Energy-environment-religion nexus in coastal Ghana: A structural equation modelling approach

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Abstract

This study examines household concerns about Ghana's deteriorating coastal ecosystems, focusing on declining forest cover, reduced aesthetic value, and biodiversity loss in relation to national conservation ambitions. Situated within the context of persistent global energy poverty and nationally recognized high levels of religiosity, the analysis investigates how these two phenomena shape environmental concern. Primary data were collected from 1,153 households across 51 fishing communities and analyzed using descriptive statistics and structural equation modelling (SEM). Results show that more than four-fifths of households' express concern about coastal environmental degradation, while 93% experience some form of energy deprivation. Religiosity scores clustered at the upper end of a 1-10 scale, reflecting the strong role of faith in everyday life. SEM results indicate that a one-standard-deviation increase in energy poverty is associated with a 0.156 decrease in environmental concerns ($p < 0.001$), while a similar increase in religiosity is linked to a 0.156 reduction in energy poverty ($p < 0.001$). Religiosity also positively influences environmental concerns both directly ($\beta = 0.085$, $p < 0.05$) and indirectly ($\beta = 0.028$, $p < 0.01$) through its alleviation of energy poverty. Socioeconomic factors, including income, gender, and occupation type, significantly shape these relationships, with female-headed and non-agricultural households showing stronger energy-environment-religion nexus. The findings underscore the potential of religiosity as a social resource to counteract the adverse effects of energy poverty on environmental behaviors, offering insights for integrated policy interventions aimed at sustaining coastal ecosystems.

Keywords:

Energy poverty, environmental concerns, religiosity, coastal ecosystems, fishing communities

1. Introduction

The inability of households to meet energy needs through modern energy and its services (energy poverty) remains a pressing challenge across coastal sub-Saharan Africa. Its nexus with poor environmental outcomes, such as deforestation, biodiversity loss, and declining ecosystem quality, is well established in the literature. Religiosity, meanwhile, has been recognized as a significant social force influencing human behavior and environmental attitudes. Yet, empirical studies have not adequately examined how religiosity mediates the relationship between energy poverty and environmental concerns, particularly within African contexts where faith permeates everyday life. This study addresses this gap by investigating the interplay between energy poverty, religiosity, and environmental concern in Ghana's coastal fishing communities, with attention to gender and livelihood dynamics.

Africa is widely regarded as one of the most religiously inclined regions globally, where faith-based institutions and beliefs profoundly shape household behavior, community norms, and coping strategies (Höllinger & Makula, 2021). High levels of religious participation are evident across Christian, Muslim, Traditional, and other belief systems, with several of the world's most religious countries located in Africa, including Nigeria and Ethiopia (Alesina et al., 2023; Johnson & Grim, 2013). Recent scholarship underscores how religion in the African context has become increasingly pragmatic (Toren et al., 2020), serving secular purposes and functioning as a means to an end.

Within this religious milieu, deprivations in affordable, clean, and modern energy services are most acute in sub-Saharan Africa, where accessibility remains persistently challenging. Emerging evidence of a growing trend in energy deprivations across the sub-region is deeply concerning (IEA, IRENA, UNSD, World Bank, & WHO, 2026), given its well-documented links to adverse environmental outcomes (Dimnwobi et al., 2023; Butty et al., 2025). Despite the pervasive role of religion, empirical literature examining its influence on household energy poverty in Africa remains limited, with only a handful of studies, such as Ampofo and Mabefam (2021) and Bakehe (2025), documenting associations. In the broader global literature, where religiosity has been incorporated, findings remain contradictory. Churchill and Smyth (2022) and Ampofo and Mabefam (2021) report a positive effect of religion in reducing energy poverty, whereas Dong et al. (2024), Li et al. (2023), and Bakehe (2025) demonstrate that religion exacerbates energy deprivations. Koehrsen (2015) and Zang et al. (2021) found no significant link between religiosity and energy poverty, while Louder et al. (2025) highlight the importance of faith-based organizations in supporting energy-insecure households.

Building on this foundation, the study situates its analysis within the broader energy-environment nexus, recognizing that household energy practices are central to both ecological degradation and sustainability transitions. In Ghana's coastal regions, reliance on traditional biomass fuels contributes to deforestation, biodiversity loss, and declining ecosystem services (Nunoo & Agyekumhene, 2022), while limited access to modern energy exacerbates intentions towards environmental change (Nsenkyire et al., 2026). Energy poverty thus emerges not only as a socioeconomic challenge but also as a critical environmental issue, shaping household attitudes toward conservation and restoration. The nexus underscores the interdependence between energy access and ecological wellbeing: households deprived of clean energy are more likely to engage in practices that accelerate coastal degradation, whereas improved energy equity fosters environmental behavior and supports national ambitions for ecosystem resilience. By framing energy poverty as both a driver and determinant of environmental concern, the study contributes to debates on energy justice and sustainability, highlighting the need for integrated approaches that link energy transitions with ecological preservation. This perspective provides the analytical bridge to explore how religiosity, as a form of social capital, interacts with and potentially transforms this nexus into a pathway for inclusive coastal development.

Furthermore, the study investigates how religiosity interacts with the energy poverty-environmental concern nexus, positioning faith-based social capital as a critical social resource for advancing sustainability ambitions in Ghana's coastal economy. By embedding ecological ethics within religious narratives and mobilizing collective responsibility, faith-based institutions provide households with moral frameworks that encourage equitable energy

practices and stewardship of coastal ecosystems. In contexts where energy poverty constrains household choices, religiosity functions as a transformative mechanism that channels moral conviction into improved energy access, thereby reducing reliance on unsustainable fuels and mitigating environmental degradation. This perspective enriches the discourse on energy poverty by integrating sociocultural dimensions into a field often dominated by economic and technical determinants, while also highlighting the potential of faith-driven collective action to align household behavior with national goals for resilience and sustainability.

Finally, the study examines how the energy-environment-religion nexus varies across male- and female-headed households as well as agricultural and non-agricultural households, thereby offering disaggregated insights into differentiated experiences of energy poverty and environmental concern. Gender dynamics are particularly important, as female-headed households often bear disproportionate burdens of energy deprivation (Nsenkyire et al., 2023a) yet simultaneously translate religious values into nurturing and conservation-oriented practices (Dhenge et al., 2022; Li et al., 2022). Similarly, household income and agricultural engagement shape the extent to which religiosity mediates energy behavior and ecological awareness, with agriculturally engaged households more directly exposed to environmental risks and thus more responsive to faith-based stewardship narratives. By disaggregating these relationships, the study contributes to intersectional understandings of energy poverty, demonstrating that religiosity's influence is contingent upon household characteristics. This nuanced perspective enriches the literature by integrating gender and livelihood dimensions into the energy-environment-religion nexus, highlighting how faith-driven social capital interacts with structural determinants to produce varied pathways toward sustainability.

The remainder of the paper is structured as follows: Section 2 outlines the conceptual framing and theoretical underpinnings of the study. Section 3 details the methodology, including data sources, variable measurement, and statistical approach. Section 4 presents and discusses the results, followed by the conclusion in Section 5.

