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# 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

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**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

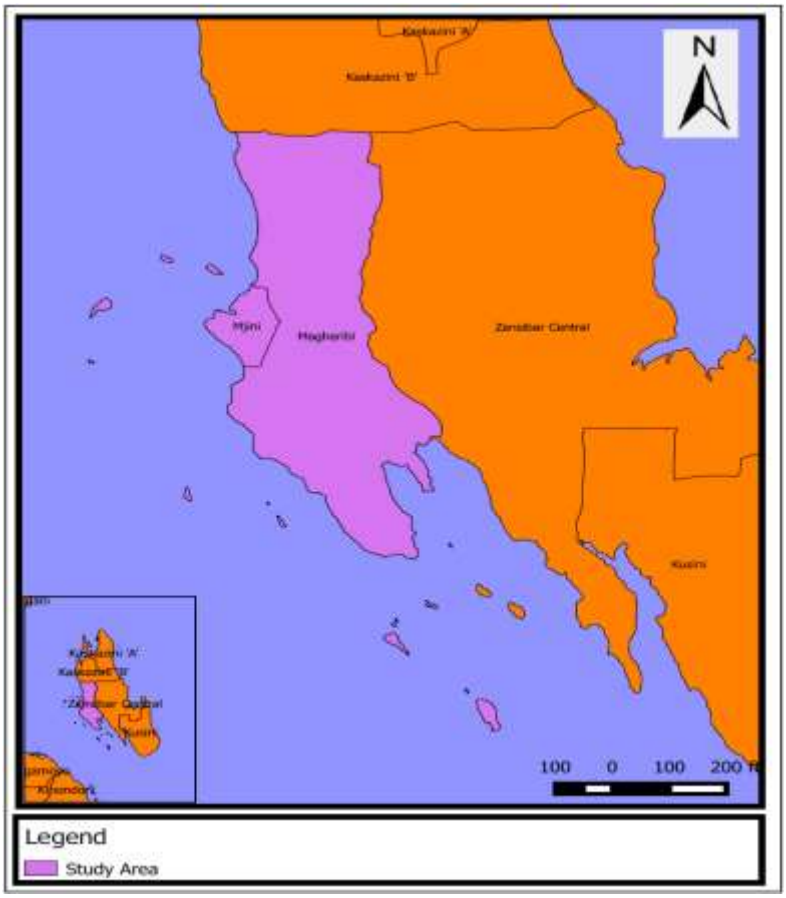


**Figure 2.** Study area.
Source: Sheha (2017)

**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

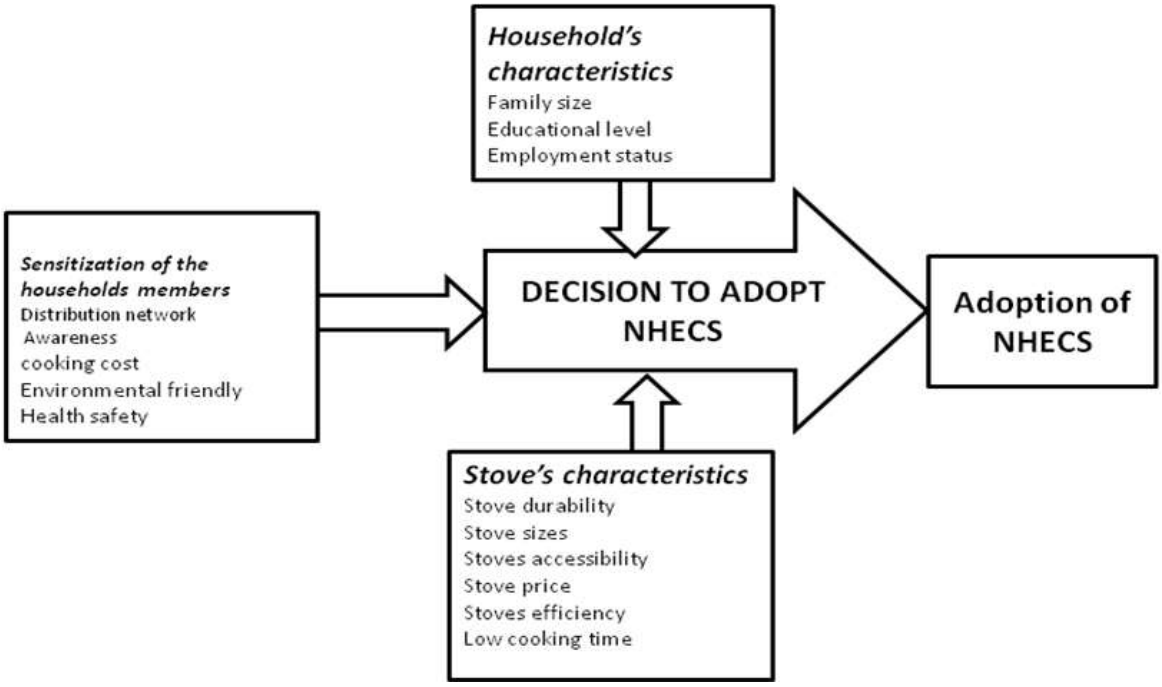


**Figure 3.** Summary of the factors that influence adoption of NHECS in urban Zanzibar.

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.

### REFERENCES


Bhojvaid V, Jeuland M, Kar A, Lewis JJ, Pattanayak SK, Ramanathan N, Rehman IH (2014). How do people in rural India perceive improved stoves and clean fuel? Evidence from Uttar Pradesh and Uttarakhand. Int. J. Environ. Res. Public Health 11(2):1341-1358.

