Probing Environmental Sustainability Through the Diversity-Pollution Nexus—a Global Perspective via PM$_{2.5}$ and NO$_2$

Saqib Amin · Mujahid Ameen Khan · Waqas Mehmood

Abstract This paper analyzes the effects of ethnic and religious diversity on air pollution for 187 countries around the world (categorized into high-income, middle-income and low-income countries) from 1990 to 2020. We determine the long-run relationship between the variables using panel-fixed effects and GMM models. Air pollution emission factors are spatially explicit into emissions of particulate matter (PM$_{2.5}$) and nitrogen dioxide (NO$_2$) and the Alesina's fragmentation index has been used to calculate ethnic and religious diversity. The results show that ethnic and religious diversity both have significant negative impacts on air pollution (PM$_{2.5}$ and NO$_2$). Furthermore, the results are more significant for high-income and middle-income countries and vice versa for low-income countries. This study suggests that diversity is a natural phenomenon; however, its disastrous effects may be curtailed by providing equal opportunities and promoting a peaceful society, as done in high-income countries, to ensure the well-being of the people through cohesiveness. Policymakers need to promote collective action and communication among different groups while acknowledging that investment for public benefits often requires broad social consensus and solidarity.

Keywords Ethnic diversity · Religious diversity · Air pollution · PM$_{2.5}$ · NO$_2$ (nitrogen dioxide)

S. Amin (✉)
Department of Economics, Oulu Business School, University of Oulu, Oulu, Finland
e-mail: Saqib.amin@oulu.fi

M. A. Khan
Department of Analytical Chemistry and Chemical Metallurgy, Wroclaw University of Science and Technology, Wroclaw, Poland
e-mail: mujahid.ameen@pwr.edu.pl

W. Mehmood
School of Economic, Finance and Banking, University of Utara Malaysia, Changlun, Malaysia
e-mail: waqasmehmood61@gmail.com

1 Introduction

Air pollution is one of the current, sensitive and serious environmental health issues that affects people in low-income, middle-income and high-income countries (Manisalidis et al., 2020). In 2005, the World Health Organization (WHO) issued air quality recommendations for assessing the health consequences of air pollution and setting pollution limits that are detrimental to human health. Every year, an estimated seven million people die as a result of air pollution around the world.[1] In 2016,

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[1] For more detail, see World Health Organization (2006). Air quality guidelines: global update 2005: particulate matter, ozone, nitrogen dioxide, and sulfur dioxide. World Health Organization at https://www.euro.who.int/__data/assets/pdf_file/0005/78638/E90038.pdf

91% of the world's population lived in those areas where WHO air quality standards were not fulfilled. However, low-income and middle-income countries disproportionately suffer the burden of outdoor air pollution, and greatest burden in the South-East Asia and Western Pacific regions. It was expected that ambient (outdoor) air pollution caused 4.2 million premature deaths worldwide in both cities and rural areas; this mortality is due to exposure to small particulate matter ($PM_{2.5}$) with a diameter of 2.5 microns or less, which causes cardiovascular disease, respiratory disease and cancers.

Ethnic diversity is a global phenomenon that has been significantly important for environmental quality of any country. Religion and culture through environmental sustainability can significantly address climate change, biodiversity loss, air pollution, desertification, and unsustainable land and water use by fostering a fundamental change in the attitude of most people, not just a minority (Niamir-Fuller et al., 2016). Ethnic and religious diversity regarded as a set of distinctive spiritual, material, intellectual and emotional features of society or a social group and that it encompasses in addition to art and literature, lifestyles, ways of living together, value systems, tradition and beliefs (UNESCO, 2001). In addition, ethnic diversity of meaning shape the way that people interpret climate change, and provide a historical and sociocultural context within which impacts are experienced and responses are generated. The association between diversity and environmental management provides expert knowledge and guidance on the values and roles of culture and cultural practices to support biodiversity conservation, ecosystem services and eco-friendly environment.

Human societies' perceptions of their surroundings are greatly shaped by their distinctive diversity and cultural practices. Modern ecosystem management has traditionally been guided by a scientific or conservation philosophy. This has occasionally resulted in a confrontation between culture and conservation, but more recently, there has been a significant acknowledgment that sustainable ecosystem management requires a greater understanding and integration of community-nature linkages. The harsh reality is that most cultures perceive and manage ecosystems through a lens dictated by long-held cultural ideas that have lasted millennia (Verschuuren, 2006). The challenge for ecosystem management is that in a changing global environment, some of these long-held practices can degrade the ecosystem, while others, with increasing ethnic and religious diversity, can play an increasingly important role in encouraging the preservation of nature while also assisting societies in dealing with the effects of climate change (O'Riordan & Stoll-Kleemann, 2002).

Pollution varies throughout different cultures due to the diverse ways of living around the globe. In some cultures, pollution is influenced by the burning of fossil fuels like coal and other factory emissions. Although some forms of pollution can be seen by individuals through smoke and fog, most aspects of pollution are invisible to the human eye (Kempton et al., 1996). Diversity determines how people support or oppose solutions to ameliorate biodiversity loss or climate change, and ethnic and religious diversity influences how people support or oppose consumption decisions that may have an impact on species or contribute to greenhouse gas emissions.

In traditions, people have adapted their ways of life and behaviours to survive in their unique environment. Explain that these customs, traditions and artefacts have developed over many generations. It also helps them understand that, even when the environmental factors that initially shaped culture no longer exist or apply, many unique aspects of a culture remain. This concentration focuses on the diverse and complex ways in which culture and environment intersect, considering both historical traditions and contemporary institutions. Human responses to landscapes or ecosystems, plants or animals and animate or inanimate features of the environment are shaped by technology, language, media and a range of cultural assumptions and institutions, while environmental factors have their own shaping influence. These intersections vary greatly among cultures and among historical periods, and understanding their dynamics varies greatly among academic disciplines (Roberts et al., 2014). The search for ways to influence—or invent—the social and ethical dimensions of environmental performance lead inevitably to questions of culture. Ethnic, religious identity and air pollution expressions are challenged in a number of ways by the processes of environmental sustainability (Das & DiRienzo, 2010).