2. Theoretical backing and conceptual framework.

Three complementary theories underpin this study; Social Capital Theory, Environmental Justice Theory, and Intersectionality Theory. Social Capital Theory, popularized by scholars such as Bourdieu and Putnam, posits that social networks, trust, and norms of reciprocity constitute valuable resources that facilitate collective action and improve societal outcomes (Putnam, 2002; Siisiäinen, 2003). In development contexts, social capital enhances access to information, cooperation, and resource mobilization. Religious institutions often serve as repositories of social capital, fostering solidarity and moral obligation among members. Within energy transitions, faith-based networks can influence household decisions by promoting shared values around stewardship, conservation, and community welfare. Thus, religiosity becomes a conduit through which social capital operates, shaping behavioral responses to energy poverty and environmental degradation.

Environmental Justice Theory emphasizes equitable distribution of environmental benefits and burdens across social groups (Agyeman et al., 2016). It argues that marginalized populations often experience disproportionate exposure to environmental risks due to structural inequalities. In coastal communities, limited access to clean energy exacerbates ecological degradation through unsustainable resource use. The theory provides a normative lens for

understanding how energy poverty intersects with social vulnerability, highlighting the moral imperative for inclusive energy policies that protect both people and ecosystems.

Intersectionality Theory, rooted in feminist scholarship, examines how overlapping social identities, such as gender, class, and occupation, compound disadvantage (Cho et al., 2013). In the context of household energy use, intersectionality explains how gender roles, income levels, and agricultural engagement jointly influence energy access and environmental awareness. Recognizing these intersections allows for more nuanced analyses of energy poverty and its differentiated impacts across household types.

Synthesizing these perspectives, the conceptual framework in Figure 1 positions religiosity, a faith-based social capital, as a sociocultural driver that shapes household engagement with modern energy systems. Through the lens of Social Capital Theory, faith communities act as enabling networks that can either mitigate or reinforce energy poverty, depending on their capacity to influence norms. It further situates energy poverty as the mediating pathway through which this sociocultural predisposition translates into environmental outcomes. Environmental Justice Theory then contextualizes the ecological consequences, particularly coastal ecosystem degradation, as manifestations of unequal energy access. Finally, Intersectionality Theory explains how household characteristics (gender, income, agricultural status) moderate these relationships, producing varied experiences of vulnerability and agency.

Collectively, these theories support the multi-layered framework that capture the interplay between belief systems, resource constraints, and environmental ethics. This theoretical synthesis advances the discourse on faith-based sustainability transitions and energy justice in coastal communities, offering the foundation needed for empirical investigation.

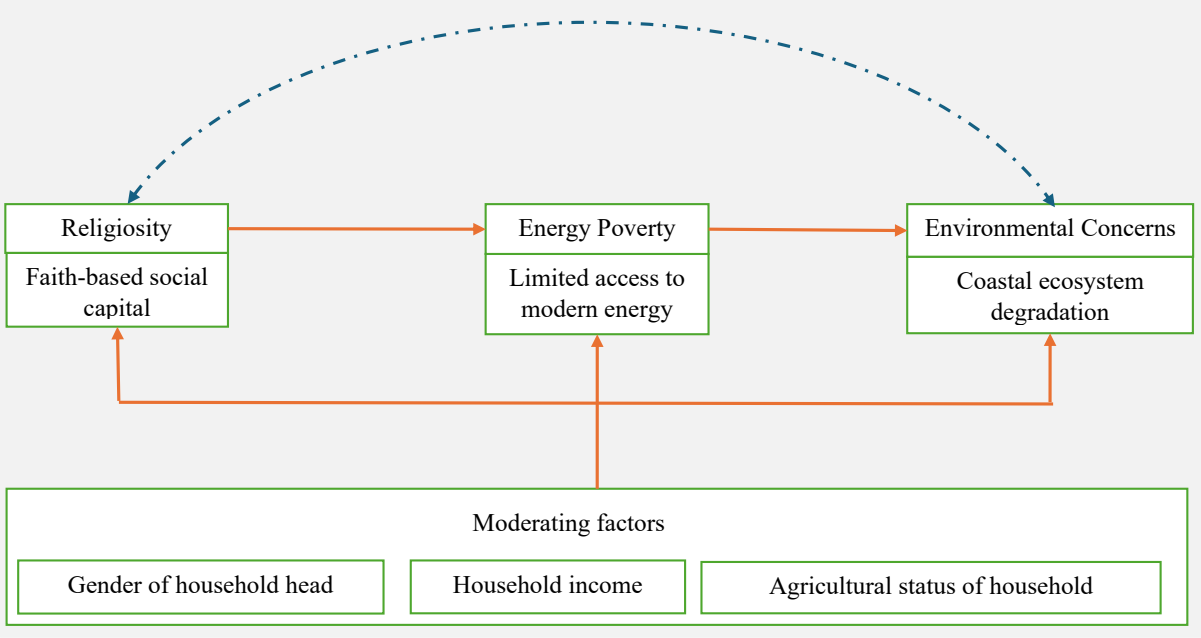


Figure 1: Conceptual Framework

3. Methods

3.1 Study context and data

This study draws on primary data collected from households in Ghana's coastal marine fishing communities. Ghana provides an especially appropriate case for this inquiry, as it remains

among the world's most energy-poor countries according to SDG 7 tracking reports (IEA et al., 2026), while simultaneously exemplifying Africa's religio-cultural landscape, with high participation across Christian, Muslim, and Traditional belief systems (Murray & Agyare, 2018). This dual context, marked by acute energy poverty and vibrant religiosity, offers a unique lens to examine the intersection of faith and fuel, situating household energy practices within broader debates on sustainability and environmental concern. The case further supports the generalization of findings to other sub-Saharan African countries where similar dynamics prevail.

The study population, coastal marine fishing communities, is particularly critical to this analysis. Ghana is actively strategizing to harness the potential of its coastal economy through the integration of a blue economy within the national framework, underscoring the need for informed planning and structuring of coastal ecosystems to which these communities are both naturally and economically tied. Marine fishing communities represent the backbone of Ghana's artisanal coastal economy, with livelihoods closely linked to marine resources and landing beaches (Fisheries Commission, 2022). Yet, households often face acute challenges in accessing reliable and affordable energy (Nsenkyire et al., 2025a, 2025b). Religiosity in this context is equally salient, given the coexistence of Christianity, Islam, and Traditional belief systems, each shaping values around resource use, collective responsibility, and resilience (Boateng et al., 2024; Adjei & Sika-Bright, 2019). Religious institutions thus serve as hubs of social support, moral guidance, and informal advocacy, influencing how households perceive and respond to energy deprivations. Focusing on these communities therefore allows the study to explore the energy-environment-religion nexus in a setting where ecological vulnerability and faith-based social capital converge.

The sampling frame comprised 187 marine fishing communities distributed across 30 Metropolitan, Municipal, and District Assemblies (MMDAs) in Ghana's four coastal regions: Western, Central, Greater Accra, and Volta (Fisheries Commission, 2022). Following the standard sample size determination formula, a nationally representative sample of 51 communities and 1,040 households was initially derived. To mitigate the effects of an anticipated 15% non-response rate, the household sample size was increased to 1,200 to strengthen statistical power.

A proportionate two-stage stratified random sampling approach was employed to minimize bias and enhance geographic representativeness (Aubry et al., 2023). In the first stage, the 30 coastal MMDAs served as strata, from which 51 communities were selected proportionately to the distribution of fishing communities and landing beaches in the four coastal regions (Fisheries Commission, 2022), yielding 19 communities from Western, 14 from Central, 11 from Greater Accra, and 7 from Volta. In the second stage, households were sampled from randomly selected dwelling structures within the 51 communities, ensuring that the final sample reflected both the diversity of Ghana's coastal settlements and the socio-economic heterogeneity of its households.

