



Environmental consciousness and household energy poverty in Ghana

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ABSTRACT

The energy poverty literature has identified numerous factors that influence the phenomenon. However, only a limited number of studies examine the role of environmental consciousness, especially in the case of cooking fuel. This variable might be essential due to the close association of energy poverty with environmental quality to aid the overall environmental sustainability discourse. This study investigates the level of environmental consciousness and its impact on household cooking energy decisions using survey data from more than 1200 households in Ghana. The study employs an instrumental variable estimation approach to investigate the impact of environmental consciousness on energy poverty. The study finds that being environmentally conscious positively affects cleaner cooking fuel choices, and thus, such households are less inclined to be energy poor.

Furthermore, it was discovered that awareness of global environmental issues has a more substantial effect on household energy poverty.

Further robustness analysis confirms the findings. The study has implications for reducing energy poverty. A nationwide awareness campaign of contemporary, global environmental concerns is recommended to make people more environmentally conscious, reduce energy poverty, and accelerate the transition to cleaner cooking energy.

1. Introduction

Energy and environmental sustainability issues have recently moved to the front burner of empirical research and policy discussions. Sustainable resource use and climate concerns have prompted policies and programs to reduce over-reliance on traditional energy sources such as firewood and charcoal and to aid households' transition to cleaner energy sources such as electricity and LPG for cooking. Evidence of cleaner cooking interventions exists in developing countries such as Ghana, Peru, and Indonesia, among others, while there is growing literature on the effectiveness of such programs and the determinants of fuel choice and clean energy (Kwakwa et al., 2021; Adjei-Mantey et al., 2021; Imelda, 2020). Energy poverty has been described as lacking access to modern energy services which manifests either through non-electrification to one's home or a reliance on solid fuels such as wood or charcoal for cooking (Simcock, 2020). Thus, households that rely on traditional energy sources, primarily heavily polluting, are considered energy poor. In addition to being energy poor, using these traditional and heavily polluting fuels have negative implications for their health as

well as the health of the environment (Bede-Ojima and Orisakwe, 2020; Sola et al., 2017).

Concerns about the environment, its sustainability, climate change and its effects are at the core of some of the Sustainable Development Goals (SDGs), particularly goals 3, 7, and 13, which focus on good health and well-being, clean and affordable energy, and climate action, respectively. Especially in developing economies, clean energy access is critical to achieving the SDGs making energy and the environment crucial development policy targets. While it is necessary to alleviate energy poverty, it might be challenging for policy actions to sufficiently address the situation and ensure rapid household adoption of clean fuels. This is because energy poverty results from several contributing factors making it a multi-faceted problem. Access to cleaner fuels or the lack of it, the ability to pay for cleaner fuels, and an awareness of the environmental and health implications of different fuel choices all contribute to the prevalence of energy poverty in developing countries. Empirical research has investigated factors that address issues of access and affordability and showed that socioeconomic characteristics such as income and education and clean energy supply infrastructure influence

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the adoption of clean cooking fuels. (Karimu et al., 2016; Adjei-Mantey and Takeuchi, 2022). There is also evidence that clean cooking interventions which improve access positively impact the adoption of clean fuel (Calzada and Sanz, 2018; Adjei-Mantey et al., 2021). These factors might be able to deal with issues of access and affordability but not necessarily, the point of awareness of the adverse effects of heavily polluting fuels. Because using heavily-polluting wood fuels impacts the environment negatively, an awareness of the adverse impact of such choices on the environment in particular and a general consciousness of the environment and issues about it might influence households against the choice of heavily polluting wood fuels. However, research on this angle has been missing from previous studies, so this study focuses on the impact of environmental awareness on energy poverty in Ghana.

Kollmuss and Agyeman (2002) explained environmental consciousness as knowing the impact of human actions on the environment. Zelezny and Schultz (2000) related environmental consciousness to human tendencies to engage in pro-environmental behaviour. In a nutshell, environmental consciousness may be explained as having a sense of awareness about the natural environment, the issues plaguing it and having concern for its sustainability. It is in this context that this study uses the term environmental consciousness. It has been suggested that in many developing countries, such as Ghana, the environmental consciousness or awareness level is relatively low (Amoah and Addoah, 2021). Households naturally place more emphasis on their primary needs of food, clothing, shelter, and health care. They are therefore more likely to channel their energies into obtaining these basic needs rather than taking actions that protect the environment, significantly if such actions limit their ability to afford them. In other words, there is low environmental consciousness and environmental care among households in developing countries primarily due to insufficient access to basic needs, which they consider more crucial to survival than the environment's health. However, suppose households have sufficient knowledge about the environment and the effects of human activities on the sustainability of the environment, being rational. In that case, they might make choices that will protect the environment. However, there is little empirical evidence from previous literature to prove this.

Many previous studies that examine access to clean energy have investigated the role of own socioeconomic characteristics such as income and education (Karimu et al., 2016; Pope et al., 2018; Mensah and Adu, 2015); or access to policy interventions (Troconso and da Silva, 2017; Calzada and Sanz, 2018; Adjei-Mantey et al., 2021). However, a shortage of studies focuses on the role of environmental consciousness. Studies such as Amoah et al. (2018) focused on using energy-efficient light bulbs as a response variable where they observed if adopting energy-efficient light bulbs for lighting as opposed to energy-inefficient alternatives had anything to do with an awareness about the environment. In the area of cooking, however, there is a scarcity of studies examining the relationship between these variables.

