Towards Public Participation for Effective Air Pollution Risk Management: Case Studies from Mongolia and Iceland

Bonjun Koo

Towards Public Participation for Effective Air Pollution Risk Management: Case Studies from Mongolia and Iceland

A dissertation submitted in partial fulfillment of the requirement for the degree of

Doctor of Engineering

Bonjun Koo

Department of Urban Management

Graduate School of Engineering

Kyoto University

2021

Acknowledgments

I would like to express my sincere gratitude to my advisor Prof. Ana Maria Cruz Naranjo for her patience and motivation in her continuous support of my Ph.D. study and related research. Her guidance and immense knowledge in subject helped me throughout my research and writing of this thesis. I could not imagine a better advisor and mentor for my Ph.D. study.

I would also like to thank the rest of my thesis committee, Prof. Minoru Yoneda and Dr. Muneta Yokomatsu, for their insightful comments and encouragement, as well as for their hard questions which incented me to widen my research from various perspectives.

My sincere thanks are also due to Prof. Throstur Thorsteinsson and Dr. Gudrun Petursdottir, who provided me the opportunity to join their team at the University of Iceland. Without their support, it would not be possible to conduct this research.

I would also like to thank my tutors, Prof. Yoshiyuki Yama and Dr. Jong-Il Na, for their valuable guidance throughout my studies. Their immense knowledge and abundant experience have encouraged me throughout my academic research and personal life.

I thank my fellow colleagues for their collaboration. Their kind help and support have made my study and life in the last five years a wonderful time.

Finally, I would like to express my gratitude to my wife Yong Hee Kim, my son Wonmo Koo, and my parents. Without their tremendous understanding and encouragement in the past few years, it would be impossible to complete my study.

Copyright Acknowledgments

A few parts of the research presented in this dissertation have been published in one peer-reviewed publication.

Chapter 4 appears in:

Koo, B., Na, J.-I., Thorsteinsson, T., Cruz, A. M. (2020). Participatory approach to gap analysis between policy and practice regarding air pollution in ger areas of Ulaanbaatar, Mongolia. *Sustainability*, *12*, 3309.

Contents

List of Figures

List of Tables

Chapter 1
Introduction

1.1 Introduction

Air pollution is one of the most severe environmental health risks globally, and it has caused approximately 8.8 million premature deaths worldwide in 2015 (Lelieveld et al., 2020). According to the Global Burden of Disease Study, 1.6 million premature deaths in 2017 were linked to indoor air pollution (Ritchie, 2013). Most indoor air pollution results from the combustion of solid fuels such as biomass fuels and coal for cooking and heating in households (Desai et al., 2004). This is a significant problem in developing countries, where the population often depends on these fuels as the main source of domestic energy. The rapid increase of rural–urban migration in developing countries (Jahan, 2012) led these migrants to inhabit informal settlements and urban slums, with higher indoor air pollution rates and health risks (West et al., 2019).

Ulaanbaatar, the capital of Mongolia, has one of the worst air quality globally, and concerns regarding air pollution are increasing (Sophie, 2019). The intensive rural-to-urban migration over the last two decades has resulted in a sharp increase in informal settlements, called “ger” (traditional nomadic dwelling) areas, on the outskirts of the city. In gers, households are heated with coal-fired stoves, and the increasing coal consumption in harsh winters have caused smog in Ulaanbaatar. The average annual $PM_{2.5}$ concentrations in Ulaanbaatar are at least seven times higher than the World Health Organization (WHO) standard.

Since the 2000s, the Government of Mongolia (GoM) has been making efforts to identify comprehensive solutions for effective air pollution risk management in partnership with national and international organizations. These efforts include the implementation of law and policy regulations on the prohibition of raw coal in certain districts, transfer of new technologies such as energy-efficient stoves, and adoption of polluter pays principles (Tsevegjav, 2013). In March 2017, the GoM approved a National Program on Reduction of Air and Environmental Pollution. This national program aims to decrease the emission of air pollutants by 80%, prohibit the use of unprocessed coal (except in thermal power plants) in Ulaanbaatar, and reduce air and environmental pollution by at least 50% by 2025. However, the air pollution mitigation measures have not been effective because, among other reasons, projects and policies have not considered the specificities of ger areas, and therefore, they do not reflect the actual needs and conditions of the population.

A top-down approach without extensive public input can lead to policies that ignore local priorities and specific development contexts. The quality of decision-making can be improved through public participation that provides decision-makers with additional and unique information about local conditions. According to Gall et al. (2013), indoor air pollution in developing countries combines technological and social complexities, and therefore, intervention and interdisciplinary studies are needed to reduce its effects.

In the past decades, many arguments have been made to encourage public participation in environmental policy-making and management. There have been demands for more collaborative, participatory, and democratic environmental management approaches (United Nations Economic Commission for Europe [UNECE], 1998; Westberg & Waldenström, 2017). According to Bowyer and Price (2019), "Current approaches to reducing air pollution exposure in informal settlements…have very little input from the residents they target. As a result, they may have a low rate of acceptance." Therefore, community-centered approaches that ensure an understanding of the local context and explore concerns and challenges faced by residents are culturally relevant, inclusive, and more effective (Bowyer & Price, 2019).

In this regard, community-based participatory research (CBPR) is a collaborative approach that combines science, practice, and policy by engaging community members, organizational representatives, and researchers in all phases of a project (Ali et al., 2008; Balazs & Morello-Frosch, 2013). Accordingly, CBPR is well suited to fill the gap in the understanding of complex social and health issues, such as indoor air pollution (Shoultz et al., 2006). CBPR enables the translation (i.e., application and interpretation) of research findings to community stakeholders and policymakers (Balazs & Morello-Frosch, 2013).

