The Nexus between Perceived Welfare Benefits and Sustained Use of Clean Cooking Technologies in Uganda.

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Abstract

This study examines the linkage between health benefits, fuel efficiency, and environmental concerns in Uganda's sustained use of Clean Cooking Technologies. The research employed a quantitative approach to investigate the relationships among the study dimensions. A questionnaire survey was administered to 379 households. Subsequently, the data was analyzed using Smart Partial Least Squares (PLS) software. The results depict that health benefits, fuel efficiency, and environmental concerns significantly predict the sustained use of Clean Cooking Technologies in Uganda. The three dimensions augment to explain 29.3% of the variance in sustained use of the dependent variable. As indicated, the predictors partly explain the Sustained use of Clean Cooking Technologies in Uganda. A host of predictors 70.7% remain unaccounted for. Having benchmarked the quantitative design in this study creates ample space for social realists who prefer the qualitative approach. A comparative analysis may be conducted between the two designs to investigate if there are any variations in the results. This research paper combined three dimensions; health benefits, fuel efficiency, and environmental concerns with Expectation Confirmation Theory/ Model (ECT) ECM using Smart PLS to explain the continuous use of Clean Cooking Technologies in Uganda.

Keywords: Continuous use, Clean cooking technologies, Health benefits, Fuel efficiency, Environmental concerns.

Introduction

The conception that sustained use of Clean Cooking Technologies (CCTs) is associated with wide-ranging health benefits, fuel efficiency and environmental benefits cannot be overemphasized. This narrative has been collectively voiced by governments, Non-Governmental Organizations (NGOs) , civil society advocates, and environmentalists; premised on the collective goal of securing the livelihoods of future generations (Newell & Daley, 2021). For example, the continuous use of CCTs has been extensively linked with the Triple Bottom-Line (TBL) effects of the social, economic, and environmental fundamentals, highly prioritized by The Sustainable Development Goals (SDGs) 2030, African Union Agenda 2063 and National Development Plan (NDP III)-Uganda (National Planning Authority, 2020; Orejon-Sanchez *et al*., 2022). In economies where the production of clean energy equipment has been established for a significant duration, there has been an increase in Gross Domestic Product (GDP), employment, and household income levels. Socially, sustained use of CCTs translates into improved quality of life, reduced respiratory diseases, mortality rates, and prolonged life expectancy rates (Katoch *et al*., 2023).

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The parameters of SDGs 2030 of the United Nations (UN) have been embraced as a benchmark to secure a safe future for humanity (Chen *et al*., 2020; Moyer & Hedden, 2020). All the 193 member states of the UN including Uganda are expected to apt their efforts in line with the set targets (Ali *et al*., 2023). Ostensibly, embracing the use of CCTs as a lifestyle phenomenon positively contributes to Goals 5, 6, and 13 which endeavor to augment clean environment for sustainable development (Paris et al., 2022; Zhao et al., 2022). Notably, a clean environment devoid of pollution diminishes death rates among children and pregnant mothers; exerting less pressure on health services that are often overstretched especially in developing countries with constrained budgets (Qu *et al*., 2020; Sun *et al*., 2024).

Ugandan government has prioritized the sustained use of CCTs through multiple interventions. For example, the National Development Plan (NDP III) advocates for sustained access and usage of clean energy among households (National Plannning Authority, 2020) in both rural and urban settings. This initiative was premised on the backdrop that overt 90% of the state and private owned institutions including schools, health centers, prisons, and commercial buildings predominantly rely on the outdated cooking systems (UNDP, 2016). Such technologies that use huge amounts of firewood and charcoal; and have had detrimental effects on climate including prolonged droughts, flooding, stress on Ecosystems, and persistent famine (Pascual *et al*., 2022). Through capacity-building efforts with Enabling African Cities for Transformative Energy project (ENACT), Uganda has registered great milestones in positive mindset change among urban households towards clean cooking. Further, the government has provided for 100% tax waiver on solar equipment to improve access to clean technology. Besides, Value Added Tax (VAT) waivers on Liquefied Petroleum Gas (LPG) and ethanol to promote domestic, institutional and commercial cooking activities are operational fully operational (Nakanwagi, 2021). Additionally, clean cooking systems are being promoted among the principal users of firewood including universities, hospitals, health care facilities including primary and secondary schools using bio-latrine support systems (UNDP, 2016). Hence, owing to the benefits associated with sustained use of CCTs, efforts to augment smooth transition are justifiable.

The motivation to conduct this study was prompted by the fact that about 7% of households who transit from the traditional to the modern methods cannot hang on beyond the first year of CCT uptake (Naluwagga *et al*., 2022); despite the collective efforts of multiple stakeholders and associated benefits. Available literature that mirrors the slow uptake and adoption of the contemporary CCTs is quite scanty for Uganda. There have been few attempts to establish why the uptake of CCTs is slow in Uganda. For instance Katutsi, Kaberuka, and Yawe (2023) analyzed the contribution of technology-specific attributes in the sustained use of CCTs. Katutsi *et al*. (2023) undertook intensive research on socioeconomic factors and suitable use of CCTs. Unfortunately, none of the aforementioned studies examined the influence of the Perceived Welfare Benefits (PWBs) of CCTs in Uganda despite their potential to influence the sustained use of CCTs in Uganda. Based on the background literature, we build a conceptual framework of perceive welfare benefits and CCTs as illustrated in Figure 1.

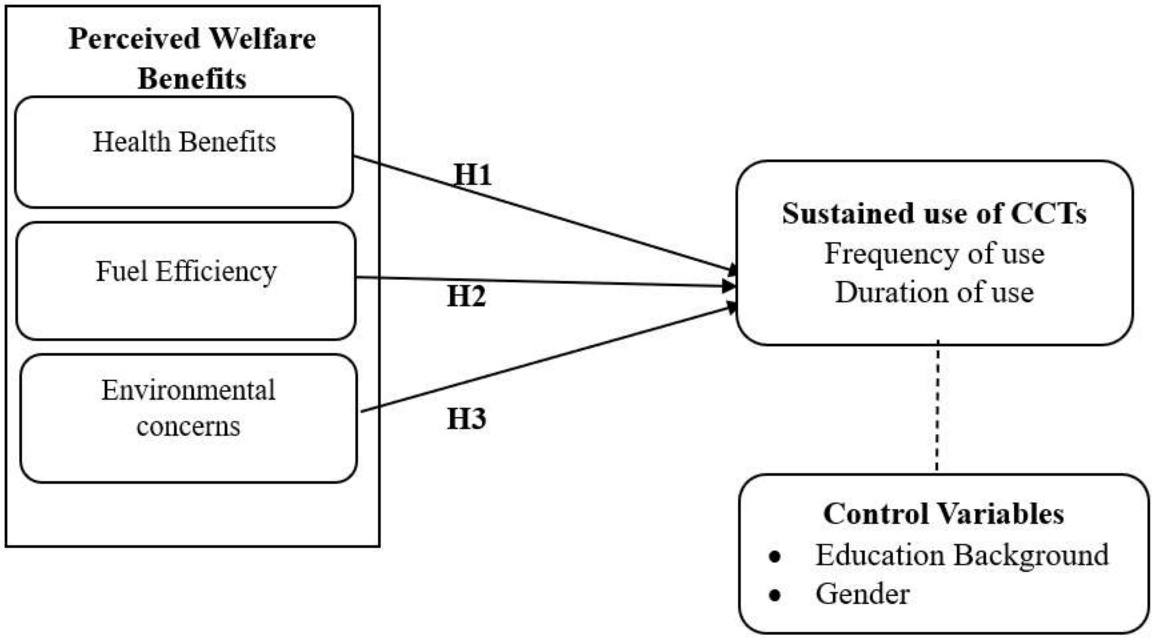

Figure. 1 A conceptual framework of PWBs and CCTs as illustrated.
Source. Authors' conceptualization

Theoretical Foundation and Hypotheses Development
Theoretical Foundation
We anchor the study in Expectation Confirmation Theory (ECT) Oliver (1980); as further validated by Bhattacherjee (2001) in the Expectation Confirmation Model (ECM); highly embedded in marketing literature which postulates that customers exhibit repurchase behavior upon product fulfillment of pre-purchase expectations (Oliver, 1980, 2014). The theory assumes that customer continuance with product is positively associated with its acceptance. Product performance can be judged consistently across customers based on specific criteria, all expectations are assumed to exert equal power to explain consumer satisfaction with a product (Bhattacherjee, 2001; Jiang & Klein, 2019; Wolverton *et al*., 2019). Accordingly, customer repurchase decisions manifest when a realignment between his or her expectations with perceived performance is positive and confirmed. Empirical studies by Blight (2015); Simkovich *et al*. (2019); Jeuland *et al*.(2018); Wolverton *et al*. (2019) and Biratu (2016) indicate that households across a wide spectrum have perceived economic, environmental , health, fuel efficiency and social welfare benefits of sustained use of CCTs. It is perceived that understanding the community welfare expectations is key in project design, implementation and sustainability (Zhuang, 2017). Notably, nonconformity between expected and actual manifestations of product utility negatively affects the potential client gratification levels (Chou *et al*., 2010; Oliver & DeSarbo, 1988). Deeply grounded in ECT and ECM model, Bhattacherjee (2001) adequately explains the empirical realism surrounding the sustained use of CCTs using perceive welfare benefits among households in Uganda.

