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(INE)QUALITY OF AIR AND WATER -

A political ecology approach to a multilevel analysis of individual- and country-level factors impacting people's experience of environmental quality in their community

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ABSTRACT

The purpose of this study is to examine inequalities in terms of air and water quality in a cross-national study comparing determinants at both individual and national level using a subjective measurement. This study explores *how uneven development and economic inequalities within and between countries affect people's experience of environmental problems (i.e. poor water and air quality) in their community*. The study design is secondary analysis of cross-national data from the World Values Survey and the World Development Index. A multilevel linear regression was conducted and the sample in the final model specification consisted of 29,307 individuals nested in 24 countries. The results indicated that there is a significant cross-national pattern of people living in larger towns (or cities) experiencing worse air and water quality in their community than those living in smaller towns. Another significant result was that experience of good air and water quality decreases as GNI per capita decreases. Being female also decreases a person's experience of good air and water quality in their community. There were no significant relationships between experienced air and water quality and individual-level income or the GINI coefficient.

Inequalities in air and water quality between rural and urban areas are discussed as the uneven development of space and nature. As the main objective of the prevailing societal mode of production – capitalism – is accumulation of wealth, centralization of productive capital (labor and means of production) occurs as a way to achieve this goal. This process changes the metabolism of nature, mainly through vehicular traffic and industrial activities.

The differences between low- and high-income countries are discussed through the perspective of world-systems analysis. Core countries contribute to environmental degradation in (semi-)periphery countries by ecological unequal exchange; by offshoring hazardous industries and thus externalizing the environmental costs of their way of living. This is possible because periphery countries, due to the shortage of economic resources, often lack the environmental regulations that are implemented in core countries.

Gender inequality is discussed through the lens of feminist political ecology, which suggest that experience of and exposure to environmental problems is gendered as a result of socially and culturally structural positions in relation to labor and nature (i.e. gender roles). In addition, women tend to be underrepresented in environmental decision-making, which affects their possibilities to improve their situation.

Key words: air quality, water quality, environmental justice, political ecology, uneven development, world-systems analysis, multilevel linear regression

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1. Introduction and Research Questions

> “Environmental pollution is an incurable disease. It can only be prevented.”
> – Barry Commoner to NY Times, 2007

> "Water and air, the two essential fluids on which all life depends, have become global garbage cans." – Jacques Cousteau

Globally, diseases caused by pollution were responsible for sixteen percent of all deaths worldwide in 2015 (Stockholm Resilience Center n.d.). The mortality rate for pollution is three times higher than that of AIDS, tuberculosis, and malaria combined. It is fifteen times higher than mortality rates from all wars and other forms of violence (ibid.).

Data shows that nine out of ten people breathe polluted air every day and around seven million people die every year due to exposure to polluted air (World Health Organization [WHO] 2018). In addition, three out of ten people worldwide (or 2.1 billion people) lack access to safe drinking water at home (ibid.).

Much like the benefits from the industries and activities resulting in environmental degradation, the burden of air and water pollution is unequally distributed amongst humans. The greatest share of death and disease due to environmental problems is in low- and middle-income countries (WHO 2016). The environmental justice movement focuses on the unequal exposure to pollutants in low-income communities and communities of color (Robbins 2012). Inhabitants of urban areas suffer from more air and water pollution than those in other areas (Charlesworth & Booth 2019). Gender has also been found to affect exposure to toxins in certain places (Pellow & Brehm 2013). The purpose of this cross-national study is to further explore the unequal distribution of air and water pollution in examining which individual- and country-level factors affect individuals’ experience of environmental problems (i.e. poor air and water quality) in their community. Of focus in this study is individual-level income, urban/rural differences, national economy, and national degree of income inequality. A political-ecology approach is used to understand some of the complex reasons behind inequalities in air and water quality. By taking this approach, disparities in terms of air and water quality are viewed as structural inequalities rooted in political-economic power relations and/or stemming from the currently prevailing political-economic system of capitalism. The research question for this study is:

How does uneven development and economic inequalities within and between countries affect people's experience of poor water and air quality in their community?

To facilitate answering this question, the following four sub-questions will be explored:

SQ_1: *Is there a relationship between individual income level and to what extent people experience poor water and air quality in their community?* This question aims to examine if there is cross-national indication that environmental injustice on the basis of individual-level income exists, meaning that people with lower incomes tend to inhabit areas where environmental quality is (or is experienced as) worse than in the areas where individuals in higher income brackets live (Robbins 2012).

SQ_2: *Is there a relationship between town size and to what extent people experience poor water and air quality in their community?* Urban political ecologists mean that "cities in both the global North and South are choking as the concentration of small particles and other forms of pollution reach dangerously high levels" (Swyngedouw in Perrault et al. 2015:609). It is estimated that by 2030, one in every three people will be living in cities with a population of at least half a million (UN Human Settlements Programme 2016). With urban pollution being responsible for so many deaths annually, there is a pressing need to expand the research on urban pollution (Charlesworth & Booth 2019).

SQ_3: Does a country's national economy have an effect on to what extent people experience poor water and air quality in their community? In other words, do inhabitants of high-income countries experience better air and water quality than people in low-income countries? Of all pollution-related deaths, ninety percent occur in low- and middle-income nations (Stockholm Resilience Center n.d.). Much of the environmental costs of the lifestyle common in developed countries are externalized to low-income countries where environmental regulations are lax or non-existent (Adeola 2000). Examples of this externalization include moving industries that use hazardous chemicals from high-income countries where these are regulated to low-income countries (Schrader-Frachette 2002), and hazardous waste export (Bhutta et al. 2010; Grossman 2006; Joines 2012). This study will discuss how a country's position in the world-system affects its inhabitants' experience of environmental quality in their community.

SQ_4: *Does national income equality have an effect on to what extent people experience poor water and air quality in their community?* Put differently, do the inhabitants of countries with a higher degree of economic equality experience better air and water quality in the communities that they live in? The relationship between economic inequality and environmental issues has also been explored, although to a lesser extent. Studies suggest that economic equality within a country results in less impact on the environment (Mikkelson 2013). In unequal societies, power relations are imbalanced which allows one group to take advantage of the others – to externalize pollution on marginalized groups in society. Research has shown that when only part of the population is exposed to environmental problems, the total public will to address the issues are low – the rest of the population do not see, or choose not to see, the consequences of the environmental problems since they are not directly affected by it (Pastor & Morello-Frosch 2018). In addition, differences in *experience* of relative environmental quality may be smaller if there are less socio-economic inequalities between groups.

While studies have explored each one of these factors (individual income level, urban/rural differences, national economy, and national degree of income inequality) and their effect on air and water quality separately (and to varying extents), no study has combined the predictors on a cross-national level. In general, cross-national studies on the subject are uncommon. Environmental problems such as air and water quality are often studied locally, regionally, or nationally. A multilevel analysis allows this study to compare individual and national determinants in one model. In addition, research on subjective air and water quality (i.e. people's *experience* of it) are rare. Air and water quality are often measured in objective terms (e.g. levels of CO or PM2.5). Some studies on subjective experience of air quality have found that sensory and health cues such as decreased visibility or nose-throat irritation are key determinants for the public perception of air pollution (Bickerstaff & Walker 2001; Wall 1973). Since pollution is not always perceptible, it is possible that results from research on subjective air and water quality differs from that of objective quality. This study examines subjective environmental quality on a large scale, including almost 30,000 individuals in 24 countries.

2. Theoretical Framework

The theories presented in this section are used to explain the results regarding inequalities in terms of air and water quality. First, subjective and objective deprivation are discussed, and the theory of relative depravation is introduced as a way of understanding disparities in *experience* of environmental quality in one's community (chapter 2.1). Subsequently, the overall approach of this study, political ecology, is described (chapter 2.2). The perspective of urban political ecology (chapter 2.2.1) is used to examine differences in experienced environmental quality between inhabitants of urban and rural areas, in combination with uneven development and centralization of productive capital (chapter 2.4.2). Feminist political ecology has a small role in this study in analyzing gender differences in experienced environmental quality (chapter 2.2.2). The chapter on environmental justice (2.3) provides a framework for how inequalities in air and water quality are viewed in this study. Lastly, a combination of the concepts of uneven development (chapter 2.4.1), world-systems analysis (2.5.1), and ecological unequal exchange (2.5.2) are used to explore differences in experience of air and water-quality between inhabitants of low- and high-income countries.

2.1 Subjective and Objective Deprivation

Since this study examines people's *experience* of environmental quality in their community, a discussion on objective and subjective deprivation is relevant. Objective deprivation, or absolute deprivation, is the actual lack of basic needs or necessities. Subjective deprivation refers to feelings of deprivation or the notion of disadvantage. Being objectively deprived of something that many other people in society have (e.g. basic needs such as housing) can cause stronger feelings of deprivation than lacking something that only few people have (e.g. luxury goods) (Muffels 2014). Feelings of deprivation come from a comparison to social norms (which usually differ from time and place). Subjective deprivation is usually associated with income poverty but has long been recognized as a concept with multiple dimensions and applications (Gasparino et al. in Graham & Lora 2009).

A critique of subjective measurements is that "disadvantaged people might report high levels of [e.g. social well-being] partly due to ignorance or deficiencies in their knowledge of the range of choices that ought to be available to them" (Muffels & Headey 2011:1160). In addition, the "adaptation and anticipation effects" might influence a subjective assessment; people adapt quickly to a new situation (e.g. increased income) or anticipate future changes and "adjust their judgment and behavior accordingly suggesting that though income or resources changes affect peoples' well-being or poverty status in the short run they do not in the longer run" (ibid.).

Arguments for using a subjective measurement comes from psychologists who claim that beliefs and motivation affect behavior, and from sociologists who argue that "well-being is relative referring to the 'keeping up with the Joneses' argument; people tend to judge their own well-being relative to others by comparing their own situation with their peers' as in social comparison and relative deprivation theory" (ibid.).

Thus, a component of subjective deprivation is relative deprivation. First introduced by Stouffer et al. (1949), the concept suggests that individuals' feelings of deprivation arise when they compare their situation to that of others. Sociologist Robert K. Merton (1950) was among the first to use the concept in arguing that the choice of reference group impacts individuals' feelings of relative deprivation. Walter Runciman (1966) introduced one of the first formal definitions of relative deprivation, where he described four preconditions of relative deprivation: (1) person A does not have X, (2) person A knows of other persons that have X, (3) person A wants to have X, and (4) person A believes obtaining X is realistic.

2.2 Political Ecology Approach

The overarching framework used in this study is political ecology, which is an approach that aims "to understand the complex relations between nature and society through a careful analysis of what one might call the forms of access and control over resources and their implications for environmental health and sustainable livelihoods" (Watts 2000:257). In this study, a political ecology approach is used to understand the reasons behind inequalities in air and water quality. By taking this approach, inequalities in terms of air and water quality are understood as structural inequalities rooted in political-economic power relations and/or stemming from the currently prevailing political-economic system of capitalism.

First described by Eric Wolf in 1972, the approach differentiates from normative *apolitical* approaches, such as eco-scarcity and modernization, to environmental problems (Robbins 2012) by claiming that ecological issues are entwined with global political structures. In contrast, eco-scarcity (originating from Thomas Malthus's *Essay on the Principle of Population*) explains ecological issues in terms of population growth and overpopulation while modernization argues that environmental problems stem from "inadequate adoption and implementation of 'modern' economic techniques of management, exploitation, and conservation" (ibid.:18).

While eco-scarcity and modernization claim to ignore political aspects, political ecology is critical of political and economic power structures and examine their relationship to environmental change. Robbins (2012) describes the worldview of political ecologists:

> All […] spheres of activity are […] arranged along axes of money, influence, and control. They are part of systems of power and influence that, unlike the imagined steady march of the population 'explosion' are *tractable to challenge and reform*. They can be fixed. (Robbins 2012:13)

In addition to focusing on political economic factors, political ecology has a global perspective since it is "a field of research predicated on the assumption that any tug on the strands of the global web of human-environment linkages reverberates throughout the system as a whole" (ibid.:14). Global political power structures can, according to political ecologists, have local ecological consequences. This perspective is used in this study to examine how differences in global power relations between low- and high-income countries affect people's experience of environmental quality at the local level.

A common theme in political ecology is that it "tracks winners and losers to understand the persistent structures of winning and losing" (ibid.:87). An environmental problem is never understood as an undifferentiated event but rather as something that has "causes and consequences that are uneven between communities, classes, or groups" (ibid.). This is often due to the fact that "environmental effects or costs of human action are typically offloaded onto communities, people, or spaces with inadequate political or financial resources to resist" (ibid.). In this notion, political ecology overlaps with environmental justice (see chapter 2.3). Political ecology research addresses the causes that lead to the structural production of winners and losers:

> It is never enough to say that outcomes have winners and losers; it is essential to understand the degree to which such outcomes are non-incidental, persistent, and repetitive: a structure of outcomes that produces losers at the expense of winners. Thus, political ecology narratives typically track the historical processes, legal and institutional infrastructures, and socially implicated assumptions and discourses that typically make unjust outcomes the rule, rather than the exception. (Robbins 2012:88)

In discussing the causes for inequalities in terms of air and water quality, this study identifies winners and losers and attempts to track the historical processes and political-economic structure that produces this outcome.

Political ecology research reveals who benefits from the actions that cause environmental changes, hidden costs, and power differences that produces social and environmental outcomes. These revelations often include explanations that evaluate the influence of variables at different levels; local decisions, regional policies, and global politics and economics. Each are nested within each other with the global influencing the regional and the local decision-making (Robbins 2012). In this regard, political ecology is useful for this multi-level study.

Within political ecology, this study is situated within a neo-Marxist approach. The point of departure for neo-Marxist studies is “explaining the injustices of 'underdevelopment' and 'poverty', which – as political ecologists – they examine from a broader political economy framework, linking it with the issue of environmental change and the exploitation in terms of class, gender, or subaltern status” (Khan 2013:461). Neo-Marxists within political ecology also often use frameworks such as world-systems analysis or class inequality analysis to explain environmental change in the context of underdevelopment and poverty (ibid.). According to Marx, capitalist production requires the exploitation of both labor and nature since it is driven by capitalists appropriating a surplus (Marx 1876). The surplus must come from somewhere; usually, from workers performing extra labor and nature being expropriated while restoration of impacted ecological systems is underinvested in (Robbins 2012). Especially attractive for capital production are areas where labor is cheap and environmental regulations lax, which is often the case in low-income countries, since the surplus will increase as costs for labor and environmental safeguarding can be cut (Pellow & Brulle 2005).

An advantage of a neo-Marxist framework is its “emphasis on global-local dimensions and linkages between a local community, such as a village in a developing country, and a nation-state, a region, and even the global market and institutions” (Khan 2013:462). However, it has been criticized for its economic reductionism, meaning that it is “too 'narrow' in vision, and overlooking other important non-material dimensions of power” (Bryant 1998:154). The post-Marxist lens of feminist political ecology somewhat balances out the one-dimensional focus on economic power in this study.

2.2.1 Urban Political Ecology

The field of urban political ecology was initiated with the 1996 article *The City as a Hybrid* (Swyngedouw 1996). The approach seeks to understand the way political, social, and economic relations structure access to the urban environment. It focuses “on the uneven urbanization of nature, the socio-ecological inequalities that pattern cities, and the perplexing socionatural landscape that capitalist urbanization produces within, between, and beyond cities” (Erntson & Swyngeduow 2019:4). Similar to the political ecology from which it stems, urban political ecology has a focus on who benefits and who loses, and in what ways, from processes of socio-environmental change (Desfor & Keil 2004). It also recognizes power relations on different levels – from the local to the global – through which unjust socio-environmental conditions are produced and maintained (Heynen, Kaika & Swyngedouw 2006). Thus, urban political ecology is a useful approach for this study in attempting to explore how differences in air and water quality between urban and rural areas are produced.

A key concept in urban political ecology is metabolism, which is a metaphor used to describe the flow of materials and energy within cities. It is a framework used to study the interactions of human and non-human systems in specific regions (Robbins 2012). Urban metabolism has been described as "the sum total of the technical and socio-economic process that occur in cities, resulting in growth, production of energy and elimination of waste" (Kennedy et al. 2007:44). The purpose of studying metabolic flows is to explore which resources flow into the system of the city, how these resources are being used, and what happens with any output (i.e. pollution or waste) coming from the use of the resource (ibid.).

Another meaningful concept often used in urban political ecology is environmental justice (see chapter 2.3) which helps describe how "control over the flow of environmental goods and bads results in uneven exposure, risk, and opportunity" (Robbins 2012:83). However, according to Heynen, Kaika and Swyngedouw, environmental justice research is "sensitive to the centrality of social, political and economic power relations in shaping process of uneven socio-ecological conditions" but lacks the recognition of "how these relationships are integral to the functioning of a capitalist political-economic system" (Heynen, Kaika & Swyngedouw 2006:9). Environmental justice has a liberal and distributional perspective on justice whereas neo-Marxist urban political ecology argues that "uneven socio-ecological conditions are produced through the particular capitalist forms of social organization of nature's metabolism" (ibid.). This view relates to the concept of uneven development (see chapter 2.4), which also emphasizes that capitalism shapes space and nature in processes of uneven geographical development – such as urbanization (Smith 1984).