Previous CBPRs on air pollution have focused mainly on engaging residents in air quality measurement and monitoring to raise their awareness of air pollution. Moreover, studies on indoor air pollution from household combustion of solid fuels in developing countries have focused mostly on health issues. Therefore, studies on air pollution policies based on public participation are needed to provide information and policy recommendations to governments, public health authorities, policymakers, and other stakeholders of sectors related to air pollution risk management to develop and strengthen effective air pollution policies.

Furthermore, air pollution studies should collect objective information on actual pollution levels and people's perceptions of those levels (Gatersleben & Uzzell, 2000). Understanding the public perception and attitude toward air quality and policies is significant for a successful citizen involvement in the transition to new technologies and management of measures (Saksena, 2011). In the previous study of the author of this thesis, a survey on air pollution awareness and the perceptions of ger residents in

Ulaanbaatar was conducted. The study showed that residents are well aware of the severity and causes of air pollution, and that they are willing to undertake certain burdens to mitigate air pollution.

In this study, a survey was also conducted in Reykjavik, Iceland, to compare the differences between the air pollution awareness and perceptions of residents from a developing country (Mongolia) and a developed country (Iceland) with relatively clean air.

1.2 Study Questions

This study was initiated with the question: Why have air pollution problems in Ulaanbaatar, Mongolia, persisted for decades and are still ongoing despite the efforts of various stakeholders to solve them? As previously mentioned, a possible reason is the lack of input of the needs and living conditions of residents in the ger areas, which can decrease public participation and acceptance of proposed policies. Therefore, it is necessary to investigate and analyze the difference between the residents' actual needs and perceptions in the ger areas and policymakers' views using a participatory approach to ensure that public needs and demands are considered during policy-making and implementation. In this way, it is essential to suggest policy directions that minimize gaps between policy and practice. In addition to traditional science and technology-centered aspects, policies should accommodate the residents' socio-economic conditions and needs.

In this regard, this study addresses the following questions:

- What are the views and perceptions of stakeholders and residents on air pollution issues?
- How are stakeholders responding to air pollution issues?
- What are the challenges faced by the community when participating in air pollution policies?
- What solutions does the community propose to mitigate air pollution?
- How do the residents in Reykjavik, Iceland perceive air quality in the city?

1.3 Study Aims

The overall aim of this research is to elucidate authentic opinions of stakeholders and residents regarding air pollution issues through participatory approaches to identify critical challenges and barriers that have limited the success of government policies regarding air pollution in the ger areas of Ulaanbaatar, Mongolia. Hence, this study aims to (i) review existing laws and policies concerning air pollution reduction; (ii) analyze them by considering the perspectives of stakeholders and residents through participatory approaches; (iii) collect and organize public discourse and community preferences

on air pollution issues; and (iv) suggest policy directions and provide practical recommendations.

The study findings will provide insights to address the challenges faced by communities in relation to air pollution risk management. Furthermore, the findings are expected to contribute in establishing appropriate air pollution policies and strategies through effective participation of residents. Similarly, the results can be useful for national and international agencies implementing air pollution-related projects to improve the involvement of stakeholders and residents in project development activities.

This study also investigates the public awareness and perception of air pollution problems in Reykjavik, Iceland, including air pollution causes, residents' perceptions of air quality, and environmental and health effects.

1.4 Structure of Thesis

This thesis consists of seven chapters, including this introductory chapter. Chapter 2 presents a literature review that includes previous studies regarding community-based air pollution, indoor air quality, and limitations of existing studies; air pollution as a global risk and its research importance; indoor air pollution problems in developing countries; definition and concepts regarding particulate air pollution and its health effects, and particulate air pollution in developing countries; concepts of participation; needs for public participation in environmental policy-making; participatory methods for research; and benefits of CBPR. Chapter 3 describes the overall research methodology used for data collection, including the participatory approaches. Chapter 4 presents the results of gap analysis between air pollution policies and practices in ger areas of Ulaanbaatar. Based on the data collected from participatory approaches, including interviews and a workshop, this study analyzes the gaps between government policy approaches, actual conditions in ger areas, and the desired situation of ger residents for effective air pollution risk management in Ulaanbaatar. Chapter 5 collects and organizes public discourse and community preferences on air pollution issues in Ulaanbaatar through a narrative approach. This information is analyzed aiming to enhance public participation. Chapter 6 presents the results of an air pollution awareness and perception survey in Reykjavik, Iceland. The last chapter presents the key findings, conclusions, and limitations of the study, and recommendations.

References

1. Ali, R., Olden, K., & Xu, S. (2008). Community-based participatory research: A vehicle to promote public engagement for environmental health in China. *Environmental Health Perspectives*, *116*(10), 1281–1284.

2. Balazs, C. L., & Morello-Frosch, R. (2013). The three R's: How community based participatory research strengthens the rigor, relevance and reach of science. *Environmental Justice (Print)*, *6*(1), 10. https://doi.org/10.1089/env.2012.0017

3. Bowyer, C., & Price, H. (2019, March 5). *Using art to tackle air pollution: A story from a Nairobi slum.* The Conversation Media Group Ltd. https://theconversation.com/using-art-to-tackle-air-pollution-a-story-from-a-nairobi-slum-111212

4. Desai, M. A., Mehta, S., & Smith, K. R. (2004). *Indoor smoke from solid fuels: Assessing the environmental burden of disease at national and local levels.* World Health Organization (WHO Environmental Burden of Disease Series, No. 4).

5. Gall, E. T., Carter, E. M., Earnest, C. M., & Stephens, B. (2013). Indoor air pollution in developing countries: Research and implementation needs for improvements in global public health. *American Journal of Public Health*, *103*(4), e67–e72. https://doi.org/10.2105/AJPH.2012.300955

6. Gatersleben, B., & Uzzell, D. (2000). The risk perception of transport-generated air pollution. *IATSS Research*, *24*(1), 30–38.

