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Effect of Education on ICS Adoption Level

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Abstract: ***The study investigated the influence of education levels on adoption of improved cook stoves (ICS) in Kakamega, Kisumu and Uasin Gishu counties. Sampling in stages was applied to categorize the population into low, middle and high income household using income levels. Convenience sampling was used to select six estates to represent the counties. The Institutions and hotels used population served and nearness to urban setting. Three estates in Kakamega (Shikambi, Amalemba and Milimani), Kisumu (Manyata, Tom Mboya and Milimani) and Uasin Gishu (Langas, Kapsoya and Elgon View) counties were sampled. In low-income estates 50 households were sample, 40 in middle income and 30 in high-income. In each county, 7 educational institutions and 23 hotels (4 large hotels serving more than 601 people per day, 7 medium hotels serving between 301 to 600 and 12 small size hotels serving less than 300 people) were sampled too. Data was collected using semi-structured questionnaires, direct interviews and focus group discussions. Data collected was analyzed through both descriptive and chi-square (χ^2) statistics in SPSS version 23. The results revealed that education level and charcoal saving cook stove properties significantly influenced ICS adoption in households (χ^2=115.7548; p<0.05). However, the education level of the head cooks (χ^2=0.6622) and awareness level of head cooks (χ^2=0.5057) did not significantly influence adoption in institutions. In hotels, no socio-economic factor (head cooks education level χ^2=0.4333) or head cook ICS awareness χ^2=0.1000 significantly influenced ICS adoption in hotels at p<0.05. The study concluded that socio-economic factors influenced adoption of ICS in varied degrees. However, increasing the awareness of ICS availability and benefits would increase adoption in spite of education levels among households, institutions and hotels. The stove manufactures should also maximize on the availability and benefits such as durability and charcoal saving aspect of the ICS stove.***

1. Introduction

1.1 Introduction: Effect of education on ICS adoption

Education plays a major role in increasing adoption and at the same time reducing traditional biomass use (Wilson, D.L *et al*., 2016). The more highly educated household tend to adopt ICS more than less-educated (Mohapatra, S *et al.,* 2017*)*. Studies have demonstrated that primary or secondary education increase adoption rates compared with non-educated (Jan, I *et al.,* 2017). Several researchers have determined that education is not a key element of ICS adoption where women have an open mind regardless of their years of formal education (Troncoso *et al*., 2007). It has also been found that there is no significant effect of education on ICS adoption in rural Tanzania (Kulindwa *et al*., 2018). In most cases there is a bad attitude toward a technology in low income areas; a lack of knowledge about the availability of alternative/efficient technologies but not availability of ICS for purchasing (Wickramasinghe *et al*., 2011). Awareness of the health and environmental impacts of traditional stoves determines the choice of more sustainable fuels/stoves to reduce such a negative effect (Poddar and Chakrabarti, 2016). Studies conducted about the willingness to pay for ICS found that safety awareness campaigns could significantly increase the demand for stoves (Maré *et al*., 2017). Nevertheless, some users don't consider the related health benefits as being important in the decision to buy a new stove like in the case of a study conducted in Uganda were users were aware that ICS produces less smoke, but they did not consider the related health benefits as an important factor in the decision to buy a new stove (Martin *et al*., 2017). Furthermore, a study conducted in India shows that advertisements emphasizing smoke reduction and health-related benefits of ICS do not significantly influence purchase decisions (Thurber *et al*., 2014).

2. Materials and Methods

The broad objective of the study was to investigate the effect of education levels on adoption of the ICS among households, institutions and hotels in Uasin-gishu, Kisumu and Kakamega counties in Kenya. Specifically, the study aimed at investigating the social, economic and ICS characteristics that influence adoption for use. The study used survey method for collecting data.

2.1 Study Areas

2.1.1 Uasin-gishu County

Uasin-gishu has a total area of 2,955.3 km^2 and a population of 894,179 (2009 National Census) (Fig 2.1.1).