Further, neo-Marxist urban political ecologists argue that "urbanism is the mode of appropriation of the natural and human environment by capitalism" (Debord 1994:121). Swyngedouw means that this perspective is "not primarily concerned with the city as a dense and heterogeneous assemblage of accumulated socio-natural things and gathered bodies in a concentrated space, but rather with the particular forms of capitalist urbanization as a sociospatial process whose functioning is predicated upon ever longer, often globally structured, socio-ecological metabolic flows. These flows not only weld together things, natures and peoples, but do so in socially, ecologically, and geographically articulated, but uneven, manners" (Swyngedouw in Perrault et al. 2015:609). In this statement, urban political ecology distances itself from the eco-scarcity perspective of primarily using overpopulation as a mode of explanation, and instead lean towards neo-Marxist theories such as uneven development (see Chapter 2.4). An example of these uneven global socio-ecological flows is how "the excesses of urbanization − from (e-)waste to CO 2 − are customarily decanted onto the socio-ecological dumping grounds of the periphery of cities" (ibid.:610).

2.2.2 Feminist Political Ecology

A subfield of political ecology, feminist political ecology initially developed from gender and development studies "with which it shares a broad commitment to understanding the dynamics of gender in relation to the natural environment and in the context of natural resource-based livelihoods" (Elmhirst in Perreault et al. 2015:519). Although not a main focus in this study, a feminist political ecology approach is used to briefly discuss gender differences in experience of air and water quality in one's community. The approach emphasizes politics and power at different scales, just as political ecology, while it is highlighting gendered powered relations and is contributing to combatting gender inequality. An important element of feminist political ecology is that it "seeks to complicate arenas of assumed common interests, such as 'community' or 'household'" (ibid.). In this approach, feminist political ecology recognizes gendered differences among individuals grouped in households and communities.

The core philosophy of feminist political ecology is that "human-environmental interactions and processes are gendered, meaning that men and women experience the environment differently and often have different access to and control over ecological systems, as a result of their divergent social and cultural roles" (Robbins 2012:64). The differences mentioned are not due to physical/physiological differences, but rather results of socially and culturally structural positions in relation to labor and nature. Gender norms "explain much about what women and men know about the environment, how much access they get to environmental systems, and their level of tolerance and resistance to environmental risks and burdens" (ibid.).

Feminist political ecology has moved in new empirical directions "in response to the impacts of a changing (and increasingly neoliberal) policy climate" (Elmhirst in Perreault et al.

2015:519). Elmhirst means that neoliberal policies in combination with urbanization, globalization and an increased pace of environmental degradation (which may all be interlinked) have affected livelihood practices in gendered forms. There has been a new interest in how feminist political ecology can address the challenges that stem from these processes (Elmhirst in Perreault et al. 2015).

2.3 Environmental Justice

As previously mentioned, environmental justice overlaps with political ecology in its focus on winners and losers in terms of socio-ecological conditions. Insight in the field of environmental justice facilitates this study's attempt to understand inequalities in air and water pollution since it brings attention to economic and political power differences as the cause of disproportionate exposure to pollution among minority communities. Environmental justice "attends specifically to the dynamics of locating environmental hazards, and the tendency for minority communities to be exposed to toxic dumping, poor air quality, and soiled water resources" (Robbins 2012:87). It is both a movement and a type of analysis which recognizes that:

> Access to a healthy and clean environment is increasingly distributed by power, class, and race. Where one can afford to live has a major effect on the nature and extent of one's exposure to toxic pollutants. Within this dynamic, elites can move from polluted industrial areas to less polluted suburban neighborhoods and locations featuring natural amenities, such as Aspen, Pebble Beach, or the Hamptons. The poor and powerless cannot. (Pellow & Brulle 2005:2)

The field of environmental justice has been described as "one that fully unites political action and mobilization, environmental systems and considerations, and the uneven development of urban landscapes, underscoring the way white privilege and wealth can offload ugly externalities precisely by controlling the metabolism of the city" (Robbins 2012:74). This quote illustrates how environmental justice relates to and overlaps with other concepts in the theoretical framework used in this study. Similar to political ecology, it emphasizes the importance of political-economic power relations in understanding environmental inequalities. The quote also specifically touches on urban political ecology in discussing how power relations are affecting the metabolism of cities, relating this to uneven development of landscapes (see chapter 2.4).

The environmental justice movement is commonly thought to have its beginning in the US in the late 1970's and early 1980's with the events of Warren County, North Carolina (Jessup 2017) where a marginalized black community was exposed to toxins from contaminated soil as a result of an illegal PCB landfill in the area (Bullard & Wright 2008; Burwell & Cole 2007). The Warren County event was one of the first cases of environmental justice in the US. Since it is a good example of how crucial it is to examine economic and politic power relations in understanding unequal distribution of pollution, the Warren Country event will be briefly described below.

In 1978, a trucking company illegally disposed of over 100,00 liters of PCB-contaminated waste oil by spraying it along 210 miles of North Carolina road. The act, which was done to avoid the expense of transporting the waste out of state, was the largest PCB spill in US history (Burwell & Cole 2007). The State of North Carolina started a process to establish a dump site where they could dispose of the PCB-filled waste. Although more than hundred sites in thirteen North Carolina were inspected, the chosen area (in the small, rural community of Afton in Warren County) was not the most scientifically suitable, since the water table was too shallow and the inhabitants of the community used local wells for access to drinking water (Bullard & Wright 2008). Months after the site was chosen and declared as the safest site by the State, a detailed analysis was done where the State and the United States Environmental Protection Agency (EPA) discovered that it failed to meet the federal standards for disposal of toxic waste. Other than the water table being too shallow, the soil under the site was not as compact as required (Burwell & Cole 2007). Since the site failed to meet the standards, EPA had to grant waivers for the State to construct the landfill. Despite all the evidence that the site was unsafe, EPA approved it in 1979 (Burwell & Cole 2007).

Bullard and Wright (2008:224) argue that the decision to locate the landfill in Warren County "was more political science than toxicology or hydrology". Since the site was claimed to be safe by the State despite not meeting federal standards, it is clear that the decision was not based on scientific testing. Instead, it was the demographics of the area that affected the decision. Warren County is located in Eastern North Carolina which has a predominantly black population. In addition, the area is considerably poorer than the rest of North Carolina. Bullard & Wright explain that "the county ranked 92nd out of 100 counties in median family income in 1980" (Bullard & Wright 2008:223). The same authors mean that "Warren County, in sum, exhibits the 'quadruple whammy' - in that it is mostly black, poor, rural, and politically powerless" (ibid.:224). It was because the area was considered the most powerless, the least likely to successfully argue the decision, that it was chosen to be the site of the toxic landfill. Here, the importance of understanding the issue as political rather than apolitical, in accordance with a political ecology approach, is clear. Bullard and Wright claim that “many dirty industries have followed the ‘path of least resistance’, allowing low-income and people of color neighborhoods to become the ‘dumping grounds for all kinds of health-threatening operations’ (ibid.:218). The same reasoning is expressed by one of the Warren County residents, Reverend Luther Brown, who fought the decision:

> “We know why they picked us,” the Reverend Luther Brown later told the Washington Post. “It's because it's a poor county - poor politically, poor in health, poor in education and because its mostly Black. Nobody thought people like us would make a fuss”. (Burwell & Cole 2007:15)

The Warren County controversy, along with Love Canal in New York State (Shrader-Frechette 2002) and Cancer Alley (Bullard & Wright 2009) in Louisiana, are considered as “key trigger moments for the environmental justice movement born from resistance” (Jessup 2017:52). However, the issue of unequal distribution of pollution that was raised by the Warren County community has existed since the late 1880’s and early 1990’s. This was when industrialization brought about the growth of the wealthy class and the development of urban metropolises (Melosi 2005).

Three key components to environmental justice are human health, environmental protection, and economic security (Jessup 2017). Environmental justice “is about championing the underdog, those experiencing financial disadvantage and a lack of political power, including that experienced by ethnic and immigrant groups, the working and lower classes” (ibid.:54). It often refers to “an injustice perceived to have been brought about through the environmental harm wrought by industry and the unwillingness of governments to respond, to listen or to demonstrate care” (ibid.:65). Again, the environmental justice field situates itself within political ecology in exploring the economic and political power relations that produces a certain ecological outcome in which some are winners, and some are losers.

Since its beginning in the US, environmental justice has become a national and supranational phenomenon (Jessup 2017). Globalization played a role in this transition as it changed the terrain for scholarship and movements (Walker 2009). By the early 2000’s, environmental justice had transitioned beyond the local, recognizing global parallels with the local environmental justice studied in the US (Jessup 2017). Jessup (2017:60) argues that:

> Irrespective of the local experience of the environmental justice concept, diverse communities across the globe have shared a process of battling decisions and impacts affecting them. Less politically and socially powerful groups have engaged in resistance, networked, and demanded enforcement action and inclusion in decision-making.

Thus, environmental injustice appears to be a phenomenon that occurs globally; a network of local environmental injustices spans over the globe. This is made visible by an online tool called the Environmental Justice Atlas, where cases of environmental justice are positioned on a global map so that site visitors can zoom in on specific regions or cases and learn more (*https://ejatlas.org/*). Looking at the numerous dots symbolizing cases of environmental justice all over the globe, it is logical to assume that a cross-national relationship between income level and experience of environmental problem in one's community could be visible in a statistical analysis. However, this study only focuses on the economic aspect of environmental injustice while the Environmental Justice Atlas also includes environmental injustice on the basis of race and ethnicity, rural communities, native populations etc. Many cases of environmental injustice are a complex combination of these and other factors.

During the transnational transition, the movement and discourse of environmental justice has expanded to include intra- and intergenerational equity (Watson & Bulkeley 2005) as well as analyses of disability, and gender (Jessup 2017). The discursive and legal setting has broadened to involve developing nations as well as indigenous peoples (ibid.). Therefore, the concept is meaningful in this study also when discussing gender differences and differences between inhabitants of low- and high-income countries.

It is important to emphasize that environmental justice is not just an outcome, but to a great degree a battle and a process (ibid.). Schlosberg means that "for all of the focus on the reality of [...] inequities, environmental justice was never only about such maldistributions" (Schlosberg 2013). Since the 1990's, it has been acknowledged that it is not just distributional inequity, but also political disempowerment that needs to be addressed. Environmental problems are now recognized as not always a result of distributive effects, but also a result of unequal power and opportunity to participate (Jessup 2017). Environmental justice discourse has shifted to a realization that "distributive justice cannot be separated from participatory justice" (ibid.:61). Jessup (2017:61) argues that:

> [A] community will not be able to achieve the transition from a site of unequally distributed harm to a community with equal access to environmental health until it has the capacity and

> power to shape its destiny. Environmental injustices are instances of not being asked, not being considered, not being recognised and hence not having an equality of opportunity to contribute to decisions that affect livelihoods and wellbeing.

This means that equality can be denied through processes of ignoring communities that lack power to get their needs addressed, like in the case of Warren County. Because of this, environmental justice necessitates "structural changes in social, economic and political systems that effect distribution of environmental inequalities" (London, Sze & Lievanos 2008:258) which leads to the recognition of the community (Jessup 2017). In examining environmental injustices in terms of air and water quality, it is therefore important to take a political ecology approach to the causes of the injustices.

A concept used within environmental justice literature is slow violence (Nixon 2011). It refers to how environmental harm in some situations occurs "gradually and out of sight" (Nixon 2011:2), affecting marginalized groups to a greater extent. Nixon describes it as "a different kind of violence, a violence that is neither spectacular nor instantaneous, but rather incremental and accretive, its calamitous repercussions playing out across a range of temporal scales" (Nixon 2011:2). Air and water pollution are understood as a form of slow violence in this study; it is often not visible and its effects on human health is not instantaneous, yet severe.

2.4 Uneven Development

Uneven development originated with Marx's writing on uneven and combined development (see Ashman 2012) and has been expanded upon by several neo-Marxist scholars, including Neil Smith (1984) and David Harvey (2003). Smith suggests that uneven spatial development is a function of the procedural logic of capital markets. He means that "the societal mode of production […] binds space and nature together into a single landscape" (Smith 1984:143). In this way, society and economies "produce" space and it is a process that happens at multiple scales, from the urban to the national to the global. Smith means that capitalism is characterized by structural inequalities and produce uneven development at different scales (Smith 1984). The concept is meaningful for this study to examine (1) how wealth inequalities between countries are produced and reproduced, and (2) why urban areas form and how this affects nature.

2.4.1 Uneven Development at the Global Scale – Inequality Between Nations

At a global scale, the uneven development of countries is "the historical product of past and continuing economic and other relations between the satellite underdeveloped and the now developed metropolitan countries" (Frank 1969 in Timmons & Hite 2007:77). In this study, uneven development at the global scale is used to understand why some countries are more affluent than others and, in combination with world-systems analysis (see Chapter 2.5), how the wealth differences come to influence inequality in terms of air and water pollution on a global scale.

An important part in the explanation for uneven development between countries is that "core or metropolitan countries [i.e. 'developed countries'] developed by under-developing the periphery [i.e. 'developing countries']" (Kiely 2010:11). Part of the reason for the historical and contemporary wealth differences between countries, and the "underdevelopment" of periphery countries, lie in resource extraction. In the 1960's-1970's, Marxist scholars further developed a theory – called dependence theory – which explored to what extent the wealth of developed countries come from resource extraction and other forms of exploitation of formal colonial countries (Frank 1969; Rodney 1972). The cause of wealth differences between countries has also been extended to include developed nations' use of cheap labor in developing countries to increase their wealth (Timmons & Hite 2007). Smith discusses the inclusion of developing countries into international capitalism and means that (in contrast to what Marx predicted) "capital, rather than using the underdeveloped world as a source of markets, has instead used the Third World as a source of cheap labor, thus preventing its full integration into the world market" (Smith 1984:209). This reinforces the uneven development as developing countries only being used for labor and resource extraction are being prevented from growing economically. Harvey expands on the theory of uneven development by describing the process of "accumulation by dispossession" – a continuing form of global uneven development. He illustrates numerous capitalist and neoliberalist activities that contributes to plundering the world's working class and poor in order to accumulate wealth in the hands of the ruling class; for example, commodification and privatization of land, conversion of various forms of property rights into private rights, and commodification of labor power (Harvey 2003).

Smith argues that nowhere is it clearer that capital creates a world after its own image than in "the geographical contradiction between development and underdevelopment where the over-accumulation of capital at one pole is matched by the over-accumulation of labour at the other"

(Smith 1984:149). In this, Smith situates his theory in the context of dependency theory from which world-systems analysis was developed (see Chapter 2.5) (Rogers 2012).

2.4.2 Uneven Development and Urbanization

The concept of uneven development, and especially centralization of productive capital, is used in this study to examine political-economic factors that produce bigger towns and cities and cause inequalities in terms of pollution between rural and urban areas.

A key component in how capitalism shapes space and nature is the concentration and centralization of capital. This happens because the goal in capitalist societies is constant accumulation of capital. Concentration and centralization of capital are ways for capitalists to increase surplus and thus accumulate more wealth. Smith distinguishes between social and spatial concentration and centralization of capital. The social process is one in which "individual units of capital come to control larger and larger quantities of capital" (Smith 1984:160) – for example, owners of growing businesses becoming wealthier – while the spatial process refers to the physical location of capital, which is mainly a matter of centralized productive capital (Smith 1984). Productive capital is the physical capital, such as means of production and labor-power. Centralization of productive capital, then, is the centralization of people (workers) and industries (offices, factories, transport systems etc.) in a geographical area – a city or a town. This process shapes space and nature since it "requires a continuous investment of capital in the creation of a built environment for production. Roads, railways, factories, fields, workshops, warehouses, wharves, sewers, canals, power stations, dumps for industrial waste—the list is endless" (ibid.:159).

On this process of spatial centralization, Smith adds that "the effect of capital, then, has been to differentiate previously undifferentiated geographical space" (ibid.:166). In other words, the process has created a division between rural and urban landscapes. Smith describes how the process increases surplus for capitalist by writing that:

> Where workers are concentrated in one location, the cost of reproduction of labor power is reduced because a number of necessities can be consumed in common. In particular, the necessary journey to work is kept to a minimum, thus keeping wages and hence socially necessary labor to a minimum, and maximizing the period of surplus labor. Accumulation of capital is not just accumulation of the proletariat, as Marx said, but accumulation of the proletariat in certain places of production. (Smith 1984:166)

Centralizing workers in the same area as production allows businesses to keep wages lower since costs of living are lower for the workers. This way, the surplus for capitalists increases.

In sum, the accumulation of capital that is an integral part of capitalism changes the geographical landscape in that it gathers means of production and workers in the same areas, resulting in uneven development. The concentration of industry and people in a certain area affect nature, partly through the release of air and water pollutants. The main causes of urban pollution are both industrial and civil emissions from sources such as "industry, traffic, domestic heating, coal and oil combustion, incineration, construction activities, road weathering, and maintenance activities such as street sweeping and gully emptying" (Charlesworth & Booth 2019:2).