7. Jahan, M. (2012). Impact of rural urban migration on physical and social environment: The case of Dhaka city. *International Journal of Development and Sustainability*, *1*(2), 186–194.

8. Lelieveld, J., Pozzer, A., Pöschl. U., Fnais, M., Haines, A., & Münzel, T. (2020). Loss of life expectancy from air pollution compared to other risk factors: a worldwide perspective. Cardiovascular Research, 2020; DOI: 10.1093/cvr/cvaa025

9. Ritchie, H. (2013). *Indoor air pollution.* https://ourworldindata.org/indoor-air-pollution

10. Saksena, S. (2011). Public Perceptions of Urban Air Pollution Risks. *Risk, Hazards & Crisis in Public Policy*, *2*(1), 2.

11. Shoultz, J., Oneha, M. F., Magnussen, L., Hla, M. M., Brees-Saunders, Z., Cruz, M. D., & Douglas M. (2006). Finding solutions to challenges faced in community-based participatory research between academic and community organizations. *Journal of Interprofessional Care*, *20*(2):133–144.

12. Sophie, C. (2019). World Health Organization. *Bulletin of the World Health Organization*, Geneva, *97*(2), 9–80. https://doi.org/10.2471/BLT.19.020219

13. Tsevegjav, B. (2013). *Assessment of urban air pollution abatement policy implementation vis-à-vis the role of household energy use in ger areas of Mongolia.* University of Twente.

14. United Nations Economic Commission for Europe (UNECE). (1998). *Convention on access to information, public participation in decision-making and access to justice in environmental matters.* http://www.unece.org/env/pp/treatytext.html

15. West, E. S., Büker, P., Ashmore, M., Njoroge, G., Welden, N., Muhoza, C., Osano, P., Makau, J., Njoroge, P., & Apondo, W. (2019). Particulate matter pollution in an informal settlement in Nairobi: Using citizen science to make the invisible visible. *Applied Geography*, *114*. https://doi.org/10.1016/j.apgeog.2019.102133

16. Westberg, L., & Waldenström, C. (2017). How can we ever create participation when we are the ones who decide? On natural resource management practice and its readiness for change. *Journal of Environmental Policy & Planning*, *19*(6), 654–667. doi:10.1080/1523908X.2016.1264298

Chapter 2
Literature Review

2.1 Previous Studies

In recent years, the number of community projects for air pollution risk management has been increasing, and there is a growing interest in research that explores the potential of those projects. Most community-based air pollution studies focus on air quality monitoring to increase the residents' awareness and perception of air pollution. A few decades ago, community-level air quality monitoring was difficult because ambient air quality data were obtained through expensive and complicated stationary equipment operated at the state or federal level. Therefore, most communities had little or no means to address local air quality concerns (Commodore et al., 2017). However, recent advancements in environmental monitoring technology and communications have increased the availability of relatively cheap and easy-to-use air pollution sensors, which in turn has increased the prospect of projects and studies on this topic (Commodore et al., 2017). Ngo et al. (2015) conducted a pilot study to assess the health risk perceptions of air pollution by residents in an informal settlement in Nairobi, Kenya. They involved the residents in measuring $PM_{2.5}$ levels and later presented the obtained data at a community forum with the participants of the monitoring and focus group discussions. The study observed that this type of approach helped residents to improve their understanding of air pollution and develop responses. In the study of Schaefer et al. (2020), citizens used low-cost measurement devices to monitor tropospheric ozone. In addition, interviews conducted with involved residents demonstrated that the active involvement of individuals in processes such as tropospheric ozone measurement can significantly impact their knowledge and attitudes.

Indoor air quality (IAQ) has also received significant attention from the international scientific community, political institutions, and societies dealing with environmental problems (Cincinelli & Martellini, 2017). Interest in IAQ topics has increased since the World Health Organization (WHO) published the first specific IAQ guidelines in 2010 (Pierpaoli & Ruello, 2018). Previous studies on IAQ have mainly addressed IAQ monitoring, health impacts, and assessments. A few IAQ studies regarding coal and biomass burning in households, mostly in rural areas of developing countries, have also been conducted. Those studies mostly investigate the health impacts in Chinese coal-burning households (Baumgartner et al., 2011; Jin et al., 2006; Li et al., 2011; Mestl et al., 2007; Peabody et al., 2005; Shen et al., 2009; Zhang & Smith, 2007).

As Gall et al. (2013) stated, considering the socio-economic complexity of air pollution issues in developing countries, transdisciplinary studies are required so that researchers and the population can discuss and act together. Few studies illustrate strategies to establish an effective communication between stakeholders and residents. Muindi et al. (2014) assessed the perceptions and attitudes of residents regarding air pollution in two slums in Nairobi by conducting focus group discussions and revealed an apparent disconnection between knowledge and practices. Rickenbacker et al. (2019) developed a model to establish community–academic partnerships and co-facilitated training and workshops with residents to raise environmental consciousness in underserved communities of Pittsburgh, Pennsylvania. Andradóttir and Thorsteinsson (2019), through semi-structured interviews, explored the physical and societal factors contributing to extreme recreational fireworks pollution in Reykjavik, Iceland, and investigated stakeholders' perspectives on the resultant pollution and possible mitigation, highlighting the challenges faced by governments and societies in air quality mitigation.

The literature review indicates that a limited number of studies investigate the challenges of communities that burn coal and biomass for cooking and heating in adopting government policies aimed at reducing indoor air pollution. According to WHO (2002), although the benefits of interventions are known, it is unclear which factors would motivate households to adopt such interventions, as this adoption is not always successful. Moreover, there is a lack of knowledge concerning the broader implications and sustainability of many proposed interventions within specific environmental and socioeconomic contexts (WHO, 2002). Therefore, these topics should be further investigated.

