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Religiosity and climate change: An eco-religious approach

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ABSTRACT

An eco-religious approach is one that combines religious beliefs with ecological awareness, thus giving rise to responsibility for the natural environment, such as the threat of a climate crisis due to climate change, as part of the understanding of religion itself. This approach is not universally accepted because views on climate change, and the role of humans in addressing it, can vary among different religions and religious traditions. This research explores the relationship between religiosity and climate change, with a focus on the concept of an eco-religious approach. The aim was to understand how religiosity can influence climate change using the ecological footprint as a proxy. The cross-country robust regression analysis method was employed to address this objective. Robustness and sensitivity model checks were also performed, resulting in reliable regression analysis that can be generalized to various situations. The results of the study suggest that increased religiosity is associated with a decrease in per person ecological footprint. This research suggests a transformation of religious values towards a more inclusive eco-religious perspective, encompassing bio-centric and eco-centric ethics, and not just anthropocentric views. Collaboration between religious and non-religious communities is key in addressing climate change. Religious institutions are also identified as essential agents in mobilizing environmental movements, participating in international forums, and incorporating climate change issues into educational curricula. This research supports the potential of religiosity as a positive catalyst in global efforts to preserve environmental sustainability and address the holistic challenges of climate change.

KEY WORDS: religiosity measurement, religious transformation, climate crisis, ecological footprint, environmental sustainability

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1. Introduction

Climate change is the most serious environmental issue that triggers a human-induced climate crisis. It can lead to global disasters and stands as the greatest collective challenge ever faced by humanity (KEMP ET AL., 2022; STEG, 2023; LYON ET AL., 2023; HARVEY ET AL., 2023). According to the 2016 World Economic Forum (WEF) report, climate change cannot be fully addressed without involving religious beliefs (WOODHEAD, 2016). There are at least four fundamental reasons that support this statement. First, religious traditions possess cultural integrity, spiritual depth, and moral strength that have been tested throughout history. This allows religions to create narratives, rituals, and motivations necessary for lifestyle changes. Second, climate change is a matter of global justice, and religious traditions often emphasize the importance of justice and listening to vulnerable voices. Third, religious leaders wield extensive influence, from the local to the international level, and religious communities form a global network capable of mobilizing actions. Fourth, religions have experience in formulating hopes and solutions for the challenges posed by climate change.

Among social institutions, religion is often considered to be one of the most crucial pathways for values, motivations, morals, and worldviews. Therefore, observers have suggested several key reasons why world religions, once engaged, can become a vital part of society's response to climate change (VELDMAN ET AL., 2012; MÜLLER, 2021; POSAS, 2007). First, religion may encourage responses to climate change through its influence on worldviews or cosmology and the moral obligations it promotes. Second, religion can engage a wide audience, many of whom accept and respect their moral authority and leadership. Third, religion has significant institutional and economic resources. Fourth, religion has the potential to provide connectivity (such as in the form of social capital) that encourages the achievement of collective goals. Each of these characteristics can be applied to the issue of climate change. In short, religion is regarded as an influential force in shaping the attitudes and behaviours of its followers and serves as a potent social actor.

The involvement of religion in environmental issues has been a growing movement for some time (WATLING, 2015). This movement is particularly evident in the field of religion and ecology, which seeks to facilitate the exploration and promotion of eco-religious ideas by analysing, comparing, and integrating different religious perspectives on nature and human interactions with the environment.

The concept of eco-religiosity has inspired many researchers worldwide who have contributed to understanding the relationship between religion, spirituality, and nature. Among them, some notable researchers stand out. One of them is COBB JR (2021), a theologian and philosopher, who has written extensively on environmental issues and ecological theology. In his work, he explains that eco-religiosity is a worldview, or religious understanding, that integrates the values of spirituality and ecological sustainability. Eco-religiosity is seen as an approach that combines religious beliefs with ecological awareness, thus fostering responsibility toward the natural environment as an integral part of religious understanding. This means that the natural environment is placed as a crucial aspect of religious belief and encourages responsible actions towards nature as a form of reverence for God's creation.

In the book "Ecology and Religion" published by GRIM & TUCKER (2014), various religious and cultural perspectives on nature and the environment are investigated. The book emphasizes the importance of interfaith dialogue in addressing climate change and preserving the environment. GRIM & TUCKER (2014) seek to build bridges between religious practitioners and ecological scientists, demonstrating how religion can make a positive contribution to understanding the relationship between humans and nature. The challenges of integrating ecological concerns into various cultures worldwide are also discussed, along with common patterns connecting humans to the environment. The book offers an inclusive view of various religious traditions worldwide, illustrating that religious perspectives are not limited to monotheism. Furthermore, the importance of understanding the role of religion in understanding human motivation and social change is acknowledged, despite challenges and tensions in this dialogue. By presenting thoughts from various theologians and ecological scientists, this book makes a valuable contribution to understanding the relationship between religion and ecology and the role of religion in achieving global ecological sustainability, a recognition echoed by ALLISON (2016).

Previously, NASR (2007), a prominent philosopher and scholar of religion, promotes the integration of religious beliefs with responsibility for the environment. He emphasizes that religion plays a crucial role in inspiring the protection of nature as an integral part of spiritual life. His ideas have also influenced the Islamic understanding of environmental issues, with global implications due to the large Muslim population worldwide. His contribution is a reminder to individuals and communities of the central role of religion in ecological awareness and sustainable actions to protect the environment, supporting global efforts to maintain the planet's sustainability (SAYEM, 2022).