This study aims to examine the level of environmental consciousness in Ghana and to investigate the impact of environmental consciousness on household cooking energy decisions. This study seeks to gauge environmental consciousness and examine the relationship between environmental awareness and household energy poverty.¹ The novelty of this study lies primarily in the attempt to investigate the extent to which knowledge of the environment is associated with household cooking energy choices, as this variable has not yet been studied in the energy poverty literature and, more so, in Ghana. This is important to investigate within the context of the prevalence of energy poverty in countries such as Ghana. Furthermore, this study relies on a unique dataset of over 1200 households spread across different parts of the country. Data on environmental consciousness, particularly in developing countries, including Ghana, has been almost non-existent. Thus,

¹ Energy Poverty in this study is restricted to the cooking energy dimension of energy poverty.

this dataset containing this unique variable contributes to the environmental consciousness literature in the quest to achieve sustainable development.

2. Literature review

A few studies exist on the relationship between environmental consciousness and pro-environmental behaviour; which might include making choices that have implications for energy poverty, with most focusing on countries outside Africa. They include Li et al. (2021), who investigated the nexus between environmental awareness and pro-environmental behaviour in China. Utilizing household-level data and ordinary least squares (OLS) and probit regressions, the study found that awareness has a significant effect on pro-environmental behaviour and partly affects energy consumption even though, on its own, awareness alone is not enough to induce reductions in energy consumption. The findings confirm an earlier study by Kikuchi-Uehara et al. (2016) on the effect of environmental awareness on product choice in Japan. Their findings in Japan showed that differences in preference between products with an ecolabel and those without it reduced with decreased awareness, suggesting that improving environmental awareness could yield better environmentally friendly choices. While the focus of the study by Kikuchi-Uehara et al. (2016) was not energy consumption directly but rather environmentally friendly products evidenced by an ecolabel, the study points to the likelihood for people to engage in making environmentally friendly decisions in product choices which includes cleaner energy, if they have a good sense of environmental awareness. Jaciow et al. (2022) examined the effect of environmental awareness on responsible energy consumption in Poland. The findings confirmed the effect of environmental awareness on energy efficiency behaviour; the more significant the environmental awareness level, the greater the likelihood of consuming energy efficiently and responsibly. This is in agreement with findings from Japan and China explored earlier.

In Ghana, Amoah et al. (2018) ascertained whether households' level of awareness of the environment influenced their decision to use Compact Fluorescent Lamps (CFL) bulbs. The authors measured environmental consciousness by disaggregating it into domestic knowledge and international knowledge of the environment. The former was proxied with domestic environmental issues, and the latter with knowledge of climate change. The study sampled 1650 respondents from the Greater Accra Region of Ghana, which is predominantly urban. Employing a probit regression model, the results revealed that environmental consciousness has a positive and statistically significant role in explaining changes in the choice of light bulbs. The study found that increasing individuals' environmental awareness through education could result in individuals making energy-conserving decisions, such as choosing CFL light bulbs over incandescent bulbs. The study further affirmed the role of socioeconomic features such as households' income and education levels in influencing energy behaviour positively. This effect of socioeconomic characteristics confirmed the findings of Paço and Varejao (2010), who argued that individuals with higher income levels are more encouraged to buy green products. Amoah and Addoah (2021) examined whether environmental awareness impacts on pro-environmental behaviour of households in urban Ghana using a cross-sectional dataset of households in Ghana's capital, Accra. The authors measured environmental knowledge as a dummy variable, which took a value of 1 if respondents knew the environment either locally or internationally and 0 if they did not know the environment locally or internationally. The study employed the logit regression model and found that households with knowledge of the environment have a positive and significant relationship with promoting sound environmental practices. On demographics, the study observed that age had a positive but insignificant effect on good environmental behaviour. This contradicts Mensah and Dei Mensah (2013), who found that older people were more likely to behave in environmentally friendly ways. The findings further

revealed a positive link between income and sound environmental practices and between larger household sizes and good environmental practices. However, contrary to Amoah et al. (2018), the level of education was found to have insignificant effects on good environmental or pro-environmental behaviour. The role of income in pro-environmental behaviour, as observed from the literature on Ghana, lends credence to the earlier claim that households might tend to pay less attention to the care of the environment if they struggle to meet their basic needs of food, clothing, and shelter, significantly if actions that care for the environment limit their abilities to meet their basic needs.

Azadeh et al. (2015) ascertained the influence of environmental consciousness on the electricity consumption of households in Iran. The study employed the ANOVA technique and found that environmental consciousness does not significantly affect electricity consumption. Rosak-Szyrocka and Żywiołek (2022) conducted a qualitative survey to ascertain the extent of household energy awareness in Poland. The study sampled 1097 respondents and found that respondents have knowledge of how to conserve energy but are not fully aware of the consequences of neglecting aspects of preserving or wasting energy. The authors argued that to reduce energy consumption, it is essential to undertake educational activities that not only build awareness but also make people aware of the importance of creating good environmental practices. A relevant point of note is that the studies of Azadeh et al. (2015) and Szyrocka and Żywiołek (2022) examined the quantity of electricity and energy used, respectively, in relation to environmental consciousness rather than the choice of a particular energy type over an alternative, while the current study investigates the relationship between environmental consciousness and the choice of cleaner fuels over traditional options or vice versa. This distinction assumes an essential role within the developing country context since, in developing countries, multiple clean alternatives might be non-existent, or the quantity of clean fuel available might be insufficient, as pointed out by Adjei-Mantey and Takeuchi (2023), and the only alternative to cleaner energy sources for households might be dirty fuels.

