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Full Length Research Paper

An analysis of multidimensional poverty and its determinants in rural Nigeria

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Human beings live to get happiness, livelihood, peace, security, safety, dignity and respect among others. Deprivation of any of these could be frustrating. Thus, attempts were made to determine multidimensional poverty index (MPI) of rural households and its decomposition by geo-political zones in Nigeria using the Alkire-Foster MPI approach. The result showed that the headcount poverty ratio H was 78.1% when K = 30 as compared to 58.8% for K = 40 and 23.6% for K = 60. The adjusted headcount ratio also suggested that 41% of the households were poor at K=30, whereas 34.2 and 16.7% of the households were considered poor for K=40 and K=60, respectively. The intensity of poverty from the result showed that the share of dimensions in which the poor were deprived increased with K, while the MPI of the households was decreasing with K. The result further revealed that living conditions contributed the largest value (59.9%) to the multidimensional poor, followed by education (14.3%), health (13.4%) and assets (12.4%). Therefore, the living condition and education of households should be prioritized in targeting poverty as it contributes largely to MPI across all the geopolitical zones in the country.

Key words: Asset, multidimensional poverty, Nigeria, rural, wellbeing.

INTRODUCTION

The most dehumanizing aspect of life in the entire world is poverty. This assertion is based on the fact that poor people lack basic necessities of life (food, shelter, clothing and medications). Different authors and researchers have explicitly defined poverty. According to Gbosi (2001), poverty is a condition of destitution and want; a state in which people cannot meet their fundamental needs to live, such as social amenities and economic structure needed for their sustenance. Poverty is deprivation of basic and valuable necessities to live good life which is germane for manful existence. Sule (2006) opined that, poverty is a result of inability of individuals, groups and society to meet up the minimum required social and economic infrastructure needed for

survival, a condition where individuals or group could not afford the cost to obtain desirable good and services in the economy.

According to World Bank (2007), extreme poverty is when individuals lives on less than $1.25 (purchasing power parity; PPP) per day, while moderate poverty is living on less than $2 a day. If an individual or family has access to subsistence resources for instance, that is, a condition of subsistence farmer with low cash income without a corresponding low standard of living, they live on their cash income but use the cash to augment what they have. On this note, poverty is taken to be cankerous and a menace that manifests through hunger, destitution of shelter, being sick, inability to attend school, illiteracy, not been able to speak properly, unemployment, future phobia, loss of children through insufficient access to clean water, powerlessness, lack of representation and freedom (World Bank, 1999). The major cause of an increase in poverty level in most African countries is a series of conflicts, civil war, political instability, drought, high external debt and rapid rise and spread of HIV/AIDS (Arimah, 2004). Therefore, the people living in poverty according to the assertion of the World Bank, (2000) feel a bypass of new economic privileges via insufficient access to market, denial of resources for fair participation and/or hindrance to a higher level of society through their less ability. They believe that poverty is more than the consideration of income alone; good life or well-being is multidimensional, with both material and psychological aspects.

Sub-Sahara Africa is reported to have the largest population suffering from hunger (FAO, 2015). Nigeria is the most populous country in the region and is vastly blessed with natural, geographical and socioeconomic factors, which makes up the country's wealth and potentials (Omotola, 2008). This could enlist the country among the richest in the world that should have no business with extreme poverty. But, it is quite disturbing, that despite the largely endowed natural resources, active labor force, and high production, Nigerians still suffer hunger. The nation is threatened by food insecurity, with a higher number of its populace not able to afford one US dollar per day (Francis, 2010). Looking at the trend and poverty level in Nigeria, Garba (2006) reported that the United Nations estimated that only about 15% of 42 million Nigerians were poor when the country got her independence in 1960. As the population increased to about 147 million in 1980, the poverty level also rose to about 28%. Poverty has been on the increase and according to the report of the United Nation Development Programme UNDP (2010), the number of people wallowing in poverty has increased to 68.7 million, in spite of the rise in GDP growth rate that the country has witnessed. This assertion is supported by the National Bureau of Statistics (NBS, 2012) which shows that 69% of the populace was in acute poverty; this showed that poverty in Nigeria is at endemic stage.

According to NBS (2012), about 112,519 million Nigerians were relatively in poverty condition, which represents 69% of the total population. The figure fluctuates when compared with the country's estimated population (163 million). It is pertinent for individuals or households to design means of meeting their basic needs or insufficient outcomes with respect to education, nutrition and health, and with deficient social relations, low self-esteem, insecurity and powerlessness to combat poverty. Therefore, if potential impacts of several anti-poverty programs, such as food security intervention programs are not considered, the poverty trend may further increase in the future. Therefore, developing a strong framework for measuring multidimensional poverty that corroborates the techniques developed to measure unidimensional poverty is required. To this end, this study is geared towards investigating multidimensional poverty of rural households in Nigeria

Literature review

Poverty has presumably always been understood as a multidimensional problem, yet traditionally, it has been measured unidimensionally with income or expenditure. This is based on the assumption that the income level could capture fairly well whether people were able to achieve certain minimum thresholds in a variety of dimensions such as nutrition, clothing and housing. But studies in recent years have being witnessing growing consensus regarding the shortfall of income poverty measures (Sen, 1992). Firstly, some fundamental needs are not satisfied in the market, or markets function very imperfectly. In these cases, non-market goods or institutions are required to provide for these needs. One example of this is access to clean water and education, which is sometimes provided by the state or NGOs. Secondly, each household has a different capacity to convert income into functioning.

Ukwu (2002) recognizes two basic concepts of poverty and it includes: Absolute poverty and relative poverty. On defining absolute poverty, the African Medical and Research Foundation (AMREF, 1998) views it as a condition in which individuals, households or society are deficient in or lack access to some basic necessity of life like clothing, food, education housing and health. Relative poverty is observed as a situation or condition when an individual, household, group or community are considered against some reference standards or parameters such as the average for the group or region, a target standard or objective or its ranking on given criteria. Therefore for this study, all concepts of poverty are relative. In other words, when referring to absolute poverty, it is a condition of existence below a reference standard of living. The concept of multidimensional poverty has gained grounds among researchers and policymakers. The fundamental and irresistible buildup of

Amartya Sen on participatory poverty exercises in many countries, and the principles behind the Millennium Development Goals (MDGs) have all drawn attention to the number of deprivations that the poor suffer from and the linkage among these deprivations.

According to Bruck and Kebede (2013), multidimensional poverty measure is composed of different variables. Viewing from literacy or tangible assets could be more reasonable methods for the assessment of poverty which could also capture long-term poverty. The identification of "poor" is the main focus of both the unidimensional and multidimensional poverty approaches which serve as a leap towards the accuracy of poverty measurement and analyses (Zedini and Belhadj, 2015). Poverty in sub-Sahara Africa (SSA) is endemic and thus causes low level of infrastructural development in the region. According to the African Development Bank Group (AfDB, 2015), Nigeria contributed 26.2% of SSA poor as at 2010 with a poverty rate of 68.0% from her total population. This assertion was confirmed by Alkire and Housseini's (2014) study when they estimated that 71.2 million Nigerians are MPI poor; this represents 15.4% of the total number of Sub–Saharan African (SSA) MPI poor.

In like manner, Batana (2008) used the Alkire and Foster (2008) method to estimate multidimensional poverty in 14 Sub–Saharan African countries. Identification of who is poor and who is not poor was based on four dimensions: assets, health, schooling and empowerment. Four main results included: Firstly, there were important cross-country differences in multidimensional poverty; secondly, the ranking of countries based on the Alkire and Foster (2008) multidimensional poverty measure differs from rankings based on standard welfare measures (HDI and income poverty); thirdly, decomposition of multidimensional poverty is more prevalent in rural than urban areas and; fourthly, decomposition of poverty by dimensions indicated that lack of schooling is the key contributor to multidimensional poverty.

Oyekale and Yusuf (2010) determined the socio-economic factors that influence experience of shocks by households and decomposed multidimensional poverty across welfare shocks and coping methods. The 2006 Core Welfare Indicator Questionnaire (CWIQ) data of the National Bureau of Statistics (NBS) was used for this study and the data were analyzed through the use of descriptive statistics and Fuzzy Set. The increasing price of agricultural inputs was the major shock experienced by rural households in the study area. The households that were multidimensional poor are faced with the shock of insufficient farmland. Most of the rural household heads engage in working on farms that belong to other households in order to survive poverty. Also, household heads that turned to begging on the street for survival were multidimensional poorer than those that adopted other coping methods.

Multidimensional poverty measure

In measuring the multidimensional poverty, the headcount ratio was firstly considered which can also be referred to as the percentage of poor households. This is given as:

$$H = \frac{q}{n}$$

where $q = q(y;z)$ is the number of households in the set zh, as identified using ρh the dual cutoff method.

Alkire and Foster (2008) proposed a headcount measure that is adjusted by the average number of deprivations experienced by the poor. To this end, a censored vector of deprivation counts kh is defined so that if $k_i \geq h$, then $k_i(h) = k_i$; and if $k_i < h$, then $k_i(h) = 0$.

This indicates that the count of deprivations in k(h) is always zero for non-poor households according to the ρh dual cutoff method, while the identified poor households keep the original vector of deprivation count k_i. Then, $\frac{ki(h)}{d}$ represents the shared possible deprivations experienced by a poor across the poor. This is given by:

$$A = |k(h`qd)$$

By focusing on the poor, the Alkire-Foster approach allows computing a final adjusted headcount ratio that satisfies the properties of decomposability and poverty focus. The dimension adjusted headcount ratio $M_0 (y;z)$ is given by: M_0 = HA or simply the product of the headcount ratio H and the average deprivation shared across the poor A. The dimension adjusted headcount ratio clearly satisfies dimensional monotonicity, since A rises when a poor households becomes deprived in an additional dimension. In addition, similar to the headcount ratio H, M_0 satisfies decomposability, replication in variance, symmetry, poverty and deprivation focus, weak monotonicity, non-triviality, normalization and weak rearrangement (Alkire and Foster, 2008). An attractive property of M_0 is that it can be decomposed by population decomposition obtained by:

$$M_0 (x,y;z) = n(x) M_0 (x;z) + n(y) M_0 (y;z) n (x,y) n(x,y)$$

where x and y are the distribution of two subgroups (x,y), the distribution obtained by merging the two: (n(x) the number of households in x, n(y) the number of households in y, and n(x,y) the number of households in n(x,y).