Other equally renowned eco-religious thinkers are TAYLOR (2010, 2020) and BERKES (2017), who have deeply considered the relationship between religion, humans, and nature. Taylor is famous for developing the concept of "Earth religions" or "ecological religions," revealing how some traditional religions and beliefs connect humans and nature as an inseparable unity. This inspired Berkes, an environmental scientist and anthropologist, to delve deeper into the understanding that in traditional cultures and societies, nature is considered sacred. Berkes emphasizes the importance of recognizing and respecting local knowledge and traditional wisdom in natural resource management.

In a broader context, GLAESER (2023) argues that religious responses to global environmental change have significant potential to influence how we treat the environment and our perceptions of human

actions and rational social order. This perspective has shaped the current cultural situation that views global environmental change as a risk. Glaeser proposes that eco-religiosity is a necessary condition to implant rational and sustainable ecological behaviour in society. Thus, this thinking illustrates the importance of integrating spiritual values and ecological understanding in responding to the challenges of climate change and environmental preservation.

Social science research examining the relationship between religious institutions and human-induced climate change is still limited. Most current research is theological, normative, or related to specific religions. Recently, empirical, and social scientific research has begun to explore the perspectives and actions of world religions and their followers regarding climate change. RONAN (2017) and JENKINS ET AL. (2018) have shown that the study of religion and climate change has evolved into an academic field that collaborates with various other disciplines, such as science, economics, education, and public policy, in an effort to find comprehensive solutions to global and local environmental challenges.

In recent years, research on the connection between religious considerations and climate change has seen an increase (SMITH & LEISEROWITZ, 2013; HALUZA-DELAY, 2014; KILBURN, 2014; ALLISON, 2015; EDENHOFER ET AL., 2015; MURPHY ET AL., 2016; HULME, 2017; CLINGERMAN & O'BRIEN, 2017; JENKINS ET AL., 2018). The increased substance of this research has focused on cultural and value aspects, prompting researchers to analyse the role of religion in understanding the cultural dynamics related to climate change (ADGER ET AL., 2013; HULME, 2016; ABSON ET AL., 2017; JENKINS ET AL., 2018; CHRISTIE ET AL., 2019; IVES & KIDWELL, 2019;; OTTO ET AL., 2020; IVES ET AL., 2020).

Tracking previous empirical research is a crucial step towards checking if the research to be conducted has been done before and to assist in structuring the writing and research methods. For example, in the study by TSIMPO & WODON (2016), the relationship between religious affiliation, religiosity levels, and attitudes toward the environment and climate change was analysed. Data used was from the World Values Survey (WVS), which included 52 countries with a sample of 76,303 respondents. Through probit regression analysis, it was found that individuals with higher levels of religiosity tended to prioritize environmental issues over economic growth. They were also more willing to support policies to address pollution through voluntary contributions, increased taxes, or the use of existing government revenue, and they considered environmental issues as a serious matter.

SHARMA ET AL. (2021) conducted research on the impact of religiosity on climate change policies in 75 countries worldwide. Religiosity was measured in terms of five crucial aspects of an individual's religious orientation, namely considering oneself as a religious person, belief in God, the importance of God, religious participation, and the importance of religion. Data used was from the WVS. By using cross-country regression methods, they found that religiosity hindered efforts to implement climate change policies and sustainable development programs.

In SQUALLI'S (2019) study on the impact of religiosity on the environment in the United States, data from the Pew Research Center's 2014 survey were used. Estimation results through cross-state regression showed variation in the relationship between religiosity and environmental impact. There was no correlation between religiosity and PM_{25} and SO_2 emissions. However, higher levels of religiosity were associated with higher toxic releases into state waters. Additionally, states with larger Christian populations had higher CO_2 and SO_2 emissions, while states with larger Muslim populations had lower toxic releases into state waters. This suggests that environmentally related actions associated with religious behaviour do not have to be limited to specific religious groups but can be influenced by common factors such as levels of religious socialization, consistent religious enforcement, behaviour within families and communities, and commitment to religious beliefs.

The study by ZEMO & NIGUS (2020) revealed the positive impact of religion on pro-environmental behaviour. In this study, religion encouraged individuals to donate money, reduce protests against contributions to environmental protection, increase participation in environmental demonstrations, and contribute to ecological efforts. The importance of religion in supporting environmental protection was more pronounced in low-income countries than in high-income countries. These findings emphasize the importance of integrating religion into environmental policies and programs for better results, consistent with previous findings by ERGUN & RIVAS (2019), which stated that more religious individuals, such as the Turks, tend to be concerned about climate change.

Referring to the background, literature review, and previous empirical studies, this research aims to analyse the influence of religiosity on climate change using an eco-religious approach, where

climate change is proxied using ecological footprints. This study also involves economic, demographic, and political aspects in the analysis.

2. Method

This research is a quantitative study that utilizes secondary data sourced from the World Value Survey (WVS), Global Footprint Network (GFN), World Development Indicator (WDI), Worldwide Governance Indicators (WGI), Our World in Data (OWD), and the Pew Research Center (PRC).

2.1. Construction of the Religiosity Index

This study adopts an approach to measure religiosity based on five key indicators of individual religious orientation, including self-perception as a religious individual, belief in God, importance of God, participation in religious activities, and importance of religion (BÉNABOU ET AL., 2015; SHARMA ET AL., 2021; see Table 1). Data were collected from the World Value Survey (WVS) over a period spanning approximately four decades (1981–2022), using combined data from seven waves of the WVS. Initially, 106 countries were included in the sample, which was later reduced to 95 countries after incorporating control variables. Based on the five measures of religiosity at the country level, an overall religiosity index was formed by calculating the average of these five measures. The values of the religiosity index range from zero to one, with higher values indicating higher levels of religiosity.