Bawakyillenuo and Agbelie (2021) sought to ascertain the extent to which business owners in Ghana are environmentally conscious, as well as the characteristics that influence the environmental consciousness of entrepreneurs in Ghana. The authors argued that consumers are increasingly becoming more sensitive and selective in what they consume or purchase. The authors further argued that this change in consumers' attitudes should motivate entrepreneurs to produce goods and services that are more friendly to the environment. The study used the 2013 Global Entrepreneurship Monitor (GEM) survey data and analyzed the data using the logistic regression model. Among the study's key findings is that entrepreneurs were generally less concerned about the environment, thus emphasizing the need to promote green entrepreneurship in Ghana. This was not unexpected as the constituents of this group of respondents, i.e., entrepreneurs, are essentially the same persons who make up households and were found to have a low level of environmental consciousness by Amoah and Addoah (2021). The results revealed that female business owners are more conscious of the domain. The study recommended that education is key as it was found to enhance environmental consciousness. Efobi et al. (2019) examined the level of adoption of environmental protection policies by small and medium-scale firms in Ghana and Nigeria. The study used the simple random sampling approach to sample 447 and 395 firms in Nigeria and Ghana, respectively, and found that the level of adoption of policies that protect the environment by firms is shallow. The studies of Efobi et al. (2019) and Bawakyillenuo and Agbelie (2021) reinforce each other, showing that attention to the environment among business owners in Ghana is deficient. This reflects the generally low level of environmental consciousness among the populace, including business owners.

Forkuor and Otiaku (2015), contributing to the literature on the extent of environmental consciousness in Ghana, ascertained whether landowners along rivers and streams in Kumasi, Ghana are conscious of the environment. The study was purely qualitative and sampled

respondents using the purposive sampling technique. The study found that despite respondents having adequate knowledge of the importance of water for human life, the level of environmental consciousness was extremely low. The respondents were generally ignorant about the environment and the need to conserve it. This finding is confirmed by the later studies of Efobi et al. (2019), Amoah and Addoah (2021), and Bawakyillenuo and Agbelie (2021) about the generally low level of environmental consciousness in Ghana. Mensah and Dei Mensah (2013) investigated the environmental behaviour of international tourists in Ghana. The study concentrated on a sample of 343 international tourists in Accra. The respondents were chosen using the convenience sampling technique. The results revealed that older tourists had a positive attitude toward the environment. Even though this study was conducted in Ghana, the target group was international tourists and non-Ghanaians. Their finding corroborates those of Vining and Ebreo (1990), who concluded that older people regularly engaged in purchasing decisions that were environmentally friendly. In contrast, Andereck (2008) revealed that younger people valued environmental practices higher. Concerning gender, Laroche et al. (2001) argued that women are more environmentally friendly than men, while Han et al. (2009) also argued that female customers value the environment higher than male customers, a view supported by Bawakyillenuo and Agbelie (2021) among entrepreneurs in Ghana.

In summary, the empirical studies reveal that environmental consciousness in Ghana is generally low, even though there might be heterogeneities concerning age and gender. The literature review also shows that environmental awareness influences pro-environmental behaviour. Broadly, this would include household energy choices. Yet, the review reveals a gap in the literature on environmental awareness and energy poverty; the role of environmental awareness in household cooking energy decisions remains understudied, neither in Ghana nor elsewhere. This makes the current study a valuable addition to the literature. While the review points to the potential for environmental consciousness to influence good environmental practices, which might include choosing cleaner energy instead of heavily polluting alternatives, the empirical evidence to support the same, particularly in the case of cooking fuels for households, is nonexistent. The current study fills this gap.

3. Research methodology

3.1. Theoretical and conceptual framework

Theoretically, household consumption choices, such as the choice of cooking fuel, can be explained by behavioural economics theories. The concept of bounded rationality suggests that households do not have adequate information-gathering and information-processing capabilities to make the most rational choices and, therefore, will shorten their decision-making process by opting for choices that exceed their acceptability threshold – a certain minimum expectation level (Simon, 1987; Angner and Loewenstein, 2012). In other words, households will choose a good if the good, per their knowledge, can meet a minimum accepted performance threshold, no matter how limited. This points to the potential role that awareness or information plays in the choices of households and provides a theoretical foundation for linking environmental awareness and energy choice in this study.

We hypothesize that high environmental awareness or knowledge implies that households are conscious of the environment and the adverse effects of human actions on the environment. As a result, they take positive actions that favour the environment instead of negative actions that are likely to harm the environment. Thus, households conscious of the environment will adopt cleaner cooking fuels. On the other hand, households with low environmental awareness or knowledge are less likely to make clean cooking fuel choices. They would likely stick with traditional and heavily polluting fuels. In keeping with previous studies in this area, such as Amoah et al. (2018) and Amoah

and Addoah (2021), this study employs knowledge of global and local environmental concerns as a proxy for environmental consciousness. However, we expand on the previous studies by including wider global and local environmental problems. Fig. 1 displays the conceptual framework for the analysis.