Table 1: Community and household sample size distribution by region

Administrative Regions	Number of marine fishing communities [%]	Number of landing beaches [%]	Averages No. [%]	Community Sample	Household sample
Western	72 [38.5]	92 [33]	164 [35.2]	19	422
Central	43 [23.0]	91 [32.6]	134 [28.8]	14	345
Greater Accra	45 [24.1]	56 [20.1]	101 [21.7]	11	260
Volta	27 [14.4]	40 [14.3]	67 [14.4]	7	173
Total	187 [100.0]	279 [100.0]	466 [100]	51	1200

With ethical approval obtained from the University of Cape Coast Institutional Review Board (UCCIRB), and all procedures adhering to standards of anonymity, confidentiality, and informed consent, data collection was conducted between September and November 2024 through face-to-face interviews. Research assistants administered the questionnaire using computer-assisted personal interviewing (CAPI) technology, soliciting details on household geographic location, demographic characteristics, and energy use behaviors. A final sample of 1,153 households, representing 96% of the sampled population, was analyzed for having complete information.

3.2 Sociodemographic profile of study sample

Figure 1 presents the socio-demographic characteristics of the study sample. Most households were headed by middle-aged persons (45-60 years) and majority were males (60%). Educational attainment of household heads was generally low; nearly half (49%) reported completing only primary-level education, while approximately 31% had no formal education. Household monthly income was measured across five categories: one=GHS 0-500), two=GHS 501-1500, three=GHS 1501-2500, four=GHS 2500+, and five=Don't Know. The most common was GHS 501-1500 (33.9%), with 13.6% earning GHS 0-500 and only 15.3% earning above GHS 2500. These showcase relatively modest income levels in the communities. Spatially, Western region accounted for the largest share of households (35.3%), followed by the Central and Greater Accra regions, while the Volta region contributed the smallest proportion (12.2%). This distribution mirrors the relative concentration of fishing communities and landing sites along Ghana's coastline, with Western and Central serving as major hubs of marine activity (Fisheries Commission, 2022).

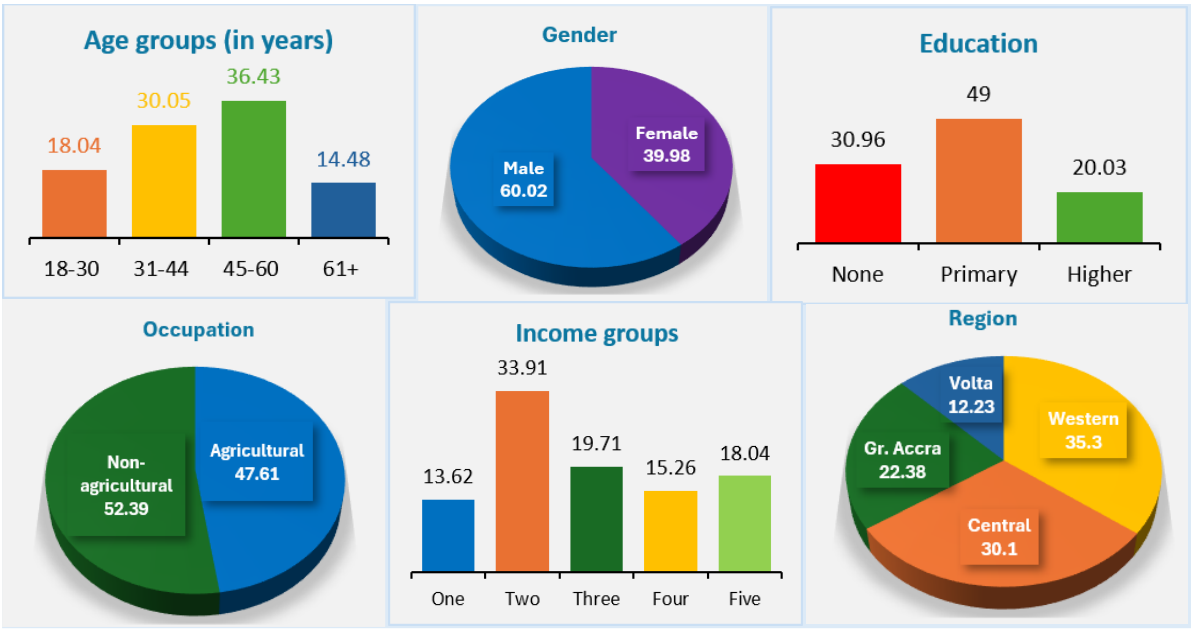


Figure 1: Profile of study sample

3.3 Measurement of variables and their distributive statistics

Energy poverty

Following the multidimensional approach adopted in earlier studies (Mefful et al., 2026; Nsenkyire et al., 2024), energy poverty in this study was assessed across two distinct dimensions: accessibility and utilization. As detailed in Table 2, this framework captures the

multidimensional nature of household energy deprivation in Ghana's coastal context (Crentsil et al., 2019).

Accessibility was measured through households' primary sources of lighting and cooking fuels, reflecting access to electricity and clean cooking energy. Utilization was assessed through ownership and use of energy services, specifically refrigeration (refrigerator/freezer), food processing (blender), and heating (heater or kettle). All indicators were coded as binary variables, with 1 denoting deprivation and 0 denoting non-deprivation, thereby distinguishing households lacking access or use of modern energy services from those adequately served.

Table 2: Energy poverty measurement

Dimensions	Indicators	Variables	Description	Measurement
Accessibility	Lighting	Source of lighting	Household has access to electricity	No=1; Yes=0
	Cooking	Source of cooking fuel	Household uses modern sources like LPG and electricity	No=1; Yes=0
Utilization	Refrigeration	Refrigeration	Household owns a functional refrigerator or freezer	No=1; Yes=0
	Blending	Blending	Household owns a blender or food processor	No=1; Yes=0
	Heating	Heating	Household owns a heater or kettle	No=1; Yes=0

Figure 2 presents the descriptive statistics of energy poverty indicators. Except the lighting indicator where only 7.98% were non-deprived, more than half of the household population were deprived in the remaining indicators, with heating (81.79%) and cooking fuel (67.3%) recording the highest deprivations. These show non-use and ownership of heating appliances and clean cooking fuels. The results further reveal that energy deprivation was pervasive across the sample, as nearly every household experienced at least one form of deprivation. When considering the cumulative burden of deprivations across all five indicators, the largest proportion of households (32%) faced four simultaneous deprivations, underscoring the multidimensional nature of energy poverty in the study area. By contrast, only 7% of households reported no deprivation with an equal percentage also deprived in all five indicators, representing households at the most extreme ends of the energy deprivation spectrum.