Table 1. Religiosity measurement (Source: Polled WVS Dataset, 1981–2022)

Measure	Construction Method
Religious person	The questionnaire asked, "Independently of whether you attend religious services or not, would you say you are: a religious person, not a religious person, or an atheist?" This study utilizes the percentage of respondents who consider themselves to be religious persons.
Belief in God	The questionnaire asked, "Do you believe in God?" This study utilizes the percentage of respondents who answered "yes."
Importance of God	The questionnaire asked, "How important is God in your life?" Respondents were asked to rate importance on a scale from 1 (not at all important) to 10 (very important). This study takes the percentage of respondents who rated this from 6 to 10.
Religious Participation	The questionnaire asked, "How often do you attend religious activities?" Respondents were asked to choose, on an eight-point scale, from "never, almost never" to "more than once a week." This study takes the percentage of respondents who said, "once a week" or "more than once a week."
Importance of Religion	The questionnaire asked, "How important is religion in your life?" Respondents were asked to rate on a four-point scale from "not at all important" to "very important." This study takes the percentage of respondents who said, "somewhat important" or "very important".

2.2. Regression model

The empirical model in Equation 1 was employed in the cross-country regression analysis. This model is adapted from the studies by SQUALLI (2019) and SHARMA ET AL. (2021).

$$LEFP_i = \alpha + \beta Religiosity_i + \gamma' CV_i + e_i \quad (1)$$

The $LEFP$ variable represents the dependent variable, climate change, proxied using the ecological footprint per person in a country i. $Religiosity$ is the independent variable, an index of religiosity. CV stands for the set of control variables, including economic growth (real GDP per capita, PPP 2017 transformed into the natural logarithm), population growth (population number transformed into the natural logarithm), the contribution of the industry, including construction (% of GDP), fossil fuel-based electricity consumption (transformed into the natural logarithm), and institutional quality. Institutional quality is constructed from the average of political stability and control of corruption, on a scale from -2.5 to 2.5 (KAUFMANN ET AL., 2011). Higher index values represent higher institutional quality. Additionally, this research includes regional dummy variables based on the World Bank classification. All variables use cross-sectional data for the year 2020, except for the religiosity index, which uses the average data from WVS waves (1981–2022). The sample consisted of 95 countries.

3. Results and discussion

3.1. Descriptive analysis

Table 2 provides a summary of the statistical values for the variables used in this study, including the mean, standard deviation, minimum, and maximum values. Focusing on the variables of interest, the religiosity index ranges from a minimum of 0.12 in China to a maximum of 0.97 in Qatar. The average value of the religiosity index is 0.66. Countries with religiosity index values at, or around, the overall average include Singapore, Chile, Bosnia and Herzegovina, and Moldova. As the industrial sector is not transformed into natural logarithms, it has a relatively high standard deviation. The minimum value for the institution variable is negative, while the other variables have positive values.

Ecological footprint is a concept that measures the impact, or demand, made by individuals, groups, or countries on global natural resources. This concept was first developed by Mathis Wackernagel and William Rees in 1990 while they were working at the University of British Columbia. The ecological footprint describes how much the use of natural resources by an entity exceeds the Earth's capacity to renew those resources within a specific timeframe (WACKERNAGEL & GALLI, 2007). The ecological footprint has become one of the most widely used measures to assess human impact on the environment and has been used to highlight both unsustainable current practices and inequality in resource consumption among and within countries (REES & WACKERNAGEL, 2023; HAYDEN, 2023).

Visually, the distribution of the ecological footprint can be seen in Figure 1. Based on data published by the Global Footprint Network, it can be observed that in 2020, the ten largest contributors to the ecological footprint among the 95 studied countries were China, the United States, India, the Russian Federation, Brazil, Japan, Indonesia, Germany, Mexico, and Turkey. These ten countries accounted for approximately 74.98 percent of the world's ecological footprint. China alone contributed 29.34 percent of the world's ecological footprint. The countries with the lowest ecological footprints per person are Montenegro, Cyprus, and Moldova. When calculated per person, the largest contributors to the ecological footprint are Qatar, Mongolia, Estonia, Kuwait, Latvia, the United States, Lithuania, Singapore, the Netherlands, and Australia. The distribution map of the ecological footprint per person can be seen in Figure 2.

Table 3 presents the estimated results of the influence of religiosity on the ecological footprint per person. Column (1) shows the results of OLS regression without including control variables. Column (2) shows the results of OLS regression with the inclusion of control variables to better complement, or control, the causal relationship and obtain a more complete empirical model while preventing calculation bias. By adding control variables, the coefficient of determination (R^2) increased from 0.52 to 0.82. In column (2), the estimation results show that the religiosity index has a significantly negative effect on the per person ecological footprint.