Hypotheses Development
This section presents knowledge and understanding of academic literature in relation to the measures of PWBs including health, fuel efficiency and environmental concerns in the Sustained

Use of Clean Cooking Technologies in Uganda. In line with hypothesis testing benchmarks, we focused on the relational literature between measures between independent and the dependent variables. From the emerging relationships, we generated directional hypotheses to test the emerging relations.

Health Benefits and Sustained Use of CCTs

It has been observed that reduction air pollution is one of the factors that motivate households to use clean cook-stoves (Kuhe & Bisu, 2020). The mitigation of air pollution syndrome is of interest to household clean energy consumers (Jeuland & Pattanayak, 2012) who emphasize that the practice improves indoor air quality. One reason why several communities have embraced novel cooking styles is their positive effect on human health including lower acute respiratory infections among children under five years old (Mehetre *et al*., 2017). Furthermore, clean air emissions from clean cooking stoves control the effects of chronic obstructive pulmonary disease in adults (Shankar *et al*., 2014). The enormous health benefits cited have attracted both the public and the private sector to find the best interventions that trigger and sustain the uptake and utilization of CCTs. Improved health living arising from clean technologies comes with attendant benefits associated with women and children; who often find themselves fending for biomass energy sources (Gebreegziabher *et al*., 2018). A new generation of clean cook-stoves has improved the quality of life of women and are increasingly becoming more productive in commercial activities (Modern Energy Cooking Services , 2022) thereby contributing significantly to family welfare. Barua (2018) advocates for adoption and sustained use of improved cooking technologies to free more space to women for better child care (Bandyopadhyay, 2017). Health considerations are at the top of the agenda to cause a fundamental transition to CCTs, especially in developing countries with significantly high death rates.

From policy and consumer perspective, health-related benefits have been rated among the key factors that have influenced household sustainable use of CCTs (Chen & Peng, 2018). The behavioral change engineered projects towards sustained use of health-supportive technologies for clean cooking have had far reaching effects in attitude change (Jewitt *et al*., 2022). World-over, community health based professionals have successfully advanced clean cooking technology sensitization campaigns (Erikson, 2019). For instance, in endeavors realize SDG3; Good health and well-being of the communities, use of cleaner fuels including LPG, ethanol and biogas have been recommended (Rosenthal *et al*., 2018). Over the past three decades, the NGO world alongside donor agencies have been at the forefront of promoting clean cooking; citing health and environmental benefits as key outcomes (Govinda & Mallab, 2021). The quest to attain sustainable public health has been on the rise and the massive transition to modern cooking is of global interest (Baker *et al*., 2020; Blight, 2015). Based on the enormous health benefits associated with sustained use of CCTs, efforts towards entrenching the practice are of strategic concern. Hence, we envisage:

H_1. There exists a positive relationship between health benefits and sustained use of CCTs.

Fuel Efficiency and Sustained Use of CCTs

The search for efficient energy conservation mechanisms is on the rise in the 21st century. This is against the backdrop that traditional fuels have indirectly cost households unprecedented expenditures in managing the attendant diseases worldwide. Most efficient energy conservation mechanisms have been a major reason why most households in some communities have continuously practiced fuel-stacking behavior (Jewitt *et al*., 2020b; Shankar *et al*., 2020). Households both in rural and urban settings have become more creative than before by applying an assortment of cookware; all aimed at optimizing energy resources subject to cooking needs at a time (Samadhiya *et al*., 2023). Consistent and efficient use of different cook technologies optimize energy consumption compared to conventional linear cooking models (Gebreegziabher *et al*., 2018). Empirical studies have alluded to fuel efficiency, speed of cooking, money savings, and reduced smoke emissions; all of which motivate the sustainable use of clean cooking solutions (Namagembe *et al*., 2015). Research works by Yunusa *et al*. (2023) posit that fuel efficiency was the most cited as the reason to why households among rural communities purchase improved cook-stoves. Attaining greater efficiencies is a key factor in determining the preferred household energy cooking choice (Ali & Khan, 2020; Ven & Sampedro, 2017). It is of interest to note that renewable energy high-efficiency powered clean systems would augment the uptake and sustained use of novel cooking technology (Karanja & Gasparatos, 2019).

In highly resource-constrained communities, innovative energy-efficient but fundamentally traditional household cooking systems have been adopted (Nabukwangwa *et al*., 2023;). Therefore, commercial scaling of energy-efficient cook mechanisms will be effectively achieved among low-income communities if the cost of system purchase and operations are addressed (Akolgo *et al*., 2018; Pereira & Marques, 2023). The continuous use of innovative household cooking technologies results into fuel efficiencies compared to conventional stoves thereby reducing household expenditures (Mehetre *et al*., 2017). The search for energy conservation mechanisms is high on the NGO agenda both in developed and developing countries. For example, studies indicate that governments have provided tax subsidies, wavers, and concessional loans to accelerate the uptake of efficient fuel-cooking technologies (Pereira & Marques, 2023; Puzzolo *et al*., 2019) much as their empirical evidence on sustainability behavior is scanty (Redonda, 2016).

H_2. There exists a relationship between fuel efficiency and sustained use of CCTs.

Environmental Concerns and Sustained Use of CCTs.

The sustained use of CCTs is synonymous with current environmental conservation intervention practices which positively impact the quality of life for the future generations (Sharma *et al*., 2020). When communities are concerned with realization of environmental conservation benefits for future generations, they will endeavor to adopt the prolonged use of CCTs. Greenhouse gases mitigation endeavors have had direct affirmative environmental conservation benefits and this has encouraged governments to support the sustained use of CCTs (Yadav & Pallissery, 2023). Reduction in air pollution, preservation of the biosphere, protection of endangered species, and conservation of natural resources have been cited as motivators for the sustainable use of modern cooking technologies (Mehetre *et al*. 2017) among urban communities. It has been popularly held that reduction in environmental pollution and positive climate change are twin effects that augment sustained use of clean fuels (Mohammed *et al*., 2024). We note that the quest for environmental sustainability has resulted in the massive transition of rural communities from traditional cooking to modern cleaner systems in rural India (Yadav & Pallissery, 2023). Worldwide, the combined effects of social, economic, and environmental welfare benefits extend the desire for sustainable use of CCTs in line with key SDGs benchmarks (Hainsch *et al*., 2022).

Elsewhere, environmental advocates have tasked developed countries to support climate funding through concessional loans from, sovereign green bonds, carbon trading and taxes (Rossitto, 2021). Progressive outcomes relating to environmental management create a conducive atmosphere for a voluntary and sustainable transition to contemporary household cooking systems (Lanza *et al*., 2024). The necessity for environmental conservation has led governments and NGOs to work together with the common goal of advancing value-driven clean cooking in both developed and developing nations (Pereira *et al*., 2021). Environmental health threat has been identified as one single world challenge; affecting over 30% of the world´s population (Martínez *et al*., 2017). Therefore, to mitigate the underlying threat, continuous use of clean cook-stoves among other interventions was recommended by environmental relates NGOs (Pakravan & MacCarty, 2020). Conceptually, progressive environmental influences are closely associated with the preferred choice of household cooking technologies across communities (Lanza *et al*., 2024). Sustainability endeavors, growing energy consumption, and rising extinction of traditional source of household fuels have generated a favorable paradigm shift to clean cooking systems (Sharma *et al*., 2020). With respect, we conceive that:

H_3. There exists a positive relationship between environmental concerns and sustained use of CCTs.