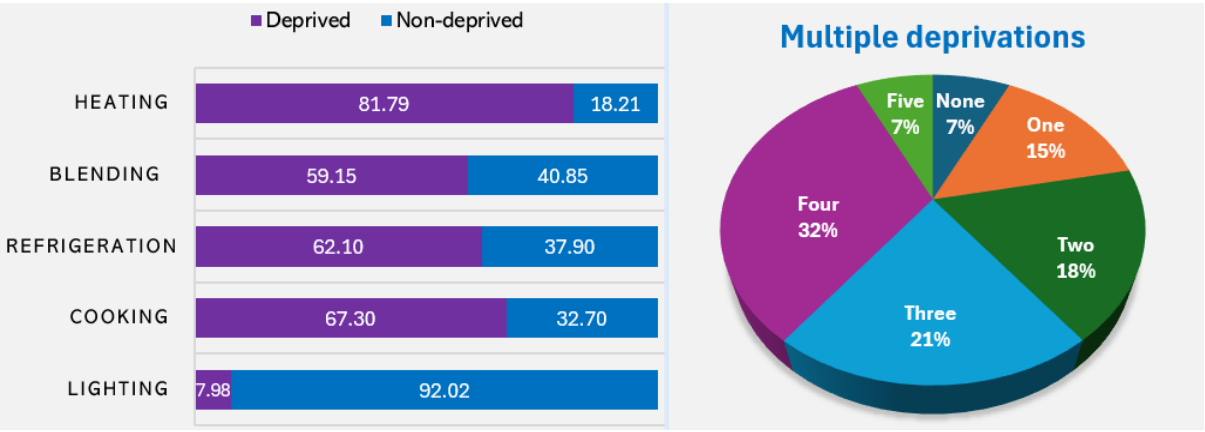


Figure 2: Household deprivations in energy poverty indicators

Religiosity

Religiosity was conceptualized using two items: the frequency of attending religious events (Ampofo & Mabefam, 2021) and the importance placed on religion (Boateng et al., 2024) as

used to capture the phenomena in the study context and similar contexts. Each item was measured on a 10-point scale with 1 being the lowest and 10 being the highest. These complementary measures of religiosity operationalized in this study provide a balanced representation of both behavioral and attitudinal aspects of religious engagement compared to previous studies, for instance by Bakehe et al (2025).

Figure 4 illustrates the distribution of scores for the two religiosity indicators, frequency of religious attendance and importance of religion, across a ten-point scale. The pattern of the importance indicator shows that respondents who rate religion as more important tend to cluster toward the upper end of the scale. This upward trend suggests a strong concentration of respondents who perceive religion as highly significant in their lives. The frequency of attending religious gatherings, however, displays a more fluctuating pattern. While religious importance consistently intensifies with higher scores, the frequency of practice varies more irregularly across the scale. This divergence suggests that although many respondents consider religion deeply important, their actual engagement in religious activities does not always follow this linear pattern.

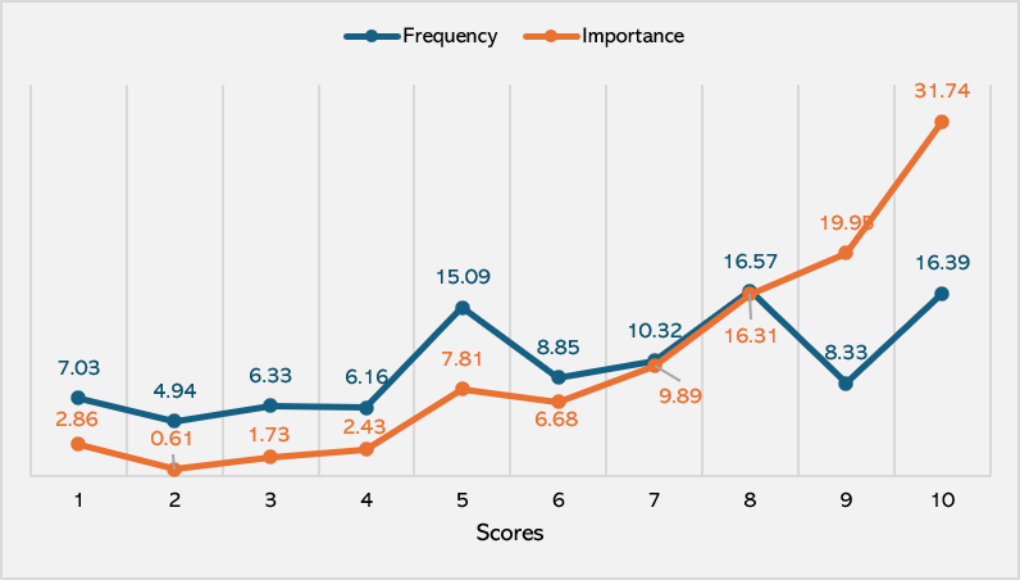


Figure 3: Frequency distribution of religiosity indicators

Environmental concerns

Concerns regarding coastal ecosystem degradation were assessed across three dimensions, biodiversity loss, reducing aesthetic value, and decline in forest covers, using a five-point Likert scale, where 1 indicated strongly disagree and 5 indicated strongly agree. These dimensions are critical because they undermine ecological resilience, erode cultural and recreational benefits, and accelerate coastal vulnerability to climate change and resource scarcity.

Figure 4 presents the frequency distribution of responses for these variables, which reveals a pronounced level of concern among households. Most respondents expressed agreement or strong agreement across all three indicators, underscoring widespread recognition of environmental degradation. Biodiversity loss attracted the highest concerns suggesting that species decline is perceived as the most pressing ecological issue. Comparable levels of concern were observed for forest decline reflecting awareness of both ecological and cultural dimensions of coastal deterioration. The relatively low proportions of disagreement and

neutrality indicate a strong consensus among coastal households that environmental decline is a tangible and urgent problem.