Table 2. Descriptive statistics

Variable	Mean	Std. Dev.	Min.	Max.
Religiosity index	0.66	0.21	0.12	0.97
ln Ecological footprint per person (*LEFP*)	0.94	0.68	-0.55	2.43
Economic growth (ln Real GDP per capita)	9.64	0.96	7.60	11.46
Population growth (ln Total population)	16.79	1.54	13.34	21.07
Industry (% of GDP)	26.68	7.68	6.64	52.33
Electricity consumption (ln Fossil fuel-based electricity per capita)	6.92	1.79	-2.46	9.69
Institutional quality	-0.11	0.88	-2.01	1.82

Note: The sample size was 95 countries

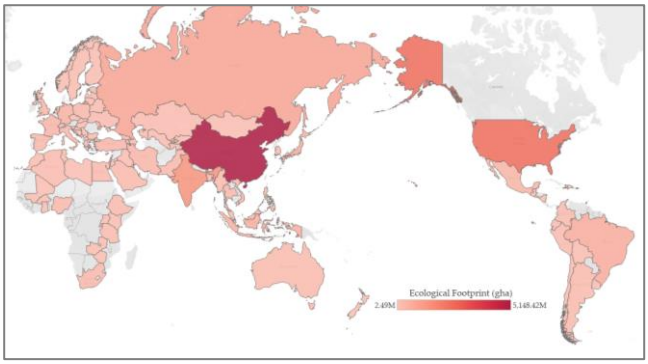


Fig. 1. Spatial distribution of the ecological footprint. Darker red areas represent higher values (Source: Global Footprint Network, 2020 (processed))



Fig. 2. Spatial distribution of the ecological footprint (per person). Darker red areas represent higher values Source: Global Footprint Network, 2020 (processed))

Table 3. Estimation results

Dependent variable = *LEFP*	OLS regression		Robust regression	
	Basic specification	Main specification	Basic specification	Main specification
	(1)	(2)	(3)	(4)
Religiosity index	-1.29*** (-3.73)	-0.47* (-1.83)	-1.50*** (-4.68)	-0.46** (-2.16)
Economic growth	-	0.57*** (6.15)	-	0.64*** (8.32)
Population growth	-	-0.09*** (-3.26)	-	-0.07*** (-3.02)
Industry (% of GDP)	-	0.01* (1.97)	-	0.01** (2.12)
Electricity Consumption	-	0.04 (1.31)	-	0.05* (1.89)
Institutional quality	-	-0.09 (-1.17)	-	-0.13* (-1.98)
Region dummy	Yes	Yes	Yes	Yes
R-squared	0.52	0.82	0.57	0.87
Observation	95	95	94	95

Note: The religiosity index measures overall religiosity and varies continuously from zero to one. The region dummy variables are East Asia and Pacific, Europe and Central Asia, Latin America and the Caribbean, Middle East and North Africa, North America, South Asia, and Sub-Saharan Africa. The best estimation method uses robust regression as shown in column (4). t-statistics are reported in parentheses. *, **, and *** respectively indicate significance at the 10%, 5%, and 1% levels. Intercept estimates are not shown.

3.2. The effect of religiosity on ecological footprint

The estimation results need to be checked for whether the OLS regression model is free from data outlier issues and heteroskedasticity. Figure 3 shows a leverage plot with normalized squared residuals. This plot is used to help identify individual observations with very high leverage or large residuals. The leverage plot has leverage on the Y-axis and normalized squared residuals on the X-axis. The red line indicates the average of the leverage and normalized squared residuals. Leverage is the diagonal element of the hat matrix (h_{ii}) that captures the influence of the observed value on the corresponding value. Leverage observations are bounded by the limits of 1/n and 1, where n = 95. Any point whose diagonal element of the h_{ii} value exceeds 2p/n is considered a leverage point (WILLIAM, 2016), where p is the number of coefficients. With p = 13, data will be considered outliers if $h_{ii} > 0.27$. The United States, Qatar, Pakistan, India, Ethiopia, and Bangladesh have leverage values greater than 0.27. WILLIAM (2016) states that residuals are problematic if 2/sqrt(n) > 0.21. Figure 3 shows the case of South Korea having very large residuals (i.e., the difference between the predicted value and the observed value for South Korea is very large) but does not have high leverage. Furthermore, the results of the White test for heteroskedasticity in column (2) indicate that there is a heteroskedasticity problem with a chi-square probability of 0.17.

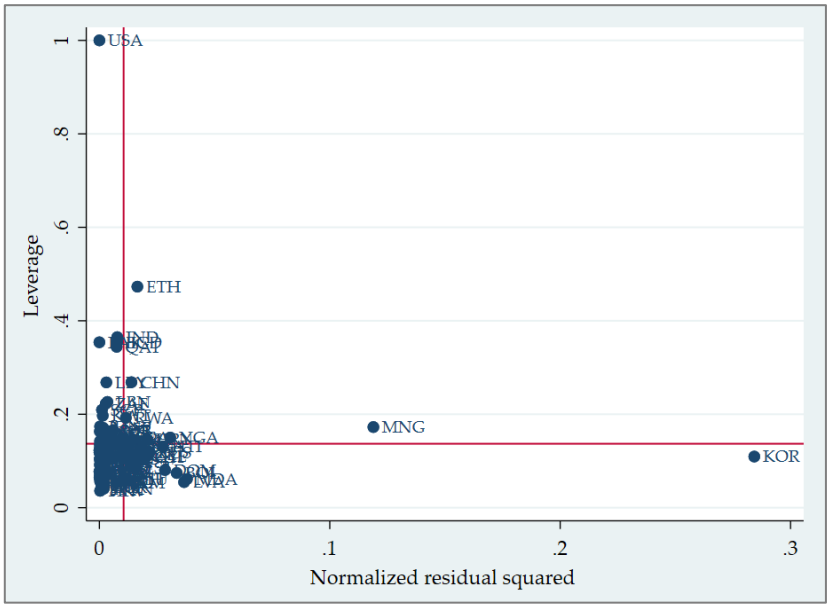


Fig. 3. Plot of leverage and normalized residual squared for detection of influential observations. The plot diagram was obtained by estimating column (2) of Table 3

The issue can be addressed by applying robust regression. Robust regression is a regression analysis method that is not sensitive to outliers and hetero-skedasticity. Columns (3) and (4) of Table 3 show the estimation results using robust regression. The coefficient of determination (R^2) increased from 0.57 to 0.87. Thus, 87 percent of the variability in the ecological footprint per person can be explained by the model in the main specification of this study, which is in column (4). The strength of the influence of the religiosity index is corrected after adding control variables. If religiosity increases by one point in the index, the ecological footprint per person will decrease by 0.46 percent.

