forests' economic, social and health benefits**.** These threats manifest themselves in the form of deforestation and forest degradation. The main cause of deforestation is agriculture and illegal logging. In 2019, the tropics lost close to 30 soccer fields' worth of trees every single minute (WWF, 2021).

The use of fuel wood as a source of energy for cooking is also among the factors that contribute to deforestation. Currently, about two billion people in the world depend on forest products such as fruits, game meat, fibres and fuel wood to meet their basic needs (FAO, 2011; May-Tobin *et al*., 2011; Mead, 2005). Fuel wood harvesting in developing countries is so important that it rivals other sources of industrial energy such as electricity, principally among poor people in rural areas (FAO, 2011; May-Tobin *et al.*, 2011; Mead, 2005). In the African region, 58 percent of the energy supply comes from fuel wood and charcoal and this percentage for Latin America and Asia regions are, 15 percent and 11 percent respectively (Salim and Ullsten, 1999). Although their percentages are lower than those for the African region they cannot be ignored. Furthermore, the African region is suffering deforestation at twice the world's rate. According to Sarkar (2014), 77.2 percent of West Africa's most natural forest has suffered deforestation; Nigeria has lost 81 percent of its old-growth natural forests in just 15 years (1990–2005). Massive deforestation threatens food security in some African countries. This impacts people's livelihoods and threatens the disappearance of a wide range of plant and animal species. Likewise, in Sub-Saharan African countries, the rate of deforestation exceeded the global annual average of 0.8 percent due to farming, charcoal burning, wood fuel for energy and building materials collections; and bush fires (Koranteng and Niedwiecki, 2008; Salim and Ullsten, 1999).Africa is the second-fastest rate of deforestation in the world, after Southeast Asia. 241,000 square kilometres (4.1 million hectares) of natural forest in Africa arebeing lost every year (RES, 2021).

A similar case was observed in Tanzania where rates are quite high. The global analysis of Curtis *et al.* (2018) found that 93–94 percent of tree cover loss (at >10 percent tree cover) in Tanzania between 2010 and 2015 was associated with shifting cultivation, 4–5 percent with forestry and 2 percent with commodity-driven agriculture. However, most deforestation in Tanzania is caused by small-scale agriculture, charcoal production, pole cutting and timber harvesting (Doggart *et. al*., 2020; Blomley*et al*., 2008). URT (2015) reported that 97.8 percent of the households in Rungwe District Council use firewood and charcoal as the main source of cooking and about 22,526 bags of charcoal equivalent to 56 kg were consumed daily.

The emerging situation of deforestation in Tanzania aroused the attention of different organisations including Tanzania Traditional Energy Development Organisation (TaTEDO) and C-Quest Capital on forest conservation in Tanzania to introduce improved cooking stoves (ICS). The device is designed to improve the combustion efficiency of biomass; consume less fuel, save cooking time, provide convenience in the cooking process and to create a smokeless environment relative to the traditional stoves (TaTEDO, 2015; C-Quest Capital, 2017). The technology was disseminated through local technical and business capacity building. Technology awareness, technical assistance in making ICS, market test and launching as important tools for adoption theory were employed.

In Rungwe ICS were introduced in 2017 by C -Quest Capital as a donor fund project through Ant Deforestation as Agency aimed at conserving forests in the wards. This organisation through Ant-Deforestation Agency created awareness to ward leaders including Ward Executive Officers (WEOs), Village Executive Officers (VEOs), Ward Forest Officers (WFOs) and Environmental Officers (EOs) on the advantages of using ICS and thereafter sensitization of 1,000 households in wards. However, it was noted that, only 45 percent of households in Makandana Ward adopted the technology (URT, 2020). Based in adoption theory there are multiple influencing factors responsible for the decision of the customer. These factors might include the consumers' knowledge and awareness of the product, their acceptance of innovation, as well as experience in buying such products. Thus, adoption is a process starting from awareness, interest and information, evaluation or trial and finally full adoption (Bhasin, 2018). Therefore, the study intended to answer the following questions. What is the status of ICS availability in the study area? What are factors that influence the use of the improved cooking stoves? What were the initiatives employed to motivate the community to use ICS? Through literature review, the study established the conceptual frame work. The framework had independent, intermediate and dependent variables. The dependent variable is influenced by independent and intermediate variables (Figure 1).