2.2 Air Pollution as a Global Risk

Air pollution is a significant risk factor for global public health, and its level has declined in high-income countries over the past 25 years. However, it has risen sharply in low- and middle-income countries, thereby threatening public health and economic development (Boogaard et al., 2019). The Global Burden of Disease project mentions air pollution as one of the main risk factors for global mortality in 2017, and the United Nations Sustainable Development Goals require significant reductions in air pollution exposure by 2030 (United Nations, 2019). Exposure to fine particulate matter from the combustion of solid fuels outdoors and in households is the fifth factor causing mortality risk worldwide, accounting for 4.9 million deaths and 8.7% of mortality in 2017 (Health Effects Institute, 2019).

Asia has been the world's highest emitter of air pollutants in recent years (Acid Deposition Monitoring Network in East Asia [EANET], 2015), and severe $PM_{2.5}$ pollution is affecting human health, ecosystems, and regional-scale climate change (Sato & Ohara, 2018). According to the latest data in the 2018 World Air Quality Report, most polluted cities in the world are located in Asian developing

countries, including India, Pakistan, Bangladesh, Thailand, and China, and the main cause is fossil fuel combustion (IQAir AirVisual, 2018). In addition, outdated vehicles in informal transport with poor maintenance aggravate urban air pollution in developing countries (Cervero, 2000; Gwilliam et al., 2004). Therefore, governments in Asian developing countries have a significant interest in air pollution issues and have investigated effective ways to reduce pollution levels. However, there is a mismatch between public perceptions and fundamental health risks and solutions, which is a barrier for the development of effective clean air policies (Schlesinger, 2019).

2.3 Indoor Air Pollution in Developing Countries

Indoor air pollution can be traced to prehistoric times when humans first migrated to temperate climates approximately 200,000 years ago. Because of the cold winter climate, they built shelters and used fire indoors for cooking, warmth, and light. Fire, which allowed humans to enjoy the benefits of living indoors, also led to exposure to high pollution levels, as evidenced by the soot found in prehistoric caves (Albalak, 1997). Globally, more than three billion people, mainly in developing countries, rely on biomass fuels (coal, wood, and other solid fuels) for their domestic energy needs (WHO, n.d.). Consequently, household air pollution from the combustion of solid fuels for cooking and space heating is one of the top five major risk factors for the global disease burden (Smith et al., 2014). Inefficient stoves for cooking and heating emit large quantities of health-damaging particulate matter (PM) and climate warming pollutants (e.g., black carbon) into the household environment, thereby increasing the risk of respiratory illnesses, including childhood pneumonia and chronic obstructive pulmonary disease, cardiovascular diseases, and lung cancer.

Most air pollution-related deaths occur in developing countries where laws are weak or not enforced, vehicle emission standards are less stringent, and coal power plants are more prevalent (United Nations Environment Programme, 2019). Moreover, the poorest people living in informal settlements in cities of developing countries are greatly afflicted with air pollution, particularly indoor air pollution. These are primarily the most vulnerable people in the developing world, as they are unable to afford cleaner fuels or alternative technologies, thereby suffering the most damage. Therefore, in many developing countries, energy choice and household energy transitions are essential from a policy perspective, which has attracted increasing research attention (Muller & Yan, 2018). Most of these countries are making efforts to encourage and facilitate the use of more efficient energy sources that cause less environmental, social, and health impacts.

However, in low- and middle-income countries, governments often lack the information and policy tools required to take effective action. There are concerns that inadequate or even well-designed air

pollution policies could hinder economic growth. Nevertheless, public and governmental concerns about air pollution are increasing, and significant actions to improve air quality in middle-income countries are becoming more evident. Local conditions and the participation of different stakeholders should be considered to obtain effective policies to reduce pollutant emission levels.

2.4 Particulate Air Pollution

Particulate air pollution, also known as PM, is any solid or liquid suspended in the air (Dockery, 2009). Common components of PM are metals, organic compounds, inorganic and carbonaceous materials, elemental carbon, sulfate, nitrate, ammonium, and other ions (Adams et al., 2015). According to particle size, PM is subdivided into coarse (PM_{10}, diameter < 10 μm), fine ($PM_{2.5}$, diameter < 2.5 μm), and ultrafine ($PM_{0.1}$, diameter < 0.1 μm).

Exposure to larger airborne particles can also be harmful; however, exposure to high average concentrations of $PM_{2.5}$ over the years is fatal considering cardiovascular, respiratory, and other types of diseases. $PM_{2.5}$ air pollution can originate from vehicle emissions, coal-combustion power plants, industrial emissions, and several other human and natural sources. Ambient levels of $PM_{2.5}$ worldwide continue to exceed the Air Quality Guidelines established by WHO. In 2017, 92% of the world's population lived in areas that exceeded the WHO guidelines for $PM_{2.5}$ (WHO, 2016).

Some developed countries have significantly reduced particulate air pollution in recent decades, but the situation has drastically aggravated in many developing countries (Brugge & Lane, 2018). Developing countries emit a significant share of the global PM air pollution. The primary sources of particulate air pollution in developing countries is industrial production and combustion of solid fuels in households. In this context, public acceptance of mitigation policies is essential to reduce particulate air pollution, and it requires various public participation activities.

2.5 Participation

Public participation for the planning and implementation of governmental policies have attracted the attention of researchers since the 1970s. The demand for increased participation of non-state actors in policy-making arises from the criticism movement that questioned hierarchical authority and called for a "direct democracy" with the support of political theorists. Participation approaches were developed to address basic needs and reach the most underprivileged people (Michener, 1998). Participation is a means of meeting local needs and redistributing scarce resources and intrinsic value by empowering the

underprivileged, which strengthens local management capabilities, confidence in indigenous potential, and collective awareness. Today, participation is one of the most widely used concepts in development due to the benefits reported in academic studies and policy statements. Participation facilitates local people's acceptance of new policies and technologies promoted by outsiders. Participation is a concept that varies depending on its application and definition. The term participation is often used as an adjective for other terms such as citizen participation, community participation, people's participation, and public participation.