Most of the literature in science and social science used CO_2 emission as a good proxy for environment performance, whereas ignore the other indicators $PM_{2.5}$ and NO_2 (proxies for air pollution) which are

more important and sensitive for environment performance. Racial-ethnic and socioeconomic disparities in air pollution exposure in the globe are well documented (Johnson, 2002; WHO, 2016) and have persisted despite overall decreases in $PM_{2.5}$ pollution. The World Health Organization (WHO) reported the quantification of impacts of policy scenarios on projected improvements in population health burden and evaluation of air quality standards. Here, our study proposed models for $PM_{2.5}$ exposure and NO_2 emission affected by ethnic and religious diversity in high-income, middle-income and low-income countries. The aim of this study is to fill this gap in literature.

1.1 Diversity at a Globe and Importance in Environment Sustainability

In a globalized world with interconnected societies, intercultural dialogue is vital if societies are to live together while acknowledging diversity. The future of nations depends on not only their economic capital or natural resources but also their collective ability to understand and anticipate changes in the environment through education, scientific research and knowledge sharing (Gass, 2011; Woolcock & Narayan, 2000). In a connected world endowed with the emergence of creative economies and knowledge societies along with the dominance of the internet, the full participation of everyone in the new global public space is a prerequisite for development and environment (Mansell & Tremblay, 2013).

In the last decade, environmental sciences have acknowledged the potential of ethnic and religion in addressing the ecological crisis (Tucker & Grim, 2001). Recently, environmental psychology has provided insights on how to promote behavioural change (Niamir-Fuller et al., 2016), pointing to the manifold routes through which religion influences individuals' perceptions, beliefs and practices (Amin, 2019a; Tucker & Grim, 2001). Thus, religious beliefs, ideas and practices may drive the adoption of energy consumption behaviour by fostering salient and inner motivations for behavioural change. Other studies have shown that ethnicity and religion are the most important determinants of consumer behaviour (Bailey & Sood, 1993) and more specifically, consumer ethics, evaluation of product quality, product pricing and materialism (Orellano et al., 2020). In view of this evidence, it is plausible to think that ethnicity and religion at the individual level

may influence the patterns of environmental sustainability as well. However, past studies have reached mixed, inconclusive and contradictory results about how individuals' ethnicity and religion are linked to energy consumption behaviour (Güney, 2019).

The international community needs to take critical action to address the urgent and increasing environmental degradation and related challenges of social and economic unsustainability. Religion and culture can significantly address climate change, biodiversity and ecosystem loss, pollution, deforestation, desertification and unsustainable land and water use, and other urgent issues identified in a shared vision by all nations in line with the 2030 Agenda for Sustainable Development (Amin 2020; 2019a, 2019b). According to the United Nations, protecting the environment is an urgent moral imperative and a sacred duty for people of all faiths and people of conscience (Niamir-Fuller et al., 2016).

Ethnic and religious diversity are parallel with science and technology. Diversity promotes the creation of new ideas, inventions and innovations that leads to less environmental degradation. Many people nowadays are turning to renewable energy as a power source. They know that renewables are a necessary alternative to fossil fuels and other non-renewables that will eventually run out. Most people are also aware that renewable energy is kinder to the planet and society. However, exactly how does non-renewable energy affect the environment? Non-renewables can often pollute the environment and cause other damage, making the switch to renewable energy even more important to reduced air pollution (Rao, 2007). It is becoming increasingly important to understand the drivers of renewable and non-renewable energy consumption behaviour (Caruso et al., 2020). Among the drivers that have been receiving growing attention in the literature are ethnic and religious diversity (Amin, 2018, 2019). It is estimated that 84% of the world's population belong to a religious group, where approximately 32% are Christians, 23% are Muslims, 15% are Hindus, 7% are Buddhists, 0.2% are Jews, 6% are folk or traditional religionists and less than 1% are people of other religions (Orellano et al., 2020). These religions are a significant source of wisdom, morality and ethics for individuals (Orellano et al., 2020).

Our research aims to answer the following research question: What is the relationship between ethnic and religious diversity and environmental quality through air pollution? The study analysed what influences a

country's environmental performance in protection measures and whether this is linked with ethnic and religious diversity. This study is believed to be the first to explore the link between ethnic and religious diversity and a country's air pollution.

Low-income ethnically or religiously diverse countries tend to be reluctant to invest in environmental protection activities because of social differences that may reduce collective efforts and public spending on environmental protection. The countries that are either ethnically or religiously diverse are inclined to underinvest in environmental protection even when differences in income and industrial activity are controlled. Geographically concentrated groups and differences in their preferences may cause the government to be reluctant to take environmental protection measures.

Ethnically or religiously diverse countries underinvest in measures to improve their environmental performance. Papyrakis (2013) found that religious diversity has a more detrimental impact on environmental performance (by using proxy of CO_2 emission) than ethnic differences. He argued that social differences influence environmental performance simultaneously, and ethnic and religious diversity alone can explain a substantial part of the differences observed in environmental performance across countries.

Based on these linkages, it is surprising, why economists believe that social indicators are less important to influence on environmental sustainability. This relationship has become quite fashionable in a variety of policy areas, but about this review, several questions arise. Does ethnic and religious diversity cause of air pollution? And what are channels through which diversity show the relationship with environment? Does ethnic and religious diversity affect the air quality same for the high-income, middle-income and low-income countries? Which economic variable has an important impact on air pollution? Which variable describing the level of democracy has an important impact on air pollution? Therefore, the relationship between ethnic and religious diversity and air pollution is an issue that remains to be empirically addressed. Consequently, we postulate the following hypothesis based on diversity-environment relationship:

H1: Ethnic diversity is positively related to air pollution.

H2: Religious diversity is positively related to air pollution.

The research described in the following sections is set out in the following way:

In Section 1, the introduction is described. This section describes the introduction to diversity, implication at global level and its importance in financial sector. Section 2 is related to theoretical framework. In Section 3, the research methodology is described. It describes the types of data, structure and how indices have been constructed, based on the suitability of data in which empirical technique is applied and why. Section 4 discusses the empirical findings of ethnic and religious diversity in relationship with air pollution. The final section weaves together the conclusions and policy implication drawn based on empirical findings.