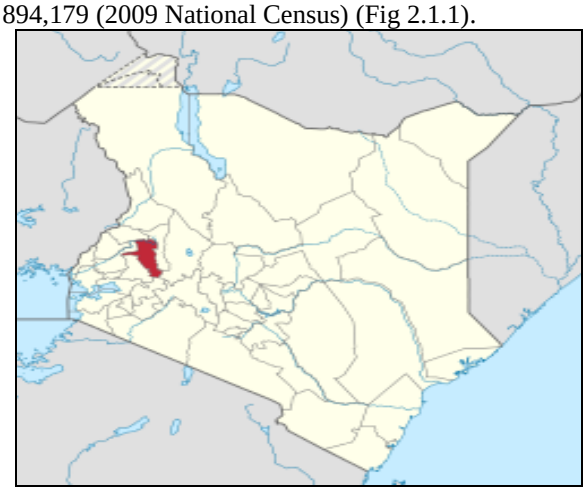


Figure 2.1.1: Uasin- gishu county (Source: Kenya county fact sheets, 2011).

2.1.2 Kisumu county

Kisumu county has a total area of 2085.9 Km² with a population of 968,909 (2009 census) (Fig 2.1.2).

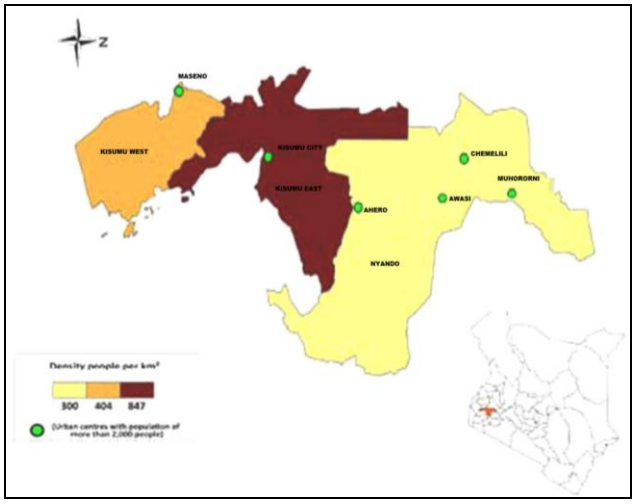


Figure 2.1.2: Kisumu County (Source: KCFS, 2011).

2.1.3 Kakamega County

Kakamega county has a population of 1,660,651 according to 2009 census and an area of 3,033.8 km² (2009 census) view figure (Figure 2.1.3).

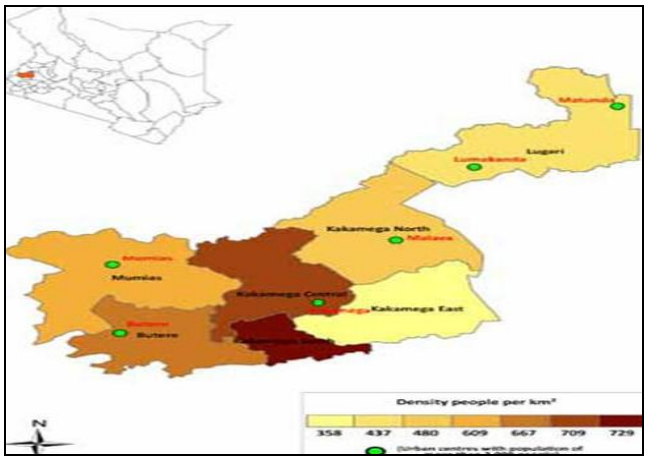


Figure 2.1.3: Land area of Kakamega County (Source: KCFS, 2011).

2.2 Research design

The choice of the population to participate in the study was conducted in several stages; first, three counties were selected from western region of Kenya. Second, the major estates were classified as low, middle and high-income levels.

2.2.1 Sample population and sample size

In each income level, 50 households were randomly selected adding up to 150 households in total. Twenty one institutions were randomly selected (7 in each County) while a total of 69 hotels (4 large hotels serving more than 601 people per day, 7 medium hotels serving between 301 to 600 and 12 small size hotels serving less than 300 people) were randomly selected.