Armitage (1988) defines citizen participation as a process by which citizens act in response to public concerns, express their opinions on decisions that affect them, and take responsibility for community changes. Cook (1975) states that citizen participation in community affairs serves to check and balance political activity by allowing full access to a democratic society. According to Cahn and Camper (1968), one rationale for citizen participation is that it provides a unique source of insight, information, knowledge, and experience that contributes to community solutions. The liberal democratic theory stated that citizen participation in decision-making influences leaders to adopt policies that address the needs of citizens.

Pran Manga and Wendy Muckle suggest that community participation can be a response to the feeling of powerlessness among the public when decisions, such as government decisions made outside their community, affect them (Chappel, 1997). Community participation is an essential component of community development and reflects a grassroots or bottom-up approach to problem-solving. Community participation refers to the active voluntary engagement of individuals and groups to change problematic situations and influence policies and programs that affect their lives or the lives of others (Gamble & Weil, 1995).

People's participation is an essential factor for development, and the notion of people's participation in their development has gained momentum in the human empowerment and development process. Contemporary development scholars have advocated the inclusion of people in development projects because they believe that the objectives of any project cannot be completely achieved without the participation of the people involved. Stone (1989) argues that people's participation in development projects can lead to a more effective social change than imposing an external culture on society.

Public participation in decision-making by government agencies has increased drastically in recent decades. It is widely believed that the public should be involved in decision-making, and there are many laws, regulations, and policies that require public participation in environmental decision-making. Heberlein (1976) suggests that public participation leads to better decisions, and community decisions involving citizens are more acceptable to local residents. Public participation also provides valuable local knowledge and experience that complement the knowledge of experts, thereby providing the basis

for a more effective risk management.

Since the 1970s, public participation has been widely recognized as an integral part of strategies to improve the living standards and quality of life of underprivileged rural communities in developing countries (Clark, 1991). Public participation can support decentralization by increasing the effectiveness and efficiency of development projects and public programs at the local level (Nijenhuis, 2002). The proponents of public participation consider that top-down leadership and policy-making have failed to promote development and improve the lives of the underprivileged. They suggest that to implement efficient policies, underprivileged communities should be considered during planning and implementation stages through public participation.

2.6 Public Participation in Environmental Policy-Making

Policymakers in the 1990s accepted that the public should be involved in policy discussions on controversial issues such as the environment. Accordingly, participatory research practices have been adopted in environmental science, and policymakers have incorporated participation in regulatory texts (Wesselink et al., 2011). Academic authors have suggested approaches to expand the scientific debate beyond the views of traditional scientific experts. However, these suggestions still exclude truly public or non-scientific participation in debate and do not address other ways in which people relate to their environment, which can influence the acceptance of environmental policies in everyday life (Eden, 1996). Therefore, these approaches do not necessarily lead to successful policy implementation, and therefore, contributions other than scientific ones should be considered, especially those related to the socio-cultural aspects of environmental issues. In this respect, public participation in environmental policy is being increasingly emphasized. The need of public participation for a successful environmental policy has been recognized at the international and national levels (Eden, 1996). In the next section, CBPR is introduced to promote public participation in solving local problems.

2.7 Community-based Participatory Research

Minkler et al. (2003) defines CBPR as “a collaborative process that equitably involves all partners in the research process and recognizes the unique strengths that each brings.” They also consider that “CBPR begins with a research topic of importance to the community intending to combine knowledge and action for social change to improve community health and eliminate health disparities.” In other words, CBPR is an approach that promotes community participation, social action, and collaborative

inquiry, and it is often employed to address public concerns (Castleden et al., 2010; Israel et al., 2005; Minkler, 2005). CBPR is a useful method to simultaneously approach the community, local authorities, universities, and civil society organizations to address complex social and health issues (Shoultz et al., 2006).

CBPR can be used to (i) engage more actively with community members in the field of clean household energy, (ii) understand how to best facilitate adoption and continued use of cleaner fuels from a community perspective, and (iii) reach key stakeholders, so that the users' opinions and needs can directly influence interventions and policies that address local needs.

2.8 Participatory Research Methods

Participatory methods emphasize the importance of using non-academic local knowledge to address local problems (Bowd et al., 2016). Park (1993) describes the participatory research method as a way of empowering deprived and disenfranchised people to take effective action to improve their life conditions. According to O'Kane (2008), the roots of participatory methods and approaches can be traced to many sources and traditions, and particularly influential research includes activist participatory research inspired by Paulo Freire (1968), agroecosystem analysis (Conway, 1987), applied anthropology, field research on farming systems, and rapid rural appraisal (Cornwall et al., 1993; Pretty et al., 1995). Activist participatory research is used to collectively refer to the approaches and methods that use dialogue and participatory research to enhance people's awareness and confidence to empower their actions. Freire suggested that underprivileged and exploited people can and should be enabled to analyze their own reality (Chambers, 1994). Freire believed that critical reflection was essential for personal and social change. Agroecosystem analysis is a codification of the type of information that should be collected to create technologies suitable for different agricultural systems. It entails extensive and often visual system analysis to understand the opportunities and constraints of an agroecosystem. The diagrams of systems components are the primary tools of agroecosystem analysis, and they are designed to be accessible to researchers, farmers, and policymakers; however, agroecosystem analysis does not require the participation of local groups (Blumenthal & Jannink, 2000). Applied anthropology is the application of anthropological knowledge, methodology, and theoretical approaches to address social issues. Anthropologists mobilize their skills in various settings or domains for the development of policies and to initiate actions that alleviate pressing social, economic, health, and technological problems faced by communities and organizations. In particular, applied anthropologists are essential for the development of programs and projects that have a lasting impact on the lives of individuals and communities. The work of applied anthropologists is interdisciplinary and involves various stakeholders,

including local communities. Field research on farming systems by different professionals has revealed the complexity, diversity, and rationality of untidy and unsystematic farming practices (Chambers, 1994). Therefore, the participation of farmers in agricultural research is meaningful, especially in the context of complex, diverse, and risk-prone farming systems (Catley, 2005). Rapid rural appraisal (RRA) is an approach that emerged in the 1970s as an attempt to identify better approaches to familiarize rural life and conditions in different countries. Experts had been disillusioned with conventional methodologies that relied heavily on questionnaire surveys because such gathered information tended to be tedious, difficult to process, and often failed to obtain accurate and reliable data (Toness, 2001). Field practitioners conduct RRA in a way that allows outsiders to obtain accurate and reliable insights and information about rural people and conditions in a cost-effective and timely manner (Pretty et al., 1995).