2 Theoretical Framework

Ethnic and religious diversity with environment sustainability is an emerging interdisciplinary subfield in the academic disciplines of anthropology, religious ethics, the sociology of culture and religion, and theology, with environmentalism and ecological principles as the primary focus. By the 1990s, many scholars of culture and religion had joined the debate and begun to generate a substantial body of literature discussing and analysing how environmental quality is valued in the world's various ethnic and religious systems (Orellano et al., 2020). Abruzzi et al. (1982) explained in their paper regarding the relevance of ecological theory in explaining human ethnic differentiation and attempted to find out if the formation and maintenance of ethnic boundaries could be one area of social behaviour to benefit from the explicit application of ecological modernization theory. He argued that traditional approaches based on a static conception of discrete ethnic groups have been proven incapable of dealing with the dynamics of new concerns. Ecological modernization theory is used to gain the best understanding of the impact of these driving forces on $PM_{2.5}$ concentrations and obtains an analytical framework.

Michalopoulos ([2012](#)) argued that geographical distances increase migration costs. For example, the physical space between two geographical areas reduce the similarities in attitude, linguistic style and race. Correspondingly, heterogeneous communities encourage groups to develop specific skills within their local environment. Numerous studies have concluded that well-developed countries promote economic freedom, transparent governments and effective institutions, which will reduce the corruption intensity to successfully achieve environmental goals. Papyrakis ([2013](#)) argued that ethnically or religiously diverse countries underinvest in measures to improve their environmental performance. The study found that religious diversity has a more detrimental impact on environmental performance than ethnic differences. These social differences, if they cannot be overcome, may lower collective action and reduce public spending on environmental protection and performance. Social fragmentation has a negative effect on environmental performance (Torres, [2002](#)). Countries that are either ethnically or religiously diverse tend to underinvest in environmental protection even when one controls for differences in income and industrial activity. This might be because of differences in preferences across the various, and often geographically concentrated, ethnic or religious groups about which environmental measures should be introduced and when and where. For example, public spending for waste treatment facilities or reforestation can become a particularly contentious issue when different ethnic or religious groups do no benefit equally. Even when preferences over what should be done do not differ much, differences in language and culture may hinder communication and collective action. If these differences cannot be bridged, investment will not be made and positive action will not be taken.

Although several factors influence environmental performance simultaneously, ethnic and religious diversity alone can explain a substantial part of the differences observed in environmental performance across countries. Some of the worst environmental performers, given their level of economic development, have been either ethnically or religiously fragmented nations such as China, the Democratic Republic of Congo, Angola or the United Arab Emirates. Regarding the role of ethnicity and religion in shaping human behaviour, ethnic and religious diversity can affect social cohesion, consumption trends and willingness to pay for climate change mitigation or adaptation initiatives (Skirbekk et al., [2020](#)). As the impacts of climate change become greater, the world is becoming more religious; the share of the world population with a religious affiliation is expected to rise from 84% in 2010 to 87% by 2050. The world is also becoming more polarized in regard to how different nations affect the environment with high and growing emission shares coming from Europe and China, and both regions have a high share of people without a religious affiliation.

Milem ([2003](#)) suggested that since the environment is a public good that cannot be provided in isolation, harmony and collective effort are required. Esty ([2008](#)) used various environmental indicators such as air pollution, local ozone and other variables in his model. Air pollution is measured using regional ozone, CO_2 emission and sulphur dioxide emission. The study of Das and DiRienzo ([2010](#)) used cross-sectional data and found a non-linear link between environmental performance and ethnic diversity. The study used the environmental performance index and ethnic diversity based on the fractionalization measures by Alesina et al. ([2003](#)). The present study also uses Alesina et al. ([2003](#)) measures of fractionalization and energy consumption patterns, which are the major ingredients of environmental sustainability (Ahmad & Amin, [2019](#)). Das and DiRienzo ([2010](#)) also captured data on sulphur dioxide emission and water quality. Most of the previous studies used CO2 storage for air pollution, such as Newton et al. ([2016](#)) and Amin et al. ([2021](#)), which used carbon storage as the dependent variable and ethnic diversity as one of the socioeconomic independent variables in their model. Among other studies, Agarwal ([2009](#)) and Matos et al. ([2017](#)) also used ethnic diversity based on Simpson's index to see its effect on the environment.

The sustainable development goal (SDG) aims to reduce the ecological footprint by changing the methods of production and consumption of goods. It means using resources efficiently, respecting resource constraints and reducing pressure on the natural capital in order to increase the overall well-being, keep the environment clean and healthy and safeguard the needs of future generations (Wood, [2009](#)). Choosing a sustainable option when purchasing; decreasing waste generation by reducing consumption, reusing and recycling; and being more efficient in using energy

are some of the actions that individuals may carry out to achieve the SDG. These actions are included in the umbrella term of "renewable energy consumption", also referred to as ethical, green or responsible consumption or pro-environmental behaviour.

Conceptually, ethnic and religious diversity may be negatively or positively associated with air-friendly environment depending on the channels of influence. Drawing on Hofstede and Usunier (2003) cultural dimensions, a growing body of literature has examined how a country's cultural features influence energy efficiency and environmental sustainability and performance (Orellano et al., 2020). The literature has shown that cultural values, which vary across different ethnic groups, are important to environmental outcomes because such values determine the attitudes of groups and individuals that collectively determine the institutional and social capacity for energy efficiency and environmental sustainability (Amin, 2019c; Güney, 2019). Different ethnic groups exhibit different attitudes toward energy efficiency. Some ethnic groups are more inclined to insulate their homes and use more energy-efficient vehicles than others (Abruzzi et al., 1982). Compared to other ethnic groups, African Americans and Europeans have more positive environmental attitudes that reflect a stronger commitment to particular values that are more environmentally friendly (Papyrakis, 2013).

Existing research has, however, shown that ethnic diversity is associated with poorer democracy quality and lower provisions of public goods and infrastructure (Miguel & Gugerty, 2005). Rent-seeking activities by different ethnic groups make agreeing on public goods, such as infrastructure and good government policy, difficult (Alesina et al., 1999). Given that energy prices are likely to be much higher when appropriate infrastructure is not in place, the role of ethnic diversity in deterring the provision of public goods becomes an important channel in influencing energy consumption (Caruso et al., 2020). Furthermore, weaker institutions and poorer collective action associated with ethnic diversity may hinder public policies targeted at reducing energy prices (King, 2013). Public goods provision is also closely linked with trust, given that with lower levels of trust, individuals are less able to resolve their collective action problems and reach an agreement on the provision of an optimal level of public goods (Miguel & Gugerty, 2005).