In other words, overall poverty is the weighted average of subgroup poverty levels, where weights are subgroup population shares. This decomposition can be extended to any number of subgroups. In addition, it is also possible to break down overall multidimensional poverty measure to reveal the contribution of each dimension j to it. Once the identification step is completed, a censored matrix of deprivations $g_0 (k)$ is defined whose typical entry

is given by $g_{0ij}(h) = g_{ij0}$ for every i satisfying $k_i \geq h$, while $g_{0ij}(h)$ for i with $k_i < h$. Then, $M_0(y;z)$ can be broken down into dimensional groups as:

$$M_0(x,z) = \frac{\Sigma j\psi(gij0(h))}{d}$$

Consequently, $\frac{1}{d}\psi \frac{(gij0(h))}{M0(y;z)}$ can be interpreted as the post-identification contribution of dimension j to overall multidimensional poverty.

METHODOLOGY

This study was carried out in Nigeria. Households' food expenditure data were extracted from the Wave 2 of the Nigerian General Household Survey (GHS) – Panel 2012/13 conducted by the National Bureau of Statistics (NBS) in collaboration with the World Bank Living Standards Measurement Study (LSMS) team, with funding support from the Bill and Melinda Gates Foundation. It contains rich demographic data and few relevant socioeconomic data on households and household assets.

A two-stage stratified sampling technique was used for the study. The first stage involved clusters of housing units called enumeration area (EA), and the second stage involved the selection of housing units. About 3,217 housing units were found useful for the study. Expenditure on food consumption of each household (production share, purchase share, and the meal away from home) was explored. The production share of the food product was estimated with the use of the prevailing price of the product in the same EA.

Analytical techniques

Alkire and Foster (2008) methodology include two steps: an identification method (ρk) that identifies 'who is poor' by considering the range of deprivations they suffer, and an aggregation method that generates an intuitive set of poverty measures (Mα) (based on traditional FGT measures) that can be broken down to target the poorest people and the dimensions in which they are most deprived. It also proposes two additional measures in the same class of multidimensional poverty measures: the adjusted poverty gap and the adjusted FGT measure, which are sensitive to the depth of deprivation in each dimension, and the inequality among the poor.

The notation: Let y = [y_{ij}] denote the n × d matrix of achievements,

where n represents the number of households, d is the number of dimensions, and $y_{ij} \geq 0$ is the achievement of households I = 1, 2…..,n in dimension j=1,2,…d.

Each row vector $y_i = y_{i1},y_{i2},….,y_{id}$ lists households i's achievements, while each column vector $y_o j = y_{1j},y_{2j},….y_{nj}$ gives the distribution of dimension j achievements across the set of households.

Let $z_j > 0$ denotes the cutoff below which a household is considered to be deprived in dimension j and let z be the row vector of dimension specific cutoff. The expression |v| denotes the sum of all the elements of any vector or matrix v, and µ(v) represents the mean of |v|, or |v| divided by the total number of elements in v.

For a given matrix of achievements y, it is possible to define a matrix of deprivation g0=[gij0] whose typical element gij0 is defined by g ij0=1 when $y_i < z_j$, while gij0 = 0 otherwise. Hence, g 0 is a n × d matrix whose ij[th] entry is 1 when child i is deprived in dimension j,

and 0 otherwise according to each dimension cutoff zj. From this matrix, we can construct a column vector c of deprivation counts, whose i[th] entry $c_i = |g_{i0}|$ represents the number of deprivations suffered by a child. It is noteworthy that the matrix and vector can be defined for any ordinal and cardinal variable from the matrix of achievements y.

Following Alkire and Foster (2008), the vector c of deprivation counts is compared against a cutoff k to identify the poor, where k = 1…d. Hence, the identification method ρ is defined as $\rho k (y_i;z) = 1$ whenever $c_i \geq k$, and $\rho k (y_i;z) = 0$ whenever $c_i < k$. Finally, the set of households who are multidimensional poor is defined as Zk= {i :ρk(yi;z)}. In other words, the method identifies as poor any household who is deprived in more than k number of dimensions.

Alkire and Foster (2008) refers to ρk as a dual cutoff method because it first applies the within dimension cutoff zj to determine who is deprived in each dimension, and then the across dimension cutoff k to determine the minimum number of deprivations for a household to be considered multidimensional poor. They identify absolute poverty as those household who suffer from at least two or more deprivations (equivalent to k = 2), and as in severe deprivation those who suffer from at least one deprivation (equivalent to k = 1).

Logit regression analysis

Logit model was used to estimate the determinants of poverty in rural Nigeria. Logit model is a statistical method for analyzing a data set in which there are one or more independent variables that determine an outcome. The outcome is measured with a dichotomous variable (in which there are only two possible outcomes). Following Menard (1995) and Agresti (1996), the study's logistic model is specified as:

$$P = E (Y_i = 1 /X_i) = e(\beta_0 + \beta_1 X_1 + \beta_2 X_2 ………\beta_i X_i) \tag{1}$$

where Pi is a probability that dependent variable Y_i = 1 poor and Y_i = 0 otherwise. β_0 is the intercept which is constant, β_1 is the coefficient of determinants of poverty in the study area. X_i is a set of independent factors/variables. The factors hypothesized include: Age, household size, gender, education, share of dependent on household head, married, land ownership, agricultural wages, non-agricultural wages, distance to the nearest health centre, share of HH with portable water.

RESULTS AND DISCUSSION

The multidimensional poverty estimates are based on four dimensions: Education, health, assets and living conditions (Table 1). Deprivation on each dimension was obtained through the generation of weights for each indicator. The number of dimensions in which household must be deprived, a second cutoff K, was set below which a household is considered poor. The estimated poverty index based on the value of cutoff, K is presented in Table 2. From the table, a decrease in poverty measures as the level of K decreases was noticed. When K = 30, the headcount poverty ratio H was 78.1% as compared to 58.8% for K = 40 and 23.6% for k= 60. This agrees with the findings of Adeoti and Popoola (2012). The adjusted headcount ratio also suggested that 41% of the households were poor when K=0.3, and that 34.2 and 16.7% were poor for K = 0.4 and k = 0.6, respectively.

Table 1. Dimension, indicators, deprivation cut-off and weights of multidimensional poverty index (MPI).

Dimension	Indicator	Deprivation cut-off
Education	Child enrollment	A household is deprived, if any school aged-child is not currently enrolled
Health	Child mortality	A household is deprived, if any child is dead due to illness
	Nutrition	A household is deprived, if any household member is malnourished
Assets	House ownership	Households living in a single room, house made of wood, and straws.
	Electric gadgets	The household is deprived in this indicator if they do not own more than one of a group of small assets (radio, TV, telephone, bike, motorbike, or refrigerator) and do not own a car or truck.
Living conditions	Lighting fuel	The household is deprived if they do not have access to electricity.
	Cooking fuel	The household is deprived if they cook with wood, coal, straw or dung.
	Drinking water	The household is deprived if its main source of water is from unprotected wells, open spring, and surface water or they require more than 30 min to fetch water.
	Floor materials	The household is deprived if it has a dirt floor (earth, sand or dung).
	Type of toilet	The household is deprived if it uses uncovered pit latrine, bucket and hanging toilet does or is shared with another household.
	Refuse disposal	The household is deprived if it dump its refuse in an open area, water side, within and outside the compound.

Source: Alkire and Foster (2008).

Table 2. Multidimensional poverty indices

K (%)	Adjusted headcount (Mo =HA)	Headcount (H)	Poverty gap (A)	Average deprivation (A/K)
0.3	0.410	0.781	0.525	1.75
0.4	0.342	0.588	0.582	1.46
0.6	0.167	0.236	0.707	1.18

Source: Author's computation (2016).

Table 3. Relative contribution of dimensions to MPI.

K (%)	Education	Health	Assets	Living condition
0.30	0.124	0.167	0.168	0.540
0.40	0.131	0.150	0.158	0.561
0.60	0.143	0.134	0.124	0.599

Source: Author's computation (2016).

Table 4. Decomposed multidimensional poverty indices by geopolitical zones in Nigeria.

Poverty cutoff Zones	K (%) = 0.3				K (%) = 0.4				K (%) = 0.6				Pop. share
	M_o	H	A	AD	M_o	H	A	AD	M_o	H	A	AD	
SS	0.347	0.687	0.506	1.69	0.273	0.477	0.573	1.43	0.136	0.191	0.700	1.17	0.169
SW	0.318	0.674	0.472	1.57	0.240	0.452	0.531	1.33	0.067	0.098	0.680	1.13	0.167
SE	0.352	0.741	0.475	1.58	0.257	0.473	0.542	1.36	0.086	0.124	0.688	1.15	0.190
NC	0.522	0.916	0.569	1.90	0.471	0.773	0.610	1.53	0.274	0.383	0.716	1.19	0.163
NW	0.465	0.859	0.541	1.80	0.407	0.695	0.586	1.47	0.205	0.291	0.705	1.18	0.158
NE	0.475	0.825	0.576	1.92	0.428	0.692	0.619	1.55	0.260	0.363	0.716	1.19	0.154

Source: Author's computation (2016).

The intensity of poverty showed that the share of dimensions in which the poor were deprived increased with K. Meanwhile, the MPI of the households was decreasing with K. This indicated that the numbers of poor households reduced but the intensity of poverty increased.

The relative contribution of the various dimensions to overall multidimensional poverty is shown in Table 3. The result showed increased contribution of Education to MPI as the cutoff (K) increased. Similar trend was observed with the living condition, where the result increased with increase in the cutoff (K), but the case was different with health and assets, where the result decreased with increase in cutoff (K). The result also suggested that the highest contribution was from living condition with 54%, followed by assets (16.8%) and health (16.7%), while education contributed the least with 12.4% at k= 0.3. Similar results were observed at k= 0.4 when living condition recorded a value of 56%, followed by assets with 15.8%, health with 15% and education with 13.1%. At k= 0.6, the living condition contributed the largest value (59.9%) to the multidimensional poor followed by education (14.3%), then followed by health (13.4%) and assets with 12.4%.

The results clearly showed a wide gap between households' living conditions and other dimensions considered, that is, assets, health and education at all the cutoff points. This indicated that living condition, health and education of the respondents should be a policy target to reduce poverty in the study area and that effort should be geared towards improving the standard of living of the people through provision of basic amenities.