Accordingly, participatory research approaches can be designed to help vulnerable and underprivileged people by critically reflecting their living conditions, learning the causes of their powerlessness and deprivation, and addressing power imbalances for meaningful outcomes. In conventional approaches for research and policy development, the subjects or those who benefit from the policy are generally not involved in the design process and have limited involvement in the implementation phase. In contrast, participatory methods transfer most of the power held in these relationships from the researcher to the subject, and through a flexible approach and constructive communication, the researched community is empowered to become active in the research process (Bar-On & Prinsen, 1999). This power shift amplifies the voices of marginalized people such as children, women, and the disabled so that they can clarify their needs and demands and contribute to the construction of knowledge. The development of participatory methods arises essentially from the recognition and belief that local voices could and should be heard within the policy design and implementation.

According to Bergold and Thomas (2012), among the various data collection methods in participatory research, two procedures are often applied: interviews and focus groups. Interviews conducted within a participatory research framework are generally semi-structured, which is often used in qualitative research. Focus groups are crucial to create a "communicative space." Focus group participants commonly have the opportunity to communicate with each other in an open and relaxed atmosphere and to address several aspects of the project. Therefore, focus groups are frequently used to collect data because it is easier to address sensitive themes in such atmosphere (Cook, 2012; Dentith et al., 2012; von Unger, 2012).

In a study by Harper et al. (2003), potential health effects (and exposures) of air pollution in communities were identified relatively rapidly through focus group discussions. Moreover, data could

be collected from the groups of experts, community leaders, individuals from the community, and in-depth interviews with selected individuals. Focus group interviews can be used to obtain critical in-depth qualitative data to investigate local perceptions and examine people's knowledge, attitudes, and behavior (Harper et al., 2003).

References

1. Acid Deposition Monitoring Network in East Asia (EANET). (2015). *Review on the state of air pollution in East Asia.* Task Force on Research Coordination (TFRC), Scientific Advisory Committee (SAC). Retrieved January 14, 2021, from http://www.eanet.asia/product/RSAP/RSAP.pdf

2. Adams, K., Greenbaum, D.S., Shaikh, R., van Erp, A. M., & Russell, A. G. (2015). Particulate matter components, sources, and health: Systematic approaches to testing effects. *Journal of the Air*, *65*(5), 544–558. https://doi.org/10.1080/10962247.2014.1001884

3. Albalak, R. (1997). *Cultural practices and exposure to particulate pollution from indoor biomass cooking: Effects on respiratory health and nutritional status among the Aymara Indians of the Bolivian Highlands* [Doctoral Dissertation, University of Michigan].

4. Andradóttir, H. Ó., & Thorsteinsson, T. (2019). Repeated extreme particulate matter episodes due to fireworks in Iceland and stakeholders' response. *Journal of Cleaner Production*, *236*, 117511. doi: https://doi.org/10.1016/j.jclepro.2019.06.342

5. Armitage, A. (1988). *Social welfare in Canada: Ideals, realities and future paths* (2nd ed.). McClelland and Stewart.

6. Bar-On, A. A., & Prinsen, G. (1999). Planning, Communities and Empowerment: An Introduction to Participatory Rural Appraisal. *International Social Work*, *42*(3), 277–294.

7. Baumgartner, J., Schauer, J. J., Ezzati, M., Lu, L., Cheng, C., Patz, J., & Bautista, L. E. (2011), Patterns and predictors of personal exposure to indoor air pollution from biomass combustion among women and children in rural China. *Indoor Air*, *21*, 479–488. https://doi.org/10.1111/j.1600-0668.2011.00730.x

8. Bergold, J., & Thomas, S. (2012). Participatory research methods: A methodological approach in motion. *Historical Social Research/Historische Sozialforschung*, *37*, 191–222. https://doi.org/10.2307/41756482

9. Blumenthal, D., & Jannink, J. L. (2000). A classification of collaborative management methods. *Conservation Ecology*, *4*(2), 13. http://doi.org/10.5751/ES-00226-040213

10. Boogaard, H., Walker, K., & Cohen, A. J. (2019). Air pollution: The emergence of a major

global health risk factor. *International Health*, *11*(6) 417–421. https://doi.org/10.1093/inthealth/ihz078

11. Bowd, R., Ozerdem, A., & Kassa, D. G. (2016). A theoretical and practical exposition of 'participatory' research methods. In A. Ozerdem, & R. Bowd (Eds.), *Participatory research methodologies development and post-disaster/conflict reconstruction* (pp. 1–20). Routledge.

12. Brugge, D., & Lane, K. J. (2018). *Fine particle air pollution is a public health emergency hiding in plain sight.* https://theconversation.com/fine-particle-air-pollution-is-a-public-health-emergency-hiding-in-plain-sight-106030

13. Cahn, E. S., & Camper, J. C. (1968). Citizen participation. In H. B. C. Spiegel (Ed.), *Citizen participation in urban development* (vol. 1, pp. 211–224). Center for Community Affairs, NTL Institute for Applied Behavioral Science.