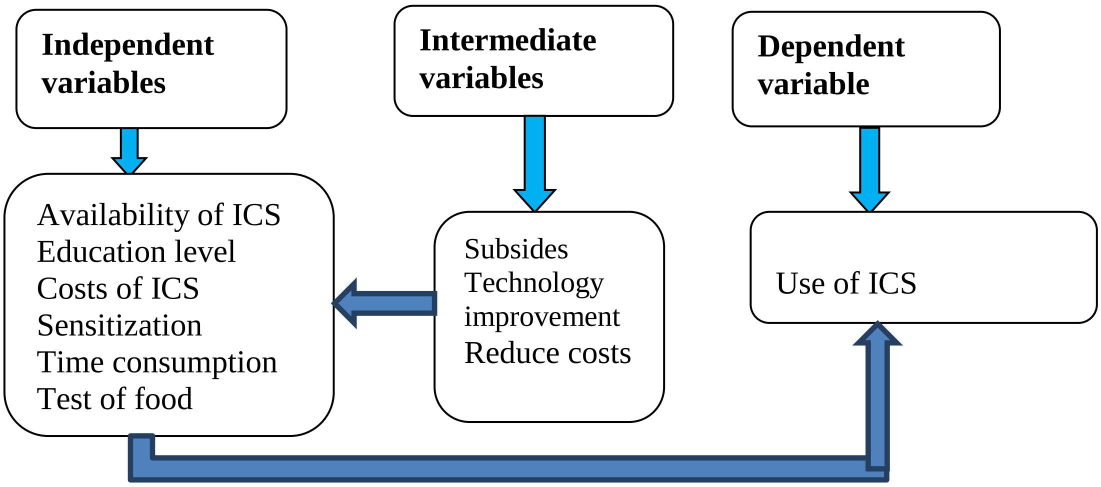

Figure 1: Conceptual framework

2.0. Methodology

2.1 Study area

Rungwe is one of the eight districts of the Mbeya Region of Tanzania. It is bordered by the Mbeya Rural District in the Northern part, Iringa Region in the Eastern part, Kyela District, Ileje District and Mbeya Urban District on Southeast, Southwest and Western parts respectively (Fig. 2).According to URT (2012), the population of the Rungwe District was 42,809. The district experiences an average temperature of 19.4 °C and receives average rainfall of 2177 mm which is favourable for natural vegetation growth. The dormant volcano of Mount Rungwe, rising to 2,961 meters above sea level rises above the town, a part of the Great Rift Valley. Much of the mountain's area contains forest reserves established as reserves by the British in 1949 (URT, 2015). The scope of the study was the Makandana ward. The selection of the area is based, on the availability of natural forest which is the source of income and firewood to the surrounding community. Also the introduction of improved stoves project in 2017 by C- quest Capital. The types of these stoves were wood and charcoal improved stoves (ICS) known as Rockets Improved Cooking Stoves.