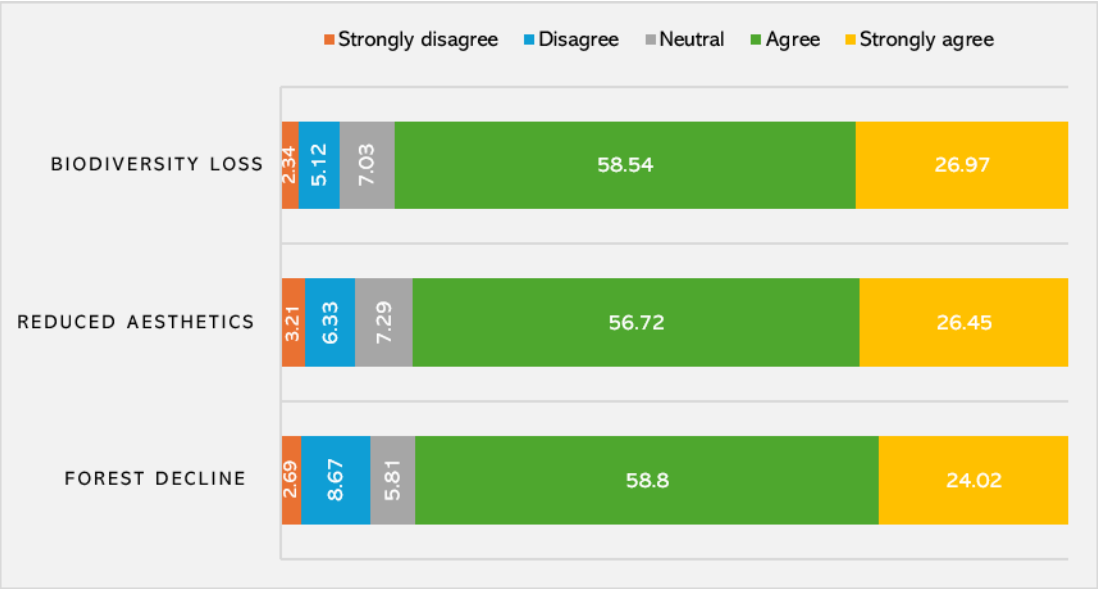


Figure 4: Frequency distribution of environmental concerns variable

3.4 Statistical approach

To examine the energy-environment-religion nexus, the study employs structural equation modelling (SEM). SEM is a multivariate regression technique that enables the simultaneous estimation of multiple relationships within a single model specification. Its application is well established across diverse fields, including health, environment, and behavioral studies. Importantly, SEM facilitates the operationalization of latent constructs through measurement variables, while also capturing the structural relationships typically emphasized in standard regression approaches. The robustness of this technique, however, depends on meeting established thresholds for the measurement component to establish reliability and validity of constructs and the model as detailed by Nsenkyire et al. (2025c). These include acceptable fit indices such as Comparative Fit Index (CFI), Non-Normed Fit Index (NNFI), Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR), evidence of discriminant and construct validity, appreciable factor loadings, and sufficiently high Coefficient of Determination (CD) values.

Table 3 shows the goodness of fit indices of the measurement model. The measurement model demonstrated reliability and validity across the three latent constructs. For energy poverty, factor loadings ranged from 0.307 to 0.778, with Cronbach's alpha of 0.654, Raykov's reliability of 0.702, and an average variance extracted (AVE) of 0.308, indicating moderate internal consistency despite the AVE falling below the conventional threshold. In contrast, environmental concerns exhibited excellent fit properties, with loadings between 0.861 and 0.941, Cronbach's alpha of 0.922, Raykov's reliability of 0.924, and AVE of 0.799, confirming strong convergent validity. Similarly, religiosity showed robust measurement quality, with loadings from 0.733 to 0.972, Cronbach's alpha of 0.832, Raykov's reliability of 0.872, and AVE of 0.741. Discriminant validity was supported by low squared correlations (less than all AVE values) among the constructs (0.029-0.032), suggesting that the latent variables are empirically distinct. Global fit indices further confirmed adequacy, with SRMR = 0.040,

RMSEA = 0.047, CD = 0.999, NNFI = 0.974, and CFI = 0.982, all within recommended cut-offs. Collectively, these results indicate that the measurement model provides a reliable and valid basis for subsequent structural analyses of the energy-environment-religion nexus.

Table 3: Measurement model fit statistics.

Latent constructs	Factor loadings	Cronbach's alpha	Raykov's factor	Average variance extracted
Energy poverty		0.654	0.702	0.308
Lighting	0.307***			
Cooking	0.498***			
Blending	0.778***			
Refrigeration	0.653***			
Heating	0.411***			
Environmental concerns		0.922	0.924	0.799
Forest	0.878***			
Aesthetics	0.941***			
Biodiversity	0.861***			
Religiosity		0.832	0.872	0.741
Frequency	0.972***			
Importance	0.733***			
Squared correlations	Energy poverty	Environmental concerns		Religiosity
Energy poverty	1.00			
Environmental concerns	0.029	1.00		
Religiosity	0.032	0.013		1.00
Model fitness	RMSEA	0.047	SRMR	0.040
	NNFI	0.974	CD	0.999
	CFI	0.982	Observations	1153

Figure 5 presents the structural models estimated in this study alongside their hypothesized paths. Model 1 depicts the baseline specification, examining the associations among energy poverty, environmental concerns, and religiosity, each represented by their respective measurement indicators. Model 2 extends this framework by incorporating socioeconomic factors, namely gender of the household head (male or female), household income (log of monthly income in Ghanaian cedis), and occupation type (agricultural versus non-agricultural engagement), to assess their influence on the three core constructs.

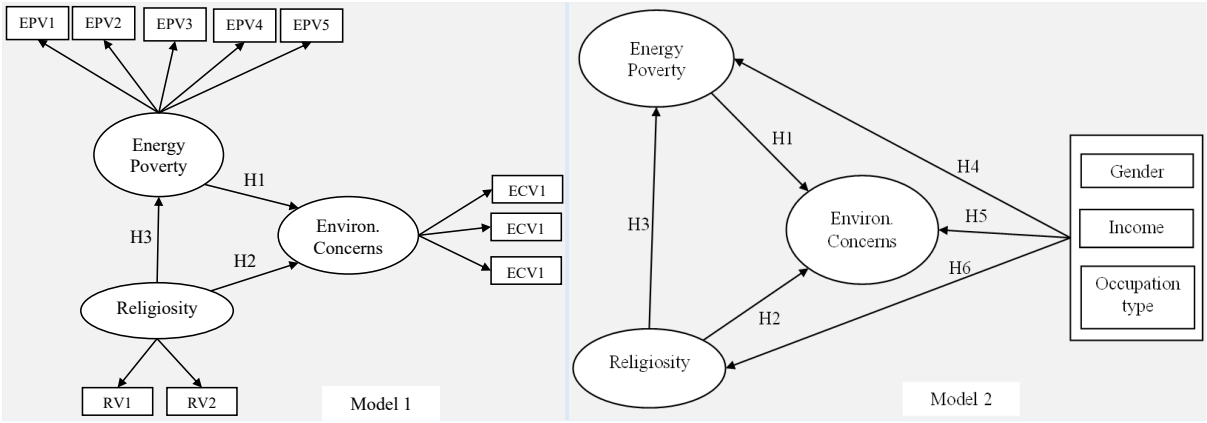


Figure 5: Structural models with hypothesized paths

The hypothesized paths in the structural models are specified as follows. H1 and H2 capture the effects of energy poverty and religiosity on environmental concerns, reflecting the central nexus of the study. H3 examines the influence of religiosity on energy poverty, highlighting the role of faith as a potential social resource in alleviating household energy deprivation. H4, H5, and H6 specify the impacts of gender, income, and occupation type on energy poverty, environmental concerns, and religiosity, respectively.

It is important to note that hypotheses H2, H4, H5, and H6 capture total effects, encompassing both direct and indirect pathways. For instance, religiosity not only exerts a direct influence on environmental concern in H2, but also indirectly through its effect on energy poverty. Similarly, gender, income, and occupation type affect environmental concern and energy poverty both directly and indirectly through their effects on religiosity. This specification allows the models to account for the multidimensional and interconnected nature of the energy-environment-religion nexus.

4. Results

The baseline model results presented in Table 4 provide confirmatory evidence for the hypothesized energy-environment-religion relationship. For H1, the direct effect of energy poverty on environmental concerns was consistently negative across all subsamples. These confirm that households experiencing higher levels of energy poverty report lower concern for coastal ecosystem degradation consistent with previous studies (Batool et al., 2023; Nsenkyire et al., 2026). In the full sample, the effect was significant ($\beta = 0.156$, $p < 0.001$), with stronger magnitudes among male-headed households ($\beta = 0.191$, $p < 0.001$) and non-agricultural households ($\beta = 0.183$, $p < 0.001$). Female-headed households ($\beta = 0.105$, $p < 0.05$) and agricultural households ($\beta = 0.110$, $p < 0.01$) also exhibited significant but comparatively weaker effects. These findings suggest that socioeconomic heterogeneity shapes the strength of the energy-environment nexus, with non-agricultural and male-headed households showing sharper trade-offs between energy deprivation and environmental concern.