14. Castleden, H., Sloan Morgan, V., & Neimanis, A. (2010). Researchers' perspectives on collective/community coauthorship in community-based participatory Indigenous research. *Journal of Empirical Research on Human Research Ethics*, *5*(4), 23–32.

15. Catley, A. (2005). *Participatory epidemiology: A guide for trainers.* African Union – Inter-African Bureau for Animal Resources.

16. Cervero, R. (2000). *Informal transport in the developing world.* UN-Habitat.

17. Chambers, R. (1994). The origins and practice of participatory rural appraisal. *World Development*, *22*, 953–69.

18. Chappel, R. (1997). *Social welfare in Canadian society.* ITP Nelson.

19. Cincinelli, A., & Martellini, T. (2017). Indoor air quality and health. *International Journal of Environmental Research and Public Health*, *14*(11), 1286. https://doi.org/10.3390/ijerph14111286

20. Clark, J. (1991). *Democratizing development: The role of voluntary organizations.* Earthscan.

21. Commodore, A., Wilson, S., Muhammad, O., Svendsen, E., & Pearce, J. (2017). Community-based participatory research for the study of air pollution: a review of motivations, approaches, and outcomes. *Environmental Monitoring and Assessment*, *189*, 378. https://doi.org/10.1007/s10661-017-6063-7

22. Conway, G. R. (1987). The properties of agro-ecosystems. *Agricultural Systems*, *24*, 95–117.

23. Cook, J. B. (1975). *Citizen participation: A concepts battery*. University of Missouri, Department of Regional and Community Affairs.

24. Cook, T. (2012). Where participatory approaches meet pragmatism in funded (health) research: The challenge of finding meaningful spaces. Forum Qualitative Sozialforschung/Forum: *Qualitative Social Research*, *13*(1), 18. http://nbn-resolving.de/urn:nbn:de:0114-fqs1201187

25. Cornwall, A., Guijt, I., & Welbourn, A. (1993). Acknowledging process: Challenges for agricultural research and extension methodology. In I. Scoones & J. Thompson (Eds.) (1994), *Beyond farmer first* (pp. 97—117). IT Publications.

26. Dentith, A. M., Measor, L., & O'Malley, M. P. (2012). The research imagination amid dilemmas of engaging young people in critical participatory work. *Participatory Qualitative Research*, *13*(1). https://doi.org/10.17169/fqs-13.1.1788

27. Dockery D. W. (2009). Health effects of particulate air pollution. *Annals of Epidemiology*, *19*(4), 257–263. https://doi.org/10.1016/j.annepidem.2009.01.018

28. Eden, S. (1996). Public participation in environmental policy: Considering scientific, counter-scientific and non-scientific contributions. *Public Understanding of Science*, *5*(3), 183–204. https://doi.org/10.1088/0963-6625/5/3/001

29. Gall, E. T., Carter, E. M., Earnest, C. M., & Stephens, B. (2013). Indoor air pollution in developing countries: Research and implementation needs for improvements in global public health. *American Journal of Public Health*, *103*(4), e67–e72. https://doi.org/10.2105/AJPH.2012.300955

30. Gamble, D. N., & Weil, M. O. (1995). Citizen participation. In R. L. Edwards (Editor-in-Chief), *Encyclopedia of social work* (19th ed., vol. 1, pp. 483–494). National Association of Social Workers/NASW Press.

31. Gwilliam, K., Kojima, M., & Johnson, T. (2004). *Reducing air pollution from urban transport.* World Bank.

32. Harper, C. C., Mathee, A., von Schirnding, Y., de Rosa, C. T., & Falk, H. (2003). The health impact of environmental pollutants: A special focus on lead exposure in South Africa. *International Journal of Hygiene and Environmental Health*, *206*(4–5), 315–322. https://doi.org/10.1078/1438-4639-00227

33. Health Effects Institute. (2019). *State of global air 2019.* Special Report. Health Effects

Institute.

34. Heberlein, T. A. (1976). Some observations on alternative mechanisms for public involvement: The hearing, the public opinion poll, the workshop, and the quasi-experiment. *Natural Resources Journal*, *16*, 197–221.

35. IQAir AirVisual (2018). *2018 World air quality report: Region & city PM2.5 ranking.* https://www.iqair.com/world-most-polluted-cities/world-air-quality-report-2018-en.pdf

36. Israel, B., Eng, E., Schulz, A., & Parker, E. (2005). *Methods in community-based participatory research for health.* Jossey-Bass.

37. Jin, Y., Ma, X., Chen, X., Cheng, Y., Baris, E., Ezzati, M., & China Rural Energy and Health Research Group. (2006). Exposure to indoor air pollution from household energy use in rural China: The interactions of technology, behavior, and knowledge in health risk management. *Social Science & Medicine*, *62*, 3161−3176.

38. Li, Z., Zhang, L., Ye, R., Pei, L., Liu, J., Zheng, X., & Ren, A. (2011). Indoor air pollution from coal combustion and the risk of neural tube defects in a rural population in Shanxi Province, China. *American Journal of Epidemiology*, *174*(4), 451–458. https://doi.org/10.1093/aje/kwr108

39. Mestl, H. E., Aunan, K., Seip, H. M., Wang, S., Zhao, Y., & Zhang, D. (2007). Urban and rural exposure to indoor air pollution from domestic biomass and coal burning across China. *Science of the total environment*, *377*(1), 12–26. https://doi.org/10.1016/j.scitotenv.2007.01.087

40. Michener, V. J. (1998). The participatory approach: Contradiction and co-option in Burkina Faso. *World Development*, *26*(12), 2105–2118. https://doi.org/10.1016/S0305-750X(98)00112-0

41. Minkler, M. (2005). Community-based research partnerships: Challenges and opportunities. *Journal of Urban Health*, *82*(2, Suppl. 2), ii3–ii12.