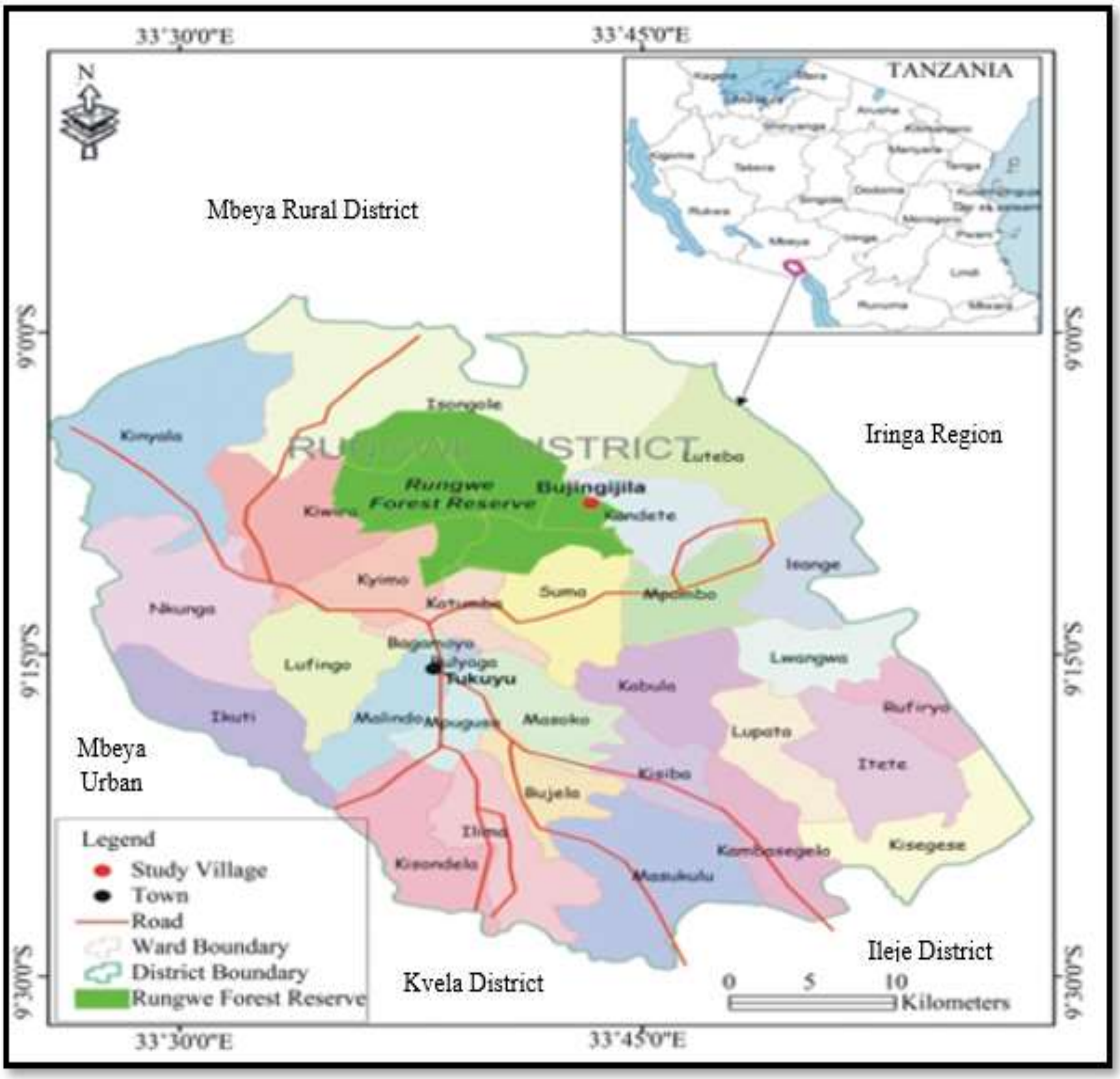

Figure 2: Location of the study area

2.2 Data collection Methods

The study employed primary and secondary data sources. Primary data were collected through interview; focus group discussion and observation methods while secondary data were extracted from documents of different offices in the district, textbooks, journal articles, and websites. Non-experimental design using cross section design was employed as it allows data to be collected at a single point at a time. A list of Makandana ward households (6840) was a sampling frame for this, study from which heads of households were taken as the sampling units. From this unit a sample size of 75 was used to obtain data from the study area. Yamane's (1967) formula was employed to obtain the sample as shown hereunder:

$$n = \frac{N}{1 + N(e)^2}$$

Where by,

n= sample size

N=Total house hold population i.e. sampling frame
e=Error of detection (10 percent)

$$n = \frac{6840}{1+6840(0.1)^2} = 74.559$$
$$= 75$$

The key informants involved were Village Executive Officer (VEO), Ward Executive Officer (WEO), District Environmental Officer (DEO) and District Forest Officer (DFO). Probability sampling techniques preferably simple random sampling and non-probability techniques were used to select households' heads and key informants respectively.

The focus group discussion method was also applied to collect information which could not be provided by an individual easily. The observation method was used to verify the types of wood fuel technologies used in households. The last three methods employed a checklist as a tool for data collection. However, the digital camera was also used to snap pictures related to study objectives.

Edited data were classified, coded and entered into the Statistical Package for Social Science (SPSS), computer software version 20 ready for the analysis. Descriptively, data were analysed by using cross tabulation, frequencies and percentages. Logistic regression model was applied in the analysis. The probability of a positive outcome for a binary 0 or 1 outcome variable as a function of covariates (Gujarati, 2004) was employed as narrated hereunder:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \beta_{13} X_{13} + \beta_{14} X_{14} + \beta_{15} X_{15} + \varepsilon_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, Y_i =dependent variable (the use of ICS), β_0 is constant, βi are estimated coefficients of the explanatory variables, and Xi are explanatory variables (Table 1)