2.3 Data collection

Semi-structured questionnaires were prepared and 10 questionnaires were used for pre-test among estates. Interviews and discussion sessions were used for key informants to verify the information collected via questionnaires. The dependent variable was ICS adoption tested against the independent variable education levels. Permission was sought from the institutions and government agents through a signed introduction letter (they could not be informed of the visit in advance). The researcher assumed high standards of professional conduct and ethics in the research process.

2.4 Data analysis

Questionnaires were revised to remove unclear statements and incomplete answers/documents. Then the data was coded and fed in excel spread sheet. Information was then imported into SPSS version 24 analytical tool. The frequencies of adoption of the ICS were descriptively presented in frequency tables, graphs and pie charts. The significant level of adoption was regressed against education levels at $p<0.05$. The expected ICS adoption level was set at 70% based on Chinas adoption rates (Shen *et al.*, 2015). The result was presented in table form.

3. Results and Discussions

Barriers to adoption were reported in cases of adopters as well as non-adopters who had complaints, while barriers to use were only discussed exclusively by adopters. Cost savings was another frequently mentioned factor promoting adoption and use. Several the price comparisons between what they used to spend on charcoal before and their current expenditure. Peer encouragement from interaction with users of ICS came out as a key step in their decision to adopt.

3.1 Adoption trends based on education level of household heads

Among low income households headed by those with college diplomas and above higher adoption levels were recorded with the lowest adoption being among household headed by informally educated/trained heads. Among middle income household the trend was similar with the lowest adoption levels being among those headed by informally educated heads. High-income household recorded the highest adoption levels among all groups with the lowest adoption levels being among those headed by informally educated heads.

Table 3.1: Education level of household heads and ICS adoption levels

Education Level	Low Income %	Middle Income %	High Income %	Average %
College	61.47	63.38	66.29	63.71
Secondary	50.98	49.05	52.38	50.80
Primary	44.81	39.26	28.89	37.65
Informal	30.56	28.89	23.33	27.59

3.1.1 ICS awareness and adoption

Generally, the percentage awareness of the ICS was high (above 76%) in all the three counties. Awareness level and subsequent adoption was highest among the low income estates (93.3%) followed by middle income (81.1%) and least being the high income estates (76.7).

Table 3.1.1: ICS awareness and adoption

Income Levels	Estates	Counts	Percentage Adoption	Average adoption level
Low	Shikambi	28	93.3	
	Manyatta	29	96.7	
	Langas	27	90	93.3
Middle	Amalemba	23	76.7	
	Tomboya	24	80	
	Kapsoya	26	86.7	81.1
High	Milimani	21	70	
	Milimani	24	80	
	Elgon View	24	80	76.7

3.1.2 Chi square analysis for factors affecting ICS adoption among household

The Chi Square results revealed that Education Level (χ^2=18.367) and ICS Properties significantly (χ^2=32.8286) influence the adoption levels of households in the three counties.

3.2 ICS adoption among institutions

3.2.1 Education levels of head cooks and ICS adoption

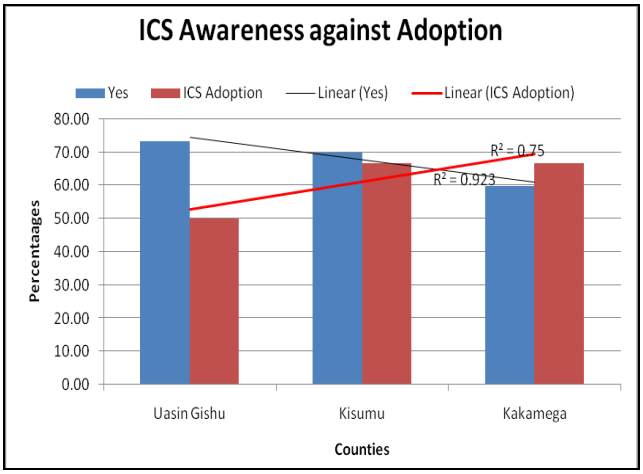
The level of ICS adoption was high among institutions that had a head cook with college level education (70.06%) followed by secondary (53.3%) and least was those with informal education (44.4%). Education level of the institutions head cooks influenced adoption positively in Uasin- gishu (59.7%) followed by Kisumu (58.5%) and least in Kakamega (55%).