The results for H2 (a) indicate that religiosity exerts a positive and significant direct influence on environmental concerns in most subsamples. In the full sample, the effect was modest but significant ($\beta = 0.085$, $p < 0.01$). Subgroup analysis revealed stronger effects among female-headed households ($\beta = 0.134$, $p < 0.01$) and non-agricultural households ($\beta = 0.140$, $p < 0.001$), suggesting that religiosity is particularly salient in shaping environmental awareness within these groups. Male-headed households also demonstrated a significant positive effect ($\beta =$

0.078, $p < 0.05$), whereas agricultural households did not exhibit a statistically significant relationship. Contradictory to Arbuckle and Konisky (2015) and Saroglou et al. (2025) observations, these findings imply that religious values are an important driver of environmental concern, but their influence is moderated by gender and occupational context.

For H3, religiosity was negatively associated with energy poverty in the full sample and across all subsamples, indicating that higher religiosity is linked to reduced energy deprivation. The effect was strongest among non-agricultural households ($\beta = 0.225$, $p < 0.001$), followed by male-headed households ($\beta = 0.183$, $p < 0.001$), agricultural households ($\beta = 0.130$, $p < 0.01$), and female-headed households ($\beta = 0.139$, $p < 0.01$). This finding suggests that religiosity functions as a protective social resource, consistently reducing household energy deprivation. The stronger effects among non-agricultural and male-headed households highlight how faith-based networks may be particularly effective in contexts less constrained by subsistence livelihoods. The relationship observed contradicts Dong et al. (2024), Li et al. (2023), and Bakehe (2025) positive associations found between religion and energy poverty.

Beyond the direct pathways as seen in H2 (b), religiosity also influenced environmental concerns indirectly through its negative association with energy poverty. The indirect effect was significant in the full sample ($\beta = 0.028$, $p < 0.001$), as well as among male-headed households ($\beta = 0.035$, $p < 0.001$) and non-agricultural households ($\beta = 0.041$, $p < 0.001$). These results suggest that religiosity contributes to heightened environmental concern not only by shaping values directly but also by alleviating energy deprivation, which in turn fosters greater sensitivity to ecological issues. The absence of significant indirect effects among female and agricultural households underscores the heterogeneity of this mediating mechanism.

Table 4: SEM results (Model 1)

	All sample	Gender		Occupation type	
		Male	Female	Agricultural	Non-agricultural
Direct effects					
H1: Energy poverty → Environmental Concerns	-0.156*** (0.036)	-0.191*** (0.047)	-0.105* (0.055)	-0.110** (0.054)	-0.183*** (0.048)
H2a: Religiosity → Environmental Concerns	0.085** (0.04)	0.078* (0.043)	0.134** (0.052)	0.057 (0.048)	0.140*** (0.048)
H3: Religiosity → Energy poverty	-0.179*** (0.034)	-0.183*** (0.045)	-0.139** (0.06)	-0.130** (0.054)	-0.225*** (0.049)
Indirect effects					
H2b: Religiosity → Environmental Concerns	0.028***	0.035***	0.015	0.014	0.041***
RMSEA	0.047	0.044		0.067	
NNFI	0.974	0.977		0.946	
CFI	0.982	0.980		0.952	
SRMR	0.040	0.046		0.058	
CD	0.948	0.901		0.894	
Observations	1153	692	461	549	604

The results from model 2 presented in Table 5, which integrates the socioeconomic factors, further confirm the hypothesized pathways across the energy-environment-religion nexus. H1 shows that energy poverty has a significant negative effect on environmental concerns ($\beta = -0.124$, $p < 0.001$), indicating that households facing greater energy deprivation express lower concern for ecological degradation. H2 demonstrates that religiosity exerts a positive and

significant direct influence on environmental concerns (β = 0.110, p < 0.001), highlighting the role of religious values in fostering environmental awareness. H3 reveals that religiosity is negatively associated with energy poverty (β = –0.175, p < 0.001), suggesting that higher religiosity is linked to reduced energy deprivation.

Socioeconomic factors also show significant direct effects. Under H4, gender (female household head) increases energy poverty (β = 0.157, p < 0.001), while higher income (β = –0.134, p < 0.001) and non-agricultural occupation type (β = –0.312, p < 0.001) reduces energy poverty. Under H5, gender negatively affects environmental concerns (β = –0.084, p < 0.001), whereas income (β = 0.076, p < 0.01) and non-agricultural occupation (β = 0.088, p < 0.001) positively influence environmental concerns. Finally, H6 shows that gender (β = 0.154, p < 0.001) and non-agricultural occupation type (β = 0.078, p < 0.01) positively influence religiosity, while income has no significant effect.

These results highlight the role of socioeconomic factors in shaping the energy-environment-religion nexus. The positive association between female household headship and religiosity suggests that faith may serve as a compensatory resource for groups disproportionately burdened by energy poverty. At the same time, higher income and non-agricultural occupations consistently reduce energy poverty and strengthen environmental concern, underscoring the importance of economic security and livelihood diversification in advancing environmental sustainability in the study area. These findings support earlier studies documenting the effects of gender and income on energy poverty (Nsenkyire et al., 2023b; Bakehe, 2025).

Regarding the indirect pathways, for H2, religiosity influences environmental concerns via energy poverty (β = 0.022, p < 0.001), confirming that part of its effect operates through reducing energy deprivation. Under H4, gender exerts a negative indirect effect on energy poverty (β = –0.027, p < 0.01), with occupation type also showing similar indirect effect (β = –0.013, p < 0.01). For H5, only occupation type demonstrated a stronger positive indirect effect (β = 0.049, p < 0.001).

These findings indicate that income does not produce any significant indirect effect, suggesting that its role is limited to direct improvements in energy access and concerns for the environment. Gender exerts a negative indirect effect on energy poverty, implying that female-headed households reduce deprivation partly through religiosity, though this pathway does not extend to environmental concern. Occupation type, however, affects both energy poverty and environmental concern, showing that livelihood differences provide the clearest socioeconomic route through which households translate reduced deprivation into ecological attitudes.

Table 5: SEM results (Model 2)

Direct	Direct effects	Indirect effects
H1: Energy poverty → Environmental concerns	-0.124*** (0.038)	
H2: Religiosity → Environmental concerns	0.110*** (0.035)	0.022***
H3: Religiosity → Energy poverty	-0.175*** (0.035)	
H4:		
A: Gender → Energy poverty	0.157*** (0.034)	-0.027**
B: Income → Energy poverty	-0.134***	0.007

	(0.033)	
C: Occupation type → Energy poverty	-0.312*** (0.033)	-0.013**
H5:		
A: Gender → Environmental concerns	-0.084*** (0.032)	0.001
B: Income → Environmental concerns	0.076** (0.031)	0.011
C: Occupation type → Environmental concerns	0.088*** (0.034)	0.049***
H6:		
A: Gender → Religiosity	0.154*** (0.033)	
B: Income → Religiosity	-0.039 (0.033)	
C: Occupation type → Religiosity	0.078** (0.032)	
RMSEA		0.042
NNFI		0.967
CFI		0.977
SRMR		0.033
CD		0.156
Observations		1153

The study results confirm that energy poverty is not only a socioeconomic challenge but also an environmental issue. When households rely on traditional energy, they contribute to deforestation, biodiversity loss, and declining ecosystem services (Nunoo & Agyekumhene, 2022). In such contexts, environmental concern may diminish as immediate survival takes precedence. This reinforces the broader literature on the energy and environment nexus (Liu & Nguea, 2025), where deprivation accelerates ecological degradation (Asifat et al., 2025) and undermines conservation efforts (Chen & Usman, 2025).