Table 1: Description of the explanatory variables

X_1= Age	1 if youth, 0 if elder
X_2=Sex	1 if male, 0 if female
X_3=Marital status	I if married, 0 if single
X_4=Education level	1 if formal, 0 if informal
X_5= Income	1 if high, 0 if low
X_6= Availability of ICS	1 if yes, 0 if otherwise
X_7= Environmental education	1 if yes, 0 if otherwise
X_8= By-Laws and regulation	1 if strict, 0 if loose
X_9=Costs of ICS	1 if affordable, 0 if otherwise
X_{10}=Sensitization	1 if yes, 0 if otherwise
X_{11}=Taste of food	1 if good , 0 if bad
X_{12}=Durability of ICS	1 if yes, 0 if otherwise
X_{13} =Time consuming during cooking	1 if reasonable, 0 if otherwise
X_{14}=Comfort ability	1 if good, 0 if poor
X_{15}=User friendly for traditional clay pots	1 if high, 0 if low

Qualitative data was presented in descriptive narrations while quantitative data was presented through tables and charts.

3.0 Results and Discussion

3.1. Availability of improved cooking stoves in the study area

3.1.1. Respondent's use of ICS

The study on the use of ICS among 75 sampled respondents showed that 39.0 percent use the technology. This implies that at the initial stage of new technology the number of users is small. However, this will grow as community gain experience and awareness. Rosenzweig, (1995); Conley and Udry, (2002 commented that the early stages of new technology users may be few due to limited experiences and awareness.

3.1.2 Types of ICS available

Further analysis was done to determine the types of ICS available in the study area. The results presented in Table 2 show that muddy stoves (36.0 percent), rocket wood fuel (34.7 percent) and bell bottom (29.3 percent) were mostly available in the study area. Charcoal barbeque and cooking baking oven were used by a few respondents (6.7% and 2.7%) respectively. The study results revealed that most of the respondents use muddy and rocket wood fuel due to low purchasing costs. Bensch *et al*. (2015) had supportive evidence that the major limiting factor for ICS initial users is the upfront investment costs.

Table 2: Types of ICS available (n=75)

Varieties	Frequency*	Percentage case
Muddy stoves	27	36.0
Rocket wood fuel	26	34.7
Bell bottom	22	29.3
Senzawa	18	24.0
Straight wall	12	16.0
Double box with stoves	8	10.6
Charcoal barbeque	05	6.7
Cooking and baking oven	02	2.7

*Multiple responses

Through household visit women were observed to use mostly straight wall wood stoves, rocket wood fuel, muddy wood fuel, and bell bottom improved charcoal stoves (Plate 1, 2, 3 and 4) respectively.

Plate1: Straight wall wood fuel stove

Plate 2: Rocket wood fuel stove

Plate 3: Muddy wood fuel stove

Plate 4: Bell bottom charcoal stove

Further information was collected from non-users of ICS (61.0%) regarding the types of cooking stoves that they use. Summarised information is presented in Table 3.

Table 3: Types of cooking stoves used by ICS non users (n=61)

Variable	Frequency	Percentage
Traditional three stone stoves	42	91.3
Gas cooker	10	21.7
Kerosene stoves	5	10.8
Electric cooker	2	4.3

Table 3 shows that majority of respondents were using traditional three stone stoves (91.3%). Very few respondents were using gas cookers (21.7%), kerosene stoves (10.8%) and electrical cooker (4.3%). This study results are in agreement with those of Beyene and Koch (2013) who reported that most of the households in the rural areas prefer to use traditional three stones cooking stoves as they are available and less expensive. Also, URT (2015) explained that over 98 percent of Rungwe District households use traditional three stones stoves.

3.2 Factors which influence the use of the ICS

3.2.1 Descriptive analysis on factors influencing the use of ICS

The respondents were required to determine factors influencing the use of ICS. Among of the factors determined were availability of enough ICS (38.7 percent), sensitization on ICS stove use by 33.3 percent and costs of ICS (28 percent). This was followed by time consuming on cooking by 23.3 percent, the income of the respondents by 22.7 percent, taste of food (18.7 percent), loose by- laws and regulations in controlling the use of forests for wood and charcoal harvesting by 17.3 percent and are not user friendly for those who use traditional clay pots by 16.0 percent. The three least scored factors were environmental education 14.7 percent, durability of the stoves by 12.0 percent and cooking comfortability by 6.7 percent (Table 4).These results revealed that availability of ICS, sensitization and costs of ICS were leading factors for ICS use.