Boy E, Bruce N, Smith K, Hernandez R (2000). Fuel efficiency of an improved wood-burning stove in rural Guatemala: implications for health, environment and development. Energy Sustain. Dev. 4(2):23-31.

CARE (2010). Tanzania, Piloting REDD+ in Zanzibar through community forest management, Tanzania.

Clark M, Peel L, Balakrishnan K, Breysse P, Chillrud S, Naeher L, Balbu J (2013). Health and household air pollution from solid fuel use: the need for improved exposure assessment. Environ. Health Perspect. 121(10):1120.

Debbi S, Elisa P, Nigel B, Dan P, Eva R (2014). Factors influencing household uptake of improved solid fuel stoves in low-and middle-income countries: A qualitative systematic review. Int. J. Environ. Res. Public Health 11(8):8228-8250.

Dherani M, Pope D, Mascarenhas M, Smith K, Weber M, Bruce N (2008). Indoor air pollution from unprocessed solid fuel use and pneumonia risk in children aged under five years: a systematic review and meta-analysis. Bull. World Health Org. 86(5):390-398C.

Foell W, Pachauri S, Spreng D, Zerriffi H (2011). Household cooking fuels and technologies in developing economies. Energy Policy 39(12):7487-7496.

Gill J (1987). Improved stoves in developing countries: A critique. Energy Policy 15(2):135-144.

Gujba H, Mulugetta Y, Azapagi A (2015). The household cooking sector in Nigeria: environmental and economic sustainability assessment. Resources 4(2):412-433.

Heltberg R (2004). Fuel switching: evidence from eight developing countries. Energy Econ. 26(5):869-887.

Kamoleka M, Mkini R, John J (2015). An Efficient and Environmentally Friendly Modified Natural Draft Coffee Husks Gasifier. Stove For Coffee Farmers in Tanzania 3(1):105-111.

Karanja L (1999). Adoption of energy conserving technology by rural household in Kathiani division, Machakos District. Unpublished masters in environmental sciences thesis - Kenyatta University. pp. 52-69.

Makame M (2007). Adoption of improved stoves and deforestation in Zanzibar. Management of Environmental Quality: Int. J. 18(3):353-365.

Masoud R (1993). Fuel wood use in Zanzibar Town. Technical Paper No. 3, Forest Department, Zanzibar.

Njogu P, Kung J (2015). Factors Influencing Adoption of Woodfuel Energy Saving Technologies in Nakuru County , Kenya, International J. Science and Research 4(2), 1028–1036.

Person B, Loo J, Owuor M, Ogange L, Jefferds M, Cohen A (2012). "It Is Good for My Family's Health and Cooks Food in a Way That My Heart Loves": Qualitative findings and implications for scaling up an improved cookstove project in rural Kenya. Int. J. Environ. Res. Public Health 9(5):1566-1580.

Pine K, Edwards R, Masera O, Schilmann A, Marrón-Mares A, Riojas-Rodríguez H (2011). Adoption and use of improved biomass stoves in Rural Mexico. Energy Sustain. Dev. 15(2):176-183.

Pohekar S, Ramachandran M (2004). Application of multi-criteria decision making to ensure sustainable energy planning A review. Renewable and Sustainable Energy Rev. 8:365-381.

Revolutionary Government of Zanzibar (RGZ) (2013). Potential energy technologies and services in Zanzibar and their potential. Final report. 2013, Zanzibar.

Ruiz-Mercado I, Masera O, Zamora H, Smith K (2011). Adoption and sustained use of improved cookstoves. Energy Policy 39(12):7557-7566.

Saatkamp B, Masera O, Kammen D (2000). Energy and health transitions in development: fuel use, stove technology, and morbidity in Jarácuaro, México. Energy Sustain. Dev. 4(2):7-16.

Sehjpal R, Ramji A, Soni A, Kumar A (2014). Going beyond incomes: Dimensions of cooking energy transitions in rural India. Energy Policy 68:470-477.

Sesan T (2012). Navigating the limitations of energy poverty: Lessons from the promotion of improved cooking technologies in Kenya. Energy Policy 47:202-210.

Sheha AH (2017). Adoption of the New High Efficient Cooking Stoves in the Households in Zanzibar, Tanzania. MSc (Environmental Science) Thesis of the State University of Zanzibar, Tanzania.

Smith K, Mehta S, Maeuzezahl-Feuz M (2004). Indoor air pollution from household use of solid fuels. World Health Organization 1:94-1435.

Sota C, Lumbreras J, Mazorra J, Narros A, Fernández L, Borge R (2014). "Effectiveness of Improved Cooking stoves to Reduce Indoor Air Pollution in Developing Countries The Case of the Cassamance Natural Sub-region, Western Africa", J. Geosci. Environ. Prot. 2(1):1-5.

Suliman K (2010). Factors Affecting the Choice of Households' Primary Cooking Fuel in Sudan. Research Report presented at Economic Research Forum, Cairo. Khartoum: University of Khartoum.

Troncoso K, Castillo A, Masera, O, Merino L (2007). Social perceptions about a technological innovation for fuelwood cooking: Case study in rural Mexico. Energy Policy 35(5):2799-2810.

United Republic of Tanzania (URT) (2012). Population and Housing Census. Basic Demographic and Socio- Economic Profile, 2014 report, Dar es Salaam.

Venkataraman C, Sagar A, Habib G, Lam N, Smith K (2010). The Indian national initiative for advanced biomass cookstoves: the benefits of clean combustion. Energy Sustain. Dev. 14(2):63-72.

World Health Organization (2014). Burden of Disease from Household Air Pollution". Public Health, Social and Environmental Determinants of Health Department 1211(17):27-35.