3.2. Data

A household survey across six regions in Ghana – the Greater Accra, Eastern, Bono, Bono East, Northern, and Savannah regions- was conducted to collect primary data on households’ environmental consciousness, energy use, and other household variables. Over 1,200 households were sampled from the six regions. The survey was conducted using computer-aided personal interviewing (CAPI). A structured questionnaire with closed-ended questions was administered via face-to-face interviews. Enumerators used an electronic device for the household interviews and entered responses directly onto the device. This ensured that the data was readily captured after each interview without needing a separate exercise to code responses after the survey. Using the CAPI also helped project supervisors effectively monitor the fieldwork to ensure completeness and adherence to standards in the interviewing process. Before the primary survey, enumerators were trained on the instrument and standard interview practices. After this, a pre-testing survey was carried out in selected sampled areas. The pre-tests allowed enumerators to get familiar with the questionnaire and test the clarity and ease of understanding of the questions on the respondents. The pre-test was also used to identify additional variables from the field that should be included in the questionnaire. Feedback from the pre-testing surveys was used to review and improve the questions to ensure they were appropriate and relevant and captured all the data needed for the study.

3.3. Empirical analysis

The study follows a random utility model, which assumes that the choice of a good among different alternatives depends on the utility derived from the good’s consumption, which in turn depends on a set of observable and unobservable features. These features include characteristics of the good and attributes of the consumer. In the case of this study, a household is either energy poor (because of their choice of cooking fuel) or otherwise, based on, among other factors, their level of environmental awareness. Thus, we specify a model that explains energy poverty as follows:

$$Fueltype = \alpha + \beta_1 W_i + \beta_2 X_i + \beta_3 M_j + \epsilon_i \tag{1}$$

Where W is environmental consciousness, measured as an additive index for knowledge of specific global and local environmental issues; X is a vector of individual level control variables; M is a vector of household level control variables; ϵ is the idiosyncratic error term; β s are coefficients to be estimated, and α is the constant. The dependent variable, $Fueltype$ (1- if LPG/electricity is the main cooking fuel for the household, 0- if firewood/charcoal is the main cooking fuel), is determined by the household’s primary cooking fuel and is the indicator for the household’s energy poverty status. Households that use firewood or charcoal are classified as energy poor, whereas households that use cleaner cooking fuels such as Liquefied Petroleum Gas (LPG) or electricity are classified as otherwise.

3.4. Endogeneity issue and the instrumental variable

Environmental consciousness is potentially endogenous. Unobserved factors may influence households’ level of environmental consciousness, thus not making the variable wholly exogenous, thereby confounding the effect of environmental consciousness on the choice of cooking fuel and, consequently, energy poverty. If this is the case, a regression analysis that fails to account for this will render the purported effect of environmental consciousness found from such an analysis inaccurate. To address this problem, we employ an instrumental variable (IV) approach. We use the distance (measured in kilometres, km) between a respondent’s household and the nearest educational institution or school as our instrument for environmental consciousness. Distance to educational institutions has been used in several studies that seek to explore the role of knowledge on some outcome variables (Pokropek, 2016). The idea is that persons who live closer to an educational institution are more likely to benefit from the knowledge on offer by the institution. This is true for both persons who can enrol in the institution and cut down on commuting costs due to proximity but also true for persons who may not necessarily enrol in the institution but might benefit from the institution’s presence in their surroundings. Activities of the institutions such as running public educational campaigns occasionally on matters of public interest within the areas of their location give residents the opportunity to benefit from the institution. In this study, we explore the distance to educational institution as an instrument for the environmental consciousness variable. Furthermore, the instrument is deemed to have no direct effect on the outcome variable, energy poverty, except through the endogenous variable (see: Appendix A), therefore it presumably satisfies the exogeneity condition for a good instrument. Parameters from diagnostic tests conducted through the instrumental variable regression further confirm the validity of the instrument chosen.

Due to the presence of an instrument to estimate the effect of envi-

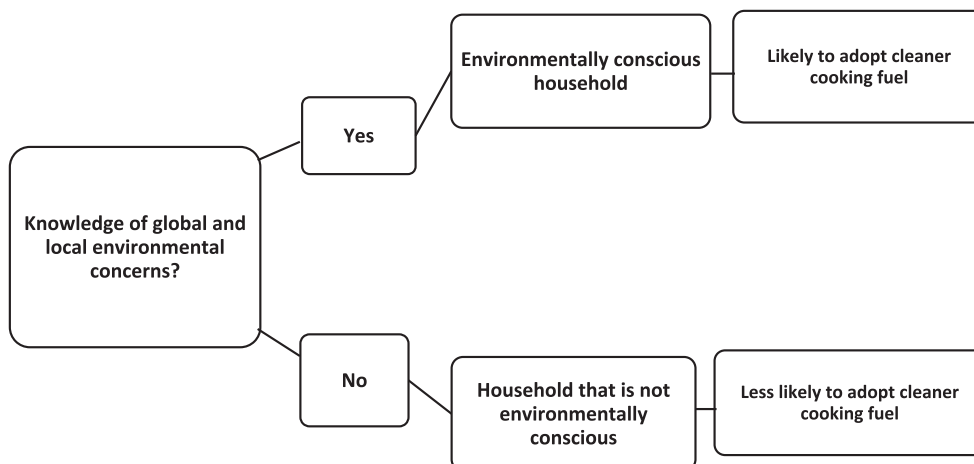


Fig. 1. Conceptual Framework.