To our knowledge, this is the first empirical study that attempts to differentiate between the roles of ethnic and religious fractionalization and to explain the air pollution paradox. We attempt to answer the question of whether an increase in ethnic and religious diversity will lead to air pollution or not. The next section is devoted to our empirical analysis, linking ethnic and religious structure (fractionalization) to air pollution. In our proposed model, we measured ethnic and religious diversity (ED and RD) through the Alesina's formula of ethnic fractionalization index (EFI). The degree of ethnic fractionalization index (EFI) has been calculated based on the annual percentage of ethnic groups in each country which is often referred to as ethnolinguistic fractionalization (ELF).[2] To find out the direct effects of ethnic diversity on air pollution, this study follows the models specified by Das and DiRienzo (2010), Papyrakis (2013) and Churchill et al. (2019) by incorporating some socioeconomic variables for empirical analysis.

$$PM_{2.5} = f(ED, RD, GDPPC, FDI, POP, TOT, DEMO) \tag{1}$$

$$NO_2 = f(ED, RD, GDPPC, FDI, POP, TOT, DEMO) \tag{2}$$

In the above equations, $PM_{2.5}$ represents fine particles and NO_2 represents nitric dioxide. The dependent variables $PM_{2.5}$ and NO_2 were used as proxies for air pollution. Population-weighted exposure to ambient $PM_{2.5}$ pollution is defined as the average level of exposure of a nation's population to concentrations of suspended particles measuring less than 2.5 microns in aerodynamic diameter, which are capable of penetrating deep into the respiratory tract and causing severe health damage. Pollutant concentrations are sensitive to local conditions, and even monitoring sites in the same city may register different levels. Direct monitoring of $PM_{2.5}$ is still rare in most parts of the world, and measurement protocols

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[2] Please see "Alesina, A., Devleeschauwer, A., Easterly, W., Kurlat, S., & Wacziarg, R. (2003). Fractionalization, Journal of Economic growth, 8(2), 155-194" for more information. In economics, the majority of studies employ a measure of ethnic fractionalization index as called the ELF measure that was first used in an influential article by Easterly and Levine (1997) which is computed as one minus the Herfindahl index of ethnolinguistic group shares, and reflected the probability of that two randomly selected individuals from the population belonged to different groups.

and standards are not the same for all countries. The guideline set by the World Health Organization (WHO) for $PM_{2.5}$ is that annual mean concentrations should not exceed 10 μg/m^3, representing the lower range over which adverse health effects have been observed. The WHO has also recommended guideline values for emissions of $PM_{2.5}$ from burning fuels in households. Data of $PM_{2.5}$ were retrieved from the Word Development Indicators, World Bank.

Nitrous oxide (NO_2) emissions are defined as emissions from agricultural biomass burning, industrial activities and livestock management. Nitrous oxide emissions are mainly from fossil fuel combustion, fertilizers, rainforest fires and animal waste. Nitrous oxide is a powerful greenhouse gas, with an estimated atmospheric lifetime of 114 years, compared with 12 years for methane. The per kilogramme global warming potential of nitrous oxide is nearly 310 times that of carbon dioxide within 100 years. The emissions are usually expressed in carbon dioxide equivalents using the global warming potential, which allows the effective contributions of different gases to be compared. That is way literature considered NO_2 emissions a good proxy for air pollution. Data of NO_2 emissions were retrieved from the World Development Indicators, World Bank.

The main explanatory variables are ethnic diversity (ED) and religious diversity (RD) that show the share of different ethnic and religious groups out of the total population. Diversity is basically time-invariant data; very nominal change occurs in a long period. This study avoids using annual data (because of less variation in diversity data) and creates an index by following data per 5 years of interval from 1990 to 2020 (1990, 1995, 2000, 2005, 2010, 2015 and 2020). This time span is chosen as it maximizes the availability of data, mainly as the data retrieved from the Cline Centre for Democracy database, University of Illinois, Chicago, USA[3] at https://clinecenter.illinois.edu/projects/research-themes/Religious-Ethnic-Identity. Cline Center for Democracy (CCD) compliment of the Religious and Ethnic Groups Project (CREG) started to create a set of time-varying measures that gauge the nature and depth of country-specific sociocultural cleavages. Cline Center for Democracy is

working on CREG project that document the changing varieties of social identity around the world. In addition is to identify the causes of conflict between religious and ethnic groups.

The control variables including net foreign direct investment (FDI) inflows (as a percentage of GDP), TOT index, population size and GDP per capita as a proxy for market size have been decided as explanatory variables. Foreign direct investment (FDI) has been identified as one of the main engines of economic growth, a potential source of employment, and a channel through which advanced technologies can be transferred to host countries. The literature is dominated with this adverse view of FDI on the environment (air pollution) (Huynh & Hoang, 2019), and there is also a possibility that FDI can contribute to a cleaner environment, especially, if FDI comes with green technologies and this creates spillovers for domestic industries (Demena & Afesorgbor, 2020). Theoretically, the effect of FDI on the environment can be negative or positive. To deal with the theoretical ambiguity about the FDI-environment nexus, many empirical studies have been conducted but their results only reinforce the controversy as they produce contrasting results.

GDP per capital (GDPPC) is defined as the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data of the GDP per capita has been collected from WDI and has measured in constant 2010 US $. Economic growth means an increase in real output (real GDP). Therefore, with increased output and consumption, we are likely to see costs imposed on the environment. The environmental impact of economic growth includes the increased consumption of non-renewable resources, higher levels of pollution, global warming and the potential loss of environmental habitats. However, not all forms of economic growth cause damage to the environment. With rising real incomes, individuals have a greater ability to devote resources to protecting the environment and mitigate the harmful effects of pollution. Also, economic growth caused by improved technology can enable higher output with less pollution.

Net barter terms of trade (TOT) is calculated as the percentage ratio of the export unit value indexes

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[3] For more information about data source, see the Supplementary Information.

to the import unit value indexes, measured relative to the base year 2000. Term of trade (TOT) expansion can have an obvious direct impact on the environment by increasing pollution or degrading natural resources. In addition, trade liberalisation may lead to specialisation in pollution-intensive activities in some countries if environmental policy stringency differs across countries—the so-called pollution haven hypothesis. However, increased trade can in turn, by supporting economic growth, development and social welfare, contribute to a greater capacity to manage the environment more effectively.

Data of total population (POP) has been collected from WDI which represents the total population size (as a result of immigration or more births than deaths) of each country citizen regardless of legal status or residents or citizenship. Population increases are matched by proportional increases in emissions while a higher urbanization rate and a lower average household size increase emissions (Cole & Neumayer, 2004).