This finding challenges the common perception that religion is inherently opposed to climate change issues. The results align with the research of SALTER & WILKINSON (2023), who argue that religious followers increasingly recognize climate change as a multifaceted framework encompassing social, political, cultural, ethical, and environmental dimensions through global and local concerns. Similarly, SKIRBEKK ET AL. (2020) state that countries producing high greenhouse gas emissions with a high GDP tend to be "less religious". It's not surprising that these "less religious" countries more frequently amplify climate crisis issues and adapt more swiftly to climate change, as they are the ones contributing the largest ecological footprint on Earth. In fact, developed countries should bear responsibility for climate injustice due to their significant historical contributions to the ecological footprint and greater economic benefits derived from developing countries, which are generally more religious. Conversely, those experiencing significant losses from climate injustice are often the "religious" countries contributing the least to the ecological footprint.

TSIMPO & WODON (2016) found results consistent with the findings of this research. In their study, they observed that individuals who are more religious are inclined to prioritize the environment over economic growth. Religious individuals are more willing to support policies aimed at preventing pollution through voluntary contributions, higher taxes, or the utilization of existing government income. They also tend to view environmental issues as significant. However, they are less likely to perceive environmental problems as the most pressing issues facing their country, or the world, possibly because other issues may be more closely tied to their religious traditions and, therefore, hold even greater importance for them. Support for similar findings also comes from the research conducted by ZEMO & NIGUS (2020) in 91 countries. They discovered that religion encourages pro-environmental behaviour, fostering individuals' willingness to contribute financially and dampening individual protests against environmental protection contributions. This aligns with the findings of ERGUN & RIVAS (2018) and AGUSALIM & KARIM (2024), revealing that more religious individuals tend to be concerned about climate change issues.

In essence, for over three decades, the rise in ecological awareness has been inspired by religion, marked by an increasing number of statements on climate change issued by religious institutions in recent years (Chaplin, 2016). Religious institutions are actively involved with global climate institutions and civil society organizations addressing human-induced climate change (Huluza-Delay, 2014). Worldwide, many religious groups and denominations have taken action to address climate change and promote environmental concern. For instance, the influential encyclical "Laudato Si'," issued by Pope Francis in 2015, creates a robust framework for integrating environmental issues with Christian moral values (Francis, 2019). Christians globally are also engaged in various environmental campaigns, such as the "Season of Creation" celebrated annually from September 1 to October 4. During this period, Christians participate in prayers, environmental conservation events, and other activities to raise awareness of the importance of nature preservation and our responsebility as stewards of God's creation (Harmon, 2021). The "Catholic Climate Covenant" declaration in the United States is another example (Agliardo, 2013). The Church of England launched the "Shrinking the Footprint" environmental campaign, a leading effort to address climate change and enhance environmental awareness (Swift, 2012; DeLashmutt, 2011).

The Islamic faith has played a crucial role in global efforts to address climate change and promote environmental awareness. A significant initiative is the "Islamic Declaration on Global Climate Change," issued in 2015 by a group of prominent Muslim scholars (Chaplin, 2016; Jenkins et al., 2018; Koehrsen, 2021). This declaration underscores the moral responsibility of the Islamic community to protect the universe and emphasizes the need for concrete actions to reduce greenhouse gas emissions. It encourages Muslims to support renewable energy, reduce resource wastage, and actively participate in global efforts to tackle climate change. Additionally, tree-planting initiatives are integral to Islamic environmental preservation efforts. Programs like "Greening the Desert" in various countries aim to reclaim barren lands and address deforestation through the planting of local trees and vegetation (Bolleter, 2019; AlHammad, 2022).

Hinduism plays a significant role in addressing climate change and fostering environmental concern. A notable example is the "Green Hinduism" movement, a global initiative aiming to integrate Hindu teachings with tangible actions for environmental protection (De Koning, 2022). This movement teaches that the Earth is "Matri Bhumi" (our mother) and that preserving nature is a sacred duty. Additionally, the "Project Green Hands" initiative established by the Isha Foundation in India has successfully planted millions of trees and provided training on sustainable farming practices to local farmers (Sankar, 2011). Hindu leaders worldwide made a declaration known as the "Hindu Declaration on Climate Change" in 2015 (Lal, 2015).

Buddhist followers have long been pioneers in addressing climate change and promoting environmental awareness. A notable movement is the adoption of the "Green Sangha" concept, where Buddhists actively engage in sustainable practices, including promoting vegetarianism, reducing resource wastage, and supporting renewable energy. This movement also encourages meditation practices to raise awareness of an individual's environmental impact and alleviate stress caused by climate change. Another significant movement is "Green Buddhism" (Kaza, 2019), aiming to integrate Buddha's teachings and principles into environmental advocacy. It urges Buddhists to live mindfully, reduce ecological footprints, and practice conservation, often involving initiatives like tree planting, cleanup campaigns, and sustainable living workshops. Some Buddhist communities have also released the "Buddhist Declaration on the Environment", affirming their commitment to protecting nature and advocating for positive change.