Table 4 shows the decomposed MPI for the geopolitical zones in Nigeria. The table showed poverty headcount (H) of 68.7% in the South-South as compared to 47.7 and 19.1% when K = 0.4 and k=0.6. About 67.4% in the South-West, when K=0.3% as compared to 45.2 and 9.8% when K=0.4 and k=0.6, respectively. In the North West, poverty headcount (H) was recorded as 74.1% at k=0.3 when compared with 47.3 and 12.4% when K=0.4 and k=0.6, respectively, while North west, North Central and North East recorded 91.6, 85.9 and 82.5% respectively at cutoff (K) of 0.3% as compared to 77.3 and 38.3, 69.5 and 29.1, and 69.2 and 36.3 for K=0.4 and K=0.6, respectively. The result also showed decrease in the households' MPI as the cutoff (K) increased for each zone. This result indicated that as the number of poor households reduced, the intensity of poverty increased. It is evident from the result that poverty is more in the northern part of the country than the southern part though the MPI in all the zones was extremely high. Therefore, stakeholders should work out ways to reduce the incidence and intensity of MPI in all the zones.

Table 5 shows the relative contribution of the various dimensions to overall multidimensional poverty in different geopolitical zones in the country. From the result, it was evident that at K = 0.3, living condition had the highest contribution with the value of 43.7% followed by assets, health and education with the value of 15, 13.1 and 13%, respectively, in the south-south. Similarly, the result followed the same sequence in the South West, but in the South East it was, living condition (37.9%), assets (18.3%), education (15.4%) and health (14.3%). The result of North West, North central and North East

Table 5. Decomposed relative contribution of dimensions to MPI by geopolitical zones

Pov cutoff Geo	Education	Health	Asset	Living condition	Education	Health	Asset	Living condition	Education	Health	Asset	Living condition
SS	0.130	0.131	0.150	0.437	0.123	0.111	0.122	0.444	0.107	0.089	0.102	0.502
SW	0.104	0.150	0.166	0.357	0.107	0.126	0.135	0.334	0.081	0.051	0.061	0.205
SE	0.154	0.143	0.183	0.379	0.155	0.117	0.142	0.338	0.098	0.065	0.078	0.273
NW	0.145	0.233	0.196	0.699	0.170	0.246	0.197	0.766	0.244	0.264	0.208	0.926
NC	0.078	0.191	0.175	0.690	0.090	0.190	0.172	0.740	0.137	0.170	0.159	0.761
NE	0.129	0.163	0.137	0.730	0.139	0.166	0.135	0.812	0.201	0.182	0.148	1.025

Source: Author's computation, 2016.

Table 6. Coping strategies adopted for mitigating poverty in the study area.

Coping strategy	Frequency	Percentage
Limited food	868	42.80
Skip meal	602	29.68
Meal size reduction	654	32.25
Children first	338	16.67
No food at all	188	9.27
Sleeping hungry	156	7.69
Borrowing from neighbour	214	10.55
Working on another farms	64	3.16
Total	3084	100.0

Source: Author's computation, 2016. Multiple response.

followed the same order, that is, from living condition, health, education and assets.

Also, when K = 0.4, the result showed that living condition contributed the highest value to the MPI in all the zones with about 44.4% in the south-south, 33.4% in the south west, 33.8% in the south east, 76.6% in the north west, 74% in the north central and 81.2% in the north east zone. In the area of assets: the SS, SW, SE, NW, NC and NE, possess the value of 12.2, 13.5, 14.2, 19.7, 17.2 and 13.5%, respectively. The NW had the highest value in term of health, followed by the NC and NE. Also, the relative contribution of education to MPI was found higher in the NW, followed by SE and NE. The result suggested that living condition, health and assets needed serious attention in formulating our policy. Furthermore, when K = 0.6, living condition of the respondents contributed highly to MPI in all the zones, the contribution of assets was high in NW, NC and NE with value of 20.8, 15.9 and 14.8%, respectively. NW had the highest record to MPI in both health and education dimensions followed by the NE zone.

Coping strategies adopted in cushioning the effect of poverty in the study area

Table 6 revealed that 42.8% of the rural households consumed limited food, 32.3% engaged in the reduction of meal size, 29.8% skipped meals as a means of coping with poverty,

Table 7. Logistic regression estimates of determinants of poverty in rural Nigeria.

Poverty status	Marginal effect	Std. err.	z	P>|z|
Age	-0.0020231	0.00319	-0.63	0.526
Household size	0.0842577	0.01340	-6.29	0.000***
Gender	0.6153034	0.17966	3.42	0.001***
Education	-0.1287791	0.04828	2.67	0.008***
Share of dependent on HH	0.4425343	0.07764	5.70	0.000***
Married	-0.0241179	0.03170	-0.76	0.447
Land ownership	-0.0022548	0.00065	3.42	0.001***
Agricultural wages	0.0416926	0.03113	1.34	0.181
Non-Agricultural wages	-0.0061836	0.00207	-2.97	0.003***
Dist. to nearest health centre	0.0047955	0.00377	1.27	0.204
Share of HH with portable water	0.0055988	0.08483	0.07	0.947
Constant	-1.622204	0.34045	-4.76	0.000***

Diagnostic test

LR $Chi^2(5)$ = 97.00

Prob> Chi^2 = 0.0000

Log likelihood = -2043.8548

Pseudo R^2 = 0.2320

Source: Author's computation (2016).

about 16.7% always fed their young one first before consuming the remaining food, and 10.6% borrowed food from their neighbours. About 9.3% consumed nothing throughout the day; this could probably mean that they engaged in fasting whenever there was food shortage in the house, while only 7.7% households slept hungry and about 3.2% engaged in working on other people's farms for wages to support their households. The result showed that not much of the household engaged in off-farm income generating activities in order to improve their level of income. The result contradicted the findings of Idrisa et al. (2008) who reported that 68.3% households allowed their children to eat first.

Determinants of poverty in rural Nigeria in the study area

The result presented in Table 7 showed the logit estimate of determinants of rural poverty in Nigeria. The MPI obtained for the poverty cutoff K=3 was taken as the poverty line to group households as poor or non-poor. The logit model with a significant chi-square at 1% shows that the model is a good fit for the data. The pseudo r^2 was 23.2% and the log likelihood was -2043.8548. Table 7 revealed that household size, gender, year of education, share of dependent on household head, land ownership and non-agricultural wages were significant determinants of poverty in the study area. The result showed that household size was positively significant at 1%, implying that in an increase in the household size,

there is probability of increase in the poverty of the respondents by about 8%. The result is in consonant with findings of Fanifosi and Amao (2016) in their work where household size was significant at 1%. Increase in female headed households is seen to increase the chance of being poor by about 62%; this might be in conformity with the assertion that female access less productive capital as compare to their male counterpart. The result is in line with the findings of Adeoti (2014).

Also, more years of education is known to reduce poverty in the study area by 12.9% and an increase in the share of the dependents on the household head will raise poverty of the respondents. Increase in land ownership will reduce poverty in the study area, as this will help the respondents in increasing their farmland and cultivate more food for market purpose. Finally, non-agricultural wages showed a significant influence in reducing poverty in the study area and it means that a rise in the wages obtained from non-agricultural activities will reduce the poverty of the respondents by 0.6%.

CONCLUSION AND RECOMMENDATIONS

The study employed the Alkire-Foster approach to estimate the multidimensional poverty of the rural households in Nigeria and decomposed the MPI based on the six geo-political zones in the country. From the findings, it can be deduced that, the share of dimensions in which the poor were deprived increased with cut off (K). Meanwhile, the MPI of the households decreased

with K. This indicated that the number of poor households reduced but the intensity of poverty increased. Also, the result showed that, North East, North Central and North West of the country had the largest population in the rural area which was multidimensional poor with each cutoff. The South-western part of the country was the least followed by the south-south and south-east. Finally, it was revealed that, the highest contribution to MPI was from living condition, followed by assets, health and then education. Based on the findings, the study therefore recommends that living condition, health and education of the respondents should be a policy target to reduce poverty in rural Nigeria. So, policy should be enacted with quick implementation of effective and sustainable anti-poverty programmes that will cut across all the geopolitical zones in the country.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Full Length Research Paper

Determinants of potato seed market supply through producer cooperatives in Haraghe, Ethiopia

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Seed producer cooperatives were initiated by the Integrated Seed Sector Development Program in five regions of Ethiopia including Oromia region since 2009 as an alternative mechanism to narrow the gap between seed supply and demand in the country. Seed marketing is one of the key activities of the program to satisfy the demand of farmers by providing quality seeds in the right place, at the right time and with the right price for sale. Therefore, this study was designed to analyze market performance of potato seed through producer cooperatives in Haramay, Kersa and Chiro districts of Oromia Regional State, Ethiopia by identifying factors affecting potato seed market supply and its intensity. Three stage sampling procedure was used to select potato seed producer households. In the first stage, kebeles in the three districts were categorized into two: those with and without Seed Producer Cooperatives. In the second stage, kebele administrations with Seed Producer Cooperatives were purposively targeted from each district. In the third stage, households in the sample kebeles were stratified into two: member and non-member households. Finally, all farm households who are members of Seed Producer Cooperatives (157) in the sample kebeles were included in the sample. The Tobit model was used to analyze the data. The result of the analysis indicated that Haramaya district, literacy status, family size, extension contact, households' perception to price offered by cooperatives and distance from cooperative market center are the significant factors affecting members' potato seed market supply through cooperatives. Based on the findings, policy interventions like cooperatives capacity building, providing adult education, awareness creation on family planning, provision of extension service and accessible cooperative market center are suggested and forwarded.

Key words: Intensity, marginal effect, seed producer cooperatives, Tobit model.

INTRODUCTION

Important inputs such as fertilizer, improved seeds and chemicals are either unavailable or their prices are usually high, making them very expensive and unprofitable to farmers to use. Seed security is one of the most important sociological, political, economic and scientific challenges in Ethiopia. Securing the supply of quality seed and planting material of the most important food crops is the most effective way to sustain food security. However, inefficient seed marketing and distribution system has resulted in limited use of improved seeds by the majority of Ethiopian farmers which further contribute to low agricultural production and

productivity (Atilaw, 2010).