Materials and Methods

Design, Population and Sample

The study was a survey on a total population of 714,602 households across three districts of The Great Kampala Metropolitan Area (GKMA) that use CCTs. A multi-stage sampling technique was used to select the households to be surveyed. In the initial stage, three districts—Kampala, Mukono, and Wakiso—were chosen using purposive sampling. These districts were selected because a large number of clean cooking technology users exist in this area (UBOS, 2020). Subsequently, stratified random sampling was used to select households for the survey based on sub-counties, parishes and villages. In the final stage, a simple random sampling technique was used to select households in each village to be interviewed. The household sampling frames were constructed from the village registers. In cases where the village registers were not available, Village Local Council Chairpersons (LC) with support from other Village leaders provided the information necessary to construct the sampling frames. A representative sample of 384 households was determined based Krejcie and Morgan (1970) statistical table. However, 379 observations were usable for analysis; representing 98.7% response rate. This study used a questionnaire to gather information on health benefits, fuel efficiency, environmental concerns and other demographic indicators. The household heads were the units of enquiry while households were the unit of analysis.

Measurement and Operationalization of the Study Variables

The items of the study variables were adopted from epical studies from comparable fields of study. A five-point Likert scale ranging from strongly disagree to strongly agree was used to measure the items. Items on health benefits were constructed basing on Angoori and Kumar (2023). Items regarding fuel efficiency were adopted from Pakravan and MacCarty (2020) and items related to environmental concerns were adopted from Wang et al. (2019).

Tests for Reliability, Convergent and Content Validity and Collinearity

To understand whether the measurement tool could possibly be usable in associated research works, we performed Construct Reliability tests using Cronbach's alpha (α) and Composite Reliability (CR) (Cheung *et al*., 2024). Further, Hair *et al*. (2013) and Petreson (1994) recommend a minimum standard of (α> 0.7, CR > 0.7) for Cronbach's alpha (α) and CR coefficients respectively to mirror instrument reliability. The results depict (α) coefficient ranges of .741 and .895 for the respective lower and upper limits and .825 and .9.23 for CR. Data independence of the predictors and the complementary multicollinearity tests were also determined. The results reveal a variance inflation factor (VIF) indices between 1.526 and 1.874 quite below 5.0 maximum limit suggested by Hair *et al.*(2013). We thought the professional opinion of five experts in the industry and five academicians to validate the instrument's authenticity and rationality. We divided the total number of the valid items by the total number in the tool (Dan *et al*., 2020). The Content Validity Index (CVI) reflected a range of results above 0.7 and an Average Variance Extracted above 0.5 in line with Field (2009) minimum recommended benchmarks. Therefore, the results presented in Tables 1& 2 designate that the instrument is reliable, valid, and that the data is independent and devoid of multilinearity.

Table 1: Reliability and Collinearity

Dimension	*Cronbach's Alpha*	*Composite Reliability*	*Variance Inflation Factor*
Environmental Concerns	.841	.825	1.439
Fuel Efficiency	.741	.841	1.256
Health Benefits	.846	.829	1.547
Sustained Use			
Frequency of Use	.838	.892	1.386
Duration of Use	.895	.923	1.874

Source(s): Primary data

Table 2: Validity of the research instrument

Dimension	*Average Variance Extracted*	*Content Validity Index*
Environmental Concerns	.611	.857
Fuel Efficiency	.580	.800
Health Benefits	.618	.818
Sustained Use		
Frequency Of Use	.674	.900
Duration of Use	.706	.800

Source(s): Primary data

Discriminant validity

We test for Discriminant validity by means of Heterotrait-Monotrait (HTMT) standards. Finding the degree of association between dimensions is widely acknowledged in quantitative research studies (Henseler *et al*., 2015). The results in Table 3 indicate that discriminant validity did not manifest in the dataset since HTMT was found to be less than 0.85 maximum mark determined by Ringle *et al*. (2023).

Table 3: Discriminant validity Using HTMT

Dimensions	**EC**	**CY**	**HB**
Environmental Concerns [EC]			
Fuel Efficiency [CY]	.528		
Health Benefits [HB]	.579	.575	
Dimensions	**FU**	**VS**	
Frequency of Use [FU]			
Duration of Use [VS]	.827		

Source(s): Primary data

Results

Background Characteristics

The results are premised on 379 samples that participated in the study. Table 4 presents the background characteristics of the sample population.

Table 4. Background characteristics, Total N= 379 Household Heads

Gender of respondent	Count	Valid Percent	Cumulative Percent
Male	213	56.2	56.2
Female	166	43.8	100.0
Age bracket	Count	Valid Percent	Cumulative Percent
18-25 yrs	40	10.6	10.6
26-33 yrs	264	69.7	80.2
34-41 yrs	72	19.0	99.2
42 yrs and above	3	0.8	100.0
Marital status of household head?	Count	Valid Percent	Cumulative Percent
Married	199	52.5	52.5
Single	113	29.8	82.3
Divorced	42	11.1	93.4
Widow/ Widower	25	6.6	100.0

Source(s): Primary data

The results on gender attributes of the sample established that (56.2%) of the households were male-headed while females accounted for (43.8%). In most African cultures, matrimonial households are headed by men, who assume the leading role in determining and purchasing domestic necessities including cooking needs (Elasu *et al*., 2023). Further analysis of the background attributes indicates that most respondents 69.7% who use CCTs to meet their kitchen needs are youths, falling within the age range of 26-33years in line with Aziz *et als*' (2022) findings. It has been emphasized that CCTs are more preferred by the youths because they are user-friendly, take a short set-up time, and are faster in getting meals ready (Roy & Pagaldiviti, 2023). We also note that the majority of the participants were married (52.5%); followed by singles (29.8%) with the minority being widows or widowers (6.6%). Since the majority of the respondents fall within the age bracket of 26 -33years (marriage age), many respondents were young couples and more likely to use CCTs due to its convenience amidst competing responsibilities.

Correlation Analysis

We use Pearson's one-tailed correlation test determine existence of associations between the predictor and the outcome variables as depicted in the literature (Field, 2009). Hair *et al*. (2013) emphasize that associations between independent and dependent variables ought to be positive and significant if the validity of the more progressive statistical results (SEM, Regression and Smart-PLS) are to be obtained. As shown in Table 5, the correlation results met Hair *et al.* (2013) minimum standards to justify further analysis.

Table 5: Pearson's one-tailed correlation test results

Dimensions	Mean	SD	1	2	3	4
Health Benefits-1	4.074	.854	1.000			
Fuel Efficiency-2	3.979	.867	.483**	1.000		
Environmental Concerns-3	4.359	.562	.346**	.344**	1.000	
Sustained Use-4	4.053	.770	.467**	.422**	.238**	1.000

** Correlation is significant at the 0.01 level (2-tailed).

Source(s): Primary data

As depicted in Table 5, all the predictor dimensions mirror a positive and significant association with the sustained use of CCTs.

Model Specification and Analysis

We embraced Smart PLS-SEM software in model specification and measurement. It is a robust modelling technique that accommodates diverse traditions about the data structure with several measurement dimensions (Kock & Hadaya, 2018). Fundamentally, Smart PLS-SEM works well with varied data set sizes without regard to assumptions that underlie parametric data assumptions of a normal distribution (Richter & Tudoran, 2024). Notably, with Smart-PLS, estimation parameters remain in a stable state regardless of the data size. The technique maintains utmost accuracy forecasts even when the scale spans up to 10 five-point items with positive and negative limits (Lewis & Hf, 2018). We performed measurement model analysis for PWBs in respect of the dimensions; health benefits, fuel efficiency, and environmental concerns. The results are depicted in Figure 2:

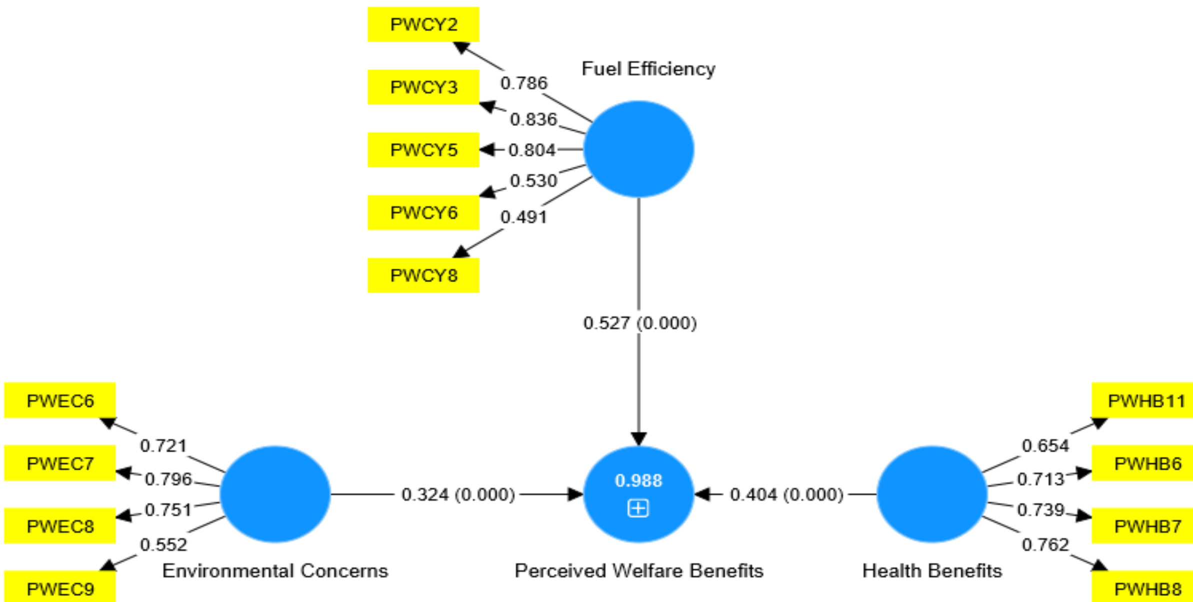

Figure 2: Perceived Welfare Benefits
Source: Authors' estimation using Smart PLS

Bootstrapped Measurement Model Estimates for PWBs

Table 6: Bootstrapped measurement model estimates for health benefits, fuel efficiency, and environmental concerns

	B	**Std. Error**	**T *statistics***	***p* values**
Health Benefits ➡ PWBs	.404	.022	18.632	.000
Fuel Efficiency ➡ PWBs	.527	.019	28.142	.000
Environmental Concerns ➡ PWBs	.324	.016	19.694	.000

Source(s): Primary data**.**

The results of the measurement model in Figure 2 portray the combined contribution of health benefits, fuel efficiency, and environmental concerns to the measurement of the variable; the PWBs. The three dimensions generate an R-squared value of 0.99% of the variance in the PWBs arising from the sustained use of CCTs. According to Hair *et al.*(2020), an R-squared value of 0.99% is perceived as significant in explaining the variance in a given variable. Henceforth, health benefits, fuel efficiency, and environmental concerns are substantive in explaining the variation in the PWBs of continued CCTs in Uganda.

We further generated a measurement model for sustained use of Clean Cooking Technologies. The results reveal a sizeable of variance in explaining sustained use of CCTs. The results are contained in Figure 3.

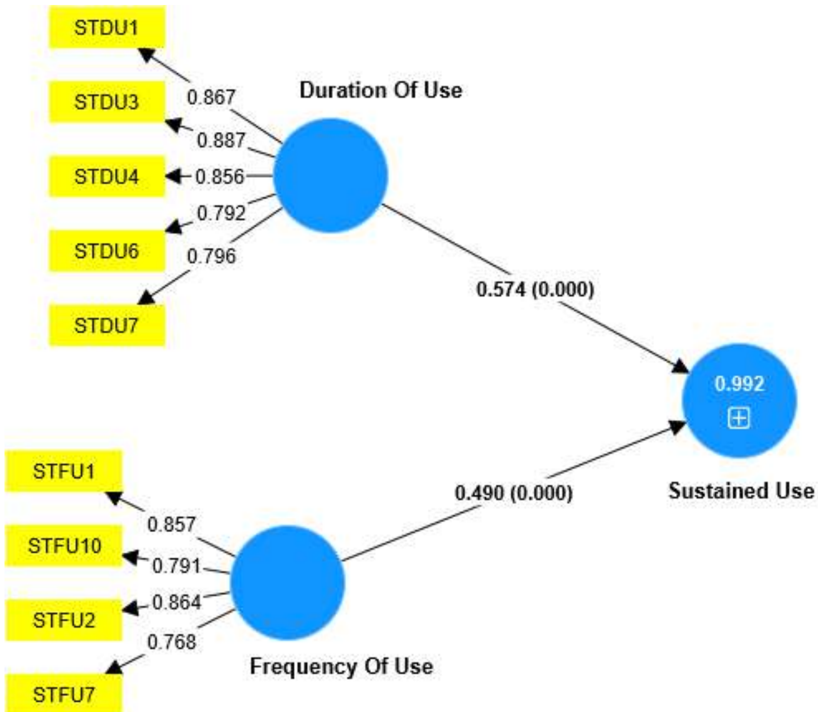

Figure 3: Measurement model for sustained use of CCTs
Source: Authors' estimation using Smart PLS

Bootstrapped Measurement Model for Sustained Use of CCTs

	B	Std.Error	T *statistics*	*p* values
Duration Of Use ━▶ SU	.574	.015	37.558	.000
Frequency Of Use ━▶ SU	.490	.015	31.786	.000

Source. Primary data

Figure 3 illustrates the measurement model for sustained use of CCTs. The results designate that the two dimensions, duration and frequency of use show an R-squared value of 0.993; suggesting that the factors explain 99.3% of the variance in the sustained use of CCTs in Uganda. Drawing from Hair *et al.* (2013), R-square values of 0.75 (75%) and above are considered significant in empirical research. Hence forth, the two dimensions of duration and frequency of use sufficiently account for the sustained use of CCTs in Uganda. Further statistical results of the bootstrap in Table 7 confirm the validity of the model, indicating that beta values (β), t-statistics and the respective path coefficients were significant. Remarkably, the results confirm the model fit based on Hair *et al*. (2013)) limits.

Measurement Model Analysis for Hypothesis Testing

Hypothetically, a model structure is a systematic mapping that connects the criterion to the outcome variables (Sukhova et al., 2023). We use (R^2) to determine the explanatory power of the measurement model according to Ramos-gonzález & Sastre-castillo (2021). In essence, coefficient derivatives closer to 1 mirror stronger explanatory power. The path estimations were calculated by a bootstrapping technique that comprised 5,000 distinct samples as illustrated in Figure 4.

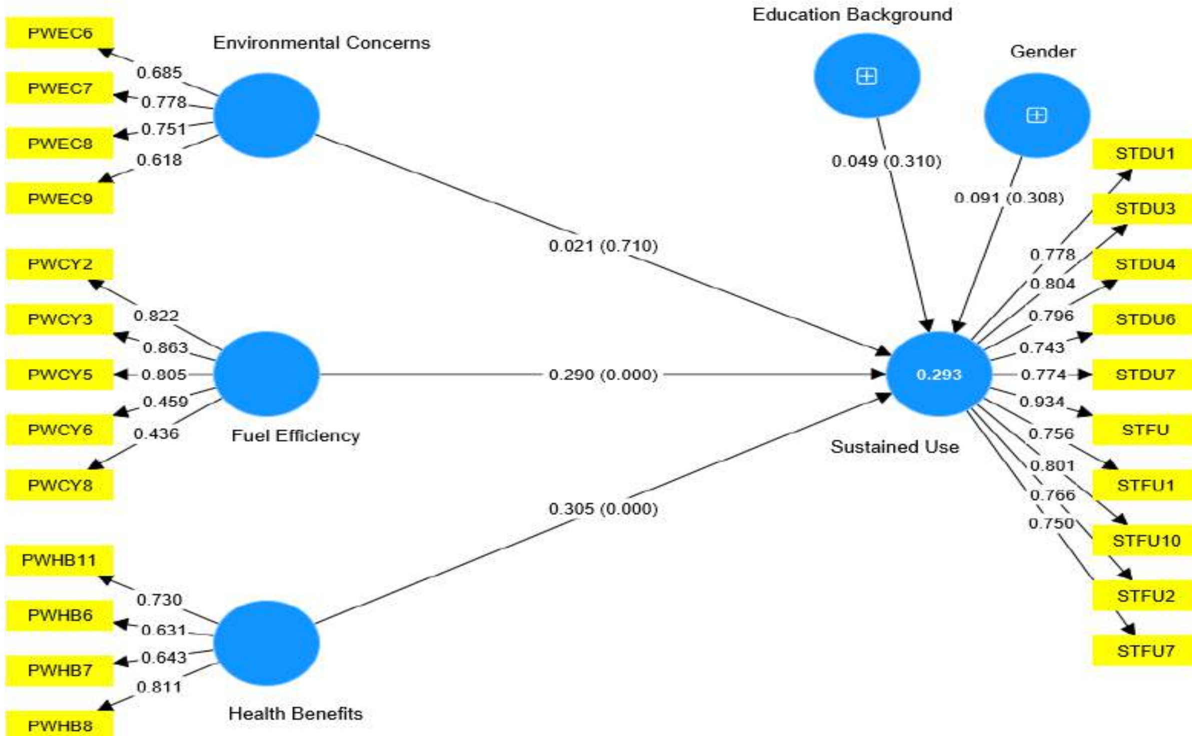

Figure 4: Structural Model for PWBs and Sustained Use of CCTs
Source: Authors' estimation using Smart PLS