The Jewish faith has also been actively involved in efforts to address climate change and promote environmental awareness. Various campaigns have been introduced by the Jewish community, such as the "Shabbat Shabbaton" campaign, encouraging people to celebrate the Sabbath without using electricity and electrical appliances as a form of energy conservation (Nevin, 2012). Jews have a significant celebration called Tu BiShvat, also known as the "New Year of the Trees" or "Rosh HaShanah La'Ilanot," observed on the 15th day of the Hebrew month of Shevat. Tu BiShvat commemorates the time when fruit trees in Israel begin to bear fruit again after the winter season. During this celebration, Jewish individuals often undertake actions emphasizing the importance of preserving nature and the environment, such as planting trees, incorporating environmental elements into worship, and considering their responsibility toward nature (Shoham, 2017).

The Sikh community has been actively involved in various movements, campaigns, and declarations to address climate change and enhance environmental awareness. An outstanding movement is "EcoSikh," which focuses on integrating Sikh teachings with

sustainable practices (SINGH, 2021). EcoSikh advocates for tree planting, the use of renewable energy, and reducing plastic waste to minimize environmental impact. The "Lakh Tree Campaign" is one initiative by EcoSikh aiming to plant one million trees worldwide. This campaign motivates Sikh followers and the public to actively participate in preserving the global ecosystem by planting trees that contribute to carbon absorption. The "Amritsar Declaration on Environment" is a statement issued by various Sikh religious leaders in 2016. This declaration emphasizes the importance of protecting water and soil, reducing plastic waste, and promoting renewable energy. The Amritsar Declaration also highlights the significant role of the Sikh faith in preserving sacred water sources and taking tangible actions for environmental protection. Sikhs often celebrate Guru Nanak's birthday by undertaking environmental initiatives, such as river cleanups and tree planting (PRILL, 2015).

While this research generally concludes that religiosity has a negative impact on climate change, some studies present contrasting results. SHARMA ET AL. (2021) found that religiosity inhibits efforts to implement climate change policies and sustainable development programs. HIRSCHL ET AL. (2023) demonstrated that individuals in the United States who literally believe in the Bible as the word of God and practice Protestant faith are indifferent to the issue of climate change. SQUALLI (2019) uncovered a more complex scenario where the relationship between religiosity and the environment varies depending on the variables used to measure environmental impact.

Research findings indicating scepticism about the role of religion in addressing climate change are likely influenced by at least four factors (PRESTON & BAIMEL, 2021). First, theological beliefs or worldviews that downplay environmental concerns, such as imminent end-time theology. Second, implementation barriers, including the level of attention given to environmental concerns and the effort put forth, especially when compared to issues like hunger or economic development in the face of poverty. Third, insufficient social criticism can act as a hindrance because religious groups may not recognize environmental issues as social problems (not rooted in individual behaviour or deemed immoral like greed). Consequently, this leads to a failure to acknowledge deeper root causes and obtain adequate solutions. Fourth, belief barriers encompass factors such as a lack of knowledge or motivation to act, or attachment to current lifestyles.

Religiosity can influence an individual's ecological footprint in ways that contribute to preventing climate change. It does so through several mechanisms (AGUSALIM & KARIM, 2023). First, it fosters environmental education and awareness, with some religious communities incorporating these values into their teachings and beliefs. This includes imparting the importance of environmental stewardship and humanity's responsibility as caretakers of the natural world. Individuals deeply engaged in their faith are more likely to gain knowledge and awareness of environmental issues. Second, religiosity promotes ethical consumption by teaching values such as simplicity, humility, and consideration for others. These values motivate individuals to reduce excessive resource consumption, thus lowering their ecological footprint.

Third, advocacy and mobilization: Religious groups often play a role in environmental advocacy and social mobilization. They can participate in environmental campaigns, influence policies that support sustainability, and mobilize communities to act on climate change. Fourth, social action and environmental service: many religious communities engage in social action and environmental service, such as beach cleanups, tree planting, or waste reduction campaigns. Religiosity can motivate individuals to actively participate in these initiatives to preserve the environment. Fifth, prayer and reflection: Religious prayer, meditation, and reflection can inspire individuals to consider their role in environmental preservation and create spiritual awareness of the importance of the natural world. This can lead to wiser actions in resource utilization.

The research results also report the influence of control variables on the per person ecological footprint, as seen in column (4) of Table 3. The economic growth variable shows a significant positive influence on the per person ecological footprint. LI & LI (2021) state that economic growth is a primary reason for the increase in ecological footprints. Other empirical studies confirming this finding have been conducted by BULUT (2021), ERGUN (2020), and SABIR & GORUS (2019).

The industrial sector significantly affects the increase in per person ecological footprint. This result is similar to the findings of USMAN ET AL. (2019) and DESTEK (2020). To limit environmental degradation, manufacturing companies should adopt and utilize more environmentally friendly technologies in their production processes. Additionally, environmental regulations should be enforced to ensure that manufacturing activities contribute to the environment

and sustainable development (OPOKU & ALUKO, 2021). This research also found that per capita consumption of fossil fuel-based electricity has a partially significant positive impact on the per person ecological footprint. NEAGU (2020) found similar results regarding energy consumption from fossil fuels and ecological footprints in 48 countries worldwide. Similar findings were also found by IBRAHIEM & HANAFY (2020) in Egypt.