In spite of decades of efforts by governments, the private sector and donors to strengthen the national seed sector, the seed situation in Ethiopia remains dismal. About 9% of farmer households use improved seed and slightly more than 5% of the total arable land is planted with improved seed. Even though the establishment of Ethiopian Seed Enterprise led to advent of organized seed production and supply system in the country, it remained the main supplier in the formal sector, the enterprise used to have a problem of carry-over stock, while the majority of farmers were unable to obtain improved seed. This problem was attributed to poor seed marketing, reaching the farmer and/or the inabilities of the enterprise to meet the farmers need in terms of varietal choice and product quality (ESE, 2010).

In Oromia region, improved varieties are only planted on 3.7% of the arable land under cultivation (Mesay, 2010). The Ethiopian Seed Enterprise (ESE) is only able to supply a very limited amount of improved seed to the farming community. This restricted use of both improved varieties and quality seeds contributes to low productivity. Therefore, such inefficient distribution channels calls for participation of cooperatives in seed production and marketing as an alternative mechanism to develop a more flexible structure for seed marketing which is believed to provide the demanded crop and variety type. It will provide the demanded variety, crop and type of quality. Such farmer-produced seed may contribute to meeting farmers' demands in a required quantity and time at reasonably acceptable seed price. Accordingly, seed producer cooperatives are initiated by the ISSD Program in five regions of Ethiopia including Oromia region since 2009 as an alternative mechanism to narrow the gap between seed supply and demand in the country. Seed marketing is one of the key activities of the program to satisfy farmers demand by providing quality seeds at the right place, time and price for sale (ISSD, 2012).

Shortage of appropriate potato seed tuber is a major bottleneck in potato market supply (Emana and Nigusse, 2011). Recognizing the Integrated Seed Sector approach for strengthening the Ethiopian seed sector through interventions in different seed systems, Ethiopian Ministry of Agriculture and Rural Development together with other key public, private and civil society seed sector stakeholders endorsed the concept note on Integrated Seed Sector Development (ISSD) in the country. Besides projects on agro-biodiversity conservation, policy development and private sector development, the ISSD programme included the projects on Local Seed Business (LSB) development and on partnerships and innovation in the seed sector. Through the LSB project, seed producer cooperatives have been supported since 2009 to be technically better equipped and more commercial in their seed production and marketing efforts, and are more autonomous in their operations in the seed sector (ISSD, 2012). Therefore, this study aimed to investigate determinants and intensity of potato seed marketed surplus through cooperatives.

Literature review

Market is traditionally defined as a specific geographical area where buyers and sellers meet for exchange of goods and services. The most common way to obtain goods and services we do not produce ourselves is to buy them from others who specialize in producing them. To make such purchases, buyers seek out sellers in markets. Markets are ways in which buyers and sellers can conduct transactions resulting in mutual net gains that otherwise would not be possible (Hyman, 1989).

Modern market may be defined as an arena for organizing and facilitating business activities and for answering the basic economic questions like how much to produce, what to produce and how to distribute production. A location, product, time, group of consumers, or level of the marketing system may define it. The choice of market definition to use depends on the problem to be analyzed. Market is an institutional and organizational arrangement to facilitate exchange of one thing for another. The most observable features of a market are its pricing and exchange processes. A market is thought of as a meeting of buyers and sellers: a place where sellers and buyers meet and exchange takes place, an area where price-determining forces (supply and demand) operate and an area where there is a demand for good (Kebede, 1990). But a market is more than a physical place. It is a mechanism or an institution through which buyers and sellers exchange information and transact.

Another basic concept that is closely related to market is marketing. This term came into use with division of labor and specialization and became common with urbanization and industrialization over many years. The term marketing has been a very debatable concept and defined in different ways by different scholars. This is because marketing, or more specifically, agricultural marketing, projects different impression to different groups of people in a society, like farmers, traders and consumers. Marketing is also described as the performance of all business activities involved in the flow of food products and services from the point of initial agricultural production until they are in the hands of

consumers. The definition of marketing as a process by which individuals and groups obtain what they need and want by creating and exchanging products and values with others involves work (Kohls and Uhl, 1985).

Marketable surplus is the quantity of the product left out after meeting the farmers' consumptions and utilization requirements for kind payment and other obligations such as gifts, donations, charity, etc. Thus, marketable surplus shows the quantity left out for sale in the market. Marketed surplus shows the quantity actually sold after accounting for loses and retention by the farmers, if any and adding the previous stock left out for sale (Thakur et al., 1997). Thus, marketed surplus may be equal to marketable surplus, it may be less if the entire marketable surplus is not sold out and the farmers retain some stock and if loses are incurred at the farm or during transit.

The importance of marketed and marketable surplus has greatly increased owing to the recent changes in agricultural technology as well as social patterns. In order to maintain the balance between demand for and supply of food grains with the rapid increase in demand due to higher growth population, urbanization, industrialization and overall economic development, accurate knowledge on marketed and marketable surplus is essential in the process of proper planning for the procurement, distribution, export and import of agricultural product. The importance of marketed and marketable surplus has greatly increased owning to the recent changes in agricultural technology as well as social patterns. In order to maintain the balance between demand for and supply of food grains with the rapid increase in demand due to higher growth in population, urbanization, industrialization and overall economic development, accurate knowledge on marketed and marketable surplus is essential in the process of proper planning for the procurement, distribution, export and import of agricultural product (Malik et al., 1993).

The most common form in which commercialization could occur in peasant agriculture is through production of marketable surplus of staple food over what is needed for own consumption. Another form of commercialization involves production of cash crops in addition to staples or even solely. At the farm household level, commercialization is measured simply by the value of sales as proportion of the total value of agricultural output. At the lower end, there would always be some amount of output that even a subsistence farmer would sell in the market to buy basic essential goods and services. For this reason, the ratio of marketed output upto a certain minimum level cannot be taken as a measure of commercialization (Neway, 2006).

Empirical studies of supply relationships for farm products indicate that changes in product prices typically (but not always) explain a relatively small proportion of the total variation in output that has occurred over a period of years. The weather and pest influence short run change in output, while the long run changes in supply are attributed to factors like improvement in technology, which result in higher yield. The principal causes of shift in the supply are changes in input prices, and changes in returns from commodities that compete for the same resources. Changes in technology that influence both yields and costs of production/efficiency, changes in the price of joint products, changes in the level of price, yield risk faced by producer and institutional constraints such as average control programs, also shift supply (Tomek and Robinson, 1990).

Seed marketing is the most important as well as challenging aspect of seed industry because of the nature of the product. Seed is a living organism, therefore, its quality deteriorate fast. Thus, its shelf life is limited and it must be marketed within the season. Another peculiar feature of seed is that it requires two to three years lead time to meet the specific requirements, that is, to meet the demand for a particular seed, its production has to be organized at least two years in advance. Changes in weather, price of crop, and price of competing crops may change the prospects of demand for the seed of a particular variety at the commencement of sowing season (Singh, 2004).

Seed marketing should aim to satisfy the farmer's demand for reliable supply of a range of improved seed varieties of assured quality at an acceptable price. However, the difficulties of organizing effective seed delivery systems, especially to small-scale farmers, have often been underestimated in comparison with the attention given to other seed industry activities. Historically, more attention and resources have been devoted to the physical aspects of seed production and storage than to the difficult organizational issues involved in managing sales and distribution. Marketing is one of the most important, yet misunderstood business activities and frequently means different things to different people. To the retailer in the agricultural sector, for example, it is selling seed together with other inputs to the farmer. To the farmer, it is simply selling what he produces on his farm. However, whatever the circumstances, a well-defined sequence of events has to take place to promote the product and to put it in the right place, at the right time and at the right price for a sale to be made (FAO, 1994).

Of all agricultural services, difficulties with organizing effective seed delivery, particularly for poor small-scale farmers, have been under-estimated in comparison with the attention devoted to, for example, agricultural produce marketing, fertilizer delivery, credit and extension services. And within the seed sector itself, more attention has been devoted to the physical aspects of production, processing and storage than to the difficult organizational issues which is essential if the sector is to function well. As a result, many developing countries have persisted, in the apparent absence of alternatives, with loss-making parastatal seed companies despite their

failure to meet the needs of small farmers effectively (Cromwell et al., 1992).

RESEARCH METHODOLOGY

Study area

The study was conducted in three districts in Eastern Ethiopia: Kersa, Haromaya and Chiro (Figure 1). With an area of 545 km², Kersa district is found in the Northern part of Eastern Hararghe Zone of Oromia Regional State. Its topography is characterized by mountains, plateaus, hills, plains, valley and gorges. It extends between 1,400 and 3,200 m altitude. The district is classified as highland (7%), midland (91%) and lowland (2%) agro climatic zones. According to the 2007 National Census Report, the total population of the district was 170,816 of which 50.4% were men and the remaining were women. About 6.7% of its population was urban dwellers. Average family size for rural and urban area was 4.3 and 4 persons, respectively. The estimated land use pattern revealed that 28.5, 2.3 and 6.2% were arable, pasture and forest lands, respectively, while the rest was attributed to degraded, built up and other areas. Sorghum, maize, haricot bean, barley and wheat are the dominant crops grown in the district (ORSFED, 2004).

The second district, Haromaya is also located in Eastern Hararghe zone of Oromia regional state. The altitude of this district ranges from 1400 to 2340 masl. A survey of land in Haromaya (released in 1995/96 shows that 36% is arable or cultivable, 2.3% pasture, 1.5% forests and the remaining 60.1% is considered built up, degraded or otherwise unusable. Chat, vegetable and fruits are important cash crops in the district. In 2007, the National Census Report, the total population for this district was 271, 018, of which 50% were men and the rest were women. About 18.46% of its population was urban dwellers. Nearly 97% of the dwellers are Muslims and the remaining minority of the population are Christian (ORSFED, 2004).

Chiro district is found in the Northern central part of West Hararghe zone of Oromia Regional state, Ethiopia. The district stretched between 1,300 and 3,170 masl. Climatically, this district is classified into lowland (49.4%), midland (32.8%) and highland (17.8%). Sorghum, haricot bean, maize, barley, wheat and teff are widely cultivated crops in the district. The population of the district was about 308,553 of which 92.7% were rural and the rest urban population. Young, economically active and old age populations accounted for 46.9, 50.3 and 2.8%, respectively (ORSFED, 2004).