Smith opposes the view of uneven development as something that occurs naturally by saying that "it is a hallmark of bourgeois ideology, indeed, to universalize the specific social forms and relations of the capitalist mode of production into permanent, 'natural' relations" (Smith 1984:134). In this, he is taking a political approach rather than an apolitical, which is fitting within the political ecology framework of this study. He also addresses what was the chicken and what was the egg in terms of capitalism and uneven development:

> It is not […] the "capitalist world system" that is a "*function* of the universal validity of the law of unequal and combined development"; rather, it is uneven development that is a function of the contemporary universality of capitalism. (Smith 1984:134)

Finally, Smith acknowledges that he is not making any claims that pre-capitalist development was even, only that the reasons for the unevenness of pre-capitalist development are different from those pertaining to capitalism (Smith 1984).

2.5 Global Relations and Environmental Degradation: World-Systems Analysis and Unequal Ecological Exchange

Originating in the U.S. in the 1970's, founded by Immanuel Wallerstein, world-systems analysis (WSA) suggests that the world should be studied as one global economic system (Klak 2014). WSA evolved "out of efforts over the past fifty years to explain how and why some countries in the world economy have been able to grow in power and wealth while others remain trapped in apparent stagnation" (Timmons et al. 2015:281). WSA has its roots in dependency theory and is related to the concept of uneven development in that it explores power relations between countries that is a result of historical uneven development. It is a type of analysis often used by neo-Marxist political ecologist since it explains injustices stemming from "underdevelopment" with a broader political-economic framework (Khan 2013). In this study, WSA is used in combination with unequal ecological exchange to understand how a country's position in the world-system affects the environmental conditions for its inhabitants.

2.5.1 World-systems Analysis

The main concepts of WSA are core, semi-periphery, and periphery nations. Regions can rise and fall in terms of power, development, and economic potential (Klak 2014), but "the ability of countries to achieve upward mobility is constrained by their trade relations with the world economy and their geo-political role and power, which together condition their structural location within the hierarchy" (Timmons et al. 2015:282).

Core countries have global economic control and wealth, and thus political and military power. They are also associated with higher-skill, capital-intensive production, and they generally exploit non-core countries for labor and resources. Semi-periphery countries have some characteristics of the core and some of the periphery. These nations are the ones that most frequently rise and fall in the hierarchy. Lastly, periphery countries are characterized by low-skilled production and export of raw materials for industries elsewhere. In these countries, poverty levels are often high and living standards low (Klak 2014). According to WSA, the different conditions of nations are shaped by "economic processes, commodities chains, division of labour and geopolitical relationships operating at the global scale" (ibid.:191). When examining an issue in a certain country, it is therefore important to understand the nation's position in the world-system, and its relationship to other nations. Their structural location in the world-system "plays an important role in shaping their class structure and internal political battles" (Timmons et al. 2015:282). This influence in combination with a country's trade relations within the world economy and its geo-political role and power "define world-system theory's relevance for understanding both national environmental policies and levels of damage by country" (ibid.). Timmons et al. expands on the effect of a country's position in the world-system on its internal politics by stating that:

> A country's "incorporation" into the global economy has a critical impact on the avenues of development available to it. This legacy helps to shape the types of products it makes (and which commodities are traded and with whom), the conditions for both capital and labor, as well as its global power *vis-a-vis* other nations. These elements in turn affect governmental policies towards the environment, decisions by firms within countries, and shape the life conditions of its peoples. (Timmons et al. 2015:282)

An example of what Timmons et al. describe is the externalization of the waste produced in core countries to periphery countries. They mean that "global North nations continue dumping waste in […] global 'pollution havens' where the cost of doing business is much cheaper, regulation is virtually non-existent, and residents do not hold much formal political power" (Pellow & Brulle 2005:11). The political and economic power of core countries, i.e. their position in the world-system, allows them to offshore waste to periphery countries where – in turn – the positions of the periphery countries in the world-system is the reason for the low business costs and lack of regulations. This affects the environment and the living conditions both for people in periphery countries and in core countries.

2.5.2 Ecological Unequal Exchange

In addition to labor exploitation, ecological unequal exchange is recognized as a mechanism which contributes to socioeconomic and environmental inequalities between core and periphery countries (Rice 2007). It is a conceptualization of "the cross-national processes and structural relations perpetuating the unbalanced flow of energy and materials within the world-system, shaping patterns of uneven development" (Rice 2007:44).

In ecological unequal exchange, there is an asymmetric transfer of resources between two nations, which does not show in conventional economic statistics on trade (Jorgenson & Rice 2007). Again, e-waste trade can serve as an example; while trade of e-waste may be egalitarian in terms of monetary value (i.e. the receiving nation gets the amount of electronic waste that has been paid for), the ecological damage resulting from it cannot be measured in the monetary terms. The environmental deterioration on ecosystems around e-waste sites in periphery and semi-periphery countries is not considered in the exchange; even if it is fair in terms of monetary value, the ecological exchange is unequal.

Ecological unequal exchange is the "increasingly disproportionate utilization of ecological systems and externalization of negative environmental costs by developed countries and, consequentially, declining utilization opportunities and imposition of exogenous environmental burdens within [developing countries]" (Rice 2007:44). It is a way for countries that are advantageously situated within the world-system to externalize "many of the negative environmental consequences of domestic production, consumption, and disposal activities supporting their standard of living and maintenance of their built industrial infrastructure" (ibid.

2007:46) which leads to environmental degradation at the local level in developing countries (ibid.).

3. Literature Review

In examination of the previous literature on environmental justice and factors that influence exposure to environmental problems, five topics were found that form the structure of this chapter. Although most previous research regards the objective exposure to air and water pollution, some studies are presented below that discuss subjective exposure (e.g. Bickerstaff & Walker 2001; Howel et al. 2002; Brody, Peck & Highfield 2004). Most research on the topic of air and water pollution is conducted locally or regionally and cross-national studies are not as common.

3.1 Individual-level Income and Environmental Quality

Studies suggest that people in lower socio-economic groups experience not only higher rates of cancer (Ward et al. 2004), asthma (Gray & Johnson 2015), and mortality (McLaughlin & Stokes 2002), but also generally poorer health than groups with higher incomes (Diaz 2016). The environmental justice movement claims that these differences are partly caused by a higher concentration of environmental harms (e.g. hazardous facilities) in lower-income communities. The unequal exposure to environmental and health risks is described as "environmental injustice" (ibid. 2016). Research in the environmental justice field in United States, Canada, Sweden, New Zealand, and the UK suggest that low-income neighborhoods tend to have poorer quality physical environments (Brainard, Jones, Bateman, & Lovett 2002; Pellow & Brulle 2006; Jerrett, et al., 2001; Pearce & Kingham, 2008).

Local studies appear to be the trend in literature regarding individual income-level and pollution is local studies, rather than studies on larger scales. However, one cross-national review of studies (Hajat et al. 2016) shows that most North American studies on individual-level income and air pollution have shown that low socioeconomic status communities experience higher concentrations of air pollutants, while the results of similar research in European countries have been mixed. Research from Asia, Africa and other parts of the world generally has shown similar results to that of North American studies, but research in these parts of the world is limited (ibid.).

Although most studies examining environmental pollutants and income focus on hazardous waste and air pollution, case studies have shown increased water contamination among low-income communities in the U.S. (Evans & Kantrowitz 2002; Johnson et al. 1993). A cross-national study examining the relationship between household socioeconomic status (SES) and pollutants in drinking water found a significant relationship in six out of the seven countries included in the study (Yang et al. 2012). Evans and Kantrowitz review studies of the relationship between income and environmental pollutants in the U.S. and find that "income is often directly related to environmental quality, especially when low-income samples are contrasted with samples that are not poor" and that "environmental quality is inversely related to multiple physical and psychological health outcomes" (Evans & Kantrowitz 2002:324).

3.2 Urbanization and Environmental Quality

Generally, some of the worst places to suffer from pollution are towns and cities (Charlesworth & Booth 2019). Research shows that the primary environmental impacts of urbanization are air, soil, and water pollution (Vlahov and Galea 2002). In many cities around the world, poor air quality is a daily environmental problem (Charlesworth & Booth 2019). In addition, the deterioration of water quality is one of the most detrimental effects of urbanization (Goonetilleke et al. 2014). Water quality issues include introduction of toxic substances, salinity, dissolved oxygen depletion, etc. (ibid.).

Air and water pollutants originate from anthropogenic activities common to urban areas. The primary sources of pollutants include vehicular traffic and industrial activities (Goonetilleke et al. 2014; Charlesworth & Booth 2019) as well as commerce, the application of fertilizers in residential areas, waste disposal (Goonetilleke et al. 2014), "domestic heating, coal and oil combustion, incineration, construction activities, road weathering, and maintenance activities such as street sweeping and gully emptying" (Charlesworth & Booth 2019:2).

Environmental degradation in urban areas are worst in low-income countries. Table 1 shows the most polluted towns or cities and the most prevalent type of pollutant in that area (Charlesworth & Booth 2019). Urban sanitation in many low-income countries is limited, and as a consequence, mortality rates are high.

Table 1. Most polluted towns or cities

	City/country	Type of pollution
1.	Linfen, China	Coal
2.	Tianying, China	Heavy metals
3.	Sukinda, India	Hexavalent chromium
4.	Vapi, India	Chemicals and metals
5.	La Oroya, Peru	Sulphur dioxide, lead, copper, and zinc
6.	Dzerzhinsk, Russia	Chemicals and toxic by-products, such as sarin and VX gas
7.	Norilsk, Russia	Air pollution, such as particulates and sulphur dioxide
8.	Chernobyl, Ukraine	Radiation
9.	Sumgayit, Azerbaijan	Organic chemicals, heavy metals, and oil
10.	Kabwe, Zambia	Cadmium and lead

Derived from http://www.blacksmithinstitute.org/

Source: Charlesworth & Booth 2019

Although most previous research on urban pollution concerns objective exposure, there are a few studies on public perception of air pollution. Sensory and health cues (e.g. reduced visibility and nose-throat irritation) were found to be important determinants for the public perception of air pollution (Bickerstaff & Walker 2001; Wall 1973). Local context also affects perception of air pollution; proximity to pollution sources (e.g. industry) increase public perceived pollution (Howel et al. 2002) and proximity to amenity plots with greenery (e.g. parks) decrease it (Bickerstaff & Walker 2001). A review of six studies conducted in different US cities in the 1960's found that perceived air pollution is strongly correlated with actual air quality in neighborhoods (de Groot et al. 1966). More recent studies, which were conducted in urban cities where air pollution was only a minor issue, suggest that perceived pollution is weakly correlated with actual air quality (Brody, Peck & Highfield 2004; Kim, Yi & Kim 2012; Nikolopoulou et al. 2011). However, these studies measured air quality in the form of pollutants that are odorless and nearly invisible at low levels.

3.3 National Economy and Environmental Quality

Over ninety percent of all pollution-related deaths occur in low- and middle-income nations (Stockholm Resilience Center n.d.). According to WHO (2016), air pollution is more prevalent in low-income countries. The mortality rates for deaths caused by air pollution are highest per hundred thousand of the population in Georgia, North Korea, Bosnia and Herzegovina, Bulgaria, Albania, China, and Sierra Leone (Charlesworth & Booth 2019). As for deaths caused by diseases stemming from water pollution, mortality rates are greatest in Africa – with Angola, Congo, Somalia, Chad, Sierra Leone, Niger, and Burundi among the highest per hundred thousand of their population (ibid.).

A reason for the disproportionate amount of environmental degradation according to the previous literature is the externalization of dirty industries from high- to low-income countries (Bunker 1985; Buttel 1987; Schnaiberg 1975). Developing countries often "lack the resources and the regulatory instruments to control MNC's [multinational corporations'] activities and environmental problems" (Adeola 2000:703). It has been suggested that "higher incomes enable higher public expenditure on environmental infrastructure as well as environmental regulations that drive private sector expenditure on abatement technologies" (Kinda 2013:4).

Because of the lack of environmental regulation in low-income countries, they represent "the path of least or no resistance" for corporations to operate in harmful ways that would not be possible in other nations. Adeola (2000:691) argues that "the absence of national environmental policy in many developing countries, lack of rigorous environmental laws and sanctions against polluters, and desperation to accept pollution for economic gains in many poor countries make this pattern of toxic waste dumping quite attractive to MNC's".

The environmental damage caused by MNC's operations in low-income countries stem from the use of hazardous materials, extraction of resources, and spread of toxins that causes immediate and long-term health risks to the inhabitants of the countries (Baran 1994, Moyers 1990).

Hazardous waste trade has been discussed as an example of how environmental costs are funneled from high- to low-income nations (Bhutta et al. 2010; Grossman 2006; Adoela 2000; Joines 2012). Disposed electronical equipment contains large amounts of toxic substances such as lead, mercury, arsenic, cadmium, chromium, and copper (UNEP 2017; LeBel 2015; Sullivan 2014). When products are being dismantled, these hazardous elements leak and contaminate nearby soil and groundwater. In addition, burning of e-waste releases toxins into the air (UNEP 2017; Sullivan 2014). According to the UN Environment Programme, the amount of global e-waste increases annually and reached a staggering 41.8 million tons in 2014 (UNEP 2017). More than fifty percent of the officially acknowledged waste is shipped from industrialized countries such as the U.S, Japan, and European countries to underdeveloped nations in Africa, Asia, Latin America, and the Caribbeans (Adoela 2000; Bhutta et al. 2010). Common recipient countries are Bangladesh, China, India, Malaysia, Pakistan, the Philippines, and Vietnam in Asia and Ghana and Nigeria in West Africa (Grossman 2006). Estimates show that 80 percent of U.S. e-waste are transported to these nations, and ninety percent of that waste goes to China (Grossman 2006).

Other examples include corporations moving to low-income countries with low environmental regulations to continue hazardous industries that have been banned in developed countries. Up to 400,000 of the one million current and former U.S. asbestos workers are expected to die from cancer. Instead of installing safer technologies as the regulations now require, many U.S. corporations move their operations to other countries, such as Mexico (Shrader-Frechette 2002). There are "no Mexican regulations to protect workers from asbestos, dust levels in the Mexican plants are not monitored, and workers wear no respirators" (ibid.:164). The workers receive minimum wage and no information about asbestos hazards (ibid.). Similarly, there are fourteen different corporations in Colombia that import "virtually every U.S. pesticide banned since 1970" (ibid.:165).

3.4 Economic Inequality and Environmental Quality

In recent years, there has been a new wave of research advocating that inequality has negative consequences for all of society in terms of health and well-being (Pastor & Morello-Frosch 2018). Probably the most recognized research in this field is the book *The Spirit Level: Why Greater Equality Makes Societies Stronger*, in which authors Richard Wilkinson and Kate Pickett lay out scientific evidence for the impact that inequality has on health and well-being. The authors argue that it is not just economic problems such as poverty that affects health, but also the degree of income and wealth inequality (particularly in wealthier societies) (Wilkinson & Pickett 2009).

An "emerging frontier" (Pastor & Morello-Frosch 2018:29) in this new field consists of research studying the relationship between social inequality and environmental degradation and particularly how social inequality in exposure to environmental problems can deteriorate environmental conditions for all of society (ibid.). Pastor & Morello-Frosch exemplifies this by describing that:

> When low-income communities and communities of color are disproportionately exposed to harmful pollution (in air and water, for example), pollution can be viewed by those not in that community as someone else's problem. This then can result in a decline in the public and political will to implement environmental policies that reduce overall pollution exposure levels and protect community health. (Pastor & Morello-Frosch 2018)

In other words, when only part of the population is exposed to environmental problems, only part of the population is motivated to address the environmental problems. The rest of the population does not see, or can choose not to see, the consequences of the environmental problems since they are not directly affected by it.

An experimental study exploring the role of social cohesion in public will to address environmental concerns showed results that support the argument that a more equal society is more likely to address environmental problems. In the experiment, participants played a game in which they were given different amounts of money. They were then asked to contribute to a public fund to prevent climate change. When all participants thought that everyone would be equally affected by climate change, regardless of what initial sum of money they had, the initial endowments of money did not affect collective action. However, when participants were told that the low-income group would be more greatly affected by the consequences of climate change, wealthier participants were less willing to contribute to the collective fund (Burton-Chellew, May & West 2013). The new field of research to which this experimental study belongs suggests that environmental inequality can reduce general environmental quality (Pastor & Morello-Frosch 2018).

3.5 Gender and Environmental Quality

The role of gender oppression in questions of environmental inequality is undertheorized, and there is little empirical analysis (Collins et al 2017). Butter (2006) means that there are three broad categories, albeit complex and interconnected, that should be considered when examining gender, health, and environment: "biological differences, the gender division of labor, and differences in power, status and visibility" (Butter 2006:221).

When it comes to *biological differences*, studies have shown that women are more vulnerable than men to different forms of pollution and risk certain reproductive health problems that men do not (Buckingham & Kulcur 2010). More studies report stronger effects between air pollution and respiratory health problems among women and girls than among men and boys, although the literature is not consistent (Clougherty 2010).