Table 4: Factors influencing the use of improved stoves

Factors	Frequency	Percentage
Availability of ICS	29	38.7
Sensitization	25	33.3
Costs of ICS	21	28.0
Time consumed during cooking process	19	25.3
Income	17	22.7
Taste of food	14	18.7
Loose by –laws on forest conservation	13	17.3
ICS are not user friendly for those who use traditional clay pots	12	16.0
Environmental education	11	14.7
Durability of improved stoves	09	12.0
Comfort during cooking process	05	6.7

*Multiple responses

3.2.2 Analysis of factors influencing the use of ICS

The descriptive results discussed in Table 4 were subjected to Logistic Regression model analysis to find out the most significant factors hindering the use of improved cooking stoves. Also, the background characteristics of respondents were considered in the analysis as they have an influence on the behaviour of the dependent variable (Table 5).

Table 5: Logistic Regression analysis on factors influencing the use of ICS

Variables	B	S.E.	Wald Chi- square	Sig.
Age	-.202	.074	7.438	.006*
Sex	-1.439	1.025	1.970	.160
Marital status	-.297	.950	.098	.755
Education level	.000	.000	3.053	.000*
Income	.000	.000	3.595	.051
Costs	-3.211	.000	3.099	.032*
Environmental education	2.781	1.541	3.259	.071
Taste of food cooked by using traditional cooking stoves	-2.118	.980	4.667	.031*
Sensitization	.000	.000	3.573	.004*
Availability of improved stoves	.000	.612	21.041	.000*
Loose by laws on forest conservation	1.521	.321	2.151	.061
Durability of improved stoves	-.287	.850	.095	.635
Time consumed during cooking process	-2.132	.000	3.413	.023*
Comfort during cooking process	.000	.000	.388	.427
Not user friendly for traditional clay pots	-.271	.860	.095	.701

B= Coefficient S.E= Standard Error Sg= Significant level

In Table 5 age of respondent was found to be statistically significant at $p < 0.05$ with a negative regression coefficient of value of -0.202. This implies that, as the age of the household head increases the probability of using ICS technology decreases. This is due to the fact that young aged group are eager to learn and adopt changes including technology compared to elders. The results comply with the findings of Irungu *et al*. (2015) who reported that youth are ready to learn, adopt innovations and modern technologies compared to their counterparts.

In the same table level of education of the head of the household was significant at $p > 0.05$ with a regression coefficient value of 0.000. This implies that, the probability of using ICS technology increases as increase of education level. This explained that education creates the ability to learn and use new technology. The results are consistent with the findings of Mamuye *et al.* (2018) who reported that formal education provides knowledge and awareness on the use of new technology.

Table 5 shows that the cost of ICS was significant at $p < 0.05$ with a negative regression coefficient of value -3.211. This implies that, as cost of ICS increase the probability of households using improved cooking stoves technology decrease. This revealed that a unit increase in the cost of ICS reduces a unit of ICS use. The results concurred to those of Bensch *et al.* (2015) who evidenced that a major deterrent factor to use of ICS is the upfront investment costs. Also, it supported is by Chianu and Tsujii (2009) in Nigeria who reported that non-users of new technology were due the cost needed to change the traditional technology.

It was noted that the taste of food cooked by using ICS was found to be statistically significant at $p < 0.05$ with a negative regression coefficient value of -2.118 (Table 5). This implies that taste of the food prepared by using ICS has the probability of influencing ICS in a negative way. The study results concurred with those of Pande *et al.* (2017) who reported that food prepared in traditional cooking stoves has a better taste than that of ICS.

Low sensitization to the use of ICS technology in households was statistically significant at $p < 0.05$ with a regression coefficient value of 0.000 (Table 5). This implies that the probability of using ICS technology decreases as sensitization efforts decrease. These findings comply with those of Kanangire et al. (2016) who noted that there was a positive relationship between the sensitization of households and the use of improved biomass.

Similarly, in Table 5 the availability of ICS was significant at $p < 0.05$ with a regression coefficient value of 0.000. This implies that, the probability of households in using ICS technology decreases as ICS availability decrease. The results are in line with those of Malla and Timilsina (2014) who have discussed that the use of ICS is influenced by the accessibility and availability of the stoves.