Data collection

Both primary and secondary data on a wide variety of variables were gathered to meet the objective of the study. Semi-structured questionnaire was used to generate primary data from members of Seed Marketing Cooperatives. Secondary data was collected from published and unpublished sources of past reports and studies conducted by institutions, researchers and local seed business reports.

Sampling technique

Multi stage sampling technique was used to select potato seed producer households. In the first stage, *kebeles* in the three districts were categorized into two: those with and without Seed Producer Cooperatives. In the second stage, *kebele* administrations with Seed Producer Cooperatives were purposively targeted from each district. In the third stage, households in the sample *kebeles* were stratified into two: member and non-member households. Finally, all farm households who are members of Seed Producer Cooperatives in the sample *kebeles* were included in the sample (Table 1).

Data analysis

Data obtained regarding whether Seed Marketing Cooperative members use their cooperatives as their market outlets and to what extent members market their seed through cooperatives, was analyzed using Tobit model. A strictly dichotomous variable is often not sufficient for examining the intensity of usage for such problems. Tobin (1958) proposed a limited dependent variable model, later called Tobit model to handle dependent variables which are a combination of these cases. This model enables one to estimate the likelihood and extents (intensity) of events. The volume of marketed surplus was, therefore, estimated using the following Tobit model:

$$y_i = \chi\beta + \varepsilon_i \tag{1}$$

$$y_i = \begin{cases} \chi\beta + \varepsilon_i, & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0 \end{cases} \tag{2}$$

y_i is the marketed surplus (log) of potato seed (in quintals) supplied by household i to its cooperative, X is a vector of explanatory variables determining intensity of marketed surplus of potato seed, β is a vector of parameters to be estimated, and ε_i is the error term assumed to be independently and normally distributed.

Definition of variables

In this study, the total quantity of potato seed (Qt) marketed by individual member household through the cooperative was taken as the dependent variable. Marketed surplus of small holders through their cooperatives is hypothesized to be influenced by a combined effect of various factors, such as household socioeconomic and other institutional characteristics.

Farm experience (fexp)

This is a continuous variable measured in number of years. It refers to number of years a farmer spent in farming activity. As farmers got more experience in agricultural production, the probability of increasing production and hence supply would be higher. Abay (2007) conducted vegetable market chain analysis in Amhara National Regional State Fogera Woreda. Accordingly, his findings revealed that farm experience was positively related to volume of vegetable marketed supply. Therefore, in this study, farm experience is expected to have positive impact on potato seed marketed supply through cooperatives.

Family size (fmsz)

This variable is a continuous variable and refers to the total number of family household. It is assumed that household with larger family size consume more of what is produced in the house and little will
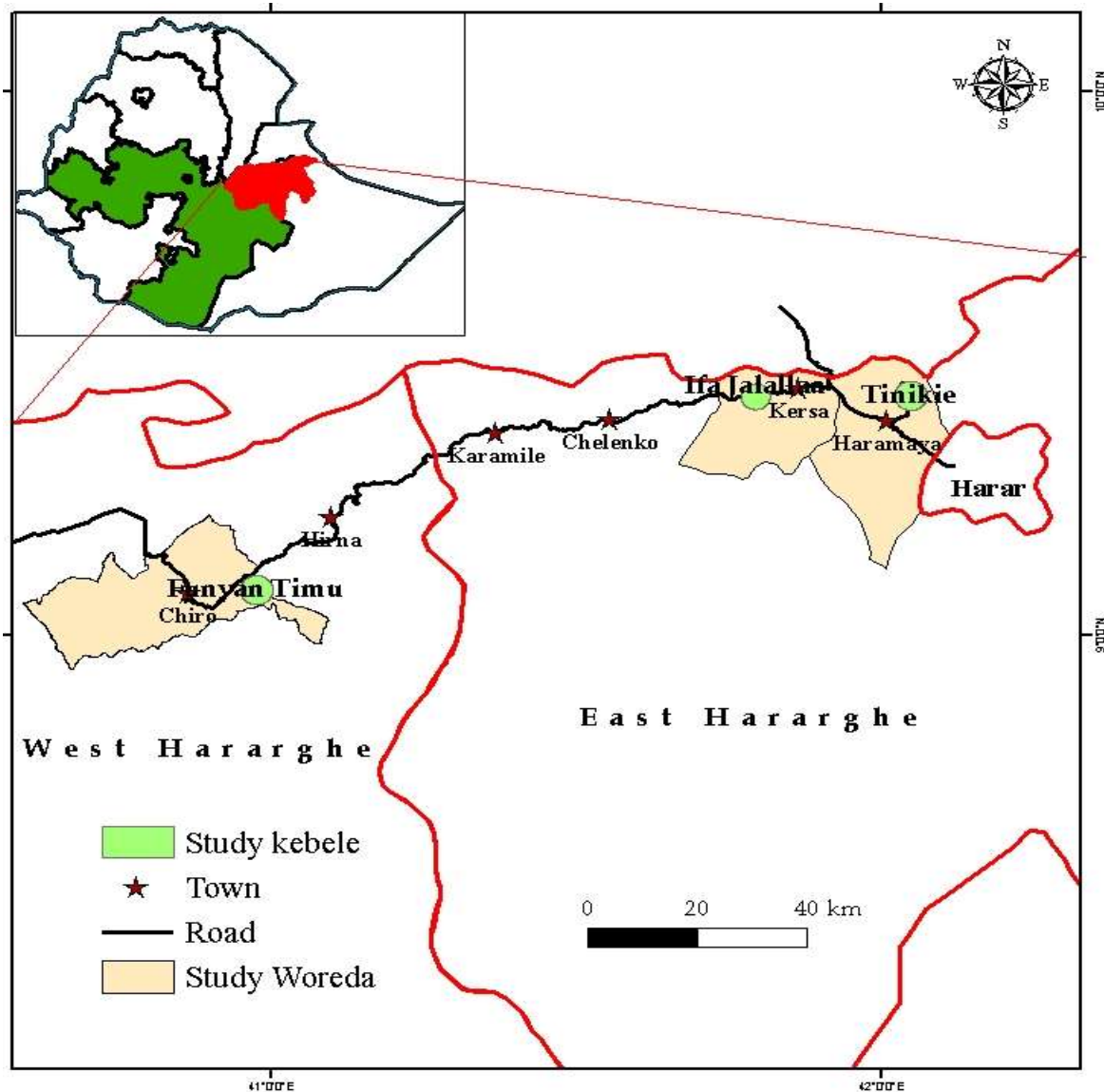
Figure 1. Geographical location of the study areas.
Source: ZoFED (2004).

Table 1. Sampling frame and sample size.

District	*Kebele*	Cooperative	Number of members
Kersa	Ifa Jalala	Hakan Guddina	80
Haromaya	Tinike	Rare Hora	41
Chiro	Fugnan Dimo	Abdi Jalala	36
Total			157

remain to be marketed. Therefore, this variable is expected to have negative influence on intensity of potato seed marketed supply through cooperative. A study by Singh and Rai (1998) found marketed surplus of buffalo milk to be negatively affected by family size.

Literacy status of household head (litert)

It is a dummy variable that takes 1 if the household is literate and 0 otherwise. This is due to the fact that a literate farmer can adopt better practices than illiterates that would increase marketed

supply. The literate household head would have better awareness of cooperative and acquire information and education on the benefit of cooperative easily (Belay, 2006). Hence, literate farmers are in a better position to know the benefit of cooperatives and are likely to market their potato seed tuber through cooperatives. Therefore in this study, this variable is expected to have positive coefficient.

Number of years of membership (memb)

This variable is a continuous one and it refers to number of years since the farmer has been member of the cooperative. Farmers having longer years of membership are in a better position to know the benefits of the cooperative than farmers with shorter years of membership (Cain et al., 1989). In this study, this variable is hypothesized to influence the marketing of potato seed tuber through the cooperative positively.

Distance of household home from cooperative market center (mktd)

It is a continuous variable measured in single foot per hour. It refers to the distance of the cooperative from the farmer house. The proximity of the cooperative to the farmer's house reduces the cost of time and labor spent by the farmer in searching for a buyer of his potato seed. The other advantage is that as the farmer is close (near) to the cooperative, they will have more knowledge on the cooperative and its benefits (Bishop and McConnen, 1999). Therefore, in this study, the distance of the cooperative from the farmer house is expected to influence the marketing of potato seed through the cooperative negatively.

Credit (crdt)

This is a dummy variable which takes a value 1 if the farmer obtained credit from rural financing institution operating in the area, 0 if otherwise. Access to credit would enhance the financial capacity of the farmer to purchase the necessary inputs (Musema, 2006). Therefore, it is hypothesized that access to credit would have positive influence on market participation and volume of sale. It also helps in renting land and purchasing other inputs that increase agricultural production. Therefore, in this study, access to credit is expected to have positive coefficient.

Access to extension service (exn)

The objective of the extension service is introducing farmers to improved agricultural inputs and to better methods of production. In this regard, extension is assumed to have positive contribution to farmer' potato seed market supply through cooperatives. It is a dummy variable with a value of one if a household head has access to extension and zero if otherwise.

Land holding (land)

This variable is a continuous one and refers to the total area of farmland in hectare that a farmer owns. The usage of the cooperative as marketing agent requires substantial economic resources of which land is the principal one (Klein et al., 1997). It is assumed that the larger the total area of the farmland the farmer owns, the higher would be the potato seed tuber produced. This implies that farmers who have larger land holding may patronize the cooperative's output marketing in a better way. Therefore, it is expected that this variable may take positive coefficient.

Perception of members to cooperative price (price)

This is a dummy variable taking a value of 1 if the cooperative price for the farmer's potato seed tuber is similar or better than other marketing agents in the area and, 0 if otherwise. The price effect is one form of cooperative effect that the cooperative passes on the farmer's economy (Chukwu, 1990). Therefore, if the cooperative charge competitive price in the area, the farmers market their produce through cooperatives (Klein et al., 1997). Therefore, cooperative price influence the marketing of potato seed tuber through the cooperative positively.

Number of livestock owned (tlu)

This variable is a continuous one and refers to the total number of livestock the household own in terms of tropical livestock unit (TLU). It is assumed that the household with larger TLU can have a better economic strength and financial position to purchase agricultural input such as fertilizer and hire labor during peak season. The member also transports their product using pack animals to the cooperative or elsewhere. So, this variable is expected to have positive coefficient.