Regarding the *gender division of labor*, previous literature suggest that gender norms shape were people spend time and their activity patterns, which in turn affects their exposure to different types of pollution (ibid. 2010). Pellow and Brehm (2013) claim that "women are often physically and socially relegated to some of the most toxic residential and occupational spaces in communities and workplaces" (Pellow & Brehm 2013:236). An example of gendered objective exposure to air pollution in developing countries is where indoor fossil fuel burning is used for cooking which increases PM2.5 concentrations. Because women generally perform more cooking in these societies, they are exposed to more air pollution (Clougherty 2010).

Clay (2003) argues that "many of women's concerns remain oriented toward local populations, including families and neighborhood communities. They may be the first to become aware of a pollution problem" (Clay 2003:36). In line with this argument, a study conducted in Philadelphia in the U.S. suggests that women are more concerned about the risk or air pollution than men (Johnson 2002).

Lastly, concerning *differences in power, status and visibility*, it has been reported that "women's involvement in the formation, planning, and execution of environmental policy remains low at all levels" (Clay 2003:37). The lack of female representation in decision-making bodies "limits women's influence over public policies and programs" (ibid.:36). Since men and women experience the environment differently as a result of their gender roles, it is crucial that both genders have "official channels to reflect their needs and to have a voice in environmental policy decision" (ibid.).

4. Hypotheses

The hypotheses of this study, which are grounded in previous literature and theories, are presented below.

H_1: A higher individual-level income increases people's experience of good air and water quality in their community.

H_2: Living in a smaller town increases people's experience of good air and water quality in their community.

H_3: Living in a country with a higher national income increases people's experience of good air and water quality in their community.

H_4: Living in a country with higher national income equality increases people's experience of good air and water quality in their community.

5. Methods

This study aims to predict individual-level experience of environmental quality in one's community using both individual-level and country-level variables. Multilevel modelling allowed for effects at different levels while considering that individual scores tend to cluster according to country differences. In a multilevel model, factors at one level can be studied while controlling for factors at both levels. In addition, it allowed for the simultaneous measurement of multiple country-level effects on experience of environmental quality in one's community (Hövermann et al., 2016; Teymoori et al., 2016). When data is hierarchical, or nested into groups, the residuals in the model will be correlated (Field 2013). A regular multiple linear regression was therefore not an option, since the assumption of independence of errors will be violated.

5.1 Data Sources and Sample

The study design was a secondary analysis of cross-sectional data. Several data sources were examined to find the most fitting variables for this study. In the end, the World Bank's World Development Indicators (WDI) was used in combination with the World Values Survey (WVS). Wave 5 (2005-2009) in WVS was used, since the most recent version (Wave 6) only contained data for a few countries regarding the dependent variable.

WVS is a global network of social scientists conducting a survey in almost hundred countries since 1981. The database consists of nationally representative surveys conducted in ninety-seven countries which contains almost ninety percent of the world's population. The data collection mainly consists of face-to-face interviews in the respondent's home. The minimum sample size in most countries is 1200 and the sample must be representative of all people age eighteen or older residing within the country. The sampling method is full probability or a combination of probability and stratified sampling. The WVS database is widely used in the scientific community (WVS n.d.).

The WDI database consists of 1,600 time series indicators for 217 economies and over forty country groups. Data for many of the indicators go back fifty years or more. The primary sources for the WDI database are national statistical agencies, central banks, customs services, and international organizations (WDI n.d.).

The sample in the final model specification of this study consisted of 29,307 individuals nested in twenty-four countries. An appropriate number of level-two units (groups) and level-one respondents have been discussed by several. Kreft and de Leuuw (1998) conclude that, especially when examining cross-level interactions, a multilevel model should aim to have more than twenty level-two units. Snijders and Bosker (2011) also mean that twenty or more units at the second level is sufficient for multilevel modeling with random effects if there are more than hundred individual-level units and not too many predictors at the second level. Considering the final model in this study only has three level-two predictors and 29,307 individual units, there is no reason for concern.

The twenty-four countries used in the final model of analysis, as well as their sample size, mean and standard deviation for the dependent variable experienced environmental quality index are shown in table 2.

5.2 Measures

5.2.1 The Experienced Environmental Quality Index

The outcome variable was an index of two categorical variables: "*Environmental problems in your community: Poor air quality*" and "*Environmental problems in your community: Poor water quality*". The response categories for both questions were a four-item ordinal scale from *Very serious* (1) to *Not serious at all* (4), resulting in a seven-item scale for the environmental quality index. The Cronbach's alpha for the environmental quality index was .85, indicating a high internal consistency. Using more than two variables in the index would make it more numerical and thus the potential correlations found in the analysis would be stronger (Djurfeldt et al. 2009). However, there were only two variables available that measured experience of environmental quality in one's community. A possible limitation of this variable is that "community" is not a specified area. Perhaps a community can be interpreted as the neighborhood you live in by some people, while others see it as an entire town or city.

5.2.2 Individual-level Income

To measure individual-level income, the variable *Scale of incomes* was used. This variable waives the problem of comparing different currencies; the respondent's household income was ranked from one to ten, where one refers to the lowest income decile in their country and ten refers to the highest. Their household income is then measured relative to that of other people in the country. This made comparison between countries possible, because even if the value of the respondent's actual household income was converted to an international currency, comparison between countries could be inaccurate since earning hundred international dollars a month in a country where the monthly income ranges from two international dollars to hundred and fifty international dollars is very different from earning hundred international dollars in a country where the monthly income ranges from eighty to two thousand international dollars. A limitation of using household income as a measurement of income is that the individual income is affected by how many people the household consists of. There was no individual income available in the dataset. In an attempt to control for how many people the household consists of, the variable "number of household members" was included. However, since the results did not change significantly, the variable was excluded in the final model.

In the multivariate analysis, this ordinal income-variable was treated as a dummy variable; categories one through three were coded into low income, four through seven into medium, and eight through ten into high income. The decision to make medium the largest group was based on a bivariate analysis of *Scale of incomes* and the dependent environmental quality index; the mean was similar for the four middle categories. The high-income category served as the reference category in the model.

5.2.3 Rural-urban Inequality

The individual-level variable town size, measured on an ordinal scale from one (2,000 inhabitants or less) to eight (500,000 inhabitants or more), was coded into dummy variables. The first two categories represent the smallest town size, the following two the second smallest, category five through six the second largest, and the last two categories the largest town size. The largest town size serves as the reference category.

5.2.4 National Economy

National economy was represented by GNI per capita, PPP (current international dollar). According to the United Nations Development Programme (n.d.), GNI per capita (PPP $) is a good measure for economic statistics across countries since it reflects people's living standards well when comparing countries with different currencies. PPP rates of exchange allow the conversion into a common currency to consider price differences between countries. Theoretically, one PPP dollar has the same purchasing power in the domestic economy of any country as one US dollar has in the US economy (UNDP n.d.). GNI was chosen over GDP since the former includes net receipts of primary income from abroad (UNICEF n.d.). In other words, GNI measures all incomes of a country's residents and businesses, regardless of where it is produced. GDP measures the income of anyone within the country's borders; including foreign businesses. GNI *per capita* was used because it takes into account how large the population of the country is.

The natural log of GNI per capita, PPP was used in this analysis. Using the natural log of GDP or GNI is commonly used by economists since it maintains proportional differences in the distribution (Njoh et al. 2017). A natural log transformation clearer shows that an increase of GNI per capita by $50 in a country where the average income is $100 has a greater impact on a person's standard of living than the same increase in another country where the average income is $1000 (UNDP n.d.). Using natural log means that every step change on the y-axis entails an identical percent change in real GNI per capita (Gelman & Hill 2007). Plotting natural logs thus allows for seeing percent increases rather than absolute ones. The natural log is a more meaningful and robust way to measure living standards in different countries (Jones & Vollrath 2013).

5.2.5 National Income Equality

National income inequality was measured by the GINI coefficient, which is a statistical measure of income distribution developed in 1912 by the Italian statistician Corrado Gini. It ranges from zero to hundred percent, with zero representing complete equality and hundred total inequality. The GINI coefficient is a very common measure of economic inequality. Data for the GINI coefficient was not available for all countries for the same year as the data for the individual-level variables were collected for the specific country in the WVS. For example, a country for which data was collected in the WVS in 2007 could only have data for the GINI coefficient from 2010 in the WDI. For the sake of minimizing missing data at the second level, data on the GNI coefficient from up to three years earlier than in the WVS were included in eleven cases. In one case, data from one year later than in the WVS was included. The line was drawn at three years before and one year after the year data was collected for WVS. The amount of included GINI data that was collected *after* the data in WVS had to be restricted more than the data collected *before* the WVS since the analysis is exploring how the GINI coefficient affects the dependent variable found in WVS. Including data gathered after the data for the variable I want to predict is collected could be a violation of the assumption of temporal priority.

The decision to include these twelve cases was based on the importance of including as many level-two units as possible and the fact that the GINI coefficient generally does not change much over a shorter period of time.

5.2.6 Control Variables

Age was measured on a scale and gender as a dichotomous variable coded into dummies. Male was the reference category for gender. Education was measured on an ordinal scale where one represents no formal education and nine university-level education with a degree. This variable was coded into dummy variables where categories one through three were coded as low education, four through seven as medium education, and eight through nine as high education. The country-level control variable fossil fuel energy consumption was measured as percent of a country's total energy consumption. Fossil fuel energy use was chosen as an indicator of environmental policy within the country; countries using less fossil fuel energy could be assumed to have more environmental policies in place. Another variable, the CIPA policy and institutions for environmental sustainability rating was originally going to serve this purpose, but there was no data for the countries included in this analysis. However, fossil fuel use was not considered a strong enough measurement of environmental policy to exclude discussion of the role of environmental policy in explaining differences in air and water quality.

Descriptive statistics for all variables used in this study are included in table 3.

Table 2. Environmental quality index in 24 countries, WVS wave 5 2005-2009 (sample sizes, means, and standard deviation for the environmental quality index)

	N	Mean	Std. deviation
Australia	1239	4.59	2.18

Brazil	1470	4.4	2.08
Bulgaria	911	3.38	1.85
Canada	1642	4.9	2.08
Chile	1041	4.35	2.03
China	1584	5.57	1.9
Cyprus	1003	3.57	2.01
Georgia	908	3.51	1.81
Germany	1826	6.06	2.01
Ghana	1417	3.91	1.79
Hungary	1005	5.69	2.02
Iran	2413	2.88	1.3
Italy	654	5.46	1.89
Malaysia	1193	4.18	1.6
Mexico	1400	4.26	1.88
Moldova	1031	3.4	1.68
Morocco	1145	2.7	1.13
Norway	938	6.39	1.98
Romania	1508	4.87	2.25
Vietnam	1442	4.55	2.16
Sweden	924	6.9	1.49
Thailand	1378	4.98	2.15
Egypt	2227	2.15	.54
United States	1189	4.15	1.93

Table 3. Descriptive characteristics of variables

	N	Mean/%	Std. deviation
Individual level			
Experienced environmental quality index (poor air quality + poor water quality) "I am going to read out a list of environmental problems facing many communities. Please, tell me how serious you consider each one to be here in your own community. Is it very serious, somewhat serious, not very serious or not serious at all?" 2 (very serious) to 8 (not serious at all)	67,375	4.13	2.1
Age Min: 15 Max: 98	83,707	41.27	16.48
Female	83,878	51 %	
Scale of incomes "On this card is a scale of incomes on which 1 indicates the 'lowest income decile' and 10 the 'highest income decile' in your country. We would like to know in what group your household is. Please, specify the appropriate number, counting all wages, salaries, pensions and other incomes that come in." 1 (lowest income decile) to 10 (highest income decile)	76,800	4.56	2.31
Highest educational level attained "What is the highest educational level that you have attained?" 1 (no formal education) to 9 (University-level education, with degree)	83412	5.23	.5
Size of town	56,374	4.82	2.48

1 (under 2,000) to 8 (500,000 and more)			
Country level			
GINI coefficient 0-100 Min: 26.4 Max: 64.8	54,013	40.1	9.3
GNI per capita, PPP (current international dollar), natural log Min: 7 Max: 10.93	53,458	9.33	.99
Fossil fuel energy consumption (% of total) 0-100 Min: 32.45 Max: 98.9	48,438	79.53	16.2

5.3 Statistical Methods

This study used multilevel linear regression to account for the two-level structure of individuals nested within countries. Maximum likelihood estimation (ML) was used for all models. Restricted maximum likelihood (REML) is known to be more accurate for random regression parameters (Twisk 2006), which was used in this analysis, but to be able to compare models ML must be used (Field 2013).

The assumptions of linearity, homoscedasticity, multicollinearity, independence of errors, and normal distribution of errors were met (see Appendix). Although three country-level variables were used in the final model, there was no multicollinearity between them (VIF = < 1.5). Two country-level variables (GINI coefficient and fossil fuel energy consumption) had a small number of outliers (see Appendix). Since removing the outliers would entail that the number of level-two units would be below the recommended twenty (Kreft & de Leuuw 1998; Snijders & Bosker 2011), a decision was made to include the outliers in the model.

The initial step in the model building was to create a null model in which the variance in the environmental quality index could be measured. Thereafter, one of the individual-level predictors of interest for this study (income) was added to the model along with the control variables age, gender and education. In model 2, the initial country-level variables of interest (GINI coefficient and GNI per capita, PPP) were included. Since the GINI coefficient was not significant, there was no reason to add the country-level variables one at a time. However, since both town size and income where significant, model 3 included all previous individual-level predictors and the additional variable town size. This model could be compared with model 1 to see how introducing town size to the model affected the effect of the other predictors. Lastly, the final model included all previously modeled variables and fossil fuel energy consumption. Model 2 and 4 can be compared to see how introducing fossil fuel energy consumption changes the effects of the other variables.

The model fit increased significantly in every step of the modelling process. However, both the country-level and individual-level *N* decreased by introducing town size and fossil fuel. This is important since a larger level-two *N* increases the reliability and predictive power of the model (Field 2013). Nonetheless, the final model still includes more countries than the recommended minimum of 20 (Kreft & de Leeuw 1998; Snijders & Bosker 2011).

Each model started with fixed intercepts and fixed slopes and I then changed the intercepts and slopes to random one by one to calculate if this significantly improved the model fit (Raudenbush & Bryk 2002; Twisk 2006). The model fit statistics used were BIC and -2 log-likelihood. The latter was used to calculate if the change was significant (if the change in chi-square was bigger than the critical value for the chi-square statistics for the specific degree of freedom change, it was significant) (Field 2013). Since the model fit increased significantly when I allowed variability in intercepts, I concluded that the level of experience of environmental quality in one's community when the different independent variables are zero differs across countries (ibid.). For all level-one variables, the model fit increased when the slopes were allowed to vary between countries. This means that the relationship between the independent variables and experience of environmental quality in one's community vary significantly across the different countries. Since there is significant variability in the slopes, it is necessary to estimate to what degree the slopes and intercepts covary (ibid.). All random-slope models were therefore tested with different covariance structures. The Variance Component structure was the best fit. This structure assumes that all random effects are independent, that variance of random effects are the same, and that they sum to the variance of the outcome variable (ibid.).

Both interactions on the same level and cross-level interactions were tried between all variables. None were significant and they were therefore excluded from the analysis. In order to increase the number of level-two units to raise the predictive power of the model (ibid.), a version of the final model was tried in which the only non-significant level-two variable, GINI coefficient, was excluded. However, the number of level-two units remained the same and the model fit did not significantly improve. The GINI coefficient was therefore left in the final model to serve as a control variable.

6. Results

6.1 Bivariate Analysis

Bivariate analysis showed significant but small direct individual-level correlations (see table 4) between all variables except gender and the environmental quality index as well as gender and age. The largest correlation (.330) was between education and income. This could be explained by higher education often leading to higher income. Another larger correlation (-.199) was that between age and education; younger generations generally tend to have more education than older. Further, there was a correlation between education and town size (.172) as well as between income and town size (.132). Age had the largest bivariate correlation with the dependent variable environmental quality index (.119) followed by town size (-.085).

At the country level, there were small significant correlations between all three variables (see table 5). The largest correlation was between the GINI coefficient and log GNI per capita (-.324), followed by the GINI coefficient and fossil fuel energy consumption (.127), and fossil fuel energy consumption and GNI per capita (-.021). All country-level predictors also significantly correlated with the environmental quality index; GINI coefficient (-.143), GNI per capita (.326), and fossil fuel energy use (-.279).

Figure 1 shows the negative relationship between fossil fuel energy consumption and the country mean of the environmental quality index. There is a linear pattern which shows that increased use of fossil fuel energy is correlated with a lower score on the environmental quality index, meaning a worse experience of air and water quality in one's community. Egypt, which is uses nearly 100 percent fossil fuel, has the lowest score on the environmental quality index; only slightly over two. Scoring a two on the environmental quality index means that you consider both air and water quality as a very serious environmental problem in your community. Sweden has the highest score on the environmental quality index (slightly below seven on a scale from two to eight) and uses the least fossil fuel (around thirty-five percent).

In figure 2, the positive relationship between GNI per capita (PPP, natural log) and the country mean of the environmental quality index is visible. Countries with higher GNI per capita tend to have a higher mean on the environmental quality index. Burkina Faso has a low score on the environmental quality index (around 2.5) and low log GNI per capita (slightly above seven). On the other side of the figure, Norway has the highest log GNI per capita of almost eleven and a high environmental quality index score of almost 6.5 on a scale from two to eight. The relationship between GINI and the environmental index is not as linear as the relationships shown in figure 1 and 2 and is presented in the appendix.