Table 3.2.1: Education levels of head cooks and ICS adoption

Institution Location/ Education level	Uasin Gishu (%)	Kisumu (%)	Kakamega (%)	County Averages
College	68.75	71.43	70.00	70.06
Secondary	60.00	62.50	66.67	63.06
Primary	60.00	50.00	50.00	53.33
Informal	50.00	50.00	33.33	44.44
Averages	59.69	58.48	55.00	

3.2.2 Awareness levels and ICS adoption among institutions

The results revealed that ICS awareness was high in Uasin-gishu (73.33%), followed by Kisumu (70%) and Kakamega (60%). However adoption levels were highest in both Kisumu and Kakamega each at 66.67% while Uasin-gishu recording the least adoption levels (50%).



3.2.3 Chi square analysis for factors affecting ICS adoption among institutions

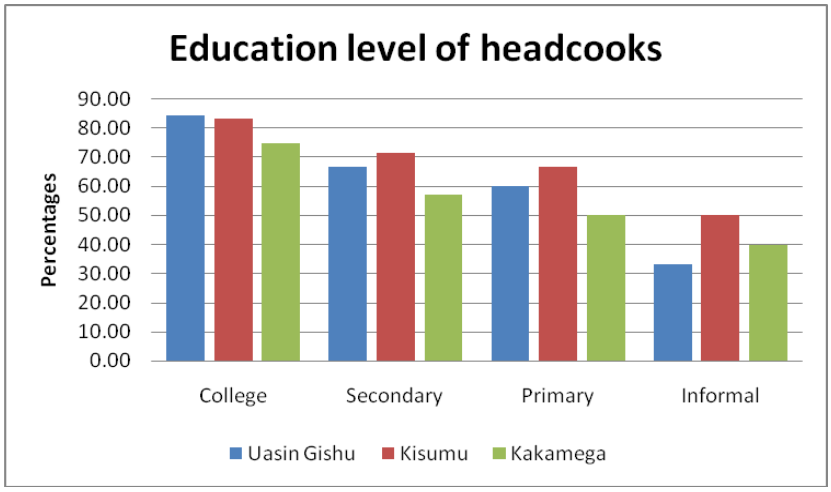
According to the results in the number of people served per day significantly influenced the rate of adoption of the ICS in institutions (χ^2=10.0535) at $p<0.05$. However, the education level of the head cooks (χ^2=0.6622), awareness level of head cooks (χ^2=0.5057) did not significantly influence adoption in institutions.

3.3 ICS adoption levels among hotels

Jagger and Jumbe (2016) suggest that fuel availability plays a key role in ICS adoption, for example there is a higher interest in ICS adoption when the users have their own forest resources (therefore interested in conserving them) or use a high proportion of crop residues as fuel (probably because of fuel wood scarcity or lack of access. Conversely, the intention to adopt ICS decreases when hotels have free access to fuel wood e.g. when located near to a source or growing their own trees for fuel. Other studies do not find significant relationship between fuel availability and intention to adopt ICS.

3.3.1 Education level of head cooks and adoption of ICS among hotels

The highest adoption of the ICS was among hotels with head cooks with higher education (diplomas and above). Overall adoption per county revealed that Kisumu had highest adoption at 67.86% followed by Uasin-gishu (61.15%) then Kakamega at 55.54%.



3.3.2 Hotels head cooks awareness levels and adoption of ICS

From the results, majority of hotels head cooks were aware of the ICS adoption due to high awareness was 34% in Kisumu, 32% in Kakamega and 30% in Uasin-gishu.

3.3.3 Chi -Square analysis for factor affecting ICS adoption among hotels

In the hotels, Chi-Square results revealed that the adoption of the ICS was not significantly influenced by cooks Education level or head cook ICS Awareness (χ^2=2.3333, 0.1000) at p<0.05.