Religiosity, however, influence this nexus by fostering environmental concern and reducing energy poverty, thereby enabling households to engage more meaningfully with environmental issues. This dual role positions faith as a practical resource, capable of reshaping household energy practices and ecological attitudes. The findings resonate with scholarship that views religion in Africa as pragmatic (Toren et al., 2020) and socially embedded, serving secular purposes (Louder et al., 2025) while guiding collective action.

Socioeconomic dynamics show that female-headed households, despite bearing disproportionate burdens of energy deprivation, translate religious values into nurturing and conservation-oriented practices. Similarly, non-agricultural households are less energy-deprived and more environmentally conscious yet translate religious values into ecological sustenance. directly to natural resource use. These differentiated pathways highlight the importance of intersectional analysis (Benites Lazaro & Day, 2026) in understanding how religiosity shapes the energy-environment nexus.

5. Conclusion

This study set out to investigate how energy poverty, religiosity, and environmental concerns intersect in Ghana's coastal fishing communities, with attention to gender and livelihood dynamics. The findings reveal that energy poverty consistently undermines environmental concern, reflecting the difficult trade-offs households face between meeting immediate energy needs and prioritizing ecological sustainability. Religiosity, however, emerges as a transformative social force, directly fostering ecological awareness while simultaneously reducing energy poverty, thereby indirectly enabling households to engage in environmental issues.

By situating religiosity within the energy-environment nexus, the study demonstrates that faith functions not only as a moral compass but also as a form of social capital that can reshape household energy practices and ecological attitudes. The differentiated effects across male and female-headed households, as well as agricultural and non-agricultural livelihoods, underscore the importance of intersectional analysis. Gender and occupation type condition how religiosity mediates energy behavior and environmental concern, revealing that sustainability pathways are contingent upon household characteristics.

The implication is that energy transitions in coastal Ghana cannot be understood solely through technical or economic lenses. They are deeply embedded in social realities, shaped by values, identities, and livelihoods. Policies that expand access to clean energy must therefore be complemented by strategies that engage religious institutions, mobilize faith-based narratives, and address gendered and occupational differences. Such integrated approaches hold promise for advancing clean energy access, ecological resilience, and inclusive coastal development.

In doing so, this study contributes to the growing literature on the sociocultural dimensions of energy poverty, offering empirical evidence from an African context where religiosity permeates everyday life. It highlights that the path toward sustainability is not only about technology and economics but also about harnessing the moral and social resources that communities already possess.

This study reveals ways in which energy poverty, religiosity, and environmental concerns intersect in Ghana's coastal fishing communities, but it also opens several avenues for further inquiry. Future research should deepen exploration of the mediating role of religiosity in energy-environment dynamics across diverse African contexts. While this study highlights faith as a social resource, comparative work across different religious traditions and regions could clarify whether these effects are universal or context specific.

Another promising direction lies in intersectional analysis. This study revealed differentiated pathways across gender and livelihood groups, but future work could expand to include age, education, and urban-rural divides. Understanding how religiosity interacts with these structural determinants would enrich debates on energy justice and sustainability transitions.

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Data Statement

The data titled "Energy behaviour, coastal ecosystem preservation, and transition willingness: An assessment towards the blue economy of Ghana (Datasets)" will be published online at https://rocdatahub.ucc.edu.gh/ when the project ends. In the interim, the data may be made available upon reasonable request to the corresponding author.

Conflict of Interest

The authors have no known financial or nonfinancial interests to disclose.

References

Adjei, J. K., & Sika-Bright, S. (2019). Traditional beliefs and sea fishing in selected coastal communities in the Western Region of Ghana. *Ghana Journal of Geography*, *11*(1), 1-19.

Agyeman, J., Schlosberg, D., Craven, L., & Matthews, C. (2016). Trends and directions in environmental justice: from inequity to everyday life, community, and just sustainabilities. *Annual review of environment and resources*, *41*, 321-340. https://doi.org/10.1146/annurev-environ-110615-090052

Alesina, A., Hohmann, S., Michalopoulos, S., & Papaioannou, E. (2023). Religion and educational mobility in Africa. *Nature*, *618*(7963), 134-143. https://doi.org/10.1038/s41586-023-06051-2

Ampofo, A., & Mabefam, M. G. (2021). Religiosity and Energy Poverty: Empirical evidence across countries. *Energy economics*, *102*, 105463. https://doi.org/10.1016/j.eneco.2021.105463

Arbuckle, M. B., & Konisky, D. M. (2015). The role of religion in environmental attitudes. *Social Science Quarterly*, *96*(5), 1244-1263. https://doi.org/10.1111/ssqu.12213

Asifat, J. T., Akintade, E. A., Oyesanmi, O. R., & Nwaezeigwe, J. O. (2025). Rural energy poverty and deforestation in nigeria: implications for sustainable development. *Journal of Energy Research and Reviews*, *17*(9), 54-73. https://doi.org/10.9734/jenrr/2025/v17i9455

Aubry, P., Quaintenne, G., Dupuy, J., Francesiaz, C., Guillemain, M., & Caizergues, A. (2023). On using stratified two-stage sampling for large-scale multispecies surveys. Ecological Informatics, 77, Article 102229. https://doi.org/10.1016/j. ecoinf.2023.102229

Bakehe, N. P. (2025). To Believe and Suffer: The Effect of Voodoo on Energy Poverty. *The Journal of Environment & Development*, 10704965251330596. https://doi.org/10.1177/10704965251330596

Batool, K., Zhao, Z. Y., Sun, H., & Irfan, M. (2023). Modeling the impact of energy poverty on income poverty, health poverty, educational poverty, and environmental poverty: a roadmap

towards environmental sustainability. *Environmental Science and Pollution Research*, *30*(36), 85276-85291. https://doi.org/10.1007/s11356-023-28238-w

Benites Lazaro, L. L., & Day, R. (2026). Gender dimensions in energy justice and just energy transitions: mapping the field and its gaps in a global literature review. *Environmental Research: Energy*, *3*(2), 022002. 10.1088/2753-3751/ae728c

Boateng, A. C. O., Sebu, J., Lekwauwa, R., Britt, K. C., Oh, H., & Doolittle, B. (2024). Religiosity & mental health seeking behaviors among US adults. *The International Journal of Psychiatry in Medicine*, *59*(2), 248-264. https://doi.org/10.1177/00912174231187841

Butty, O. N., Seraj, M., & Özdeşer, H. (2025). Does energy poverty contribute to gender inequality and environmental degradation in Africa? *International Journal of Energy Sector Management*, *19*(1), 101-116. https://doi.org/10.1108/IJESM-01-2024-0027

Chen, N., & Usman, M. (2025, November). Energy use, energy depletion, and environmental degradation: exploitation of natural resources. In *Natural Resources Forum* (Vol. 49, No. 4, pp. 3984-3995). Oxford, UK: Blackwell Publishing Ltd. https://doi.org/10.1111/1477-8947.12591