ronmental consciousness on energy poverty, we estimate (1) using the approach proposed by Lewbel (2012) that identifies structural parameters in models with endogenous regressors. According to Baum et al. (2013), the approach is useful both in the absence of external instruments and in the presence of external instruments. In the case of the latter, the approach is useful as a way of supplementing external instruments to improve the efficiency of the IV estimator. The Lewbel (2012) approach is a two-stage regression approach that allows for comparing the standard two-stage least squares (2SLS) results with results from generated instruments only, as well as from both generated and external instruments. Equations (2) and (3) show the two models fitted for a two-stage regression approach where D is the instrument – the distance between the place of residence and the nearest educational institution, and X and M are as previously explained. $E\hat{C}_i$ in (3) is the fitted value of environmental consciousness from (2).

$$EnvironmentalConsciousness(EC) = \alpha_0 + \alpha_1 D_i + \alpha_2 X_i + \alpha_3 M_j + \epsilon_i \quad (2)$$

$$Fueltype = \beta_0 + \beta_1 E\hat{C}_i + \beta_2 X_i + \beta_3 M_j + \epsilon_i \quad (3)$$

3.5. Environmental consciousness

The study identifies several global and local environmental concerns and asks respondents about their knowledge. Concerning global environmental issues, the study asks respondents about greenhouse gas emissions/global warming, climate change, the Conference of Parties (COP) meetings and the Kyoto Protocol. On the local front, the study asks respondents about illegal gold mining, known as 'galamsey', and community or district-level specific environmental-related laws or conventional practices. As earlier mentioned, households who demonstrate knowledge of a particular issue are passed for having a sense of environmental awareness. At the same time, the reverse holds for those who have no idea nor have ever heard of the specific environmental case. 'Galamsey' is an illegal small-scale gold mining practice that employs simple or slightly advanced machinery and tools to dig and gather earth suspected to contain gold. The earth is then washed and sieved to bring out the gold. This approach to gold mining is associated with several environmental issues. One of them is the muddying of freshwater resources which act as sources for water treatment by the Ghana Water Company for onward distribution to residents in Ghana as potable water. In recent times, due to the adverse effect of 'galamsey' on water resources, the practice has come under intense condemnation leading to a nationwide, government-backed war against it. It is arguably Ghana's most widely condemned environmental-related activity in at least the last decade. The study also asked respondents if, in their local community or district of residence, they must adhere to any laws or conventional practices related to the environment. All of these are added to help examine the extent of environmental awareness among households in Ghana.

4. Results and discussion of findings

Table 1 shows the summary statistics of the data. The table shows that only about a third (29 %) of households in the sample are not energy poor with respect to cooking since they adopt cleaner fuels, i.e., mostly LPG as primary cooking fuels. This is a fair reflection of the national-level statistics reported from a nationwide census in 2021, where only 36 % of households across the country used LPG as their primary cooking fuel (Ghana Statistical Service, 2022a). The implication is that about two-thirds of households in Ghana are energy poor and exposed to the adverse effects of using heavily polluting fuel and contributing to climate change through their choice of cooking fuels. There were no responses for the question on the main fuel type used by some households yielding missing data on fuel type and hence fewer number of observations. Such households contend that they are unable to stick out any of their multiple fuels as their main or primary cooking fuel. Total

Table 1
Summary statistics of the data.

Variable	Obs	Mean	Std. Dev.	Min	Max
Fuel type (1 = clean)	1,221	0.292	0.455	0	1
Gender (1 = female)	1,246	0.378	0.485	0	1
Age					
26—35	1,246	0.209	0.407	0	1
36—45	1,246	0.257	0.437	0	1
46—55	1,246	0.275	0.447	0	1
55+	1,246	0.234	0.423	0	1
Educational level					
Up to basic	1,246	0.337	0.473	0	1
Secondary +	1,246	0.417	0.493	0	1
Education (in years of schooling)	1,246	8.602	5.665	0	16
Household size	1,246	6.637	6.499	1	86
Access to information	1,246	0.882	0.323	0	1
Household monthly income (¢'000)	1,246	4.521	7.310	0	176.178
Locality (1 = urban)	1,246	0.600	0.490	0	1
Environmental consciousness index_total	1,246	1.953	1.160	0	6
Environmental consciousness index_global	1,246	0.787	0.910	0	3
Environmental consciousness index_local	1,246	1.150	0.573	0	2
Usage rate of polluting fuel	1,123	0.955	0.127	0.333333	1
Distance to nearest school (km)	1,232	0.400	1.383	0	18.26032

household monthly income averaged ¢4,535.00², while 88 % of the sample had access to information proxied by regular use of a television or radio set in the household. Our sample contained 59.5 % urban respondents, reflecting Ghana's urban-rural population (56.3 % urban) per the 2021 population and housing census (Ghana Statistical Service, 2022b). The average distance to the nearest educational institution was 0.4 km with minimum and maximum values of 0 km and 18.3 km respectively. The minimum value observed was the case of a single observation. The immediate precincts of the structure housing the respondent household was virtually the compound of the school and thus, the location information returned similar coordinates for the household location and the location of the nearest school.