Table 4. Correlations between individual-level variables

	Environmental quality index	Age	Gender	Education	Income	Town size
Environmental quality index	1					
Age	.119***	1				
Gender	-.004	.000	1			
Education	.058***	-.199***	-.056***	1		
Income	.058***	-.081***	-.035***	.330***	1	
Town size	-.085***	-.069***	.016***	.172***	.132**	1

***significant at the .001 level or better;
**significant at the .01 level or better;
*significant at the .05 level or better.

Table 5. Correlations between country-level variables

	GINI coefficient	GNI per capita, PPP (log)	Fossil fuel energy consumption
GINI coefficient	1		
GNI per capita, PPP (log)	-.324***	1	
Fossil fuel energy consumption	.127***	-.021***	1

***significant at the .001 level or better;
**significant at the .01 level or better;
*significant at the .05 level or better.

Figure 1. Scatterplot of country means of the problem index and fossil fuel energy consumption

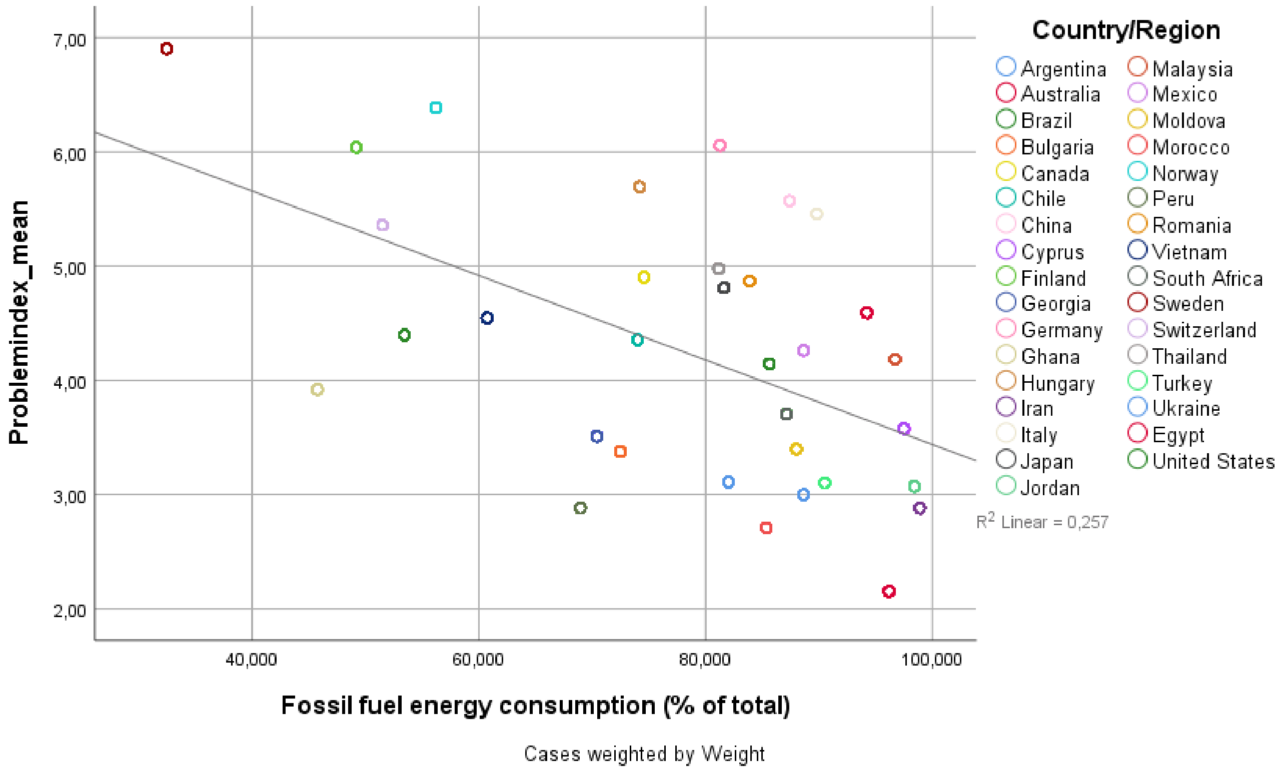
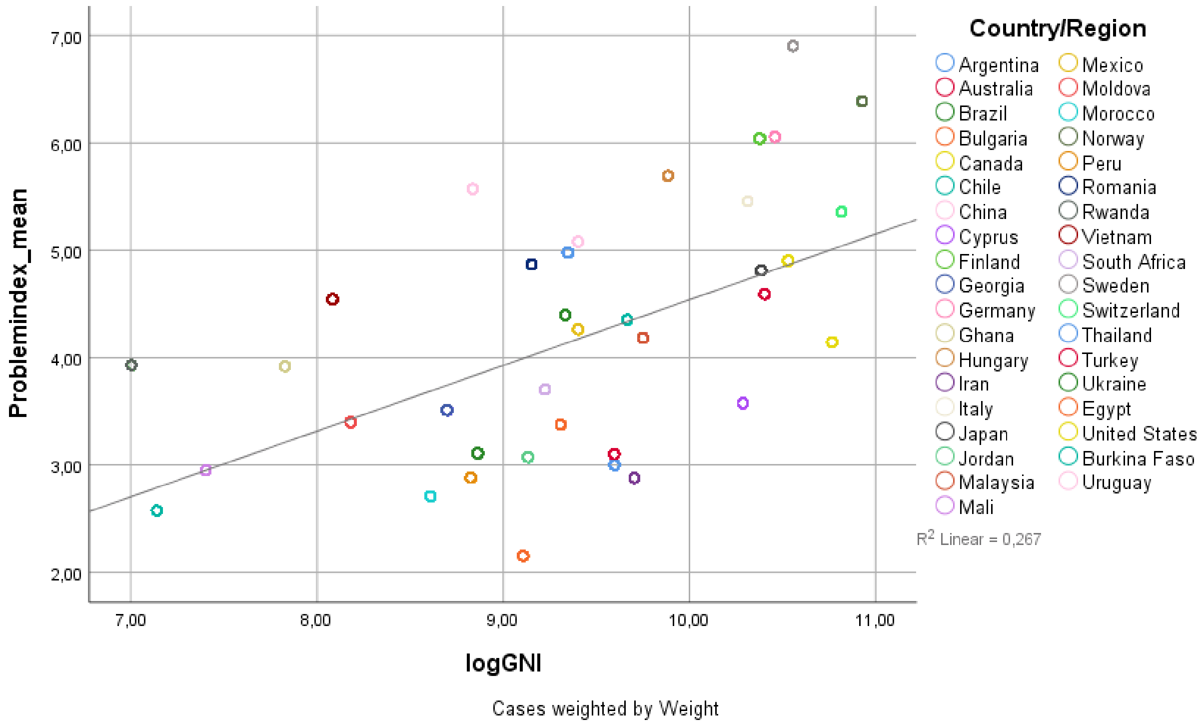


Figure 2. Scatterplot of country means of the problem index and GNI per capita, PPP (natural log)



6.2 Multivariate Analysis

A multilevel regression analysis addressed the hypotheses of this study. Each subsequent model had a better fit according to the BIC statistic and the log likelihood (see table 6). The null model shows the between-country variance in experience of environmental quality in one's community without accounting for any explanatory variables (1.252). As country-level predictors were added to the model, the between-country variance decreases. In the final model, the between-country variance had decreased to .297, meaning that the predictors used in the final model are accounting for most of the variance between countries in experience of environmental quality in one's community. Since the between-country variance in the final model was higher than zero, it is reasonable to assume that there are still other country-level explanatory factors affecting the dependent variable that have not been discovered in this study. In the null model, the variance partition component (VPC) can be calculated by dividing the between country variance with the total variance (Field 2013). In this model, the VPC was .28, meaning that twenty-eight percent of the variance in individual experience of environmental quality in one's community can be attributed to differences between countries. This motivated the use of both individual-level and country-level explanatory variables to explore the differences in experience of environmental quality in one's community.

In model 1, the individual-level predictor income and the individual-level control variables were introduced. The country-level variance remained about the same as in the null model, since no country-level predictors are entered. The effects of gender and low education were significant. Being female decreases your experience of good air and water quality in your community by .059 on a seven-grade scale. A person with low education has a score that is .204 units higher than a person with a high education. Further, the model suggested that having a medium education compared to a high education decreases your experience of environmental quality in your community. Neither low income nor medium income compared to the high-income category were significant (p= .865 and .963).

Model 2 consists of the same level-one predictors and the level-two variables GINI coefficient and log GNI per capita, PPP (current international dollar). Since level-two variables have been introduced, it is expected to see that the unexplained variance between countries has decreased from 1.252 to .895. In this model, the effect of gender was practically unchanged (.06) and the effect of low education has decreased minimally to .186. One of the country-level predictors, log GNI per capita, was significant at a ninety-nine percent confidence level. A single unit increase in log GNI per capita (PPP, current international dollar) was significantly correlated with a .6 unit increase in the seven-grade scale of experience of environmental quality in one's community. In other words, living in a country with a stronger national economy increases a person's likelihood to experience the air and water quality in their community as good. The GINI coefficient, however, is not significant (p = .25).

Table 6. Modeling results, predicting experience of environmental quality in one's community using multilevel linear regression

	Null model	**Model 1, one level**	**Model 2, two levels**	**Model 3, one level, with town size**	**Model 4, two levels, with town size and fossil fuel**
Individual level					
Constant	4.225*** (.161)	4.135*** (.165)	-1.05 (2.037)	3.97*** (.17)	.843 (1.826)
Age		.0008 (.001)	.0005 (.001)	.002 (.001)	.002 (.001)
Female (vs. male)		-.059* (.022)	-.06* (.026)	-.051* (.02)	-.05* (.023)

Low income (vs. high)		.009 (.052)	.021 (.062)	-.047 (.062)	-.08 (.08)
Medium income (vs. high)		-.001 (.03)	-.002 (.036)	-.019 (.038)	-.048 (.047)
Low education (vs. high)		.204*** (.06)	.186* (.071)	.148* (.056)	.141 (.075)
Medium education (vs. high)		-.08* (.043)	.073 (.042)	.047 (.038)	.037 (.048)
Town size 1 (5,000 or less)				.487** (.143)	.622** (.197)
Town size 2 (5,000-20,000)				.325*** (.087)	.366** (.117)
Town size 3 (20,000-100,000)				.25* (.097)	.25* (.118)
Country level					
GINI coefficient			-.01 (.02)		-.022 (.02)
Log GNI per capita, PPP (current international dollar)			.6*** (.17)		.668** (.171)
Fossil fuel energy consumption (% of total)					-.034*** (.008)
Country-level variance	1.252*** (.255)	1.197*** (.263)	.895*** (.238)	1.043*** (.25)	.297** (.101)
Model fit statistics					
BIC	270,941.504	247,684.303	193,086.185	190,858.195	126,164.924
- 2 log-likelihood	270,908.119	247,518.656	192,902.841	190,632.195	125,916.346
Countries, N	48	47	36	39	24
Individuals, N	63,230	58,146	44,597	45,545	29,307

***significant at the .001 level or better;
**significant at the .01 level or better;
*significant at the .05 level or better.

In model 3, the individual-level predictor town size was introduced to the one-level model. Town size had a significant effect on experience of environmental quality in one's community controlling for age, gender, income, and education. A person living in a town that fits in the first category of town size, the smallest towns (5,000 inhabitants or less), have a .487-unit higher score on the seven-grade scale of environmental quality in one's community than a person living in a town that fits in the fourth category; which is the largest town size (100,000 inhabitants or more). A pattern can be seen in that as town size increases, the score on the environmental quality-index decreases. Living in a town that falls under the second category (5,000-20,000 inhabitants) is significantly correlated with having a .325-unit higher score than someone who lives in the largest town size (100,000 inhabitants or more). Lastly, inhabitants of towns that fall under the third category (20,000-100,000 inhabitants) have an environmental quality score that is .25 units higher than the score of people living in the largest towns (100,000 inhabitants or more).

The effects of gender and low education were still significant in model 3, although somewhat lower than in the first one-level model. The effect of being female has decreased from -

.059 to -.051 and low education has changed from .204 to .148. The effects of age, income and medium education remained insignificant. The between-country variance has decreased from 1.252 in the first one-level model to 1.043, indicating that accounting for town size reduces the unexplained difference in experience of environmental quality in one's community between countries.

Model 4, the final model, was a two-level model including all previously used predictors and a new country-level control variable; fossil fuel energy consumption (percent of total). In this final model, there were two significant individual-level predictors (gender and town size) and two significant country-level predictors (GNI and fossil fuel energy use). Gender was still significant, while low education was not anymore. A female has a .05-unit lower score on the seven-grade scale of environmental quality compared to a male. Town size had the largest effect of the individual-level variables; living in the smallest type of town (5,000 inhabitants or less) increases a person's environmental quality score by .622 units on a seven-grade scale compared to a person who lives in the largest type of town (100,000 inhabitants or more). The effect has increased compared to in model 3, where only individual-level variables were included. The same pattern as in model 3 was visible regarding town size; an increase in town size is significantly correlated with a decrease in experienced environmental quality. Living in the second smallest type of town (5,000-20,000 inhabitants) means having a .366-unit higher score on the experienced environmental quality scale compared to living in the largest type of town. Lastly, an individual in the second largest type of town (20,000-100,000 inhabitants) scores .25 units higher than a person in the largest type of town.

On the country-level, GNI per capita and fossil fuel energy use had a significant effect on people's experience of environmental quality in their community. Log GNI per capita had the largest effect; a one unit increase in log GNI per capita, PPP (current international dollar) significantly correlates with a .668-unit increase in experience of environmental quality in one's community. This suggests that people living in richer countries experience better air and water quality in their community. However, a country's use of fossil fuel energy also significantly affected how its inhabitants experience the environmental quality in their community. A one unit increase in fossil fuel energy consumption (percent of total) significantly correlates with a .034-unit decrease in the experience of environmental quality in one's community. In countries with large use of fossil fuel energy, people experience more environmental problems (in terms of air and water quality) in their community.

The between-country variance in the final model was .297, suggesting that there are still differences in experience of environmental quality in one's community between countries that has not been explained by any of the variables in the model. However, the predictors used have decreased the unexplained difference from 1.252 in the null model meaning that the final model was able to explain most of the variance.

The final model equation is:

$$EnvironmentalProblemIndex_{ij} = (b_0+u_{0j}) + (b_1+u_{1j})Age_{ij} + (b_2+u_{2j})Gender_{ij} + (b_3+u_{3j})Education + (b_4+u_{4j})Income_{ij} + (b_5+u_{5j})Townsize_{ij} + b_6GINICoefficient_{ij} + b_7logGNIpercapita_{ij} + b_8FossilFuelEnergyConsumption_{ij} + \varepsilon_{ij}$$

7. Discussion

Before I situate the results of this study in theory and previous literature, I would like to briefly address the difficulty of discussing cross-national results. In trying to theorize the results of an analysis of people in twenty-four countries is an inherent risk of over-generalizing explanations. I believe that specific local, regional, and national conditions need to be explored in order to create a holistic explanation of inequalities in terms of air and water quality. The one-size-fits-all model will always be a little loose on some and a little tight on others. That being said, the results of this study suggest a cross-national pattern that is compelling enough to discuss.

7.1 Individual-level Income and Experience of Environmental Quality

Although most previous research has suggested a relationship between individual income-level and environmental quality (Hajat et al. 2016), the multilevel analysis in this study rendered no significant relationship between the two (H_1 rejected). There are studies which indeed claim that income level does not affect exposure to environmental problems; however, these are few (Hajat et al. 2016) and the consensus in the field of environmental justice is that low-income communities are disproportionally affected by pollution in various forms (Robbins 2012). It is therefore important to discuss the measures used in this study to examine if they have had an impact on the unexpected result.

First, previous literature on income level and environmental quality measure objective exposure (such as measurements of CO, NO, NO2, O3, PM2.5, PM10, PM1–10, and SO2), while this study examines individuals' subjective exposure – how they *experience* the air and water quality in their community. By using objective measurements, previous literature has circumvented two questions that are crucial for the subjective measure used in this study; how apparent is the pollution and what is the relative level of pollution that individuals are comparing their situation to? Air and water pollution are always detectable by the scientific tools specifically designed for this purpose, but it may need to reach a certain level before it is detectable with the human senses. A criticism of subjective measures is that "disadvantaged people might report high levels of [subjective well-being] partly due to ignorance or deficiencies in their knowledge of the range of choices that ought to be available to them" (Muffels & Headey 2011). In the case of clean water and air, this critique extends to the extent at which people can detect the pollution. In previous literature, sensory and health cues have been established as key determinants for public perception of air pollution (Bickerstaff & Walker 2001; Wall 1973). In addition, subjective exposure to air and water pollution is a case of relative deprivation. A person's subjective experience of air and water quality comes from a comparison to social norms that are not absolute and differ from time and place. In a city where the air and water quality are extremely good, having clean air and water is the norm and the slightest deviation from this norm might be experienced as depravation – as bad quality. In another city, the same water quality experienced as bad in the first one might be considered average or even good if the norm in this city is slightly polluted air and water. Even if objective exposure to pollution is affected by income, subjective does not necessarily have to be.