Table 6: Bootstrapped estimates for hypothesis testing

	β	SE	T *statistics*	*p values*	95% BC C-Intervals
Education Background ➡ SU	-.049	.048	1.016	.310	[-0.139,0.047]
Gender ➡ SU	-.091	.090	1.020	.308	[-0.271,0.082]
Fuel Efficiency ➡ SUs	.290	.063	4.610	.000	[0.157, 0.404]
Environmental Concerns ➡ SU	.021	.056	0.372	.710	[-0.093,0.125]
Health Benefits ➡ SU	.305	.058	5.230	.000	[0.187, 0.415]

Source(s): Primary data

We note from Table 6 that the bootstrapped derivatives for the hypothesis test portray a positive and significant relationship between Health Benefits and sustained use of CCTs (β .305; p< 0.001). Hence, consistent use of CCTs by given households is dependent on the resultant health benefits derived. Accordingly, H1 was supported. Further the relationship between fuel efficiency and CCTs in Uganda was found positive and significant (β .290; p < 0.001). The result indicates that efficient fuels attract and retain the users of CCTs in Uganda on sustainable basis. Therefore, H2 was supported. On the contrary, environmental concerns are not positively and significantly related to the sustained use of CCTs in Uganda (β .021; p>0.05). The result shows that continued use of CCTs is not contingent upon anticipated environmental concerns by the household in Uganda. Consequently, H3 was not supported. The overall coefficient of determination (R^2) results demonstrate that the proposed model predicts 29.3% of sustained use of clean cooking technologies in Uganda R^2 (.293).

Furthermore, the relationship between the predictors and outcome variables was assessed using f-square values. The individual effect sizes were determined founded on Cohen's (1988) decision benchmarks. Henceforth, f-square ($f^2 \leq 0.02$) was perceived representing no effect; ($f^2 \geq 0.15$) medium, and large if ($f^2 \geq 0.35$). Results in respect of the comparative importance of the predictors' effect size (f^2) depict health benefits (f^2 = .091), and fuel efficiency (f^2=.086) as having fairly good contribution to sustained use of CCTs in Uganda. However, environmental concerns posited inconsequential effect size of (f^2 =.000) on the persistent use of CCTs in Uganda. In essence, the augmented model effect size of the exogenous variables on the endogenous variable was medium (Adjusted R^2 .283).

Discussion of Results

The study investigates the nexus between PWBs and sustained use of CCTs in Uganda. The discussion structure is in respect of study objectives and respective hypotheses. In respect of hypothesis 1, health benefits and sustained use of CCTs are positively and significantly related. In context, the health-related benefits such as reduced air pollution, better indoor air quality, fewer acute respiratory infections, and enhanced clean air emissions, along with an improved quality of life for women, motivate households to consistently adopt the usage of CCTs. In consonance with the study findings, the routine application of CCTs has been associated to decrease in respiratory complications, reduction in burns and indoor air contamination (Winrock, 2017). Further, Frostad et al.(2022); Ortiz-Sanchez et al. (2024) posit that improved coking technologies diminish domestic air pollution thereby improving the quality of life of women and children who are most affected by biomass technologies. Overall, the discussion about clean fuels is a global health concern, as their swift adoption is linked to reducing child asthma infections, gasping, and improving respiratory health (Puzzolo et al., 2024; Richter & Tudoran, 2024).

In reverence to H2, fuel efficiency is significantly related to relationship the sustained use of CCTs. Over time, communities have fuel conservation mechanisms to mitigate fuel costs with conventional cooking styles. An assortment of cookware is strongly associated with fuel-efficient mechanisms subject to cooking needs. Food preparation speed, cost saving, and reduced smoke emissions of CCTs have been identified as key household hold aspects in cooking technology preference. In effect, CAETS (2022) report demonstrates that fuel-efficient cooking systems constrain carbon emission syndromes; which has been a global issue in the energy space. Consistent with our findings, efficient fuel-use technologies and infrastructure-free additional resources that augment household welfare especially in developing countries that often experience budget shortfalls(Clean Cooking Alliance, 2022). Further, the study results align with the findings by CAETS (2022) report which emphasizes the consistent use of CCTs to leverage inadequate resources. More often, the use of efficient equipment and appliances supports constructive climate effects which enhance household agricultural activities (Green Climate Fund, 2013). NGOs and Civil Society Organizations (CSO) are at the forefront of advancing household transition campaigns to more efficient CCTs which significantly contribute to sustainable incomes (Katutsi *et al*., 2023; Winrock, 2017).

In line with line H3, results typify that environmental concerns are not positively and significantly related to sustained use of CCTs. Therefore, constrained deforestation, regulated soil degradation including controlled air and water pollution effects are not considered vital in attracting households to adapt to the sustained use of CCTs. In the same vein, environmental conservation extends the current state of today's resources for the future generations (Vassiliades et al., 2023). It has been observed that reservation of the environment is one strategic goal as to why households dependably make use of CCTs for domestic cooking chores (Yorke, 2024). Notably, we anticipate that lack of sensitization, exposure and information could probably explain why environmental concerns do not matter in sustained use of CCT in Uganda.

Conclusion

This study determined the nexus between health benefits, fuel efficiency, and environmental concerns in the sustained use of CCTs. Tracing the leakages between empiricism, theory, and realism associate health benefits, fuel efficiency, and environmental concerns positively and significantly determine the continuous usage of CCTs. The dimensions in the study account for 29.3% of the variance in the sustained use of CCTs among households in Uganda. Therefore, the strategic value of health benefits, fuel efficiency, and environmental concerns in embracing application of CCTs amongst Ugandan consumers is now well established. The study confirms the empirical works that led to the formulation of the hypotheses is validated. Further, the ECT Oliver (1980) and the ECM Bhattacherjee (2001) which informed the meassurement model cofirm the empirical evidence hypothesis that health benefits, fuel efficiency, and environmental concerns are true determinants of CCTs. In essence, the three dimensions synergize to determine the sustained use of CCTs in Uganda's households.

Theoretical Implications

This study associates with Expectation Confirmation Theory (Model) (Bhattacherjee, 2001; Oliver, 1980). The theory fronts the concept of variance between customer expectation satisfaction levels against actual gratification arising from consumption, use or possession of a product. For continuity with usage of the product, the difference in expected as actual satisfaction levels should be the diminished or negative for a customer to develop the syndromes of loyalty; hence continuity with the use of the product (Bhattacherjee, 2001; Obadă *et al*., 2024; Oliver, 1980; Silva *et al*., 2022; Zanetta *et al*., 2021). Therefore, in view of the positive and significant relationships between the predictors and the depended the variable, we contend that customers perceive the health benefits, fuel efficiency, and environmental consideration derived from protracted use of CCTs as deserving (Lanza *et al*., 2024)

Policy Implications

From a policy perspective, CCTs advocates including government agencies, NGOs, and environmental activists should leverage health benefits, fuel efficiency, and environmental concerns as gate way into clean coking space. The pictorial representation of health effects of biomass coking technologies carry a clear message of the need to transit and sustain clean cooking regime. The pictorial should also mirror a contained environment; and communicating its negative effects on community livelihoods. The transition advocates should also adopt a community advocacy model, where clean cooking champions can be identified and supported to popularize the transition. Monthly barrazas should be organized by the champions to evaluate and communicate the progress. Modern CCTs are quite expensive for the rural communities. We advocate for some kind of subsidies to support sustained use of the services; at least for a given period of time.