To address the first objective, we computed three indices for environmental consciousness – one based on all environmental issues (both global and local), the second based on global environmental issues only, and the third based on local environmental issues only. The results are depicted in Fig. 2.

A higher value on the index scale depicts a higher level of environmental consciousness, whereas a lower value depicts a lower level of environmental consciousness. A zero value on the index shows a total lack of awareness or consciousness of environmental issues. From Fig. 1, it can be observed that the level of environmental consciousness is generally very low among the sample. Taking the overall index (all), more than two-fifths of the model (41.4 %) had values of zero and one, with 26.5 % scoring a value of two on the scale. Higher values of three or more were scored by only 32 % of the sample representing less than a third. The level of environmental consciousness judging by the global indicators is even direr.

More than half of the sample (52 %) have no awareness at all about the environment. They are unaware of the global issues examined in this study – GHGs and global warming, climate change, and the COP. Generally, respondents who had no knowledge about GHGs and global

² The average inter-bank exchange rate around the time of the survey was \$1: ¢8.35.

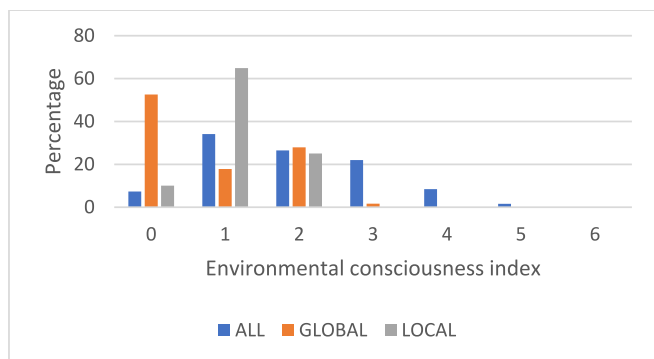


Fig. 2. Level of environmental consciousness.

warming also tended to have no knowledge about climate change. The study found knowledge of the COP and the Kyoto Protocol was even lower. The implication for promoting the global climate goals within the country at the level of households could be adverse for the government and other environmental activists. Concerning the local environmental issues, whose maximum value on the index scale was two, only 10 % of the sample had no awareness. The rest were conscious of at least illegal gold mining, popularly known as 'galamsey'. The overwhelming display of knowledge on *galamsey* is unsurprising given the recent media attention and state-sponsored communication and actions against its practice in the country. Our findings corroborate Amoah and Addoah (2021) and Forkuor and Otiekku (2015) on Ghanaians' low levels of environmental consciousness. This could result from many factors, including the fact that, as a country, there has not been a massive campaign to conscientize residents on human activities that have adverse implications for our environment and the need to protect the environment. At the same time, residents ordinarily care more about how to meet their basic needs, being a developing country, than they do about the environment, especially when the environmental resources serve as livelihoods for many of these residents. These could partly explain the low levels of environmental consciousness in the country.

4.1. Empirical analysis

Next, we present results from the instrumental variable estimates. Table 2 displays the results from the instrumental variable regressions. To avoid verbosity, this study reports the results from Lewbel's (2012) IV estimation approach with generated and external instruments³ more so since we have the opportunity of an external instrument. Columns (1), (2) and (3) examine environmental consciousness from all indicators, global indicators only, and local indicators only, respectively.

Table 2 shows that all models' F statistic is greater than the Stock-Yogo critical values. Therefore, the weak instrument identification test hypothesis is rejected in favour of a strong one. In other words, distance to the nearest educational institution is valid as an instrument for identifying the actual effect of environmental consciousness on energy poverty. The results show that environmental consciousness positively and significantly impacts household energy poverty. As the index of environmental consciousness increases by one unit, it increases the choice of cleaner cooking fuel by an average of 13.4 %, thereby reducing energy poverty. Measured by global indicators only, the impact of environmental consciousness on cleaner cooking fuel choice is 19.6 %. The finding of a positive effect of environmental consciousness on clean cooking fuel choice is expected. People aware of greenhouse gases,

³ The Lewbel (2012) estimation approach provides results with internally generated instruments only as well as results using both internally generated instruments and the external instrument. We report the latter with the added benefit of an external instrument.

Table 2 Results from IV regressions.

VARIABLES	(1)	(2)	(3)
Fueltype (1 = clean cooking fuel)			
Environmental awareness_all	0.134*** (0.044)		
Environmental awareness_global		0.196*** (0.038)	
Environmental awareness_local			-0.017 (0.069)
Gender (1 = female)	-0.003 (0.028)	-0.008 (0.027)	-0.034 (0.027)
Age	0.022* (0.012)	0.018 (0.012)	0.027** (0.011)
Education	0.080** (0.031)	0.061** (0.025)	0.162*** (0.017)
Household size	-0.010*** (0.002)	-0.009*** (0.002)	-0.011*** (0.002)
Access to information	0.100*** (0.039)	0.106*** (0.038)	0.112*** (0.038)
Household income	0.004** (0.002)	0.004** (0.002)	0.005*** (0.002)
Locality (1 = urban)	0.081*** (0.027)	0.095*** (0.027)	0.049** (0.025)
Constant	-0.410*** (0.127)	-0.295*** (0.106)	-0.173 (0.130)
Observations	1,202	1,202	1,202
F	11.33	28.89	15.53
Critical value: maximal IV relative bias	6.69	6.69	6.69

Standard errors in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1.

global warming and climate change likely know the role trees play in reducing global warming and slowing down the rate of climate change. Since wood or traditional fuels mainly come from wood resources, they might opt for alternative fuel sources that are not generated or produced by cutting down trees.