Time saving for the preparation of food by using ICS had proved to be one of the factors influencing the use of ICS with a negative regression coefficient value of -2.132 and significant at $p<0.05$ (Table 5). This revealed that an increase of ICS use reduces time for preparing food. The results concurredwith Hafner *et al.* (2018) who suggested that ICS use less firewood and less time than three-stone-fire stoves.

Therefore, variables whose coefficients were statistically significant were: age (0.006), taste of food prepared by traditional stoves (0.031), education level (0.000), cost of ICS (0.032), Taste of food (0.031), sensitisation efforts (0.004), availability of ICS (0.000) and time saving (0.023.) The variables whose coefficients were statistically insignificant were sex of the respondents (1.60), marital status (0.755), income (0.051), environmental education (0.061), durability (0.635) and comfort during cooking (0.427).

3.3 Initiatives undertaken to motivate the use of ICS

The respondents were required to provide information on initiatives were taken by the Forest Management office to motivate the community on the use of ICS technology. Table 6 shows that the main initiatives used were ICS dissemination of information by 54.7 percent, promotion by 52.0 percent and technical training of ICS making (37.3 percent). Few respondents reported for marketing of ICS (18.6 percent) and cost reduction by 14.6 percent.

Table 6: Initiatives for ICS use

Initiatives	Frequency	Percentages
Dissemination of information	41	54.7
Promotion	39	52.0
Technical trainings on making ICS	18	37.3
Marketing of ICS	14	18.6
ICS cost reduction	11	14.6

*Multiple responses

3.3.1 Dissemination

Information obtained in Table 6 shows that information dissemination is the leading initiative (54.7 percent) used to motivate households to use ICS. Secondary information from the Forest officer explained that the Forest management office in collaboration with C-Quest Capital ensured that dissemination of ICS was done through groups. These groups were provided technical and material support to build and make the ICS. The community was informed about the benefits of using ICS including time saving, smokeless, clean, energy saving and use of a few pieces of wood.

3.3.2 Promotion

As shown in Table 6, the promotion of ICS was employed as an initiative for motivating ICS use (52.0 percent). The Ward Executive Officer (WEO) disclosed the ICS promotion price as shown in Table 7. These results revealed that consumers had wide choice of ICS depending on individual income and preference. Through focus group discussion the group acknowledge the presence of training of their youth, material support for the construction of ICS, village meeting with Ant-Deforestation Agency and lesson learnt about the benefits of using ICS.

Table 7: ICS promotion price

Types of ICS	Market Price (Tsh)	Promotion price (Tsh)
Bell bottom	Between 15,000 and 20,000	Between 11,000 and 13,000
Straight wall	Between 15,000 and 20,000	Between 11,000 and 13,000
Sezawa	20,000	15,000
Double box stand	75,000	68,0000
Double stand with stove	90,000	75,000
Construction of Rockets stoves	Between 50,000 and 80,000 depend on size	Between 30,000 and 60,000

3.3.3 Technical trainings and business capacity building

The Village Executive Officer reported that through Ant-Deforestations Agency, youth groups were informed and provided technical trainings on how to construct ICS using local technology. At a starting point construction of 1,000 Rockets type of ICS were built to 1,000 households. Other types of ICS such as Bell bottom, Sanzawa and straight wall were in promotion price. The study was interested in soliciting more information on means of disseminating information to the community (Fig. 3).