In this study, it was found that population growth significantly reduces the ecological footprint per person, confirming the findings of IBRAHIEM & HANAFY (2020). This could be attributed to an increase in environmental awareness, which can help curb excessive resource exploitation. BOUMAN ET AL. (2020) state that higher human awareness of climate change can directly and indirectly influence support for climate policies and personal climate mitigation behaviour, providing valuable insights for science and policy-making. The variable of institutional quality showed a significant impact in reducing the ecological footprint per person. This result confirms the findings of UZAR (2021) conducted in seven developing countries with high economic performance and HUSSAIN & MAHMOOD (2022) in Pakistan. CHRISTOFORIDIS & KATRAKILIDIS (2021), in their research across 29 OECD countries, found that institutional quality contributes to ecological sustainability.

3.2.1. Robustness and sensitivity checks

There are three potential issues that can raise doubts about the robustness and sensitivity of the estimation results. First, disregarding the potential variability in measures of religiosity can lead to estimation bias. Second, neglecting alternative samples and measurements of religiosity can also render the estimation unreliable. Third, an examination that includes religious affiliation and income groups is also needed.

As known, the religiosity index in this study is formed from five measures (see Table 1): (i) religious person, (ii) belief in God, (iii) importance of God, (iv) religious participation, and (v) importance of religion. These five measures are estimated using robust regression, and the results can be seen in Table 4, Columns (1) to (5), which demonstrate that each measure of religiosity has a significant negative influence on the per person ecological footprint. These findings are consistent with the composite index in the main specification in Table 3, Column (4).

Table 4. Estimation results based on measures of religiosity

Dependent variable = *LEFP*	(1)	(2)	(3)	(4)	(5)
Religious person	-0.32* (-1.66)	-	-	-	-
Belief in God	-	-0.42** (-2.00)	-	-	-
Importance of God	-	-	-0.34** (-2.20)	-	-
Religious participation	-	-	-	-0.38* (-1.68)	
Importance of religion	-	-	-	-	-0.45** (-2.60)
Control variables	Yes	Yes	Yes	Yes	Yes
Region dummy	Yes	Yes	Yes	Yes	Yes
R-squared	0.87	0.85	0.87	0.86	0.87
Observation	94	87	95	92	93

Note: Control variables and region dummy are included in the model. Robust regressions are used. t-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. Intercept estimates are not shown.

In this study, the religiosity index was created by combining data from various waves of the WVS (1–7). To ensure that the coefficient estimates used are not biased, the reliability of the model was examined using religiosity indices specific to each wave of the survey. However, a significant constraint was encountered in this practice, namely a sharp drop in the number of available observations in some survey waves. For example, using data from the first wave resulted in only 10 observations that could be used in the analysis. Therefore, to maintain the reliability of the results, testing was conducted using data from the latest survey wave, which is the seventh wave covering the period from 2017 to 2022, allowing the creation of a religiosity index specific to that wave involving a relatively larger number of countries in the analysis. Alternative measures of religiosity can be found in column (1) of Table 5. Although the seventh wave survey provides data from 57 countries, column (1) only includes 54 observations due to data limitations

for some other variables. The results of this analysis are consistent with the main findings of this study.

Furthermore, a robustness test was conducted using the religiosity composite index formulated by SQUALLI (2019). This composite index utilizes four indicators that include the importance of religion, prayer frequency, attendance at places of worship, and belief in God. In this study, this religiosity index was constructed based on data from the World Values Survey (WVS). The results are consistent with and align with the main model of this research, as seen in column (2) of Table 5. This study also developed alternative measures of religiosity based on the framework of INGLEHART & NORRIS (2003). Their framework encompasses six crucial aspects of societal religious orientation, including the importance of God, comfort and strength from God, belief in God, being a religious person, belief in life after death, and religious participation. Using these indicators, a religiosity index was constructed based on the INGLEHART & NORRIS (2003) approach using data obtained from the World Values Survey (WVS). The results of this analysis are consistent with the baseline estimates in the main framework of this study, as shown in column (3) of Table 5.

Table 5. Testing based on alternative samples and measures of religiosity

Dependent variable = *LEFP*	(1)	(2)	(3)
Religiosity index: *Wave* 7	-0.55* (-1.99)	-	-
Religiosity index: Squalli	-	-0.36* (-1.70)	-
Religiosity index: Inglehart	-	-	-0.39* (-1.90)
Control variables	Yes	Yes	Yes
Region dummy	Yes	Yes	Yes
R-squared	0.86	0.87	0.88
Observation	54	94	95

Note: Control variables and region dummy are included in the model. Robust regressions are used. t-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. Intercept estimates are not shown.

Moreover, a sensitivity check was conducted regarding the impact of religious affiliation and income groups. KISHI ET AL. (2017) categorized the relationship between religion and states into the following four categories: first, countries with official religions that grant official status to a specific religion in their constitution or fundamental law. Second, countries with a preference for religion. Third, secular countries that do not have an official religion or religious preference. Fourth, countries with conflicting or hostile relationships with religion, which impose very high levels of control on religious institutions in their countries or actively take aggressive positions against religion in general. In this study, the sample was classified using dummy variables, with the fourth group being set as the omitted group. Column (1) of Table 6 presents results that associate religion with states. The results remain consistent with the main findings in the study's primary specification, indicating that religiosity has a significant negative impact on the ecological footprint per individual. However, the relationship between religion and states does not show a significant effect.