Furthermore, incomplete burning of solid fuels during cooking also plays a role in increasing emissions within the household. It may be another reason persons with a higher environmental consciousness index might adopt cleaner cooking fuels instead. In summary, persons with knowledge about GHG emissions and climate change, the causes, and the effects are more likely to choose cleaner cooking fuel as they would be more willing to take actions that will guard against further emissions or further damage to the environment compared to persons with no knowledge about these environmental concerns. The findings support those of Amoah et al. (2018) and Amoah and Addoah (2021), who found that environmental awareness was positively associated with pro-environmental behaviour but contradicts to an extent the study of Azadeh et al. (2015), which found no statistically significant effect of environmental consciousness on electricity consumption in Iran.

With regards to environmental consciousness measured solely on the local environmental issues, however, it was found that there is no statistically significant association with the choice of cooking fuel (Column 3). This finding is interesting within the Ghanaian context. Knowledge about *galamsey* had nothing significant to do with cooking fuel choice. This could be due to the fact that among the key negative effects of the practice of *galamsey* that has been communicated to Ghanaians over the recent past in the nationwide attempt to suppress it is its adverse effect on freshwater sources and the potential to drive the nation into a water crisis in the future. Thus, *galamsey* has not been widely associated with fuelwood use and pollution. Despite an overwhelming display of awareness of the practice, people's knowledge of its negative effects is probably limited to the impact on water bodies and future access to clean water. As a result, knowledge of *galamsey* was not found to have a significant relationship with the cooking fuel choice. The same could be said of community-level environmental laws and practices. The implication is that the critical environmental issues of local concern, no matter how grand, have no associations with general pro-environment

choices. In contrast, the key environmental issues of global concern are instead seen to be related to pro-environment choices such as cooking fuel decisions.

Across all models, we find that households with heads who have higher education were found to be significantly associated with the choice of cleaner cooking fuels. This shows that households whose heads have higher education are less likely to be energy poor and supports the findings of Adjei-Mantey et al. (2021), Adusah-Poku et al. (2021), and Muller and Yan (2018). Factors such as household income, access to information, and urban residential location are positively and significantly associated with cleaner energy choices across all models and confirm what is largely known from previous literature (Adjei-Mantey and Takeuchi, 2023; Karimu et al., 2016). Higher incomes help households to afford cleaner energy which is often more expensive than traditional and heavily polluting fuels. Through access to information, households can learn of the dangers of using heavily polluting fuels and the benefits of adopting clean fuels. They are more likely to adopt them if they have the correct information. Urban dwellers are likelier to adopt cleaner energy due to the lower availability of firewood, better LPG supply infrastructure and ease of access to a cleaner fuel (Adjei-Mantey and Takeuchi, 2022; Karimu, 2015).

In summary, the study finds that having environmental awareness reduces the chances of being energy poor as environmentally aware households are more likely to adopt cleaner cooking fuels. Furthermore, knowledge of global environmental issues such as GHGs, global warming, and climate change will likely motivate the adoption of cleaner cooking fuels.

4.2. Robustness analysis

As further analysis to confirm the robustness of our findings, we replace the response variable from the previous subsection with another response variable to ascertain the impact of environmental consciousness. We restrict the analysis to households that use heavily polluting fuels (firewood and charcoal) as their primary cooking fuel and investigate the impact of environmental consciousness on the usage rate of the heavily polluting fuel. We compute the usage rate as a ratio of the number of times the traditional fuel is used for cooking in a day to the number of times cooking is done in the day. A rate of 1 implies that the heavily polluting fuel is used for 100 % of the cooking in the household or that every time food is cooked, that is the fuel used. A lower ratio implies that some cooking is not done with polluting but with relatively cleaner fuel.⁴ It is possible to compute this because fuel stacking is standard among many households in Ghana and other developing countries. Even though households know which fuel type is their primary energy source for cooking, they often have another fuel type which they may occasionally use to cook particular meals or as emergency fuel in case they run out of their primary cooking fuel. We hypothesize that even among households whose primary cooking fuel is traditional, they may use it less regularly, or the usage rate will fall in the presence of increased environmental consciousness. The IV estimation approach discussed in section 3 is used to estimate the following equation:

$$EnvironmentalConsciousness(EC) = \delta_0 + \delta_1 D_1 + \delta_2 X_i + \delta_3 M_j + \varepsilon_i \quad (4)$$

$$Heavy - PollutingFuelUsageRate = \gamma_0 + \gamma_1 E\hat{C}_i + \gamma_2 X_i + \gamma_3 M_j + e_i \quad (5)$$

Where heavy-polluting fuel usage rate is the number of times using fuel in a day as a ratio to the number of times cooking is done in a day, the

⁴ For example, if the household cooks three times a day but uses the traditional fuel two times a day, the usage rate is 0.667 whereas if the household cooks three times a day and uses the traditional fuel three times a day, the usage rate in this case is 1. In the former case, the third meal is cooked with an alternative cooking fuel, most likely, LPG.

result is presented in Table 3.