Study limitations and Areas for Future Research

This research limited to only three dimensions. These include; health benefits, fuel efficiency, and environmental concerns. They account for only 29.3% of the variation in the continued use of CCTs. Consequently, 70.7 % of the variance is not explicated. This is a clear indication that more research is needed in this field of study. Additionally, the study undertook a qualitative design. This opens up space for more studies using the qualitative or blended approaches to determine. Over time, different study approaches will provide enough empirical works for reviews as we endeavor to find a lasting solution to clean cooking needs. Lastly, the scope of the study is quite urbanized covering three districts neighboring the capital city; Kampala. We therefore recommend similar study using the same dimensions in rural districts of Uganda.

References

Akolgo, G. A., Essandoh, E. O., Gyamfi, S., Atta-Darkwa, T., Kumi, E. N., & Maia, C. M. B. de F. (2018). The potential of a dual purpose improved cookstove for low income earners in Ghana – Improved cooking methods and biochar production. *Renewable and Sustainable Energy Reviews*, *82*(May 2017), 369–379

Ali, J., & Khan, W. (2020). *Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID- 19 . The COVID-19 resource centre is hosted on Elsevier Connect , the company ' s public news and information . January*.

Ali, S. M., Appolloni, A., Cavallaro, F., D'Adamo, I., Di Vaio, A., Ferella, F., Gastaldi, M., Ikram, M., Kumar, N. M., Martin, M. A., Nizami, A. S., Ozturk, I., Riccardi, M. P., Rosa, P., Santibanez Gonzalez, E., Sassanelli, C., Settembre-Blundo, D., Singh, R. K., Smol, M., … Zorpas, A. A. (2023). Development Goals towards Sustainability. *Sustainability (Switzerland)*, *15*(12).

Angoori, S., & Kumar, S. (2023). Perceived benefits of modern cooking technologies: a study of beneficiaries of Pradhan Mantri Ujjwala Yojana. *Technological Sustainability*, *2*(3), 274–294.

Aziz, S., Barua, S., & Chowdhury, S. A. (2022). Cooking energy use in Bangladesh: Evidence from technology and fuel choice. *Energy*, *250*, 123696.

Baker, P., Machado, P., Santos, T., Sievert, K., Backholer, K., Hadjikakou, M., Russell, C., Huse, O., Bell, C., Scrinis, G., Worsley, A., Friel, S., & Lawrence, M. (2020). Ultra-processed foods and the nutrition transition: Global, regional and national trends, food systems transformations and political economy drivers. *Obesity Reviews*, *21*(12), 1–22.

Bandyopadhyay, A. G. and K. R. (2017). *Exploring the nature of rural energy transition in India Insights from case studies of eight villages in Bihar*. https://doi.org/10.1108/IJESM-11-2016-0001

Barua, S. K. (2018). *Lighting up Lives through Cooking Gas and transforming society Lighting up Lives through Cooking Gas*.

Bhattacherjee, A. (2001). Understandinignformatiosnystems Continuancea: An Expectation-Confirmatiom Model. *MIS Quarterly, 25*(3), 351–370.

Biratu, A. A. (2016). *The Implication of Wood-Burning Stove Efficiency for Environment , Health and CO2 emissions in the Jogo- gudedo Watershed , Ethiopia*. *4*(July), 154–163.

Blight, K. J. (2015). Public Health Ethics: Cases Spanning the Globe. In *Public Health Ethics: Cases Spanning the Globe* (Vol. 30).

CAETS. (2022). *Towards Low-GHG Emissions from Energy use in Selected Sectors (2022*

Energy Report). 8 &10. http://www.newcaets.org

Chen, A., & Peng, N. (2018). Examining consumers' intentions to dine at luxury restaurants while traveling. *International Journal of Hospitality Management*, *71*, 59–67.

Cheung, G. W., Cooper-Thomas, H. D., Lau, R. S., & Wang, L. C. (2024). Reporting reliability, convergent and discriminant validity with structural equation modeling: A review and best-practice recommendations. In *Asia Pacific Journal of Management* (Vol. 41, Issue 2). Springer US.

Chou, S. W., Min, H. T., Chang, Y. C., & Lin, C. T. (2010). Understanding continuance intention of knowledge creation using extended expectation-confirmation theory: An empirical study of Taiwan and China online communities. *Behaviour and Information Technology*, *29*(6), 557–570.

Clean Cooking Alliance. (2022). *2022 Clean Cooking Industry Snapshot*. 1–23. https://www.readkong.com/page/2021%0A-clean-cooking-industry-snapshot-second-edition-4177518

Cohen, J. (1988). Statistical Power Analysis for the Behavioral Sciences. In *The SAGE Encyclopedia of Research Design* (2nd ed.). LAWRENCE ERLBAUM ASSOCIATES.

Dan, K., Instrumen, K., Latihan, P., & Pendidikan, G. (2020). Validity and Reliability of Evaluation Instrument on Islamic Education Teachers' Training Based on I-Cvi and Efa. *Islamiyyat*, *42*(1), 123–134.

Elasu, J., Ntayi, J. M., Adaramola, M. S., Buyinza, F., Ngoma, M., & Atukunda, R. (2023). Gender role differentiation in household fuel transition decision-making: Implications for education and training in Uganda. *Frontiers in Sustainability*, *4*.

Erikson, S. (2019). Faking global health. *Critical Public Health*, *29*(4), 508–516.

Field, A. (2009). *Discovering statistics using SpS* (3rd ed.). SAGE.

Frostad, J. J., Nguyen, Q. A. P., Baumann, M. M., Blacker, B. F., Marczak, L. B., Deshpande, A., Wiens, K. E., LeGrand, K. E., Johnson, K. B., Abbasi-Kangevari, M., Abdoli, A., Abolhassani, H., Abreu, L. G., Abrigo, M. R. M., Abu-Rmeileh, N. M. E., Adekanmbi, V., Agrawal, A., Ahmed, M. B., Al-Aly, Z., … Reiner, R. C. (2022). Mapping development and health effects of cooking with solid fuels in low-income and middle-income countries, 2000–18: a geospatial modelling study. *The Lancet Global Health*, *10*(10), e1395–e1411.

Gebreegziabher, Z., Beyene, A. D., Bluffstone, R., Martinsson, P., Mekonnen, A., & Toman, M. A. (2018). Fuel savings, cooking time and user satisfaction with improved biomass cookstoves: Evidence from controlled cooking tests in Ethiopia. *Resource and Energy Economics*, *52*, 173–185.

Govinda R. Timilsinaa and Sunil Mallab. (2021). *Clean Cooking : Why is Adoption Slow Despite Large Health and Environmental Benefits ? 10*(1), 2021.

Green Climate Fund. (2013). *Final Interim Report I Ndependent E Valuation of the C Limate I Nvestment F Unds* (Vol. 86, Issue July).

Gu, J., Renwick, N., & Xue, L. (2018). The BRICS and Africa's search for green growth, clean energy and sustainable development. *Energy Policy*, *120*(May), 675–683.

Hainsch, K., Löffler, K., Burandt, T., Auer, H., Crespo del Granado, P., Pisciella, P., & Zwickl-Bernhard, S. (2022). Energy transition scenarios: What policies, societal attitudes, and technology developments will realize the EU Green Deal? *Energy*, *239*.

Hair, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, *109*(August

2019), 101–110.

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2013). Partial Least Squares Structural Equation Modeling: Rigorous Applications, Better Results and Higher Acceptance. *Long Range Planning*, *46*(1–2), 1–12.

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115–135.

House, A., & Road, P. (2023). *Floor, Amber House, Pilkington Road, P.O. Box 7270, Kampala, Uganda, Tel: +256 417104100, email;* (Vol. 3, Issue 1).

Hu, Z. (2020). When energy justice encounters authoritarian environmentalism: The case of clean heating energy transitions in rural China. *Energy Research and Social Science*, *70*(August), 101771.

Jeuland, M. A., & Pattanayak, S. K. (2012). Benefits and costs of improved cookstoves: Assessing the implications of variability in health, forest and climate impacts. *PLoS ONE*, *7*(2).

Jeuland, M., Babyenda, P., Beyene, A., Hinju, G., Mulwa, R., & Zewdie, S. A. (2022). *Preprint not peer rev*.

Jeuland, M., Tan Soo, J. S., & Shindell, D. (2018). The need for policies to reduce the costs of cleaner cooking in low income settings: Implications from systematic analysis of costs and benefits. *Energy Policy*, *121*(July), 275–285.