In this study, sensitivity tests were also performed regarding the influence of income groups. These income groups were categorized based on World Bank data from 2020 and divided into four groups: high income, upper-middle income, lower-middle income, and low income. Those income groups were subsequently transformed into dummy variables, where the low-income group was designated as the omitted group. Column (2) in Table 6 reports the estimation results with the addition of income group control variables. The religiosity index continues to have a significant negative effect on the ecological footprint per person.

From various tests on the influence of the religiosity index on climate change, proxied using carbon footprint per person, consistent results were obtained that align with the hypothesis of this research. Religiosity plays a significant role in addressing climate change.

Table 6. Sensitivity to religious affiliation and income groups

Dependent variable = *LEFP*	(1) Adding a dummy variable for the relationship between religion and the state	(2) Adding a dummy variable for income groups
Religiosity index	-0.38* (-1.96)	-0.46*** (-2.65)
Relationship between religion and state	-	-
-Official state religion	-0.24 (-1.60)	-
-Preferred or favoured state religions	-0.07 (-0.58)	-
-No official or preferred religion	-0.09 (-0.58)	-
Income group	-	-
-High	-	0.12 (0.49)
-Upper-middle	-	0.08 (0.41)
-Lower-middle	-	0.02 (0.14)
Control variables	Yes	Yes
Region dummy	Yes	Yes
R-squared	0.88	0.87
Observation	95	95

Note: Control variables and region dummy are included in the model. Robust regressions are used. t-statistics are reported in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. Intercept estimates are not shown.

3.3. Transformation towards eco-religious

Climate change has become a concern and a matter of interest for all global communities, including religious communities. Religion is expected to encourage changes in human behaviour towards environmental sustainability, creating an inclusive and participatory society where every member collectively enjoys the Earth's blessings (Kafley, 2019). Therefore, religion can influence community behaviour to choose eco-friendly behaviours, lifestyles, and consumption patterns that are not harmful to the local ecology (Hulme, 2017).

Currently, the involvement of religion in preventing and addressing the impacts of climate change is relatively low. However, religious teachings, both theologically and in their sacred scriptures, provide guidelines for humanity to prevent environmental damage. While climate change is not explicitly mentioned in religious teachings, both religious and non-religious sacred texts provide rules that can serve as a basis for preventing and addressing climate change.

To enhance the role of religion in climate change prevention and mitigation, a change in thinking and values that prioritize environmental care is needed. This shift should encourage collaboration between religious and non-religious individuals in addressing the impacts of climate change. This research proposes five ideas for transforming the doctrines and values of religion to address the impacts of climate change, which have been synthesized from the thoughts of experts engaged in eco-religious studies.

First, reconstructing and transforming religious teachings empirically into individual behaviour and collective actions to prevent and reduce the impacts of climate change (Cobb Jr., 2021). While the term "climate change impacts" is not explicitly mentioned in monotheistic or traditional religious teachings, these religious values support the idea that humans have a responsibility to preserve nature and avoid harming it. With this understanding, we can interpret climate change because of human actions that harm nature, such as deforestation, water pollution, and excessive use of fossil fuels. In the context of religious activities, the messages conveyed in sermons are not only related to religious rituals but also point towards human actions that can trigger global warming, such as reducing the use of fossil fuels and sustaining forests responsibly.

Second, religious institutions and organizations should rally and spearhead movements and campaigns regarding the threats and impacts of climate change. Religious institutions and organizations, as practical manifestations of sacred scriptures, have been actively leading movements and campaigns to address the threats and impacts of climate change due to global warming. They are not solely focused

on personal worship but also on social concern and tangible actions to confront the current global issue of climate change (TAYLOR, 2010, 2020).

Third, religious organizations should actively engage in international, national, and local forums discussing climate change (GRIM & TUCKER, 2014). In these forums, religious organizations should provide a comprehensive and holistic perspective, recognizing that the values embedded in religious teachings inherently hold a high level of concern for preserving the environment. Climate change is part of the global environmental problem that threatens human life, flora, fauna, and the Earth's ecosystems, so ignoring these values is not an option.

Fourth, there should be a synergy between religious teachings and local knowledge and wisdom within communities to maintain ecological and ecosystem sustainability, as the knowledge and actions of these communities can prevent and mitigate the impacts of climate change. The values and teachings of religion should not be in direct conflict with the local knowledge and wisdom of communities (BERKES, 2017).

Fifth, there should be institutionalization and integration of the urgency of climate change adaptation into educational institutions, whether they are religious or non-religious. This step aims to enhance understanding and awareness of the importance of adapting to the impacts of climate change, especially for children, so that religion can be understood in a practical context. Educational institutions can achieve this by incorporating climate change, adaptation, and mitigation issues into their curricula (SAYEM, 2021).

4. Conclusions

Eco-religious is an approach that connects religious beliefs with ecological awareness, creating a responsibility towards the natural environment as an integral part of the understanding of religion itself. Therefore, religiosity can be considered a central aspect of this eco-religious perspective. Religiosity motivates individuals and communities to maintain their ecological footprint, reduce over-exploitation of natural resources, and care for the natural environment, in line with the ethical and moral values embedded in religion. This creates internal motivation for individuals with high levels of religiosity to behave more sustainably. Additionally, religious communities also play a role as social factors that strengthen conservation efforts, serving as centres for education and social activities that promote sustainability values. The results of this study demonstrate that religiosity has the potential to shape views and behaviours that are more environmentally conscious, limit ecological footprints, and contribute to addressing climate change and environmental crises. In an era of environmental challenges like today, combining religious values with scientific research and action can be a positive step towards achieving global sustainability goals.

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