Second, the income variable used in this study is household income measured on a scale on which the respondent was asked to rate their household income from one to ten, where one refers to the lowest income decile in their country and ten refers to the highest. Using household income instead of individual income might be problematic since the variable does not consider the number of people residing in the same household. However, studies have shown correlations between household income and objective pollution (e.g. Evans & Kantrowitz 2002; Pearce & Kingham, 2008). The environmental justice research consists of a mix of different measurements, including individual and household income, poverty, and index of socioeconomic status (Hajat et al. 2016; Shüle et al. 2017; Brainard, Jones, Bateman, & Lovett 2002).

Third, respondents are asked to rate the air and water quality in their *community,* and it is left to the respondent to define what a community is. Perhaps a more precise geographical demarcation would have produced a different result.

In conclusion, there are three credible scenarios: (1) poor tend to live in communities that are more exposed to environmental problems - as the bulk of the literature suggests - and experience worse air and water quality, but the variables used in this study failed to capture this; (2) poor tend to live in communities that are more exposed to environmental problems but there is no significant difference in *experience* of environmental problems between different income groups; or (3) there is no significant relationship between either subjective or objective environmental quality and individual income level. Because of the extensive literature within the environmental justice field providing support for the first two scenarios, it is my conviction that one of these is correct. However, no conclusion on this matter can be drawn from the results of this study.

7.2 Rural vs. Urban Areas and Experience of Environmental Quality

The results of this study suggest that the bigger the town a person lives in, the more environmental problems they experience in their community (H_2 supported). When discussing the objective exposure to air and water pollution in larger towns, the Malthusian eco-scarcity perspective which emphasizes overpopulation is commonly used as an explanation to why there is more pollution in cities. However, it is important to acknowledge that while a high concentration of people *can* affect the nature in that area, it does not *inherently* do so. The discussion must go further than just simply stating that there are too many people in one area. Why do people concentrate in geographical spaces and what about this concentration is harmful to nature (and, in turn, to our own health)? Why does this uneven development occur? Urban political ecologists are

> … not primarily concerned with the city as a dense and heterogeneous assemblage of accumulated socio-natural things and gathered bodies in a concentrated space, but rather with the particular forms of capitalist urbanization as a sociospatial process whose functioning is predicated upon ever longer, often globally structured, socio-ecological metabolic flows. These flows not only weld together things, natures and peoples, but do so in socially, ecologically, and geographically articulated, but uneven, manners. (Swyngedouw in Perrault et al. 2015: 609).

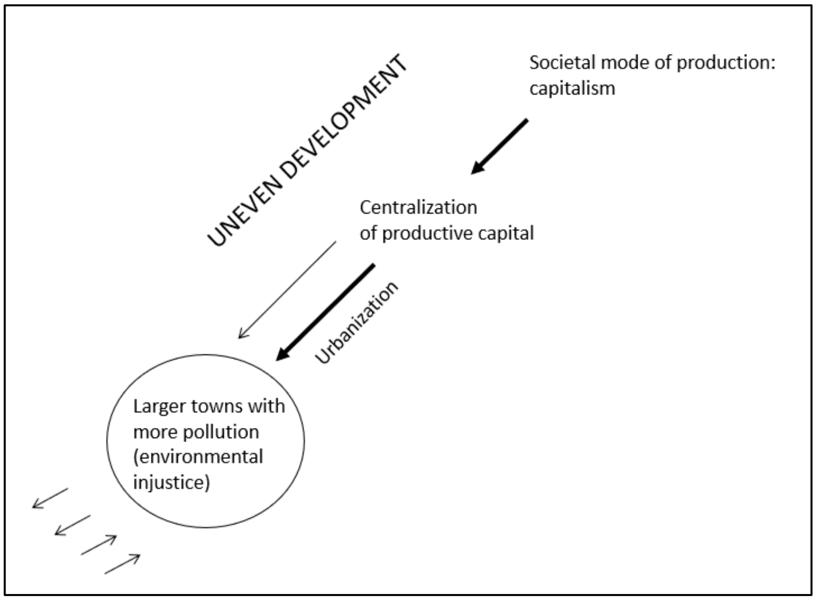
This means that urban political ecology goes beyond understanding the conditions of cities in terms of overpopulation, and instead explores urbanization as a sociospatial process whose causes are unique to capitalism.

According to the theory of uneven development, capitalism shapes space and nature through the centralization of capital. Political ecologists argue that “uneven socio-ecological conditions are produced through the particular capitalist forms of social organization of nature’s metabolism” (Heynen, Kaika & Swyngedouw 2006:9). The goal in a capitalistic society is to constantly accumulate more capital, and spatial centralization of productive capital is a means to gain more surplus. It entails that means of production (such as factories, warehouses, offices etc.) and labor-power are centralized into geographic areas – towns or cities. When workers are concentrated in one location, the cost of reproduction of labor power is lower because people can share some necessities. For example, workers can share public transportation instead of having to acquire their own means of transportation. In addition, the worker’s journey to and from work is kept to a minimum which keeps wages low and thus increases surplus for companies. Urbanization is the accumulation of the proletariat in certain places of production. Workers and industries are concentrated in one space because it means less costs for business, which means more surplus – more accumulation of capital.

Centralization of productive capital “requires a continuous investment of capital in the creation of a built environment for production”, such as “roads, railways, factories, fields, workshops, warehouses, wharves, sewers, canals, power stations, dumps for industrial waste” etc. (Smith 1984:159), all of which shape the environment and become part of the city’s metabolism. Industries are responsible for part of the environmental degradation, and civil activities such as driving cars or heating homes for some. The anthropogenic causes of urban pollution are both industrial and civil emissions from sources such as “industry, traffic, domestic heating, coal and oil combustion, incineration, construction activities, road weathering, and maintenance activities such as street sweeping and gully emptying” (Charlesworth & Booth 2019:2). Transportation technologies such as cars and power production technologies such as industrial heating and cooling and coal-burning power plants are two main causes of urban pollution. Many industries produce toxic waste that, if not properly disposed of, contaminate air and water (ibid.).

In sum, urbanization is the appropriation of the natural and human environment by capitalism and this uneven development causes inhabitants of cities to be exposed to more pollution than those living in rural areas. Figure 3 visualizes how the process of uneven development under capitalism produces larger towns or cities where levels of pollution are higher than in other, more rural areas. The thin arrows represent metabolic flows entering and leaving the city.

Figure 3. Visualization of explanation for increased pollution in cities



According to Smith (1984), reasons for uneven development are different depending on the prevailing societal mode of production. The reasons for the current concentration of people in geographic areas must therefore be understood from the current societal mode of production: capitalism. Smith acknowledges that uneven development has occurred in non-capitalist societies as well, but the reasons for this are different (1984). In other words, the formation of cities is not unique for capitalist societies but the explanation to why and how it happens is.

There are inequalities within cities as well – much research within environmental justice and urban political ecology shows that low-income neighborhoods and neighborhoods of color are more affected by pollution than other neighborhoods in the same cities (Syngedouw in Perrault et al. 2015). An example of these uneven socio-ecological flows within cities is how "the excesses of urbanization − from (e-)waste to CO 2 − are customarily decanted onto the socio-ecological dumping grounds of the periphery of cities" (ibid.:610).

If there objectively is more pollution in cities, which studies have shown (e.g. Charlesworth & Booth 2019), it could simply be that the subjective exposure to bad air and water quality of people living in cities is higher because they are experiencing what is objectively taking place.

People who have travelled outside the city could have experienced better air and water quality elsewhere and therefore feel relative deprivation. Inequalities within cities might also contribute to an increased sense of the relative deprivation. The neighborhoods where cleaner air and water is the norm might serve as reference group for people living in areas with worse air and water quality, causing them to feel relative deprivation. The geographical proximity of the different kinds of neighborhoods perhaps increase the expectation for people in the parts with worse environmental quality that they would be entitled to the same quality as other neighborhoods in the same city.

7.3 National Economy and Experience of Environmental Quality

The results of this study suggest that living in a country with a higher GNI per capita increases a person's experience of good air and water quality in their community (H_3 supported).

It is possible that the subjective deprivation of good air and water quality experienced by people in low-income countries is increased with globalization, since new reference groups become more easily available. However, previous research shows that objective pollution is in fact worse in low-income, or periphery, countries (Stockholm Resilience Center; Charlesworth & Booth 2019; WHO 2016). This is an effect of uneven development, described by Smith (1984) as "the geographical contradiction between development and underdevelopment where the over-accumulation of capital at one pole is matched by the over-accumulation of labour at the other" (Smith 1984:149). Historically, "core […] countries developed by under-developing the periphery" (Kiely 2010:11). The wealth of core countries come from resource extraction and other forms of exploitation of former colonized countries (Frank 1969; Rodney 1972).

This uneven development determines a country's position in the world-system. Core countries have economic power and are associated with higher-skill, capital-intensive production and tend to exploit periphery countries for labor and resources. Periphery countries are characterized by low-skilled production and export of raw materials. As periphery countries are used as a source of labor, which prevents their full integration into the market (Smith 1984), the process of uneven development is reinforced. In addition, the rise of neo-liberal policies reinforces uneven development through a process of accumulation by dispossession (Harvey 2003).

Another process that contributes to global uneven development and environmental degradation in periphery countries is ecological unequal exchange. Through this process, core countries which are advantageously situated in the world-system hierarchy externalize "many of the negative environmental consequences of domestic production, consumption, and disposal activities supporting their standard of living and maintenance of their built industrial infrastructure" (Rice 2007:46) which leads to environmental degradation at the local level in the periphery countries that are affected (ibid.). Extraction of resources, production of goods, and disposal of waste that are harmful to nature are offshored to periphery countries. Even if the process is fair in terms of monetary value (which can be discussed, since workers in periphery countries tend to be underpaid (Pellow & Brulle 2005)), the ecological exchange is unequal. The "environmental cost", the deterioration on ecosystems around waste and production sites in periphery and semi-periphery countries, is not considered in the exchange.

Production (higher-skill, capital-intensive) in core countries is often less harmful to the environment since these countries can "afford" to have environmental protection policies in place which protects its inhabitants from air and water pollution (Adeola 2000; Kinda 2013). This is in line with the previous literature suggesting that affluence is a mitigating factor for environmental degradation (Robbins 2012). A core country does not experience the same pressing need to grow economically as periphery countries do and can therefore "afford" to lose some business due to environmental regulations. Since it is expensive to conform to environmental regulations, dirty industries are offshored to periphery countries where regulations (both environmental and worker protection) are low – so called pollution havens (Pellow & Brulle 2005). In this way, companies can increase their surplus. The reason for the lack of environmental policies in periphery countries is once again related to uneven development and the countries' position in the world system. Timmons et al. (2015) explain that a country's world-system position has a critical effect on the avenues of development available to it and that it "affect[s] governmental policies towards the environment, decisions by firms within countries, and shape the life conditions of its peoples" (Timmons et al. 2015:282). They also mean that a country's position in the world-system is important "for understanding both national environmental policies and levels of damage by country" (ibid.). Partly due to the prevailing capitalist assumption that economic growth equals development (Rist 2008), periphery countries experience the need to prioritize growth and thus encourage companies to operate within their borders instead of implementing environmental protection that will deter them from doing so.

An example of a dirty industry that is being offshored from core to periphery countries in an ecological unequal exchange is the hazardous waste trade. The flow of e-waste goes from core countries, which are highly regulated, to periphery or semi-periphery low-wage countries with inadequate health and environmental regulations (Adoela 2000; Frey 2012; Kleine 2014; Joines 2012). While the recipient development country might benefit economically from this trade which might be fair in terms of monetary value, the ecological exchange is unequal. Toxic substances from hazardous waste sites leak and contaminate soil and water (Sullivan 2014). The damage the trade causes to the environment and in turn to the population is not taken into account. This process of ecological unequal exchange is most likely an important reason as to why people in low-income countries experience worse air and water quality than people in high-income countries.

Why are waste and hazardous industries exported from core nations equipped with high skill labor and sufficient regulation, to periphery and semi-periphery countries that lack these means and policies? The answer lies in the capitalist logic of finding the cheapest possible solution to maximize profit. Once again, e-waste can serve as an example. In the U.S., consumers dispose of their e-waste by taking it to recycling centers. These centers can then choose from paying the cost to dismantle and dispose of the e-waste or sell it to a foreign trader (Joines 2012). Due to the capitalist nature of core countries, most recycling centers will sell the waste since their only objective is maximizing profit. To dismantle the electronical products themselves, these companies would have to equip their facilities in a costly way to follow strict national environmental laws and regulations (ibid.). Instead, they choose to profit from trade. The opening of global markets has allowed for countries and businesses like these to find cheaper ways of disposing trash than to deal with it nationally. Free trade in global markets incentivize businesses to use cheap, foreign alternatives (ibid.).

The unequal exposure to environmental problems such as air and water pollution that is affecting inhabitants of low-income countries can be described as a type of slow violence (Nixon 2011). In a sort of intersectionality between two of the factors examined in this study, previous literature shows that pollution is worst in cities in low-income countries (Charlesworth & Booth 2019).

In taking a neo-Marxist political ecology approach to understanding the differences in experienced air and water quality in one's community between people in low- and high-income countries, this discussion has had an emphasis on global-local dimensions; acknowledging that global political power structures have local ecological consequences, with the global influencing the regional and the local decision-making (Robbins 2012). It has tracked the winners and losers in terms of air and water quality, and the structure that continuously produces these.

7.4 National Income Equality and Experience of Environmental Quality

While objective exposure to air and water pollution may change over time, relative deprivation will remain as long as social inequality exists – as long as some have it better than others. It is suggested in previous literature that more economically equal societies are more equal in terms of power between groups. This would theoretically prevent one group, the more affluent, from externalizing air and water pollution to a community in which another group, the less affluent, live (Pastor & Morello-Frosch 2018). Thus, there would be less deviation not only from the subjective norm but also the objective general air and water quality. However, this does not entail that the air and water quality would be better – it could still be terrible, just the same level of terrible for everyone. However, studies suggest that when environmental degradation is viewed as "everyone's problem" (as opposed to "someone else's" when it only affects low-income communities), public and political will to implement environmental policies to reduce pollution and protect the health of the community increases (Pastor & Morello-Frosch 2018; Burton-Chellew, May & West 2013).

The results of this study did not find a significant relationship between the GINI coefficient and people's experience of environmental quality in their community (H_4 rejected), but this does not disprove the idea that inequality affects environmental degradation or people's experience of it. First, the use of a different dependent variable than the environmental quality-index used in this study could yield different results. It could be an objective measure of air and water pollution, a measure of another kind of environmental degradation, or a subjective index that includes more variables than the two used in this study. Second, this study measured degree of inequality on a country-level by using the GINI coefficient. Perhaps on a smaller scale, more locally, the degree of income equality matters significantly. Social norms could be more apparent and have a stronger influence on the sense of relative deprivation on a smaller scale; it is easier to grasp a comparison between your situation and the situation of others on a local scale rather than on a national scale. If there is economic inequality on a smaller scale, for example in a town, rich and poor people live side by side and the sense of relative depravation for the poor might be high. If there is economic inequality between larger regions, it is possible that individuals are not aware of the differences in the same way, and thus do not experience the same degree of relative deprivation.

Third, the equal power relations that are necessary for pollution to be "everyone's problem" might be better measured in a different way than with the GINI coefficient. The entire reasoning behind why inequality would influence people's experience on environmental quality in their community has, so far, been built on the notion that individual-level income has a relationship with exposure to poor air and water quality. It is possible that there are other, non-economic, ways of measuring power relations affecting unequal distribution of pollution. After all, a critique of neo-Marxist political ecology approaches is that it is overlooking other important non-material dimensions of power" (Bryant 1998:154). Perhaps further studies can include measurements of democratic inequality, such as political representation or something similar.

7.5 Gender and Experience of Environmental Quality

A key element of feminist political ecology is to deconstruct areas of assumed common interests, such as "community" (Elmhirst in Perreault et al. 2015). The result of this study indeed suggest that females and males experience their community differently in terms of air and water quality, as females have a slightly lower score on the seven-grade scale of environmental quality compared to males.

Both the objective and subjective depravation can be understood through the lens of feminist political ecology, which argues that men and women experience the environment differently as a result of socially and culturally structural positions in relations to labor and nature. They have different access to, control over, and knowledge about the environmental systems as well as a different "level of tolerance and resistance to environmental risks and burdens" (Robbins 2012:64). Gender norms shape were people spend time and their activity patterns (Clougherty 2010). This affects not just your objective exposure to pollutants but also what reference groups are around you that you make a comparison with. Clay (2003) mean that "many of women's concerns remain oriented toward local populations, including families and neighborhood communities. They may be the first to become aware of a pollution problem" (Clay 2003:36). In this, women's subjective experience of pollution differs from that of men.