3.3.4 Educational among head cooks of the institutions and ICS adoption levels

Higher education levels among head cooks of institutions in the study areas is associated with higher ICS adoption levels especially among head cooks that have a college education. The above observation is in agreement with finding in the findings by the Global Alliance for Clean Cook Stoves., 2011. Due to higher literacy levels among head cooks in Colleges there is a higher ICS adoption level compared to Secondary schools .Higher ICS adoption among Colleges may also be due to their policy of cooking meals for students and the teaching staff. Hotels and hospitals policy of not employing very highly educated cooks compared to the former is correlated with a lower adoption rates. A research by Gebreegziabher Z *et al*., 2011 on Urban energy transition and technology adoption also suggests similar trends in technology adoption. Education empowers institutions staff on the cost-benefits of improved technology according to Polsky *et al* (2012) more literate kitchen staff will positively influence the adoption of new technology as is also observed in the ICS technology adoption in this study.

Table 3.1.1: Educational of the head cook of the institution and ICS adoption levels

County	Institution	Education level of head cook & ICS adoption				
Uasin-Gishu	COL	d=20	c=64	s=10	P=5	i=0
	HOT	d=40	c=35	s=14	p=2	i=0
	PRI	d=0	c=2	s=21	p=16	i=61
	HOS	d=2	c=64	s=14	p=1	i=9
Kisumu	COL	d=30	c=55	s=5	p=5	i=0
	HOT	d=31	c=35	s=24	p=0	i=10
	PRI	d=0	c=33	s=57	p=6	i=14
	HOS	d=5	c=24	s=34	p=0	i=27
Kakamega	COL	d=30	c=50	s=7	p=2	i=11
	HOT	d=7	c=35	s=44	p=8	i=6
	PRI	d=4	c=46	s=38	p=4	i=8
	HOS	d=8	c=44	s=28	p=14	i=6

3.3.5 ICS awareness and adoption

Generally, the percentage awareness of the ICS was high (above 84%) in all the three counties. Awareness level was highest among the low income estates (93.3%) followed by middle income (81.1%) and least being the high income estates (76.7).

3.3.6 Chi square analysis for factors affecting ICS adoption among household

The Chi Square results revealed that Education Level (χ^2=18.367) and ICS Properties significantly (χ^2=32.8286) influence the adoption levels of households in the three counties.

4. Conclusions and Recommendation

Education levels of the household heads, awareness levels and stove characteristics positively and significantly influence the rate of adoption of ICS (at $p<0.05$.) among house hold in Kakamega, Kisumu and Uasin-gishu counties. Among institutions the stove qualities do not positively or significantly influence ICS adoption in Kakamega, Kisumu and Uasin-gishu counties at $p<0.05$. Although ICS awareness was high, the level of understanding of the benefits of was still low. The knowledge of head cooks, mostly directly related to their education levels or their demographic characteristics do not influence the adoption levels only policies and practices that will transform Kenya into a universal clean cooking fuel will need to be developed. Such policies might include integrated approaches and collaboration among stakeholders, increase strategies to raise awareness on the ICS use and benefits, increase access to financial aid and economic incentives will encourage purchase of clean fuel and stoves and facilitate research and development for technical empowerment of manufacturers.

4.1 Recommendation

From the observation it was recommended that effectively

changing dietary patterns either directly or indirectly to encourage fewer cooked meals, shifts to foods that require less fuel wood and cooking time and conducting more research on the relationship between the households' use of ICS and the institutions. The knowledge of the owners of institutions and hotels on the benefits of ICS and how it influences their choices should be investigated further. Design of stoves for households, institutions and hotels must also consider their energy requirement and other cultural or functional needs. Follow up activities for stoves already sold should be conducted and structures for quick repair services put in place together with ICS stove promotion. Reliable and credible stores for ICS should be set up to guarantee sale of genuine stoves with least faults to ensure durability as well as proper function. Experienced technicians for repairs will reduce interferences with the proper function and efficiency of stoves or alteration to stove design. Capacity building forums should be conducted in the study areas to further increase awareness targeting secondary school level ICS users in relation to the education patterns in Western parts of Kenya.