Data on various determinants of democracy (DEMO) collected from the unique database of Varieties of Democracy (V-Dem) Institute for 173 countries can be freely access at https://www.v-dem.net/en/. V-Dem provides a multidimensional and disaggregated dataset that reflects the complexity of the concept of democracy as a system of rule that goes beyond the simple presence of elections. The V-Dem project distinguishes between five high-level principles of democracy: electoral, liberal, participatory, deliberative and egalitarian, and collects data to measure these principles. All these democracy indices are ranged between 0 and 1. Larger values present a better quality of democracy. The V-Dem democracy indices are extremely dynamic and capture fine-grained changes in politics and the quality of different components of democracy from year to year.

3 Description of Statistical Methods and Data Source

This section discusses the approaches and methods used in this study in empirical analysis. In the context of diversity and environmental sustainability, the panel data methodology is commonly used as it enables the researcher to study this nexus (Churchill et al., 2019; Das & DiRienzo, 2010). This study explores the nexus between ethnic and religious diversity and air pollution and presents results from both cross section and panel data regressions.

When we are applying panel data analysis and ignoring the country and or time-specific effects that possibly exist among cross sections and times series units can lead to heterogeneity in the model specification, as a consequence, the parameter estimates will be meaningless and inconsistent (Hsiao, 1986). To account for possible heterogeneity among countries, fixed effects models and random effects models are more appropriate for handling panel data (Gujarati & Porter, 2003; Wooldridge, 2010). However, in this case, fixed effects would be ideal, because it can control for unobserved countries and time-fixed effects.[4] Fixed effect models organize for or partial out the belongings of time-invariant variables with time-invariant effects. One shortcoming of the fixed or random model is that it cannot handle the effect of endogeneity. Hence, to control this effect, this study used the generalized method of moments (GMM) model with added lagged variables as the instrument for empirical analysis. GMM technique is considered an efficient analytical method because it overcomes the problems of normality or skewness, endogeneity and serial correlation facing during ordinary least squares (OLS) and fixed/random effect techniques (Judson & Owen, 1999). Stability of models has been tested through post-estimations tests.[5]

In our empirical findings, we used two proxies for air pollution i.e. $PM_{2.5}$ and NO_2 emission. Data were retrieved from the World Development Indicator Database (WDI), World Bank[6]. For the definitions of all the variables, descriptions and data sources,

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[4] The study used Hausman test, for selection of models whether fixed effect or random effect. The results of the Hausman test for all four empirical chapters suggested that a fixed effects static panel estimator would be a superior estimator of all models.

[5] In all models, this study has performed post-estimation model tests to check any violation of assumptions, autocorrelationship and heterosedasticity. In this regards, White's robust standard error correction has applied in all the models. White's robust standard errors allow for possible cross-sectional heteroscedasticity and contemporaneous correlation among cross sections for reliable significance interpretations and only affect the standard errors and not the estimators.

[6] See the Supplementary Information, for definitions, description and data sources of all the variables used in empirical findings.

see the Supplementary Information. Ethnic and religious diversity is calculated through the ethnic fractionalization index of Alesina et al. (2003) which has widely been used as a proxy for empirical exercises. Diversity is basically time-invariant data; very nominal change occurs in a long period. This study avoids using annual data (because of less variation in diversity data) and creates an index by following data per 5 years of interval from 1990 to 2020. This time span is chosen as it maximizes the availability of data, mainly as the data retrieved from the Cline Centre for Democracy database, University of Illinois, Chicago, USA[7] at https://clinecenter.illinois.edu/projects/research-themes/Religious-Ethnic-Identity.

The formula of ethnic fractionalization index is represented as

$$\text{FRACT}_j = 1 - \sum_{i=1}^{N} Z_{ij}^2 \tag{3}$$

where Z_{ij} is the share of group i in the total population ($i = 1 \dots N$) in the country j. The range of the fractionalization index is between 0 and 1. Zero "0" means homogeneous country and "1" shows total heterogeneous country.

4 Empirical Findings

This study indicates the robust relationship between ethnic and religious diversity with air pollution ($PM_{2.5}$ and NO_2 emission). Table 1 shows the results of GMM model estimation (robust analysis through fixed effect and panel ordinary least square can be seen in the Supplementary Information) for air pollution (columns 1-4 for $PM_{2.5}$, and columns 5-8 for NO_2 emission). The findings indicate that ethnic diversity has a significant negative impact on air pollution (for both $PM_{2.5}$ and NO_2 emissions). As ethnic diversity increases by 1 unit, $PM_{2.5}$ and NO_2 emission is deteriorated by 4.9% points and 3.0% points, respectively. However, religious diversity also has significant negative impact on $PM_{2.5}$ and negative insignificant for NO_2 emission. As religious diversity increases by 1 unit, $PM_{2.5}$ is declined by 1.8% points. It means as the ethnic and religious diversity increases, both enhance

the air quality. Results are also interesting to see that GDP per capita and population size have a significant positive impact on $PM_{2.5}$ and NO_2 emission (Table 1). $PM_{2.5}$ and NO_2 emissions both play a crucial role in environment performance which directly linked with air quality. In this regard, ethnic and religious diversity play a vital role in air quality because it directly or indirectly affected the environment to pollution or air pollution.

Diversity may be helpful in providing a rich social environment and promoting sustainable development because diversity itself necessitates an intergroup cohesion process. New ideas, inventions and innovations promote environmental quality because diversity help to promote renewable energy consumption that is more environment and air friendly. Ethnic and religious diversity can sometimes drive productivity and innovation because different ethnic groups have different productive skills that complement each other. Ethnic mix also embodies abilities, experiences and cultures that may lead to innovation and creativity (Ozgen et al., 2013; Ramasamy & Yeung, 2018).

Our results are similar to Benjamin (2011) that diverse groups improve air quality in low-income African American and Latino communities and contradicting the findings of Li et al. (2019) that shows higher diverse communities positively causing excess air pollution in the USA. However, Das and DiRienzo (2010) argued that moderate level of diversity experiences the greatest environmental performance as they reap the benefits of a civically engaged society with creative, innovative and efficient human talent pool and do not bear the negative effects of a highly fractionalized society that typically suffers from poor communication and social cohesion, among other societal ills.