District (distr)

This is a categorical variable enabling the capturing of unobserved, district specific characteristics which cannot be captured by other explanatory variables. It can be measured as taking the value of 1 if Kersa, 0 if otherwise; 1 if Haromaya, 0 if otherwise and 1 if Chiro and 0 if otherwise. The two dummy categories will enter the model while the third will be a base category serving as a benchmark for comparison. Misra et al. (1993) showed that there is performance variation among cooperatives in different places in United States. Therefore, this variable is expected to influence the marketing of potato seed through cooperative positively or negatively depending on the performance of the district in which the farmer is found.

RESULTS AND DISCUSSION

The Tobit model estimated results of the variables that are expected to determine marketed surplus and intensity of potato seed market supply are presented in Table 2. Out of 12 variables, 6 were found to be significant factor for potato seed marketed supply and its intensity. Accordingly, Haramaya district, literacy status, family size, extension contact, perception of household to potato seed price offered by cooperatives and distance from cooperative marketing center significantly affected the intensity of potato seed market supply through cooperatives.

The district (dstr) affects potato seed market supply through cooperatives, showing that farmers in Haramaya district use their cooperative as marketing agent relative to farmers in Kersa and Chiro districts (Table 2). The probability of potato seed marketing through cooperatives increases by 1% if the given household is a member of seed producer cooperatives in Haramaya district and intensity of potato seed supply among cooperative users' increases by 5.28 quintal. The implication is that performance of cooperative varies from district to district, and may be subject to many factors such as institutional

Table 2. Tobit model results of the effect of change on explanatory variables and intensity of potato seed market supply.

Variable	Coefficient	Std. Err	Marginal effect after Tobit
Constant	11.95	6.164	-
Chiro district	-4.81	4.499	-4.03
Haramaya district	6.84***	1.416	5.28
Literacy status	6.51**	2.944	5.58
Family size	-2.02***	0.551	-1.75
Farm experience	0.09	0.147	0.08
Number of years of membership	0.17	0.514	0.14
Livestock owned	-0.3	0.653	-0.02
Land holding	10.13	8.465	8.77
Extension contact	5.89**	2.834	5.09
Access to credit service	0.89	3.288	0.78
Distance from Coop market	-0.61***	0.173	-0.52
Sigma	11.93	0.8979	
LR $\chi^2(12)$		107.18	
Pseudo R^2		0.1256	
Left-censored observations		25	
Uncensored observations		132	
Predicted value (log)		38.47(3.65)	

*** and ** represent level of significance at 1 and 5%, respectively.
Source: Survey result (2014).

factor, climatic condition, organizational strength of cooperatives and infrastructural facilities. It had been observed during field survey that seed producer cooperative in Haramaya district is well organized than Chiro and Kersa in terms of provision of different services and benefits to its members. Haramaya district has better infrastructural facility such as transportation and market information access relative to that of Kersa and Chiro. Therefore, it might be because of the availability of such infrastructural facilities that Haramaya district positively affect potato seed market supply and its intensity through cooperatives. Misra et al. (1993) also found that there is performance variation among dairy marketing cooperatives in different places in United States.

Literacy status (litert) positively influenced potato seed market supply through cooperative market channel. The probability of potato seed market through cooperatives increases by 0.2% if a given household is literate. If the household is literate, intensity of potato seed marketed supply through cooperatives increases by 5.58 quintal among cooperative members who used cooperative market channel.

The implication is that households who have formal education are in a good position in using cooperative market channel as their market outlet. Family size (fams) influenced negatively, intensity of potato seed market supply through cooperatives (Table 2). If family number increases by one person, the probability of potato seed market supply through cooperatives decreases by 0.01% and its intensity among cooperative market channel users

declines by 1.75 quintal. The implication is that larger family size requires larger amounts of agricultural products for consumption, reducing marketable surplus. A study by Singh and Rai (1998) also found marketed surplus of buffalo milk to be negatively affected by family size. However, a study conducted by Amha (1994) showed that household size had significant positive effect on quantity of teff marketed and negative effect on quantity of maize marketed.

Access to extension service (extc) influenced positively, potato seed marketed supply through cooperatives (Table 2). If a given household has extension contact, the probability of potato seed market supply through cooperatives increases by 0.038 and its intensity increases by 5.09 quintal. This suggests that access to extension service improved production and farmers could be aware of the various aspects of the production and productivity of potato seed.

The distance of household from cooperative marketing center (dcoop) influenced negatively, potato seed market supply through cooperatives (Table 2). If the distance of household increases by an hour from the cooperative collection center, the probability of potato seed market supply through cooperatives decreases by 0.01%. The nearer the producers' home to cooperative marketing center, the more the potato seed supplied to the market through cooperatives. As the distance of household from cooperative marketing center increases by an hour, intensity of potato seed marketed through cooperatives decreases by 0.52 quintal. The plausible reasons for this

are that proximity of the cooperative marketing center for the farmer reduces the costs of time and labor for searching buyer. Closeness (nearness) of the farmer to the cooperative also helps in more knowledge on the cooperative and its benefits.

CONCLUSIONS AND RECOMMENDATIONS

Since most of the cooperative leaders lack leadership and agribusiness skill to compete in the free market economy, there is need to have an extensive work from government and nongovernmental organizations on capacity building for cooperative employees aiming to improve their leadership and technical skill. Family size of the households is another important variable that needs government intervention for family planning.

Literacy status requires government intervention in facilitating adult education programme for farmers. Government also needs to participate in extension service, suggesting that access to this service improved production and productivity of farmers and has considerable impact on market supply. Farmers with frequent extension contact could be aware of the various aspects of the production, productivity and marketing of potato seed.

Cooperatives are required to provide relatively better price to ensure smooth relationship with their members. As much as possible, cooperatives are required to establish collecting or assembling centers so that farmers can access them without spending much time to find buyers. Finally, further studies on seed marketing system through cooperatives should be conducted in other parts of Ethiopia so that a well-organized regional and national seed production and marketing system can be implemented.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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Full Length Research Paper

Adoption of the new highly efficient cooking stoves by urban households in Zanzibar, Tanzania

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The study was aimed at ascertaining the adoption of New Highly Efficient Cooking Stoves (NHECS) imported from China by Zanzibar's urban households for reducing cooking costs, health impacts and environmental degradation. Both primary and secondary data were used. Primary data were collected using structured questionnaires, key informant interviews and field observation, and secondary data were collected from government reports and research documents associated with this study. Based on the research plan, 200 participants were purposely selected for questionnaire interview. The Statistical Package for Social Sciences (SPSS) was used to analyze the data. The findings of the study indicated that charcoal remain the primary cooking energy used in urban Zanzibar. It was found to be used in traditional cooking stoves, although some households combine them with NHECS. Despite the significant benefits of NHECS in terms of lower use of charcoal, adoption of them is very limited, due to some constraining factors. The stoves' characteristics, household characteristics and awareness were acknowledged as the main reasons for the failure of NHECS adoption. Also, it was found that the presence of NHECS does not guarantee that they will be used comprehensively since some NHECS adopters still cook the majority of their meals on traditional stoves. In order to better influence diffusion and adoption of cooking innovation such as NHECS, the perception of the adopters on the characteristics of the innovation and other factors that may constrain adoption should be integrated within the plan intended to influence mass adoption.

Key words: Adoption, charcoal, efficient, perception, stoves, Zanzibar.

INTRODUCTION

The consumption of biomass for cooking as a primary fuel requirement for the majority of households in developing countries (Boy et al., 2000) is one of the factors that has severe consequences for the natural environment (Makame, 2007), consumers' health (Debbi et al., 2014; Gujba et al., 2015; Person et al, 2012;) and household economy (Gujba et al., 2015).

Studies show that majority of households in Africa cook over traditional stoves such as three stones for firewood and metal stoves for charcoal which is believed to

Metal charcoal stove   Improved stove with mud liner   Imported NHECS

Figure 1. Common types of charcoal stoves used in study area.
Source: RGZ (2013).

consume large amount of wood, and linked with indoor pollution and associated health problems (Foell et al., 2011; Kamoleka et al., 2015; Sota et al., 2014; Pohekar and Ramachandran, 2004).

In the early 1980s, the diffusion and adoption projects of improved stoves (both charcoal and firewood) witnessed across the developing countries aimed at reducing rural deforestation, health problems attributable to indoor pollution and increasing household income (Gill, 1987; Boy et al., 2000). In East Africa including Zanzibar, improved charcoal stoves such as those with mud inserts (Figure 1) were promoted for the same purpose. However, mass acceptance within social systems was not realized in many developing countries. A study by Gill (1987) showed that improved stoves in developing countries have failed to achieve widespread adoption as they were not efficient compared with traditional stoves in many faculties. For example, Gill (1987) argued that while improved stoves programs emphasize fuel economy, potential stoves adopters consider versatility and the ability to cook quickly as more important.

Furthermore, in Zanzibar a study by Makame (2007) revealed that improved charcoal stoves with mud insert failed to be adopted widely in urban areas, and in some cases early adopters have discontinued using these stoves. Although majorities have perceived efficiency in terms of the amount of charcoal used per meal, durability of these stoves was found to be one among the factors that limited their widespread adoption in urban Zanzibar.

Thus, according to Makame (2007), metal charcoal stoves are still used by the majority in urban Zanzibar than the improved charcoal stoves with mud liner. In this study, both metal charcoal stoves and improved charcoal stoves with mud insert are termed as traditional charcoal stoves (TCS) (Figure 1). Burning charcoal in metal stoves has been found to cause health problems and households' economic loss as they use a large amount of energy (Pine et al., 2011). They are also associated with environmental problems and increasing greenhouse gases (Kamoleka et al., 2015; Clark et al., 2013).

Poor combustion and the huge amount of smoke produced by these stoves are intensifying diseases like

lung cancer, child pneumonia and lower respiratory diseases, resulting in 4.3 million deaths each year worldwide (World Health Organization, 2014; Venkataraman et al., 2010; Pohekar and Ramachandran, 2004; Smith et al., 2004; Dherani et al., 2008). Depending on the size and quality of the metal of the improved charcoal stoves used by the majority of urban households in Zanzibar and road-side food vendors, the cost varies between 5 and 10 USD. Metal stoves and improved charcoal stoves with mud insert are made locally by a number of individual artisans and groups.