The finding shows that the usage rate of traditional cooking fuels has a negative and significant relationship with environmental consciousness. As the level of environmental consciousness increases by 1 unit, the usage rate of traditional fuels reduces by 3.7 %. This reinforces the earlier finding that environmental consciousness plays a role in reducing energy poverty among households in Ghana. It confirms that increasing awareness of environmental concerns, particularly issues of global warming through greenhouse gas emissions and climate change, could potentially motivate a transition to cleaner energy types for cooking and consequently reduce energy poverty in Ghana.

4.3. Relationship between formal education and environmental awareness

As additional analysis, the study tests the relationship between environmental consciousness and formal education. Education has often been used in the fuel choice and energy poverty literature to represent knowledge or in some cases, information. The aim of this additional analysis is to assess whether the use of education as a proxy for knowledge in the related literature captures environmental knowledge as well. The findings, presented in Table 4, show that higher education is positively associated with better environmental awareness. Thus, it suggests that the use of formal educational attainment in studies of such nature can effectively capture environmental consciousness as well as possession of general knowledge.

5. Conclusion and recommendations

This study investigated the impact of environmental consciousness on household energy poverty conditions, having observed the absence of empirical studies investigating this variable in the literature on household energy poverty. Energy poverty was proxied by the type of fuel adopted by the household for cooking. Using cross-sectional data from a survey of over 1200 households across six regions of Ghana, the study first finds that the level of environmental consciousness in Ghana is very low, especially the consciousness of global environmental concerns relative to local ones. Over half of the respondents were unaware of global environmental issues such as greenhouse gases, global warming, and climate change.

Secondly, the study found that environmental consciousness

Table 3

IV regression for the impact of environmental consciousness on traditional fuel usage rate.

	(1)
VARIABLES	Frequency of use of polluting fuel
Environmental awareness_all	-0.037** (0.017)
Gender (1 = female)	0.006 (0.011)
Age	-0.000 (0.005)
Education	0.022** (0.010)
Household size	0.000 (0.001)
Access to information	-0.012 (0.014)
Household income	-0.000 (0.001)
Locality (1 = urban)	-0.032*** (0.011)
Constant	1.057*** (0.050)
Observations	801
F	8.28
Critical value: maximal IV relative bias	6.69

Standard errors in parentheses.

*** p < 0.01, ** p < 0.05, * p < 0.1.

Table 4
Formal education and environmental consciousness.

	(1)	(2)	(3)
VARIABLES	Environmental awareness_all	Environmental awareness_global	Environmental awareness_local
Formal education (Ref: None)			
Up to basic	0.222*** (0.084)	0.183*** (0.065)	0.036 (0.046)
Secondary +	1.034*** (0.065)	0.856*** (0.064)	0.151*** (0.046)
Constant	1.607*** (0.216)	0.476*** (0.166)	1.137*** (0.118)
Control variables	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes
Observations	1,246	1,246	1,246
R-squared	0.243	0.272	0.068

Standard errors in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

positively impacts clean cooking energy choices and reduces energy poverty. Households with heads who are environmentally aware use cleaner cooking fuels comprising mostly LPG. Furthermore, it was revealed that knowledge of global environmental issues such as greenhouse gases, global warming, and climate change significantly impacted adopting cleaner cooking fuel. The study recommends an extensive environmental awareness campaign nationwide based on the findings. Educating people on the causes, effects and dangers of GHG emissions, global warming, and climate change, as well as the human activities that affect climate change, will go a long way to influence perception and actions regarding the environment and subsequently on cooking energy choices. While the formal school curriculum could be amended to include this kind of education for the benefit of children in schools, public campaigns at the community level and radio/TV campaigns can be adopted to reach the older population who are out of school. This way, the level of awareness can be increased.

Furthermore, it is recommended that environmental issues of local concern be explained in more detail to the public with all of their

Appendix A. : Relationship between instrumental variable and outcome variable

	(1)
VARIABLES	Energy poverty
Distance (in km)	0.006 (0.008)
Constant	0.541*** (0.085)
Control variables	Yes
Region fixed effects	Yes
Observations	1,202
R-squared	0.342

Standard errors in parentheses.
*** p < 0.01, ** p < 0.05, * p < 0.1.

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attendant effects so that the general public can make beneficial decisions in favour of the environment. For example, the campaign against *gal-amsey* should not be limited to discouraging the practice because of its effects on water bodies and potential impact on clean water access in the future, as is currently the case. Instead, campaigning on the impact on the entire environment ecosystem is necessary to draw out appropriate actions at the household level.

Finally, a positive association between income and clean fuel choices suggests that supporting vulnerable households to transition to cleaner cooking fuel might be a significant way to drive energy transition at the household level. A recommendation for future research is to consider the impact on other dimensions of energy poverty such as lighting and ownership of household appliances.

CRedit authorship contribution statement

Kwame Adjei-Mantey: Writing – original draft, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization.
Roula Inglesi-Lotz: Writing – review & editing, Supervision, Methodology.
Anthony Amoah: Supervision, Investigation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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