Control variables such as GDP per capita and population size both have a positive significant impact on $PM_{2.5}$ and NO_2 emission (Table 1). Increasing the GDP per capita and population size increases the $PM_{2.5}$ and NO_2 emission within countries, similar to the viewpoints of Guan et al. (2014) and Lyu et al. (2016). Generally speaking, the increase of population size can affect $PM_{2.5}$ emission in the following two ways: Firstly, increasing population size often produces an agglomeration effect, which will improve technological level, public transport sharing efficiency and energy efficiency to reduce $PM_{2.5}$ emissions. Secondly, the increase in population size

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[7] For more information about data source, see the Supplementary Information.

Table 1 Ethnic diversity and air pollution (GMM estimation for all countries)

Variables	$PM_{2.5}$				NO_2 emission			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Pollution (lag)	0.378***	0.364***	1.169***	0.977***	0.917***	1.004***	0.471***	0.596**
	(0.119)	(0.103)	(0.387)	(0.305)	(0.183)	(0.245)	(0.166)	(0.222)
ED	−3.027***		−4.904***		−4.737***		−3.082**	
	(0.834)		(1.770)		(1.437)		(1.305)	
RD		−0.981**		−1.848**		−6.022		−0.005
		(0.390)		(0.808)		(6.350)		(1.157)
Per capita GDP			0.069**	0.345**			0.797***	1.262***
			(0.196)	(0.185)			(0.207)	(0.301)
FDI			0.000	0.000			0.007	0.002
			(0.001)	(0.001)			(0.006)	(0.005)
Population size			1.119***	0.985***			1.077***	1.372***
			(0.421)	(0.351)			(0.307)	(0.364)
Terms of trade			0.000	0.000			−0.001	−0.000
			(0.001)	(0.001)			(0.000)	(0.001)
Elecdem			0.573	0.146			2.207**	1.360
			(0.947)	(0.918)			(0.942)	(0.891)
Liberdem			0.318	−0.027			−0.617	−0.481
			(0.992)	(0.982)			(0.750)	(0.663)
Delibdem			−0.538	0.005			−0.620	−0.682
			(0.736)	(0.813)			(0.745)	(0.696)
Egalitdem			−1.893	−1.458			−0.217	−0.342
			(1.378)	(1.697)			(1.183)	(1.033)
Participdem			0.669	0.760			−1.803*	0.319
			(1.071)	(0.999)			(1.021)	(1.086)
Observations	400	422	348	368	284	295	250	259
Country-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of countries	142	150	128	135	116	123	107	113
AR(1)	0.051	0.011	0.094	0.036	0.014	0.469	0.022	0.157
AR(2)	0.698	0.301	0.045	0.016	0.204	0.891	0.075	0.028

Columns 1-4 and 5-8 represent the regressions output for both dependent variables i.e. $PM_{2.5}$ and NO_2 emission, respectively. Robust standard errors are reported in parentheses. ***$p < 0.01$. **$p < 0.05$. *$p < 0.1$

will directly or indirectly lead to an increase in energy consumption, thus, increasing $PM_{2.5}$ emissions.

However, income per capita can affect PM emissions through the following three aspects i.e. scale, technical and structural effects. In scale effect, income needs to increase input, thereby, increasing energy use, and more output will inevitably lead to an increase in pollution emissions. In technical effect, income level is closely related to better environmental protection technology and high-efficiency technology. In structural effects, income changed economic structure from agriculture to energy-intensive heavy industry, increasing pollution emissions. Subsequently, the economic structure shifted to low-polluting services and knowledge-intensive industries, with pollution emission per unit output declining and environmental quality improving.

FDI and term of trade show insignificant relationship with $PM_{2.5}$ and NO_2 emissions. Table 1 also shows that all the variables under a variety of democracy (VDEM) show the insignificant impact on air pollution for both $PM_{2.5}$ and NO_2 emissions. Variety of democracy has

been judged under five dimensions i.e. electoral principle of democracy, liberal principle of democracy, participatory principle of democracy, deliberative principle of democracy and egalitarian principle of democracy. Most of the country's environment system control under political control so, there is no democracy in most of the countries in real term (Fukuyama, 2001). In this regard, democracy directly impacts the environmental policies of any country, although political economy under environmental science literature emphasizes the critical role of political institutions in promoting environmental quality (Wang et al., 2018).

Tables 2 and 3 indicate the impact of ethnic and religious diversity on air pollution (for both $PM_{2.5}$ and NO_2 emissions) for high-income (columns 1-4), middle-income (columns 4-8) and low-income countries (columns 9-12). Table 2 represents that ethnic and religious diversity both have a significant negative relationship with air pollution ($PM_{2.5}$ and NO_2 emission) for high-income and middle-income countries and vice versa for low-income countries. However, the religious diversity indicates the insignificant relationship with air pollution. As one unit increases in ethnic diversity, air pollution ($PM_{2.5}$) decreased by 0.30 and 2.63 for high-income and middle-income countries and increased by 4.61% points for low-income countries, respectively (see Table 2, columns 3, 7 and 11). Whereas Table 3 indicates that one unit increases in ethnic diversity, air pollution (NO_2) decreased by 2.20, 5.57 and 7.21% points for high-income, middle-income and low-income countries respectively (see Table 2, columns 3, 7 and 11). Religious diversity also has a significant negative impact on air pollution (for both $PM_{2.5}$ and NO_2 emissions) for the middle-income countries whereas insignificant for high-income and low-income countries. Although the effect of ethnic and religious diversity varies from country to country, however, it deteriorated more severely in low-income countries especially where civil societies are not well-organized. In low-income countries, people of different ethnicities, who follow different religions or speak different languages, live together in the same country, and it can be difficult to compromise on public policies.

In high-income and middle-income countries, air pollution control legislation in high-income nations leads to a reduction of emissions from a variety of sources. Individuals can reduce their energy use as well as invest in energy-efficient technologies, such

as high-efficiency appliances and light bulbs. Focusing on renewable sources of energy, such as wind, solar and hydroelectric power, will also reduce our use of fossil fuels for electricity and limit emissions of pollutants into the atmosphere. Vehicles have also become more efficient in an effort to control air pollution. Not only are hybrid vehicles becoming more popular, but also standard combustion vehicles now get far better gas mileage than ever. Cities are also becoming more bike friendly and are improving public transportation. International regulations have also helped reduce air pollution from high-income and middle-income countries.