Jewitt, S., Atagher, P., & Clifford, M. (2020). "We cannot stop cooking": Stove stacking, seasonality and the risky practices of household cookstove transitions in Nigeria. *Energy Research and Social Science*, *61*(May 2019), 101340.

Jewitt, S., Smallman-Raynor, M., K C, B., Robinson, B., Adhikari, P., Evans, C., Karmacharya, B. M., Bolton, C. E., & Hall, I. P. (2022). Domesticating cleaner cookstoves for improved respiratory health: Using approaches from the sanitation sector to explore the adoption and sustained use of improved cooking technologies in Nepal. *Social Science and Medicine*, *308*(July), 115201.

Jiang, J. J., & Klein, G. (2019). Expectation-Confirmation Theory : Capitalizing on Descriptive Power. *IGI Global*, 384–386.

Karanja, A., & Gasparatos, A. (2019). Adoption and impacts of clean bioenergy cookstoves in Kenya. *Renewable and Sustainable Energy Reviews*, *102*(June 2018), 285–306.

Katoch, O. R., Sharma, R., Parihar, S., & Nawaz, A. (2023). Energy poverty and its impacts on health and education: a systematic review. *International Journal of Energy Sector Management*, *April*. https://doi.org/10.1108/IJESM-10-2022-0007

Katutsi, V. P., Kaberuka, W., Ngoma, M., Yawe, B. L., Atukunda, R., & Turyareba, D. (2023). From smoke to sustainability: the role of socioeconomic factors in the continuous use of clean cooking technologies in Uganda. *Technological Sustainability*, *2*(4), 404–422.

Katutsi, V. P., Kaberuka, W., & Yawe, B. L. (2023). *Unlocking sustained use of clean cooking technologies in Uganda : the in fl uence of technology-speci fi c attributes*.

Kock, N., & Hadaya, P. (2018). Minimum sample size estimation in PLS-SEM: The inverse square root and gamma-exponential methods. *Information Systems Journal*, *28*(1), 227–261.

Krejcie, & Morgan, V. (1970). (1970) "Determining sample Size for Research Activities", Educational and Psychological Measurement. *International Journal of Employment Studies*, *18*(1), 89–123.

Kuhe, A., & Bisu, D. Y. (2020). Influence of situational factors on household's energy consumption behaviour: Towards an effective energy policy. *International Journal of Energy Sector Management*, *14*(2), 389–407.

Lanza, M. F., Leonard, A., & Hirmer, S. (2024). Geospatial and socioeconomic prediction of value-driven clean cooking uptake. *Renewable and Sustainable Energy Reviews*, *192*(March 2023), 114199.

Lewis, J. R., & Hf, S. (2018). Comparison of Item Formats: Agreement vs. Item-Specific Endpoints. *Journal of Usability Studies*, *14*(1), 48–60.

Lietaer, S., Zaccai, E., & Verbist, B. (2019). Making cooking champions: Perceptions of local actors on private sector development in Uganda. *Environmental Development*, *32*(August 2018), 0–1.

Martínez, J., Martí-Herrero, J., Villacís, S., Riofrio, A. J., & Vaca, D. (2017). Analysis of energy, CO2 emissions and economy of the technological migration for clean cooking in Ecuador. *Energy Policy*, *107*(April), 182–187.

Mehetre, S. A., Panwar, N. L., Sharma, D., & Kumar, H. (2017). Improved biomass cookstoves for sustainable development: A review. *Renewable and Sustainable Energy Reviews*, *73*(September 2015), 672–687.

Modern Energy Cooking Services , 2022). (2022). *Clean and modern energy for cooking* (Issue May).

Mohammed, S., Gill, A. R., Ghosal, K., Al-Dalahmeh, M., Alsafadi, K., Szabó, S., Oláh, J., Alkerdi, A., Ocwa, A., & Harsanyi, E. (2024). Assessment of the environmental kuznets curve within EU-27: Steps toward environmental sustainability (1990–2019). *Environmental Science and Ecotechnology*, *18*.

Mombeuil, C. (2020). Institutional conditions, sustainable energy, and the UN sustainable development discourse: A focus on Haiti. *Journal of Cleaner Production*, *254*, 120153.

Moyer, J. D., & Hedden, S. (2020). Are we on the right path to achieve the sustainable development goals? *World Development*, *127*, 104749.

Nabukwangwa, W., Clayton, S., Mwitari, J., Gohole, A., Muchiri, E., Pope, D., & Puzzolo, E. (2023). Energy for Sustainable Development Adoption of innovative energy efficiency pots to enhance sustained use of clean cooking with gas in resource-poor households in Kenya : Perceptions from participants of a randomized controlled trial. *Energy for Sustainable Development*, *72*(January), 243–251.

Nakanwagi, S. (2021). *Increasing Uptake of Liquefied Petroleum Gas in Uganda : Lessons from Morocco Susan Nakanwagi*. *October*, 1–38.

Naluwagga, A., Abbo, M. S., & Tesfamichael, M. (2022). *Uganda ' s cooking energy sector : A Review*. *May*.

Namagembe, A., Muller, N., Scott, L. M., Zwisler, G., Johnson, M., Arney, J., Charron, D., & Mugisha, E. (2015). *Factors Influencing the Acquisition and Correct and Consistent Use of the Top-Lit Updraft Cookstove in Uganda*. 76–83.

National Plannning Authority. (2020). Third National Development Plan (NDPIII) 2020/21-2024/25. *Uganda Vision 2040*, *Third*, 341.

Newell, P., & Daley, F. (2021). *Cooking up an electric revolution A briefing paper for comment*. www.mecs.org.uk

Nyandiko, N. O. (2020). Devolution and disaster risk reduction in Kenya: Progress, challenges and opportunities. *International Journal of Disaster Risk Reduction*, *51*(September),

Obadă, D. R., Dabija, D. C., & Fârte, G. I. (2024). Consumer perception towards electronic products from recycled components in the current geopolitical context: A structural

equation modelling approach. *Heliyon*, *10*(4).
Oliver, R. . L. (1980). A Cognitive Model of the Antecedents and Consequences of Satisfaction Decisions. *Journal of Marketing Research*, *17(4)*(November), 460–469.
Oliver, R. L. (2014). *A Behavioral Perspective on the Consumer Second Edition Richard L Oliver* (2nd ed.). JW.E.Sharpe.
Oliver, R. L., & DeSarbo, W. S. (1988). Response Determinants in Satisfaction Judgments. *Journal of Consumer Research*, *14*(4), 495.
Orejon-Sanchez, R. D., Crespo-Garcia, D., Andres-Diaz, J. R., & Gago-Calderon, A. (2022). Smart cities' development in Spain: A comparison of technical and social indicators with reference to European cities. *Sustainable Cities and Society*, *81*(February 2021), 103828.
Ortiz-Sanchez, M., Cardona Alzate, C. A., & Solarte-Toro, J. C. (2024). Orange Peel Waste as a Source of Bioactive Compounds and Valuable Products: Insights Based on Chemical Composition and Biorefining. *Biomass (Switzerland)*, *4*(1), 107–131.
Pakravan, M. H., & MacCarty, N. (2020). What motivates behavior change? analyzing user intentions to adopt clean technologies in low-resource settings using the theory of planned behavior. *Energies*, *13*(11).
Pangaribowo, E. H., & Iskandar, D. D. (2023). Exploring socio-economic determinants of energy choices for cooking: the case of eastern Indonesian households. *Environment, Development and Sustainability*, *25*(7), 7135–7148.
Paris, J. M. G., Falkenberg, T., Nöthlings, U., Heinzel, C., Borgemeister, C., & Escobar, N. (2022). Changing dietary patterns is necessary to improve the sustainability of Western diets from a One Health perspective. *Science of the Total Environment*, *811*.
Pascual, L. S., Segarra-Medina, C., Gómez-Cadenas, A., López-Climent, M. F., Vives-Peris, V., & Zandalinas, S. I. (2022). Climate change-associated multifactorial stress combination: A present challenge for our ecosystems. *Journal of Plant Physiology*, *276*(2022).
Pereira, D. S., & Marques, A. C. (2023). Are dynamic tariffs effective in reducing energy poverty? Empirical evidence from US households. *Energy*, *282*(August 2022).
Petreson, R. A. (1994). A Meta-analysis of Cronbach's Coefficient Alpha. *Journal of Consumer Research*, *21*(9), 381–391.
Puzzolo, E., Zerriffi, H., Carter, E., Clemens, H., Stokes, H., Jagger, P., Rosenthal, J., & Petach, H. (2019). Supply Considerations for Scaling Up Clean Cooking Fuels for Household Energy in Low- and Middle-Income Countries. *GeoHealth*, *3*(12), 370–390.
Qu, Y., Yang, B., Lin, S., Bloom, M. S., Nie, Z., Ou, Y., Mai, J., Wu, Y., Gao, X., Dong, G., & Liu, X. (2020). Associations of greenness with gestational diabetes mellitus: The Guangdong Registry of Congenital Heart Disease (GRCHD) study. *Environmental Pollution*, *266*, 115127.
Ramos-González, M. D. M., Rubio-Andrés, M., & Sastre-Castillo, M. Á. (2022). Effects of socially responsible human resource management (SR-HRM) on innovation and reputation in entrepreneurial SMEs. *International Entrepreneurship and Management Journal*, *18*(3), 1205-1233.
Redonda, A. (2016). Tax expenditures and sustainability: an overview. *Discussion Notes, Council on Economic Policies*, *November*, 1–60.
Richter, N. F., & Tudoran, A. A. (2024). Elevating theoretical insight and predictive accuracy in business research: Combining PLS-SEM and selected machine learning algorithms. *Journal of Business Research*, *173*(November 2023), 114453.
Ringle, C. M., Sarstedt, M., Sinkovics, N., & Sinkovics, R. R. (2023). A perspective on using