References

[1] Wilson, D.L.; Coyle, J.; Kirk, A.; Rosa, J.; Abbas, O.; Adam, M.I.; Gadgil, A.J. "Measuring and Increasing Adoption Rates of Cook stoves in a Humanitarian Crisis". Environ. Sci. Technol. 2016, 50, 8393–8399.
[2] Mohapatra,S.;Simon,L.Intra-household bargaining over household technology adoption. Rev.Econ. Househ. 2017, 15, 1263–1290.
[3] Jan, I.; Ullah, S.; Akram, W.; Khan, N.P.; Asim, S.M.; Mahmood, Z.; Ahmad, M.N.; Ahmad, S.S. Adoption of improved cookstoves in Pakistan: A logit analysis. Biomass Bioenergy 2017, 103, 55–62.
[4] Troncoso, K.; Castillo, A.; Masera, O.; Merino, L. Social perceptions about a technological innovation for fuelwood cooking: Case study in rural Mexico. Energy Policy 2007, 35, 2799–2810.
[5] Kulindwa, Y.J.; Lokina, R.; Ahlgren, E.O. Driving forces for households' adoption of improved cooking stoves in rural Tanzania. Energy Strateg. Rev. 2018, 20, 102–112.
[6] Wickramasinghe, A. Energy access and transition to cleaner cooking fuels and technologies in Sri Lanka: Issues and policy limitations. Energy Policy 2011, 39, 7567–7574.
[7] Rehman, I.H.; Kar, A.; Arora, A.; Pal, R.; Singh, L.; Tiwari, J.; Singh, V.K. Distribution of improved cook stoves: Analysis of field experiments using strategic niche management theory. Sustain. Sci. 2012, 7, 227–235.
[8] Poddar, M.; Chakrabarti, S. Indoor air pollution and women's health in India: An exploratory analysis. Environ. Dev. Sustain. 2016, 18, 669–677.
[9] Martin, S.L.; Arney, J.K.; Mueller, L.M.; Kumakech, E.; Walugembe, F.; Mugisha, E. Using formative research to design a behavior change strategy to increase the use of improved cookstoves in Peri-urban Kampala, Uganda. Int. J. Environ. Res. Public Health 2013, 10, 6920–6938.
[10] Maré, M.; Annegarn, H.J. The Use of Willingness to Pay in Determining Customer Preferences for Improved Flame-Based Cook stove Features in Two South African Study Areas. Soc. Mar. Q. 2017, 23, 335–353.
[11] Thurber,M.C.;Phadke,H.;Nagavarapu,S.;Shrimali,G.;Zerriffi,H."Oorja"inIndia: Assessing a large-scale commercial distribution of advanced biomass stoves to households. Energy Sustain. Dev. 2014, 19, 138–150.
[12] Person, B.; Loo, J.D.; Owuor, M.; Ogange, L.; Jefferds, M.E.D.; Cohen, A.L. "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 cook stove project in rural Kenya. Int. J. Environ. Res. Public Health 2012, 9, 1566–1580.
[13] Loo, J.D.; Hyseni, L.; Ouda, R.; Koske, S.; Nyagol, R.; Sadumah, I.; Bashin, M.; Sage, M.; Bruce, N.; Pilishvili, T.; *et al*. User perspectives of characteristics of improved cookstoves from a field evaluation in Western Kenya. Int. J. Environ. Res. Public Health 2016, 13.
[14] Gebreegziabher, Z.; van Kooten, G.C.; van Soest, D.P. Technological innovation and dispersion: Environmental benefits and the adoption of improved biomass cook stoves in Tigrai, northern Ethiopia. Energy Econ. 2017, 67, 337–345.
[15] Maré, M.; Annegarn, H.J. The Use of Willingness to Pay in Determining Customer Preferences for Improved Flame-Based Cook stove Features in Two South African Study Areas. Soc. Mar. Q. 2017, 23, 335–353.
[16] Mudombi, S.; Nyambane, A.; von Maltitz, G.P.; Gasparatos, A.; Johnson, F.X.; Chenene, M.L.; Attanassov, B. User perceptions about the adoption and use of ethanol fuel and cookstoves in Maputo, Mozambique. Energy Sustain. Dev. 2018, 44, 97–108.
[17] Patel, S.; Khandelwal, A.; Leavey, A.; Biswas, P. A model for cost-benefit analysis of cooking fuel alternatives from a rural Indian household perspective. Renew. Sustain. Energy Rev. 2016, 56, 291–302.

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