In the high-income and middle-income countries, better information about cleaner methods of transportation, better waste management, better methods of energy production and technology to reduce emissions will need to be created by government agencies and private interests. Air pollution in low-income countries tends to be worse than in high-income and middle-income countries because poor countries often lack the technology and resources to fight pollution. The causes of air pollution in low-income countries are varied, but one of the main reasons low-income countries struggle with air pollution is that their economies are still growing. High-income and middle-income countries are more likely to invest in cleaner fuel sources, and technologies that limit emissions, because they have the economic resources to do so. Low-income countries should pursue the reduction of emissions from industrial smokestacks, invest in renewable energy sources, prioritize rapid and communal transit and provide options for cycling and walking in cities. Therefore, the government should adhere to green, sustainable development and achieve a win-win situation of stable economic growth and continuous decline in $PM_{2.5}$ emissions.

Tables 2 and 3 also show that the GDP per capita and population size both have a significant positive impact on air pollution for high-income countries but insignificant for middle-income and low-income countries. Table 2 shows that the varieties of democracy variables such as Elecdem, liberdem, delibdem, egalitdem and participdem show insignificant impact on air pollution ($PM_{2.5}$) for high-income, middle-income and low-income countries except delibdem, egalitdem and participdem for low-income countries. However, delibdem and parcticipdem have positive significant impact on air pollution ($PM_{2.5}$) for

Table 2 Ethnic diversity and air pollution (GMM estimation for $PM_{2.5}$)

Variables	High income				Middle income				Low income			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Pollution (lag)	0.219***	0.115***	0.151***	0.111***	0.062	0.544***	0.563**	0.468**	0.218**	0.020***	0.372***	0.113***
	(0.076)	(0.041)	(0.054)	(0.039)	(0.059)	(0.140)	(0.286)	(0.216)	(0.109)	(0.348)	(0.125)	(0.121)
ED	-1.428*		-0.303*		-3.496**		-2.631**		3.474*		4.613**	
	(1.258)		(1.471)		(1.391)		(1.364)		(1.921)		(2.248)	
RD		-0.405		-0.057		-0.435		-0.447*		6.583		0.472
		(0.774)		(0.642)		(0.514)		(0.510)		(3.515)		(1.087)
Per capita GDP			0.739***	0.787***			0.050	0.056			0.123	0.207
			(0.228)	(0.225)			(0.480)	(0.313)			(0.179)	(0.380)
FDI			0.019*	0.009			-0.002	-0.000			-0.001	0.001
			(0.011)	(0.015)			(0.005)	(0.000)			(0.006)	(0.005)
Population size			0.647***	0.636**			0.015	0.305			1.005	0.720
			(0.214)	(0.239)			(0.487)	(0.428)			(0.713)	(0.375)
Terms of trade			-0.007*	-0.007			0.000	-0.000			-0.000	-0.000*
			(0.001)	(0.001)			(0.001)	(0.000)			(0.000)	(0.000)
Elecdem			2.382	1.550			-0.118	0.716			-0.422	-0.484
			(2.294)	(2.853)			(1.043)	(0.651)			(0.816)	(0.863)
Liberdem			-3.342	-2.767			0.200	-0.453			-0.193	-0.786
			(2.138)	(2.911)			(0.985)	(0.685)			(0.908)	(0.997)
Delibdem			0.329	0.493			0.057	0.056			1.334***	1.244**
			(1.143)	(1.845)			(0.668)	(0.519)			(0.463)	(0.539)
Egalitdem			-3.071	-1.994			-1.670	-1.095			-3.738***	-1.812
			(2.357)	(3.834)			(1.446)	(1.163)			(0.961)	(1.530)
Particimpdem			0.287	-0.255			0.895	-0.154			3.147**	2.287**
			(1.953)	(2.148)			(1.036)	(0.614)			(1.410)	(1.128)
Observations	107	116	103	112	216	234	127	197	69	72	56	58
Country-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of countries	38	41	38	41	78	82	66	70	26	27	23	24
AR(1)	0.015	0.118	0.012	0.848	0.469	0.026	0.446	0.123	0.924	0.001	NA	0.957
AR(2)	0.670	0.087	0.902	0.466	0.614	0.986	0.638	0.194	0.098	0.232	NA	0.147

Dependent variable is $PM_{2.5}$; columns 1-4, 5-8 and 9-12 represent the regressions output for high-income, middle-income and low-income countries respectively. ***$p < 0.01$. **$p < 0.05$. *$p < 0.1$

Robust standard errors are reported in parentheses.

Table 3 Ethnic diversity and air pollution (GMM estimation for NO$_2$ emission)

Variables	High income				Middle income				Low income			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Pollution (lag)	0.730***	1.551***	0.762***	1.298**	0.014***	0.894***	0.751***	0.682***	0.089	0.386**	0.188	0.130
	(0.268)	(0.373)	(0.238)	(0.511)	(0.056)	(0.220)	(0.184)	(0.129)	(0.163)	(0.185)	(0.258)	(0.160)
ED	−1.211		−2.203*		−7.069**		−5.576***		3.914**		7.219*	
	(1.953)		(1.399)		(3.199)		(2.286)		(1.245)		(4.037)	
RD		−1.343		−2.074		−2.168**		−3.035***		0.203		2.172
		(2.681)		(2.075)		(0.852)		(0.954)		(0.840)		(1.905)
Per capita GDP			0.469**	0.479			0.081***	0.668***			0.608	1.087*
			(0.177)	(0.350)			(0.444)	(0.192)			(0.626)	(0.600)
FDI			0.019*	0.042***			−0.014	−0.015			0.014*	0.017*
			(0.010)	(0.010)			(0.013)	(0.011)			(0.008)	(0.008)
Population size			0.623***	0.788***			0.795**	0.222**			1.924**	2.070
			(0.199)	(0.277)			(0.265)	(0.358)			(0.766)	(1.150)
Terms of trade			0.003	0.004			−0.001	−0.002*			−0.003***	−0.003
			(0.001)	(0.003)			(0.001)	(0.001)			(0.001)	(0.001)
Elecdem			−2.320	0.081			0.590	−1.187			3.528**	4.054**
			(2.736)	(3.504)			(1.215)	(0.891)			(1.322)	(1.994)
Liberdem			−7.162**	−8.800**			−0.357	−0.688			−2.894**	−1.546
			(2.887)	(3.889)			(0.968)	(0.888)			(1.376)	(0.931)
Delibdem			1.593	1.439			−1.021	−0.420			0.452	−0.158
			(1.323)	(1.805)			(1.020)	(0.871)			(1.199)	(1.748)
Egalitdem			1.761	2.175			1.404	2.069			−1.325	−2.075
			(2.305)	(2.695)			(1.706)	(1.316)			(2.137)	(1.613)
Participdem			8.237**	7.751**			−1.415	1.193			−1.392	−3.230**
			(3.334)	(3.512)			(2.150)	(1.623)			(1.516)	(1.516)
Observations	72	74	70	72	89	145	123	128	70	73	57	59
Country-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time-fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of countries	34	36	34	36	47	60	50	53	25	26	23	24
AR(1)	0.064	0.059	0.008	0.025	0.071	0.042	0.014	0.007	0.732	0.017	0.375	0.129
AR(2)	0.792	0.992	0.648	0.795	0.362	0.074	0.090	0.109	0.265	0.386	0.999	0.198