An example of gendered objective exposure to air pollution is how women in developing countries often are exposed to more air pollution since they generally perform more cooking in these societies and indoor fossil fuel burning, which increases PM2.5 concentrations, is often used for cooking (Clougherty 2010). There is no universal explanation to how gender roles shape different exposure to environmental problems since norms differ in different societies. Feminist political ecology research usually focuses on a specific environmental problem in a specific area. I will not take on the task of trying to identify some universal gender norm that explains the cross-national gender difference in experience of environmental quality found in this study. I believe the difference is the result of multiple gender norms that are different in different locations, but all contribute to the fact that females experience worse air and water quality. What the gender norms in question consist of needs to be studied on a local or regional level.

Another possible explanation to women's objective deprivation of good air and water quality is that women are generally poorer than men (ibid.). If income is predicting individuals' exposure to environmental problems as the environmental justice literature suggest, this might be a partial explanation to the gender difference found in this study. Polluted communities also tend to be poor communities (ibid.). However, since this study controls for income, the gender differences shown in experience of air and water quality must have another explanation. In societies where women are politically marginalized, experiencing worse air and water quality might be a question of having less power to affect your situation than men do. It has been reported that generally, "women's involvement in the formation, planning, and execution of environmental policy remains low at all levels" (Clay 2003:37). The lack of female representation in decision-making bodies "limits women's influence over public policies and programs" (ibid.:36). Since men and women experience the environment differently as a result of their gender roles, it is crucial that both genders have "official channels to reflect their needs and to have a voice in environmental policy decision" (ibid.:36). Environmental justice scholars argue that it is not just distributional inequality, but also political disempowerment that needs to be addressed. Environmental problems are now recognized as not always a result of distributive effects, but also a result of unequal power and opportunity to participate (Jessup 2017).

8. Conclusion

Literature suggests that the bane of industrialized living – air and water pollution – is disproportionately distributed. However, most studies measure objective exposure to air and water quality on a local, regional, or national scale. The purpose of this study was to further examine inequalities in terms of air and water quality using a subjective measurement in a cross-national study comparing determinants at both individual and national level. In short, this study has explored *how uneven development and economic inequalities within and between countries affect people's experience of environmental problems (i.e. poor water and air quality) in their community*.

The results of this study indicate that there is a significant cross-national pattern of populations living in larger towns (or cities) experiencing worse air and water quality in their community (H_2 supported); the larger the town a person lives in, the worse they experience air and water quality. This is understood as an uneven development of space and nature. As the main objective of the prevailing societal mode of production – capitalism – is accumulation of wealth, centralization of productive capital (labor and means of production) occurs to achieve this goal. This process changes the metabolism of nature, mainly through vehicular traffic and industrial activities.

Another significant result is that the experience of good air and water quality decreases as GNI per capita decreases (H_3 supported). Experience of air and water pollution thus appear to be worse in low-income countries. While the reasons for this may be complex, this study takes a neo-Marxist approach in discussing the inequality as a consequence of a country's position in the world-systems. Core countries contribute to environmental degradation in (semi-)periphery countries by ecological unequal exchange; by offshoring hazardous industries and thus externalizing the environmental costs of their way of living. This is possible because periphery countries, due to the shortage of economic resources, often lack the environmental regulations that are implemented in core countries.

Gender has a small effect on experience of environmental air and water quality in one's community; women experience it as slightly worse than men. The result is discussed through the lens of feminist political ecology, which suggests that experience of and exposure to environmental problems is gendered as a result of socially and culturally structural positions in relations to labor and nature (i.e. gender roles). In addition, women tend to be underrepresented in environmental decision-making, which affects their possibilities to improve their situation.

Contrary to the hypotheses (H_1 and H_4), individual-level income and national economic equality had no significant relationship with experience of air and water quality in one's community. It is possible that the use of other measurements would yield different results; for example, using individual income instead of household income. There could also be a relationship between these factors and *objective* air and water quality, but not subjective. Sensory and health cues have been found to be key determinants for perceived air pollution, and not all types of pollution are perceptible to human senses or affect our health until it reaches a certain level.

The study has contributed to the body of research in creating knowledge about the cross-national relationship between urbanization and experience of environmental quality as well as national economy and experience of environmental quality. To my knowledge, no such research has been conducted before. In addition, it can be stated that individual-level income measured in the way it is in this study does not have significant impact on experience of air and water quality measured in the way it is in this study, in the 24 countries included in the analysis. Nor does the GINI coefficient. However, it is possible that individual-level income and national economic (or other type of) inequality has an impact on environmental quality when other measurements are used.

Like all studies, this one too has its limitations. First, the experienced environmental index is comprised of only two variables, when three is usually recommended (Djurfeldt et al. 2009). This does not affect the significance of the results, only the strength of the effects. Second, household income as a variable to measure individual income is problematic since it does not consider how many people the household consists of. Regarding the discussion of the findings, it is important to note that inherent in discussing cross-national results is a risk of over-generalizing explanations. In addition, the neo-Marxist approach has been critiqued for being reductionist, and future complementary approaches to explaining inequalities in experienced air and water quality would be beneficial.

Since the result concerning individual-level income and environmental quality contradicts much research in the environmental justice field, future studies should examine the relationship between subjective exposure to air and water pollution using different measurements. Is there a relationship between *objective* exposure but not *subjective*? Additionally, experienced air and water quality should be studied separately instead of in an index to examine if the effects of the predictors are different on them. A cross-national study on *objective* exposure to air and water pollution could be conducted to explore if the results match those of this research on *subjective* experience.

The impacts of these findings are important for identifying where measures to counteract inequalities in experienced air and water quality are needed. Inhabitants of cities and low-income countries (and especially inhabitants of cities within low-income countries) experience an environmental injustice every day in breathing air and consuming water that they experience as poor quality. There is a pressing need to combat the slow violence of air and water pollution – quickly.

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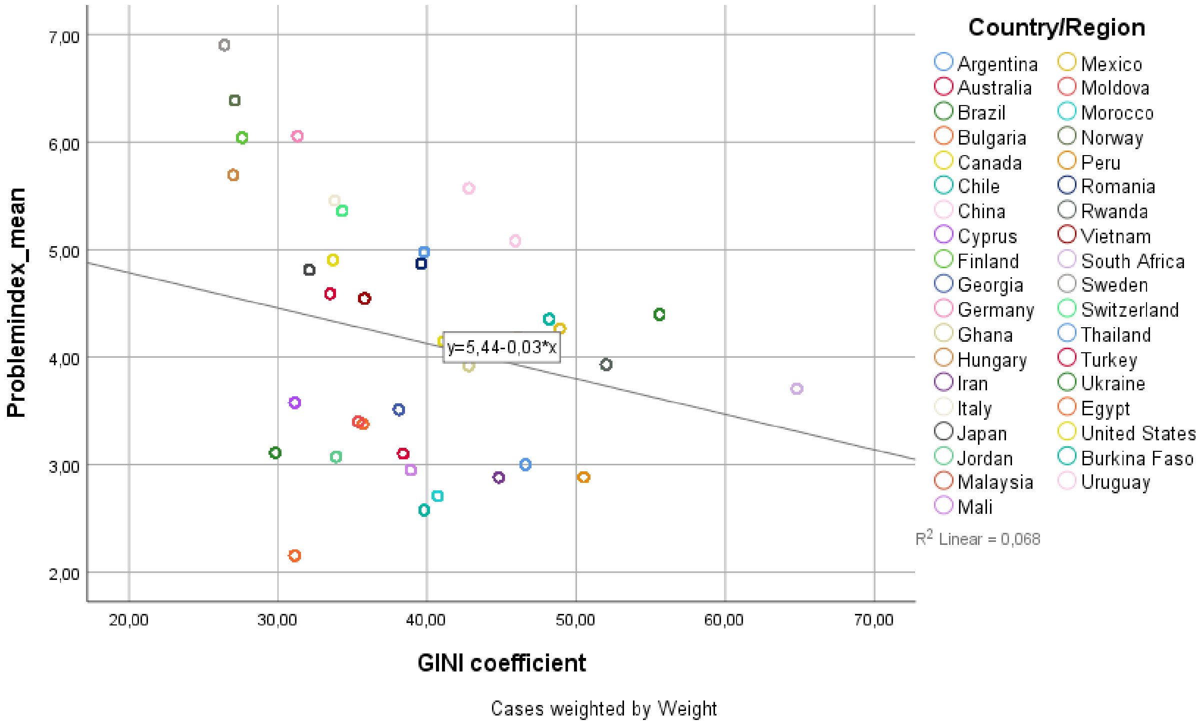
Appendix

Figure 3. Scatterplot of country means of the problem index and the GINI coefficient



Case Processing Summary

		Label	Count[a]	Marginal Percentage
Country/Region	36	Australia	1239,000000	3,9%
	76	Brazil	1470,000000	4,7%
	100	Bulgaria	911,000000	2,9%
	124	Canada	1642,000000	5,2%
	152	Chile	1041,000000	3,3%
	156	China	1584,000000	5,0%
	196	Cyprus	1003,000000	3,2%
	268	Georgia	908,000000	2,9%
	276	Germany	1826,000000	5,8%
	288	Ghana	1417,000000	4,5%
	348	Hungary	1005,000000	3,2%

	364	Iran	2413,000000	7,7%
	380	Italy	654,000000	2,1%
	400	Jordan	1,000000	0,0%
	458	Malaysia	1193,000000	3,8%
	484	Mexico	1400,000000	4,4%
	498	Moldova	1031,000000	3,3%
	504	Morocco	1145,000000	3,6%
	578	Norway	938,000000	3,0%
	642	Romania	1508,000000	4,8%
	704	Vietnam	1442,000000	4,6%
	752	Sweden	924,000000	2,9%
	764	Thailand	1378,000000	4,4%
	818	Egypt	2227,000000	7,1%
	840	United States	1189,000000	3,8%
Valid			31489,000000[b]	100,0%
Number of Cases	Included		29307	
	Excluded		54668	
	Total		83975	

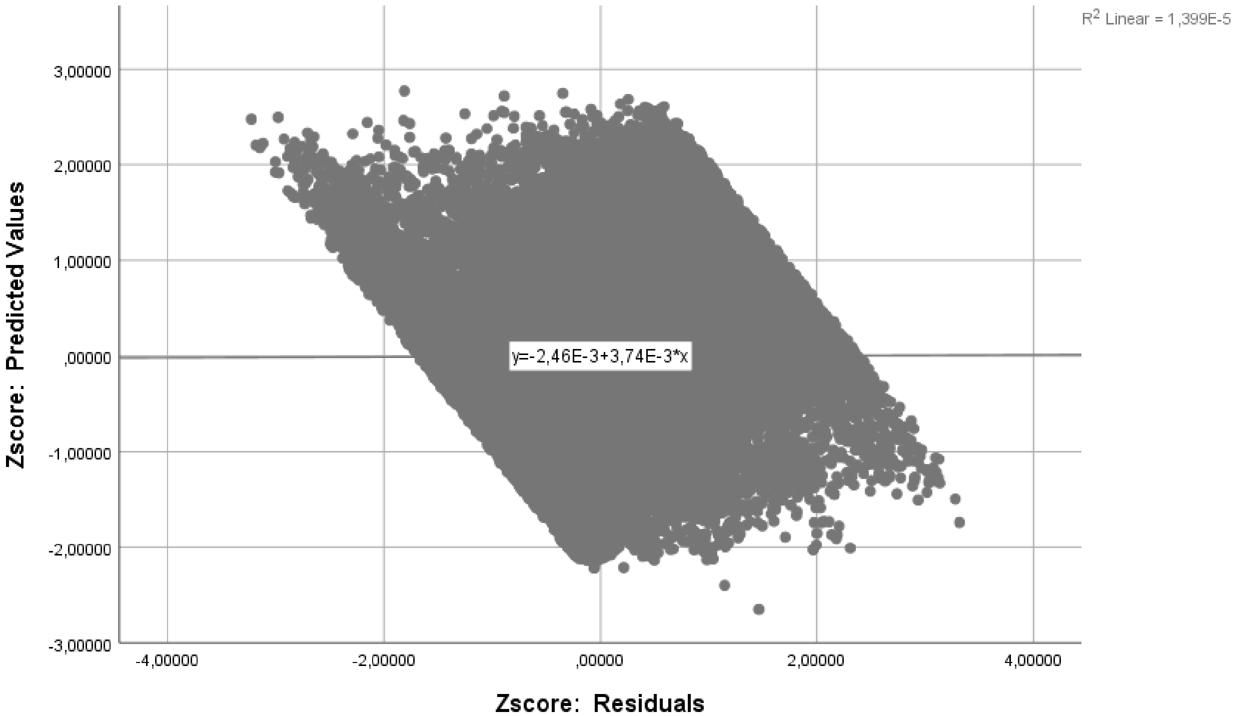
a. Positive non-integer case weights are encountered. These values are rounded to the nearest integers for the analyses.

b. The replication weight: Weight is applied.

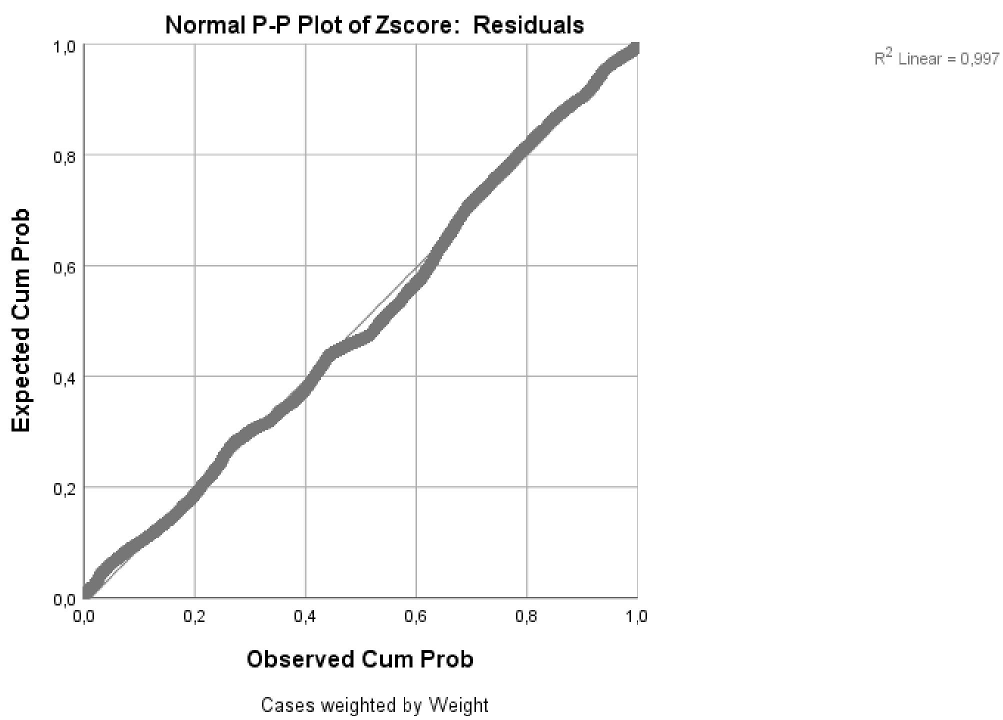
<u>On assumptions:</u>

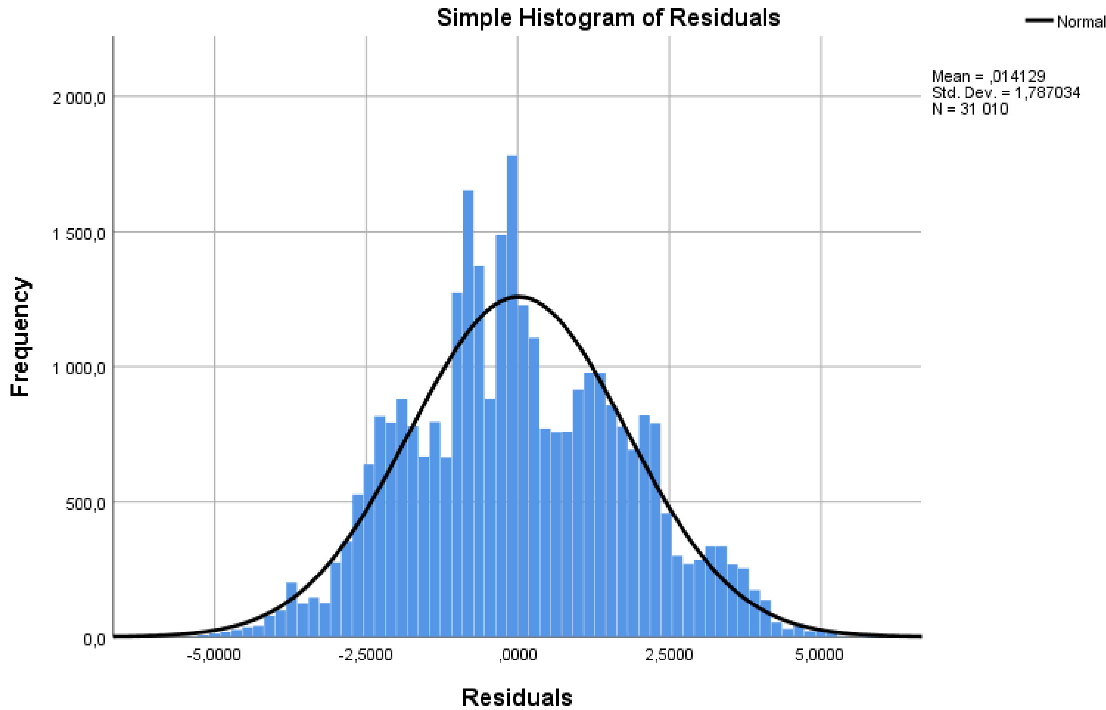
Following are graphs, plots, and tables to show that assumptions were tested. The zpred vs. zresid plot looks a little odd as a result of using a dependent variable that only had seven categories. In the first version of the plot, there were seven "bands" visible as there are seven answer categories in the dependent variable. In order to solve this problem, I created a "jitter", or a small amount of random motion, for each dot, so that the overall pattern of dots would be clearer. This is the plot shown below. It is linear and homoscedastic, but since my dependent variable is categorical with few categories, the data still gathers around these "bands" around each answer category. However, the residuals are evenly distributed meaning that the size of the error term does not differ across values of the independent variables. Testing for independence of error is not needed in multilevel modeling (Field 2013). Level 2 residuals slightly positively skewed but I deem it to be acceptable.