In rural Unguja and Pemba, few groups that made improved charcoal stoves with mud insert started through REDD+ projects under CARE, Tanzania (CARE, 2010). The aim was to reduce pressure on community forests through providing an alternative source of income while at the same time reducing the consumption of wood for cooking. However, the extent to which these improved charcoal stoves reduce the amount of wood used is unknown.

As locally made improved charcoal stoves with mud insert have not been fully dispersed and adopted by urban households (Makame, 2007), and the fact that their ability to save wood is unknown due to their poor quality, Envirofit charcoal stoves are currently being imported from China (Figure 1). In this study, these stoves are called new highly efficient cooking stoves (NHECS). They are of various types which include the CH-5200, CH-4400 and CH-2200 models. Based on the industrial description of these stoves, they use up to 60% less fuel than normal stoves, reduce toxic emissions by 80%, and have good cooking performance. These stoves are available in Zanzibar for 22 and 36 USD for a small and large stove respectively while local made metal stoves are available for 4 and 7 USD respectively, and local mud inserted stoves are available in Zanzibar market for 5 and 9 USD for small and large stove respectively. This means that NHECS are more expensive than locally made metal and improved mud-insert stoves. Diffusion and adoption studies across the developing countries revealed mixed results in relation to the factors that influence up take of

new innovation such as NHECS and other energy technologies (Saatkamp et al., 2000).

A study in Mexico revealed that economic and cultural preferences influenced diverse range of fuels and stoves adopted in the households (Saatkamp et al., 2000). Elsewhere in Africa education, cultural preferences and quality of the stoves themselves were found to influence adoption (Makame, 2007).

Although, Zanzibar government program (The Zanzibar Energy Policy and Poverty Reduction Strategies) advocate the adoption of efficient stoves and other clean cooking technologies in a way of reducing greenhouse gases emission, indoor pollution and deforestation, at the moment there is no projects or plans to stimulate the adoption of these stoves in both households and street food vendors.

In a situation where a total switch from charcoal to liquefied petroleum gas (LPG) and other clean energies within urban households still lagged behind mainly due to poverty (RGZ, 2013; CARE, 2010), the adoption of NHECS would be a step forward toward cleaner urban households. According to the data obtained from the main supplier of these stoves and local stores, more than 3,200 of Zanzibar urban households already have adopted NHECS. However, the characteristics of these adopters and their perceptions of these stoves are unknown. As the importation of these stoves is driven by the private sector, a greater understanding of NHECS, especially of the perceptions of the early adopters of these stoves, is needed to further facilitate their diffusion and acceptance by the urban community. Therefore, this study was aimed to ascertain the adoption of NHECS by urban Zanzibar's households.

Specifically, the study sought to examine the perception of the early adopters on these stoves, the factors that influenced their decision to adopt these new stoves and characteristics of the early adopters.

MATERIALS AND METHODS

Study area

The study was conducted in Mjini Magharibi region of Unguja Island of Zanzibar (Figure 2). The study was conducted in two districts of the region, namely Mjini and Magharibi. Mjini district is 100% urban while Magharibi are typically suburban, with both planned and unplanned neighborhoods. Based on the sampling frame (a list of NHECS adopters) obtained from the stores that are selling these stoves, the majority of the adopters reside in this region. This is the main reason why Mjini Magharibi region was chosen for the survey. For the purpose of this study, 200 households were purposely selected for questionnaire interviews from a list of the buyers (stoves adopters) obtained from the stores. The stores kept the names and contact details of the buyers because the stoves came with a warranty. Key informants interview was also used to collect data to inform this study. In this method, a total of five stove sellers and five government officials dealing with cooking energy were purposely selected for interview. The data collected using the questionnaire were mainly analyzed using simple percentages and frequencies using the Statistical Package for Social Sciences

(SPSS), and data obtained from key informant interviews were used to triangulate the findings.

RESULTS AND DISCUSSION

Cooking energy in urban Zanzibar and the types of stoves used by NHECS early adopters

The study found that 100% of households interviewed (NHECS adopters) in urban west region of Zanzibar still use charcoal as their main source of cooking energy (Table 1). Almost 25 and 19% of the households that adopted NHECS are also using electricity and LPG respectively. This highlights that, despite increasing availability of LPG in the market and the promotion of LPG under the REDD+ projects, charcoal remains the main source of cooking energy in urban Zanzibar, as in other East African town, such as Nairobi, Kampala and Dar es Salaam (RGZ, 2013). The results tally with previous studies conducted in urban areas of Zanzibar (Masoud, 1993; Makame, 2007; RGZ, 2013). This may demonstrate the fact that poverty still prevails in urban areas. As in many cities in the developing world, households in urban Zanzibar were also found to mix more than one type of energy needed for cooking.

In some instances, in one household you may find more than three sources of energy for cooking complementing each other, depending on cooking needs. In most cases, charcoal is used together with electricity and LPG. The findings by Masoud (1993), Makame (2007) and RGZ (2013) and the findings of this study highlight the fact that urban Zanzibar is in transition in terms of using cleaner cooking fuel. However, it is evident that this transition is very slow, especially amongst the poor. As the majority of the households interviewed in this study are working class, the findings demonstrate the transition towards clean section of energy ladder. The results highlight the fact that although there is a sign of the transition to cleaner energy, biomass remains the primary cooking fuel for the majority households in urban Zanzibar. The high cost of cooking with electricity and LPG prevented many households from depending solely on these clean energies for cooking.

As regards to the type of stoves used, metal charcoal stoves and charcoal stoves inserted with mud liner are still common in urban Zanzibar (Makame, 2007), and the study observed that even NHECS adopters are still using these traditional stoves to meet their cooking needs. The observed combination of TCS and NHECS used by households probably highlights the fact that NHECS cannot accommodate all their cooking needs as the majority of NHECS adopters have just adopted these stoves. Early adopters of NHECS are very important for the mass adoption of these stoves by society as whole, as they normally provide feedback to their peers and neighbours about the usability of the stoves. Positive feedback will always influence further adoption of NHECS
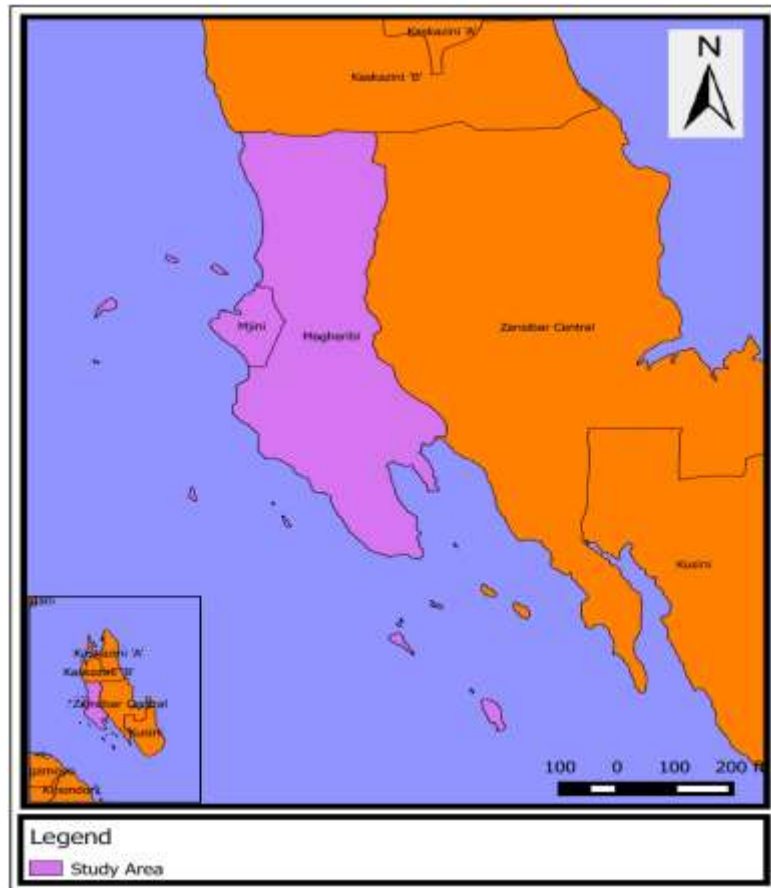
Figure 2. Study area.
Source: Sheha (2017)

Table 1. Types of cooking stoves used in households.

Stove type	Percentage of users
Charcoal	100
Firewood	40
Residues	10
Kerosene	6
Electricity	25
LPG	19

Multiple responses question.

by the wider community (Table 1).

The differences between TCS and NHECS as perceived by NHECS adopters

As NHECS adopters whom previously used TCS and some who are still using both TCS and NHECS were asked to compare these two types of stoves. The results in Table 2 show that these two types of stoves are different in terms of durability, efficiency, cooking time, stove size, accessibility and price in the market. The study found that 97% of the NHECS's adopters believed that NHECS are much better in terms of efficiency as regards the amount of charcoal used per meal and cooking time. NHECS were perceived to save more than 50% of charcoal per meal compared with metal charcoal stoves or improved stoves with mud liner. In terms of durability, size, accessibility and price, TCS were perceived to be superior to NHECS (Tables 2 and 3).

The results show that 81% of the respondents believed that TCS are more durable compared with the NHECS. NHECS are available mainly in smaller sizes, unlike TCS which are available in various sizes, depending on the household's size and cooking needs. The study also found that NHECS are less accessible while TCS are available in many stores in both urban and suburban areas of the region. With regard to the initial cost, the study found that NHECS are very expensive compared with TCS. Depending on the size, NHECS are sold between 22 to 36 USD while TCS sold between five and 10 USD. This may be influenced by the fact that NHECS are imported while traditional stoves are made locally.

Table 2. Perceived differences between NHECS and TCS.

Characteristics of stoves	NHECS	
	Responses	Percentage
Durability of the stoves	Low	19
Cooking efficiency	High	81
Charcoal saved by stoves	More saving	97
Stove's sizes	Limited options	21
Accessibility of the stoves	Low accessible/available only in few stores	2
Initial investment for buying stoves	High cost/expensive	99
Health Issues	Less pollution	71

Table 3. Perceived differences between NHECS and TCS.