partial least squares structural equation modelling in data articles. *Data in Brief*, *48*.

Rosenthal, J., Quinn, A., Grieshop, A. P., Pillarisetti, A., & Glass, R. I. (2018). Energy for Sustainable Development Clean cooking and the SDGs : Integrated analytical approaches to guide energy interventions for health and environment goals ☆ , ☆☆. *Energy for Sustainable Development*, *42*, 152–159.

Rossitto, N. (2021). *Green Bonds: an alternative source of financing in the Era of Climate Change*. *852523*, 134.

Roy, B. K., & Pagaldiviti, S. R. (2023). Advancements in arena technology: Enhancing customer experience and employee adaptation in the tourism and hospitality industry. *Smart Tourism*, *4*(1), 1–14.

Samadhiya, A., Agrawal, R., Kumar, A., & Garza-Reyes, J. A. (2023). Regenerating the logistics industry through the Physical Internet Paradigm: A systematic literature review and future research orchestration. *Computers and Industrial Engineering*, *178*(March), 109150.

Shankar, A., Johnson, M., Kay, E., Pannu, R., Beltramo, T., Derby, E., Harrell, S., Davis, C., & Petach, H. (2014). Maximizing the benefits of improved cookstoves: Moving from acquisition to correct and consistent use. *Global Health Science and Practice*, *2*(3), 268–274.

Shankar, A. V., Quinn, A. K., Dickinson, K. L., Williams, K. N., Masera, O., Charron, D., Jack, D., Hyman, J., Pillarisetti, A., Bailis, R., Kumar, P., Ruiz-Mercado, I., & Rosenthal, J. P. (2020). Everybody stacks: Lessons from household energy case studies to inform design principles for clean energy transitions. *Energy Policy*, *141*(March), 111468.

Sharma, S., Kundu, A., Basu, S., Shetti, N. P., & Aminabhavi, T. M. (2020). Sustainable environmental management and related biofuel technologies. *Journal of Environmental Management*, *273*(July), 111096.

Silva, G. M., Dias, Á., & Rodrigues, M. S. (2022). Continuity of Use of Food Delivery Apps: An Integrated Approach to the Health Belief Model and the Technology Readiness and Acceptance Model. *Journal of Open Innovation: Technology, Market, and Complexity*, *8*(3).

Simkovich, S. M., Williams, K. N., Pollard, S., Dowdy, D., Sinharoy, S., Clasen, T. F., Puzzolo, E., & Checkley, W. (2019). A systematic review to evaluate the association between clean cooking technologies and time use in low- and middle-income countries. *International Journal of Environmental Research and Public Health*, *16*(13), 1–16.

Sukhova, E., Zolin, Y., Popova, A., Yudina, L., & Sukhov, V. (2023). The Influence of Soil Salt Stress on Modified Photochemical Reflectance Indices in Pea Plants. *Remote Sensing*, *15*(15).

Sun, H. Z., Tang, H., Fang, J., Dai, H., Zhao, H., Xu, S., Xiang, Q., Tian, Y., Jiao, Y., Luo, T., Huang, M., Shu, J., Zang, L., Liu, H., Guo, Y., Xu, W., & Bai, X. (2024). A Chinese longitudinal maternity cohort study (2013–2021) on intrahepatic cholestasis phenotypes: Risk associations from environmental exposure to adverse pregnancy outcomes. *Journal of Hazardous Materials*, *463*(November 2023).

Torino, P. D. I. (2023). *Master ' s Degree in Energy and Nuclear Engineering development through the implementation of Candidate Agnese Branca*. *March*.

UBOS. (2020). *Uganda Bureau of Statistics Towards Ecosystem Accounts*. *October*.

UNACC. (2019). Policy Brief Policy Brief. In *Pancanaka* (Vol. 1, Issue September).

UNDP. (2016). *Nationally Appropriate Mitigation Action on Integrated Sustainable Energy*.

Vassiliades, A., Flouris, G., Patkos, T., Bikakis, A., Bassiliades, N., & Plexousakis, D. (2023). Argumentation Frameworks with Attack Classification. *Journal of Logic and Computation*, *33*(2), 192–229.

Ven, D. Van De, & Sampedro, J. (2017). *The cost of cooking a meal . The case of Nyeri The cost of cooking a meal . The case of Nyeri County , Kenya*.

Visconti, L. M., Minowa, Y., & Maclaran, P. (2014). Public Markets: An Ecological Perspective on Sustainability as a Megatrend. *Journal of Macromarketing*, *34*(3), 349–368.

Wang, C., Cong, J., Wang, K., Qi, Y., Cai, W., Li, Y., Fu, S., Wang, W., Wei, Y., Zheng, X., Jiang, J., Chen, M., Liu, W., Zhang, Y., Tian, Z., Chen, J., Li, R., & Zuo, H. (2021). Research on China's technology lists for addressing climate change. *Chinese Journal of Population Resources and Environment*, *19*(2), 151–161.

Wang, J., Liu, X., Li, Y., Powell, T., Wang, X., Wang, G., & Zhang, P. (2019). Microplastics as contaminants in the soil environment: A mini-review. *Science of the Total Environment*, *691*, 848–857.

Winrock, I. (2017). *Clean and efficient cooking technologies and fuels*. *September*.

Wolverton, C. C., Hirschheim, R., Black, W. C., & Burleson, J. (2019). Outsourcing Success in the Eye of the Beholder: Examining the Impact of Expectation Confirmation Theory on IT Outsourcing Colleen. *Information & Management*, 103236.

Yadav, N., & Pallissery, F. (2023). International investments and environmental protection in India - Policy and implementation gaps in mitigating the carbon footprints. *Global Transitions*, *5*, 217–224.

Yorke, F. O., & S, O. Y. (2024). A systematic review and bibliometric analysis of electric cooking : evolution , emerging trends , and future research directions for sustainable development. *Sustainable Energy Research*.

Yunusa, S. U., Mensah, E., Preko, K., Narra, S., Saleh, A., Sanfo, S., Isiaka, M., Dalha, I. B., & Abdulsalam, M. (2023). Biomass cookstoves: A review of technical aspects and recent advances. *Energy Nexus*, *11*(March), 100225.

Zanetta, L. D. A., Hakim, M. P., Gastaldi, G. B., Seabra, L. M. A. J., Rolim, P. M., Nascimento, L. G. P., Medeiros, C. O., & da Cunha, D. T. (2021). The use of food delivery apps during the COVID-19 pandemic in Brazil: The role of solidarity, perceived risk, and regional aspects. *Food Research International*, *149*(April).

Zhao, Q., Yu, P., Mahendran, R., Huang, W., Gao, Y., Yang, Z., Ye, T., Wen, B., Wu, Y., Li, S., & Guo, Y. (2022). Global climate change and human health: Pathways and possible solutions. *Eco-Environment and Health*, *1*(2), 53–62.

Zhuang, T. (2017). *Stakeholders ' Expectations in Urban Renewal Projects in China : A Key Step towards Sustainability*.