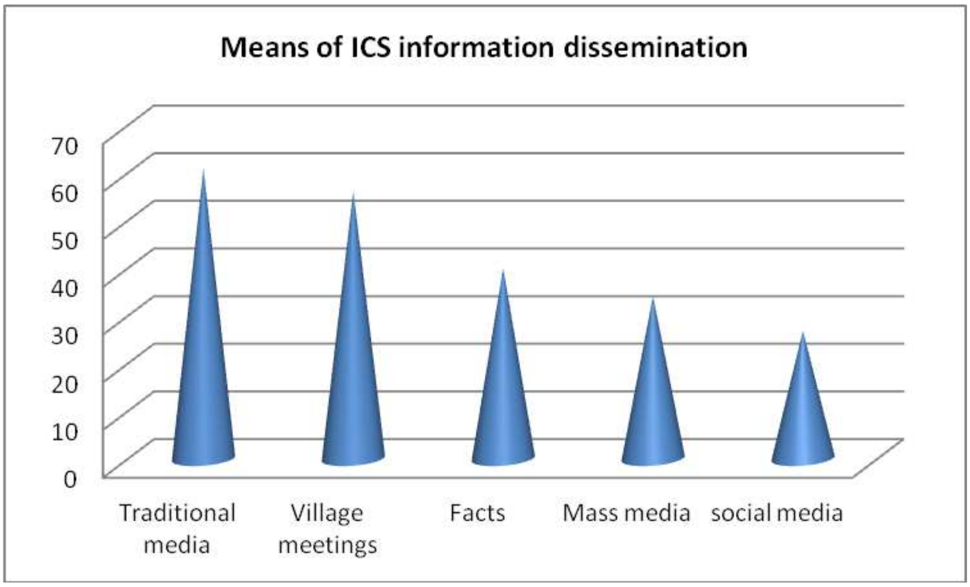

Figure 3: Means of ICS information dissemination: *Multiple responses

Based on the data analysed in Figure 3, traditional media (60.9 percent) was reported as the major means of disseminating information on ICS use. This was followed by village meetings by 56.1percent. The two least scored responses were mass media (34.1 percent) and social media by 26.8 percent. Further analysis was carried out to investigate the types of traditional media (60.9 percent) which were used to disseminate ICS information in the study area. The summarised results are presented in Fig.4.

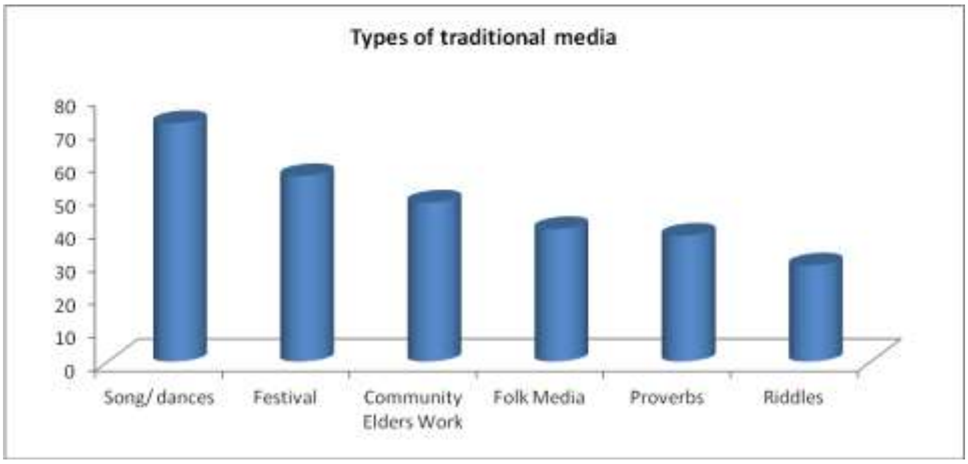

Figure 4: Types of traditional media used to disseminate ICS information

*Multiple responses

The results presented in Fig. 4 show that songs/dances (72 percent) and festivals (56 percent) were the main means used for disseminating ICS information through traditional media. The VEO reported that Ant Deforestation Agency created awareness of the sustainable management of resources such as forests through traditional media and meetings. These results differ from those of Adamides and Stylianou (2018) and Rware *et al.* (2021) who reported that radio is the most effective information media for disseminating information in rural areas.

4.0 Conclusion and Recommendations

Based on the study findings it was noted that there were few users of ICS in the study area. Through Logistic regression analysis the factors influencing ICS use which were statistically significant at $p< 0.05$ were, education level, costs of ICS, age of respondents; the taste of cooked food, community sensitization, availability of improved stoves and time consumption. The main initiatives were taken to motivate the community to use ICS were; information dissemination, promotion, technical training and business capacity building.

Therefore, the study recommends that more financial and technical support to youth groups is needed to produce good quality ICS which are cost efficient and less time consuming. Training efforts should be done to sensitize more households on the benefits of using ICS through meetings, seminars, and workshops at the village level. Subsidised costs of ICS would help the households to access and use the ICS. This could be done by seeking financial support from the Ministry of Natural Resources and Tourism and interested local and international development partners in the improvement of rural livelihood and forest conservation. The community can also be sensitized to form microfinance institutions like Savings and Credit Cooperative Societies (SACCOS) which through their own savings can get loans to acquire ICS. Adequate information dissemination on the ICS technology can be done through private and public media such as community radios, televisions and cell phones messages (SMS) to spread knowledge on the use of ICS.

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