Characteristics of stoves	TCS	
	Response	Percentage
Durability of the stoves	High	81
Cooking efficiency	Low	19
Charcoal saved by stoves	Less saving	3
Stove's sizes	More options	79
Accessibility of the stoves	More accessible/available in many stores	98
Initial investment for buying stoves	Low cost/cheap	1
Health Issues	More pollution	29

This may constrain the diffusion and uptake of these stoves by the wider public. The results also show that NHECS are quicker than TCS when cooking food like rice. Furthermore, the majority of the study households (72%) perceived that NHECS are cleaner.

The findings on the superiority of the NHECS was related to other studies conducted in Kenya, and other parts of Africa on other types of new efficient stoves developed in these countries (Debbi et al., 2014; Troncoso et al., 2007). For instance, in Kenya new efficient stoves were not only perceived to cook efficiently but they also used a small amount of charcoal per meal (Debbi et al., 2014). However, as the majority of the interviewed households are early adopters of NHECS, and because some of them perceived the problem in their durability, this may lead to discontinuation of adoption, which means they may stop using.

Among the total of 200 households interviewed early adopters of NHECS, 38 households have already stopped using them due to high initial cost, poor durability and the small size of these stoves that failed to hold their cooking needs. Discontinuation from early adopted technology was also observed in Zanzibar, Mexico and across developing world (Ruiz-Mercado et al., 2011; Gill, 1987).

The study by Ruiz-Mercado et al. (2011) in Mexico, found that some early adopters of the efficient stoves have ceased using them because of various problems, including durability. Similarly, as the decision to adopt these stoves is partly influenced by the positive feedback

from early adopters with regards to usability and efficiency, a negative perception on NHECS or any other cooking technologies may lower the pace at which they are diffused and adopted in social systems. Negative feedback on technological innovation is in fact act as barrier to adoption.

Furthermore, the respondents were asked to identify the factors that may constrain the decision of potential adopters to adopt NHECS. The results revealed that durability, high initial cost, awareness and size of the stoves may constrain their diffusion and adoption by the wider society (Table 4).   Although NHECS were perceived to be more durable than the improved charcoal stoves inserted with mud (Figure 2), when NHECS stand on their own, potential adopters are not convinced of their durability.

The study by Bhojvaid et al. (2014) in Bangladesh also found that the stoves' durability played a major role in their diffusion and adoption within communities. An interview with stove suppliers revealed that NHECS broke down in under a year, which is within the guaranteed period provided by them.   The results revealed that the durability of these stoves not only compromised their quality but they took much longer to cook beans, for instance, especially when they are cooking 2 to 3 meals each day. Furthermore, the majority of the households tend to use water to put out the fire in the stove when they finish cooking, which was found to impact the durability of these stoves in the long run.

About 66% of the respondents believed that the initial

Table 4. Factors that constrain the adoption of NHECS.

Factors that constrain the adoption	Percentage
Stove durability	86
High initial cost	66
Awareness	66
Stove size	54
Level of income	32
Accessibility of NHECS	27

*Multiple responses (A household can be affected by more than one factors to adopt NHECS).

Table 5. Characteristics of households that adopted NHECS.

Key characteristics	Class	Percentage
Education level	Illiterate	3
	Primary	7
	Secondary	15
	College/ University	75
Employment	Government employee	68
	Self-employed	24
	Others	8
Size of households	1-3 members	21
	4-6 members	62
	7 and over	17

price of NHECS may limit adoption, particularly by low-income households. With regard to awareness, it was also thought that the respondents' limited awareness also acts as a barrier to the diffusion and adoption of these stoves. Since most of the early adopters are government employees, they had the benefit to apply for credit paying back in installment (Table 5), this highlights the fact that knowledge regarding these stoves and their importance to households' economy and health is limited to a certain segment of the urban community.

A study by Suliman (2010) in Sudan found similar results that awareness plays an important role in the acceptance of the stoves. Therefore, the community in urban Zanzibar needs to be sensitised and informed about the existence of these stoves so that they can be adopted by many others. This is important not only in terms of households saving money through using efficient energy, but also in reducing the rate of deforestation both in Zanzibar and in the coastal areas of the mainland.

The results in Table 4 also show that the limited varieties of NHECS in terms of size may constrain their mass adoption. The available sizes of NHECS were found to be more suitable for smaller households than larger households cooking needs. The average household size in Zanzibar is 5.5 (URT, 2012). They are also unsuitable for street food vendors and small restaurants as they use large pots to prepare meals. As metal charcoal stoves are available in any size, they are more attractive to larger households and large-scale users, such as restaurants and street food vendors. Studies by Njogu and Kung (2015) and Karanja (1999) in Kenya found similar results that efficient stoves in the market are either small or medium in size, and are thus unable to carry large pots in which to cook a meal for a large family.

Characteristics of NHECS users in urban Zanzibar

Apart from the characteristics and newness of the technology as seen in the previous section, the characteristics of the adopters may influence adoption of the new technology by households. This study also sought to obtain the characteristics of individuals in the households in terms of education and employment as well as the size of households.

With regard to education, the results of the analysis in Table 5 show that majority of the early adopters interviewed (90%) had either completed university/college or secondary school. The findings highlight the direct relationship between education and adoption of NHECS
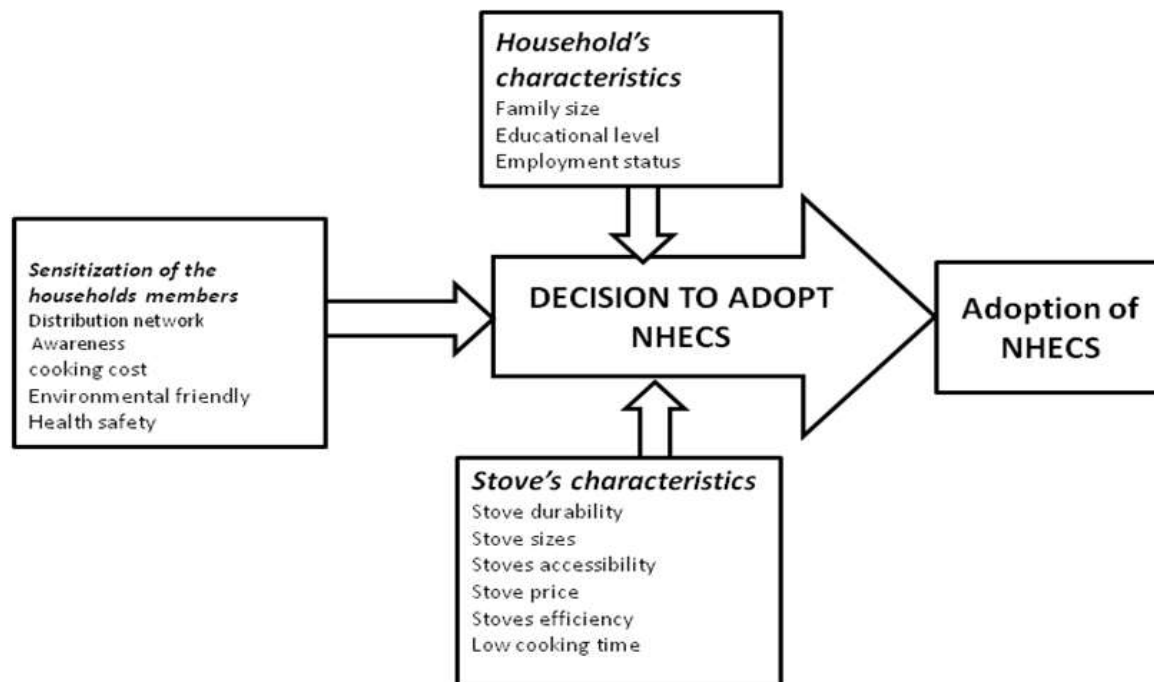
Figure 3. Summary of the factors that influence adoption of NHECS in urban Zanzibar.

by households. The level of education of household members probably exposes them to the mass media with regard to knowledge about NHECS and the negative effect of TCS on the environment and the health of the users.

Furthermore, having a few uneducated people using NHECS probably highlights the fact that knowledge and awareness-raising campaigns are very limited regarding these stoves. Currently, there is no official campaign to influence the diffusion and adoption of NHECS in Zanzibar, which may attribute to the failure of the stove traders or the institutions responsible for the environment and energy in Zanzibar to publicise them. These results tally with findings obtained from various studies in the region (RGZ, 2013; Njogu and Kung, 2015; Heltberg, 2004; Suliman, 2010), which found a positive relationship between education and the adoption of new efficient cooking innovation. For example, Suliman, (2010) in Sudan found a direct relationship between education and the uptake of improved charcoal stoves with mud liner. That shows majority of efficient stoves adopters were educated.

With regard to the occupation of the NHECS early adopters, the results in Table 5 show that 68% of the respondents are government employees while 24% are self-employed. The key informant interviews revealed that most early adopters are government employees, who bought these stoves with a soft loan or through payment by installments. Although, the initial cost of these stoves is high, it was easy for government employees to acquire a stove with a loan. The results therefore highlight the

relationship between income and the use of clean energy or stoves in urban Zanzibar.

Studies by Heltberg (2004), Suliman (2010) and Sesan (2012) also found a relationship between households with a high income and the adoption of efficient stoves. On the contrary, the study by Sehjpal et al. (2014) conducted in rural India found the opposite. They found that household income was not significantly associated with the adoption of new efficient cooking stoves. Furthermore, having good number of early adopters amongst government employees highlights the fact that the workplace facilitates the adoption of a new technology. Positive feedback of the early adopters on a certain technology always strongly influences peers to adopt the same technology.

Conclusion

The study revealed that charcoal stoves are still very important cooking energy in urban households across the neighborhood. However, there is sign transformation towards cleaner cooking energies especially amongst the working class. Traditional charcoal stoves are used for cooking by the majority of households, and this is unlikely to change in the near future unless they are sensitized about the benefits of NHECS both environmentally and economically (Figure 3). The study found that NHECS characteristics, such as stove size, do not meet the needs of larger households, which mean that the majority of urban households in Zanzibar have failed to adopt

NHECS while or many early adopters stopped using them. To achieve mass acceptance of these stove within social systems and to reduce green house gases emission in the atmosphere, the dynamic cooking needs of the potential adopters should be considered during redesigning of this stove or designing new stoves. At the same time, the adoption of NHECS should be encouraged by mass education on cooking techniques and the economic, environmental and health benefits of NHECS.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

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