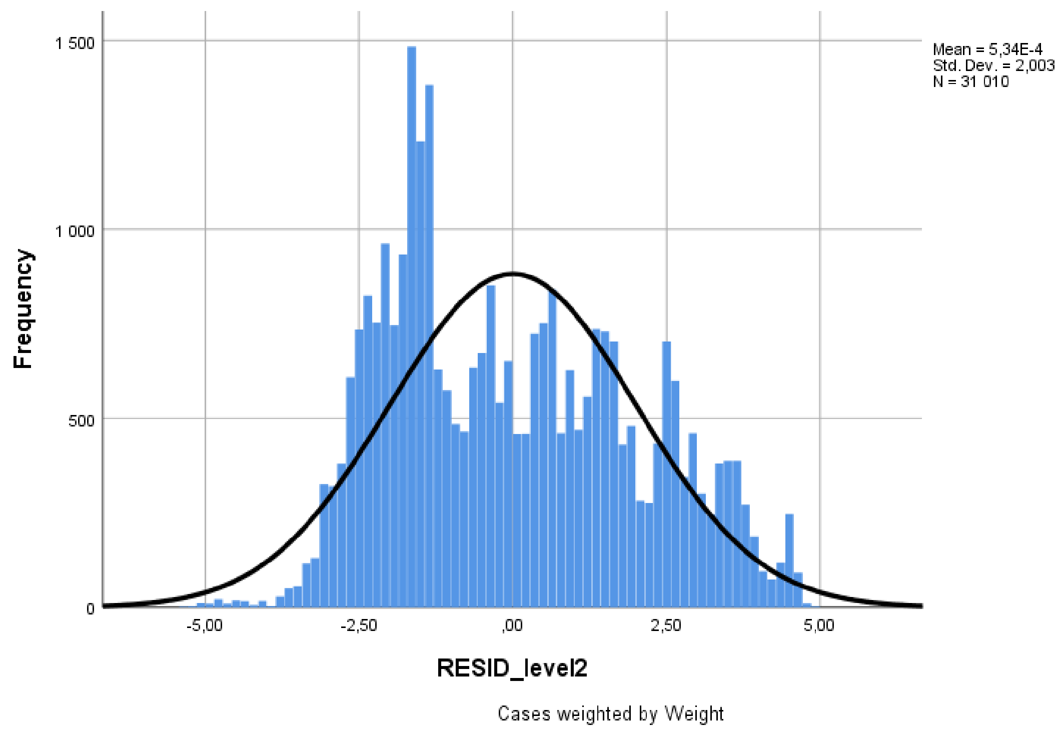
LINEARITY AND HOMOSCEDASTICITY



NORMALITY: P-P Plot and Histogram of Residuals




Simple Histogram of Residuals
Normal
Mean = ,014129
Std. Dev. = 1,787034
N = 31 010
Frequency
2 000,0
1 500,0
1 000,0
500,0
0,0
-5,0000
-2,5000
,0000
2,5000
5,0000
Residuals


Mean = 5,34E-4
Std. Dev. = 2,003
N = 31 010
Frequency
1 500
1 000
500
0
-5,00
-2,50
,00
2,50
5,00
RESID_level2
Cases weighted by Weight

MULTICOLLINEARITY: VIF and Correlations

Correlations

		GNI per capita, PPP (current international $)	Fossil fuel energy consumption (% of total)	GINI coefficient
GNI per capita, PPP (current international $)	Pearson Correlation	1	-,224**	-,430**
	Sig. (2-tailed)		,000	,000
	N	53458	47883	53458
Fossil fuel energy consumption (% of total)	Pearson Correlation	-,224**	1	,127**
	Sig. (2-tailed)	,000		,000
	N	47883	48438	48438
GINI coefficient	Pearson Correlation	-,430**	,127**	1
	Sig. (2-tailed)	,000	,000	
	N	53458	48438	54013

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

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	,734	,174		4,213	,000		
	GINI coefficient	-,006	,002	-,020	-3,488	,000	,794	1,259
	Fossil fuel energy consumption (% of total)	-,037	,001	-,286	-53,628	,000	,954	1,048
	logGNI	,739	,015	,286	48,161	,000	,769	1,300
	Age	,007	,001	,052	9,291	,000	,867	1,153
	Size of town	-,110	,005	-,123	-22,154	,000	,877	1,141
	High Education (vs. Medium)	-,144	,031	-,027	-4,653	,000	,820	1,220
	High Income (vs. Medium)	,195	,035	,031	5,532	,000	,881	1,135
	Low Education (vs. Medium)	,063	,028	,013	2,214	,027	,772	1,296
	Low Income (vs. Medium)	-,053	,026	-,011	-2,022	,043	,894	1,119
	Female (vs. male)	-,013	,023	-,003	-,581	,561	,995	1,005

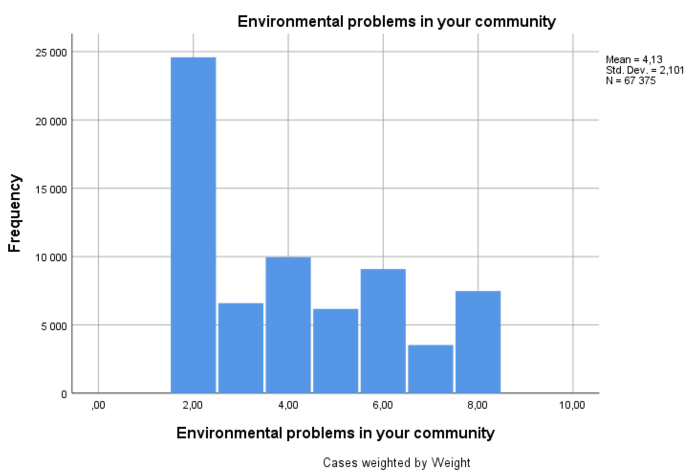
a. Dependent Variable: Environmental problems in your community

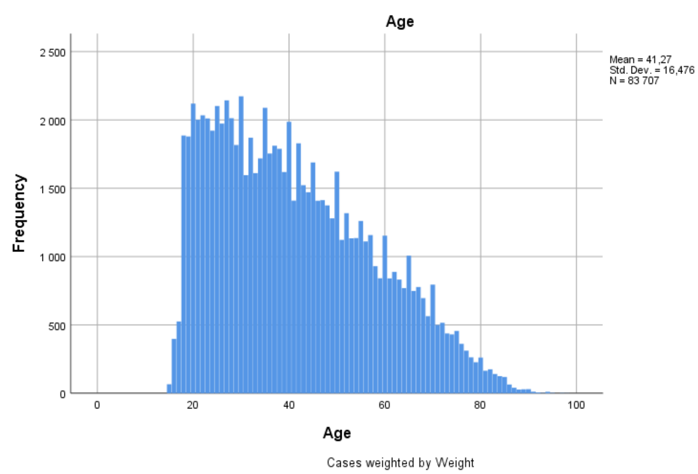
Coefficients[a]

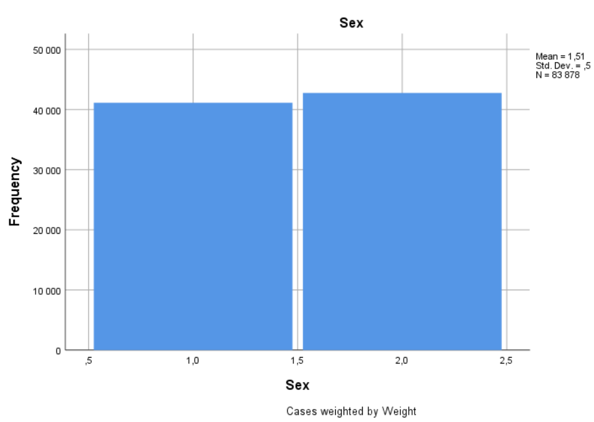
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	,792	,142		5,594	,000		
	GINI coefficient	-,009	,001	-,041	-8,947	,000	,876	1,142
	Fossil fuel energy consumption (% of total)	-,036	,001	-,272	-63,738	,000	,984	1,017
	logGNI	,697	,012	,254	56,574	,000	,890	1,124

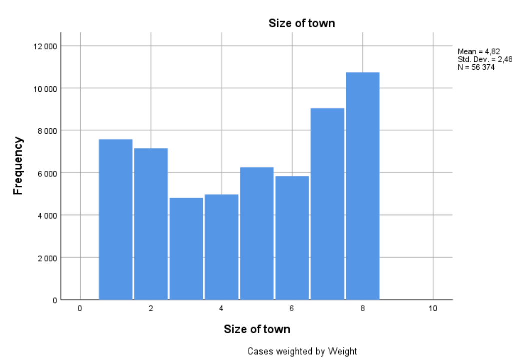
a. Dependent Variable: Environmental problems in your community

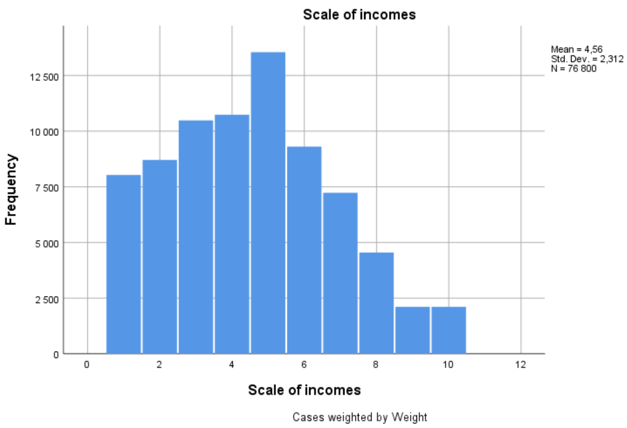
<u>OUTLIERS</u>

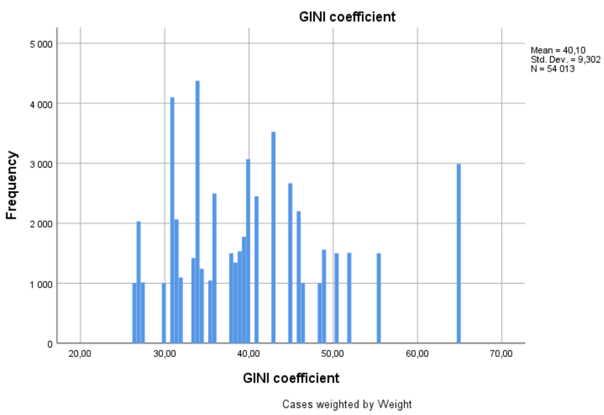


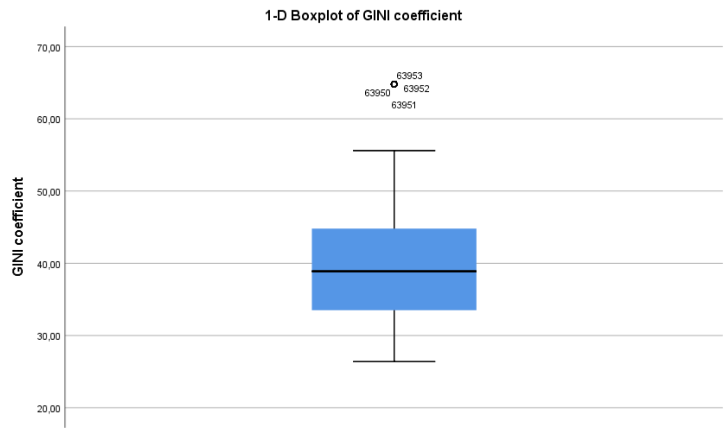


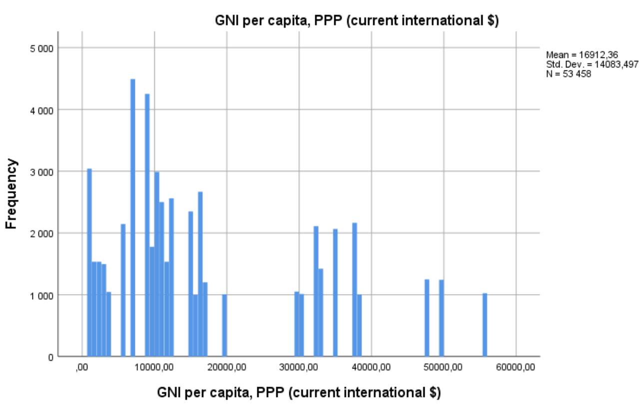


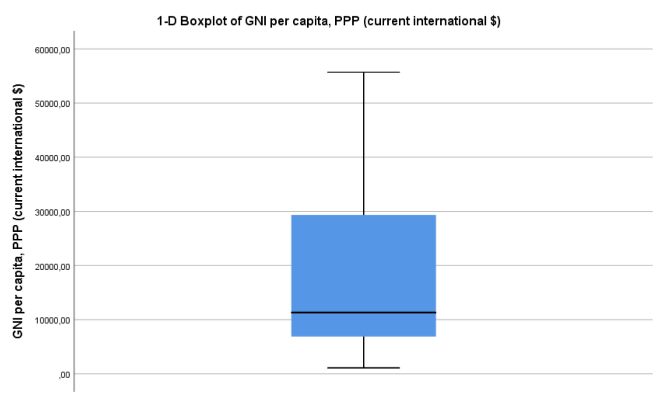


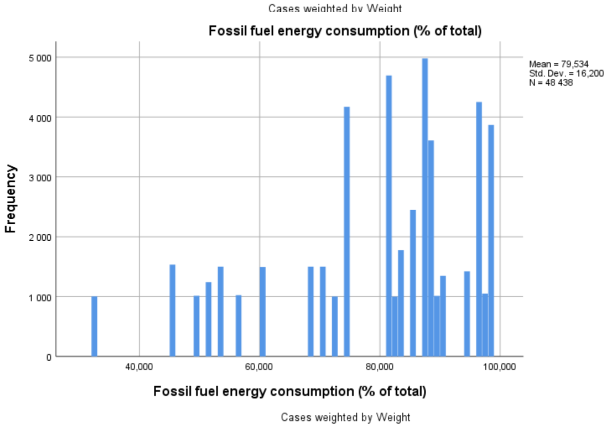

Scale of incomes
Mean = 4,56
Std. Dev. = 2,312
N = 76 800
Frequency
Scale of incomes
Cases weighted by Weight

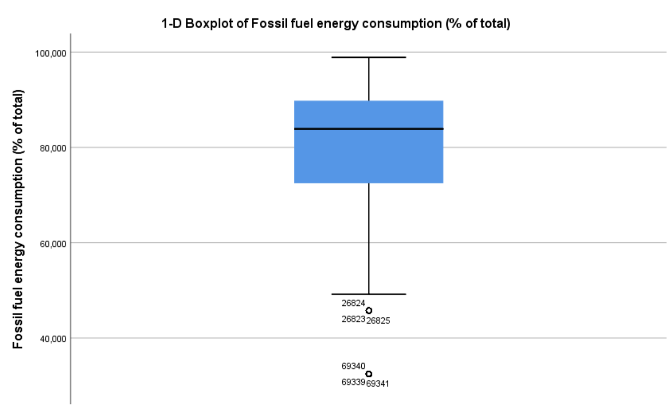

GINI coefficient
Mean = 40,10
Std. Dev. = 9,302
N = 54 013
Frequency
GINI coefficient
Cases weighted by Weight


1-D Boxplot of GINI coefficient
GINI coefficient
63953
63950
63952
63951


GNI per capita, PPP (current international $)
Mean = 16912,36
Std. Dev. = 14083,497
N = 53 458
Frequency
GNI per capita, PPP (current international $)
Cases weighted by Weight


1-D Boxplot of GNI per capita, PPP (current international $)
GNI per capita, PPP (current international $)


Fossil fuel energy consumption (% of total)
Mean = 79,534
Std. Dev. = 16,200
N = 48 438
Frequency
Fossil fuel energy consumption (% of total)
Cases weighted by Weight


1-D Boxplot of Fossil fuel energy consumption (% of total)
Fossil fuel energy consumption (% of total)
26824
26823
26825
69340
69339
69341