Dependent variable is NO$_2$ emission; columns 1–4, 5–8 and 9–12 represent the regressions output for high-income, middle-income and low-income countries respectively.

Robust standard errors are reported in parentheses. ***$p < 0.01$. **$p < 0.05$. *$p < 0.1$

low-income countries. Table 3 shows that the varieties of democracy variables such as Elecdem, liberdem, delibdem, egalitdem and participdem show insignificant impact on air pollution (NO_2) for high-income, middle-income and low-income countries except liberdem and participdem for high-income countries and low-income countries. Libredem has a significant negative impact on air pollution (NO_2) for high-income and low-income countries. However, participdem has a significant positive for high-income countries and vice versa for low-income countries. Conflicts between different groups and attempts of the government to suppress minorities in the name of the majority are mitigating in liberal democracies by the rule of law, whereas in autocratic nations, problems associated with diversity could lead to an over-reaction of political institutions which worsens the struggle.

As a result, most of the OECD countries are actively supporting the shift to a more environmentally friendly growth model. The OECD countries' diversity allows them to launch a green growth strategy (GGS) to assist policymakers and stakeholders in addressing today's significant environmental concerns while expanding economic opportunities. The approach includes policy recommendations for "greener" economic growth as well as a set of indicators to track progress toward green growth. The approach is primarily focused on enacting change and reaching a common goal: a world that is stronger, cleaner and more equitable. Diversity highlights the challenges facing energy producers and users and how these challenges can be addressed using air quality-friendly policies. Because energy underlies the global economy, the decisions made today in the energy sector will be critical toward achieving air-friendly environment. The environmental imperative to reduce CO_2 emissions, NO_2 and PM in the energy sector coincides with a looming new investment cycle in power generation in most OECD countries.

Furthermore, this study argues that high-income countries have more civilized societies and possess high moral values so that diversity consistently proves the link with air quality in high-income and middle-income countries compared to low-income countries. Low-income countries will have to implement economic reforms to foster the productive inclusion of poorer households, civil activism and social cohesion and create new competitive advantages. However,

air-friendly environment being a public good requires joint efforts of all groups because environmental quality cannot be enhanced in isolation. A large-scale transformation of the global air-friendly environment is possible, albeit requiring significant investments. Thus, in low-income countries, there is an urgent need to create an enabling policy framework for the transformation of the energy sector, which is a daunting task but must be done now to create the momentum for fundamental change.

5 Conclusion and Policy Implication

This study shows the robust relationship between two types of diversity (ethnic and religious diversity) and air pollution ($PM_{2.5}$ and NO_2) by using data of 187 countries (consisting of 56 high-income, 102 middle-income and 29 low-income countries) worldwide. This study used GMM methodologies (robustness have been checked through fixed effects and OLS) to assess the links between the dependent and independent variables. The results show that ethnic and religious diversity have a significant negative relationship with air pollution both for $PM_{2.5}$ and NO_2 for high-income and middle-income countries and vice versa for low-income countries. In low-income countries, ethnic and religious diversity both are significant cause of air pollution.

Global energy demand is fast rising as a result of rising population and economic expansion, particularly in emerging market economies. Rising demand, while accompanied by more income, poses new obstacles. Concerns about energy security may arise as more customers demand more energy resources, and increased consumption of fossil fuels results in increasing carbon dioxide (CO2) gas emissions, NO2 emissions and particulate matter (PM) emissions, all of which contribute to air pollution and global warming. A sustainable air-friendly environment future requires new thinking and new systems, essentially a transformation in the way people produce, deliver and consume energy. If the goals are to raise living standards, provide access to modern energy services, use energy more efficiently, protect the global environment and ensure reliable energy supplies, diversity with green growth must play a key role.

It is vital for governments to create the enabling policy framework to catalyse private sector

investment in the transition to a low-carbon, low NO_2 and PM emissions. Diversity helps in high levels of resource productivity and efficient energy usage lead to more dynamic and competitive economies that are better able to respond to the scale of the transition. Green growth can reduce the burden on land, air and water resources while creating expanded opportunities for gains in productivity, quality of life and social equity. This study's findings lead us to those countries that wish to rely on cohesive society into air-friendly environment as an instrument of environmental quality. Our results also suggest that beyond economic and institutional factors, ethnic and religious diversity may be a factor of interest when evaluating energy consumption as an environmental quality tool.

6 Limitations and Future Research

Diversity is a multidimensional concept, i.e. demographic, socioeconomic, political, geographical, cultural and dynamic in nature, so it is impossible to show that variables included in this study are the only predictors of diversity and air pollution. However, there are several other socioeconomic variables which may affect the air pollution such as political institutional quality and government policies, which are not covered by this study. This thesis only explores the macro-level/aggregate-level analysis relationship with air pollution. Therefore, it is more appropriate to generalize small units such as city, provinces, towns and places to places. The study uses diversity based on ethnic and religious only, whereas other determinants of diversity such as race and gender may be guidelines for further research. The current study did not include any political or ideological variables, whereas the variation of political change has an impact on the domestic conflict or civil war, and it is a new direction for future research. Therefore, future research may analyze the data and development of environmental sustainability for better policy implication.

Data Availability   Data is freely available online.
Data on various determinants of democracy (DEMO) for 173 countries can be freely access at https://www.v-dem.net/en/.

Data of ethnic and religious diversity is freely available at Cline Centre for Democracy database, University of Illinois, Chicago, USA[8] at https://clinecenter.illinois.edu/projects/research-themes/Religious-Ethnic-Identity.

Declarations

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