Cho, S., Crenshaw, K. W., & McCall, L. (2013). Toward a field of intersectionality studies: Theory, applications, and praxis. *Signs: Journal of women in culture and society*, *38*(4), 785-810. https://doi.org/10.1086/669608

Churchill, S. A., & Smyth, R. (2022). Protestantism and energy poverty. *Energy economics*, *111*, 106087. https://doi.org/10.1016/j.eneco.2022.106087

Crentsil, A. O., Asuman, D., & Fenny, A. P. (2019). Assessing the determinants and drivers of multidimensional energy poverty in Ghana. *Energy Policy*, *133*, 110884. https://doi.org/10.1016/j.enpol.2019.110884

Dhenge, S. A., Ghadge, S. N., Ahire, M. C., Gorantiwar, S. D., & Shinde, M. G. (2022). Gender attitude towards environmental protection: a comparative survey during COVID-19 lockdown situation. *Environment, Development and Sustainability*, *24*(12), 13841-13886. https://doi.org/10.1007/s10668-021-02015-6

Dimnwobi, S. K., Okere, K. I., Onuoha, F. C., & Ekesiobi, C. (2023). Energy poverty, environmental degradation and agricultural productivity in Sub-Saharan Africa. *International Journal of Sustainable Development & World Ecology*, *30*(4), 428-444. https://doi.org/10.1080/13504509.2022.2158957

Dong, J., Ren, Y., & Glauben, T. (2024). Gospel or curse: the impact of religious beliefs on energy poverty in rural China. *Humanities and Social Sciences Communications*, *11*(1), 1-17. https://doi.org/10.1057/s41599-024-03119-w

Fisheries Commission. (2022). Report on the 2022 Ghana Marine Canoe Frame Survey. Accessed on 20/07/2024.

Höllinger, F., & Makula, L. (2021). Religiosity in the major religious cultures of the world. *International Journal of Sociology*, *51*(5), 345-359. https://doi.org/10.1080/00207659.2021.1958181

IEA, IRENA, UNSD, World Bank, & WHO. (2026). Tracking SDG 7: The Energy Progress Report. World Bank, Washington DC. © World Bank.

Johnson, T. M., & Grim, B. J. (2013). *The world's religions in figures: An introduction to international religious demography*. John Wiley & Sons.

Koehrsen, J. (2015). Does religion promote environmental sustainability? – Exploring the role of religion in local energy transitions. *Social Compass*, *62*(3), 296-310. https://doi.org/10.1177/00377686155878

Li, J., & Ma, W. (2023). Sharing energy poverty: The nexus between social interaction-oriented gift expenditure and energy poverty in rural China. 10.1016/j.erss.2023.103131

Li, Y., Wang, B., & Saechang, O. (2022). Is female a more pro-environmental gender? Evidence from China. *International journal of environmental research and public health*, *19*(13), 8002. **https://doi.org/10.3390/ijerph19138002**

Li, H., Leng, X., Hu, J., Cao, A., & Guo, L. (2023). When cooking meets confucianism: Exploring the role of traditional culture in cooking energy poverty. *Energy Research & Social Science*, *97*, 102956. https://doi.org/10.1016/j.erss.2023.102956

Liu, Y., & Nguea, S. M. (2025). Linking energy vulnerability to environmental sustainability in Africa: An ecological footprint approach. *Renewable Energy*, 125005. https://doi.org/10.1016/j.renene.2025.125005

Louder, E., Harrison, C., & Luke, N. (2025). Picking up the slack: Faith-based organizations, informal support networks and energy insecurity, poverty, and vulnerability in the southeastern United States. *Energy Research & Social Science*, *129*, 104350. https://doi.org/10.1016/j.erss.2025.104350

Mefful, J., Nunoo, J., Nsenkyire, E., & Naatey Angmor, R. (2026). Breaking the darkness: How multidimensional energy poverty affects child learning outcomes in selected developing countries. *SN Social Sciences, 6*(379). https://doi.org/10.1007/s43545-026-01657-5

Murray, G., & Agyare, A. (2018). Religion and perceptions of community-based conservation in Ghana, West Africa. *PLoS One*, *13*(4), e0195498. https://doi.org/10.1371/journal.pone.0195498

Nsenkyire, E., Nkrumah, R. K., Nunoo, J., & Sebu, J. (2023a). Energy poverty and functional disability nexus: Empirical evidence from Ghana. *Energy for Sustainable Development*, *77*, 101353. https://doi.org/10.1016/j.esd.2023.101353

Nsenkyire, E., Nunoo, J., Sebu, J., & Iledare, O. (2023b). Household multidimensional energy poverty: impact on health, education, and cognitive skills of children in Ghana. *Child Indicators Research*, *16*(1), 293-315. https://doi.org/10.1007/s12187-022-09970-0

Nsenkyire, E., Nunoo, J., Sebu, J., Nkrumah, R. K., & Amankwanor, P. (2024a). Multidimensional Energy Poverty in West Africa: Implication for Women's Subjective Well-being and Cognitive Health. *Applied Research in Quality of Life*, *19*(3), 859-880. https://doi.org/10.1007/s11482-024-10271-7

Nsenkyire, E., Sebu, J., & Nunoo, J. (2025a). Energy Use Behaviors in Ghana's Coastal Zone: Does Women's Empowerment and Its Dimensions Matter? *Coastal Studies & Society*, *4*(4), 227-253. https://doi.org/10.1177/26349817251356000

Nsenkyire, E., Nunoo, J., & Sebu, J. (2025b). An assessment of cooking energy behaviours in Ghana's marine fishing communities. *Next Research*, 101160. https://doi.org/10.1016/j.nexres.2025.101160

Nsenkyire, E., Nunoo, J., & Sebu, J. (2025c). Ready or not: An assessment of energy transition willingness of marine fishing communities in Ghana towards the blue economy. *Energy for Sustainable Development*, *89*, 101853. https://doi.org/10.1016/j.esd.2025.101853

Nsenkyire, E., Nunoo, J., Sebu, J. (2026). Energy behavior and coastal ecosystem preservation intentions towards the blue economy: Evidence from fishing communities in Ghana. In *The Blue Economy in African Coastal Communities, Volume 2.* Cham: Springer Nature Switzerland.

Nunoo, F. K. E., & Agyekumhene, A. (2022). Mangrove degradation and management practices along the Coast of Ghana. *Agricultural Sciences, 13*, 1057-1079 https://doi.org/10.4236/as.2022.1310065

Putnam, R. D. (Ed.). (2002). *Democracies in flux: The evolution of social capital in contemporary society*. Oxford University Press.

Saroglou, V., El Marsni, K., & Benaicha, I. (2025). Pro-environmental attitudes and behavior: The role of religion and spirituality in secularized Europe beyond relevant individual differences. *Journal of Environmental Psychology*, 102799. https://doi.org/10.1016/j.jenvp.2025.102799

Siisiäinen, M. (2003). Two concepts of social capital: Bourdieu vs. Putnam. *International journal of contemporary sociology*.

van den Toren, B., Bangura, J. B., & Seed, R. E. (Eds.). (2020). *Is Africa Incurably Religious?: Secularization and Discipleship in Africa*. Fortress Press.

Zang, D., Li, F., & Chandio, A. A. (2021). Factors of energy poverty: evidence from Tibet, China. *Sustainability*, *13*(17), 9738. https://doi.org/10.3390/su13179738