42. Minkler, M., Blackwell, A. G., Thompson, M., & Tamir, H. (2003). Community-based participatory research: Implications for public health funding. *American Journal of Public Health*, *93*(8), 1210–1213.

43. Muindi, K., Egondi, T., Kimani-Murage, E., Rocklov, J., & Ng, N. (2014) "We are used to this": A qualitative assessment of the perceptions of and attitudes towards air pollution amongst slum residents in Nairobi. *BMC Public Health*, *14*, 226. https://doi.org/10.1186/1471-2458-14-226

44. Muller, C., & Yan, H. (2018). Household fuel use in developing countries: Review of theory and evidence. *Energy Economics*, *70*. https://doi.org/10.1016/j.eneco.2018.01.024

45. Ngo, N., Kokoyo, S., & Klopp, J. (2015). Why participation matters for air quality studies: Risk perceptions, understandings of air pollution and mobilization in a poor neighborhood in Nairobi, Kenya. *Public Health*, *142*. https://doi.org/10.1016/j.puhe.2015.07.014

46. Nijenhuis, G. (2002). *Decentralisation and popular participation in Bolivia: The link between local governance and local government.* Shaker Publishing BV.

47. O'Kane, C. (2008). The development of participatory techniques: Facilitating children's views about decisions that affect them. In: P. Christensen, & A. James (Eds.), *Research with Children: Perspectives and Practices* (pp. 125–155). Routledge.

48. Peabody, J., Riddell, T., Smith, K., Liu, Y., Zhao, Y., Gong, J., Milet, M., & Sinton, J. (2005). Indoor air pollution in rural China: Cooking fuels, stoves, and health status. *Archives of Environmental & Occupational Health*, *60*, 86–95. https://doi.org/10.3200/AEOH.60.2.86-95

49. Park, P. (1993). What is participatory research? A theoretical and methodological perspective. In P. Park, M. Brydon-Miller, B. Hall, & T. Jackson (Eds.), *Voices of change: Participatory research in the United States and Canada* (pp. 1–20). Bergin and Garvey.

50. Pierpaoli, M., & Ruello, M. (2018). Indoor air quality: A bibliometric study. *Sustainability*, *10*(11), 3830. https://doi.org/10.3390/su10113830

51. Pretty, J. N., Guijt, I., Thompson, J., & Scoones, I. (1995). *Participatory learning and action: A trainers guide.* IIED Participatory Methodology Series.

52. Rickenbacker, H., Brown, F., & Bilec, M. (2019). Creating environmental consciousness in underserved communities: Implementation and outcomes of community-based environmental justice and air pollution research. *Sustainable Cities and Society*, *47*, 101473. https://doi.org/10.1016/j.scs.2019.101473

53. Sato, K., & Ohara, T. (2018). The status of PM2.5 pollution in Asia and direction toward solving the issue. *Global Environmental Research*, *22*, 39–45.

54. Schaefer, T., Kieslinger, B., & Fabian, C. M. (2020). Citizen-based air quality monitoring: The impact on individual citizen scientists and how to leverage the benefits to affect whole regions. *Citizen Science: Theory and Practice*, *5*(1), 6.

55. Schlesinger, D. (March 28, 2019). *Asian public has 'hazy perceptions' about air pollution.*

Health Policy Watch. https://healthpolicy-watch.news/asian-public-has-hazy-perceptions-about-air-pollution/

56. Shen, M., Chapman, R. S., Vermeulen, R., Tian, L., Zheng, T., Chen, B. E., Engels, E. A., He, X., Blair, A., & Lan, Q. (2009). Coal use, stove improvement, and adult pneumonia mortality in Xuanwei, China: A retrospective cohort study. *Environmental Health Perspectives*, *117*(2), 261–266. https://doi.org/10.1289/ehp.11521

57. Shoultz, J., Oneha, M. F., Magnussen, L., Hla, M. M., Brees-Saunders, Z., Cruz, M. D., & Douglas, M. (2006). Finding solutions to challenges faced in community-based participatory research between academic and community organizations. *Journal of Interprofessional Care*, *20*(2), 133–144.

58. Smith, K. R., Bruce, N., Balakrishnan, K., Adair-Rohani, H., Balmes, J., Chafe, Z., Dherani, M., Hosgood, H. D., Mehta, S., Pope, D., Rehfuess, E., & HAP CRA Risk Expert Group (2014). Millions dead: How do we know and what does it mean? Methods used in the comparative risk assessment of household air pollution. *Annual Review of Public Health*, *35*, 185–206.

59. Stone, L. (1989). Cultural crossroads of community participation in development: A case from Nepal. *Human Organization*, *48*, 206–213.

60. Toness, A. (2001). The potential of Participatory Rural Appraisal (PRA) approaches and methods for agricultural extension and development in the 21st century. *Journal of International Agricultural and Extension Education*, *8*. https://doi.org/10.5191/jiaee.2001.08103

61. United Nations. (2019). *About the Sustainable Development Goals*. https://www.un.org/sustainabledevelopment/sustainable-development-goals/

62. United Nations Environment Programme (2019). *Air pollution hurts the poorest most.* https://www.unenvironment.org/news-and-stories/story/air-pollution-hurts-poorest-most

63. von Unger, H. (2012). Partizipative Gesundheitsforschung: Wer partizipiert woran? [Participatory health research: who participates in what?]. *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research, 13*(1).

64. Wesselink, A., Paavola, J., Fritsch, O., & Renn, O. (2011). Rationales for public participation in environmental policy and governance: Practitioners' perspectives. *Environment and Planning*, *43*(11), 2688–2704.

65. World Health Organization (2002). *The world health report 2002 - reducing risks, promoting healthy life.* https://www.who.int/whr/2002/en/whr02_en.pdf?ua=1

66. World Health Organization. (2016, September 27). *92% of the world's population exposed to unsafe levels of air pollution.* ScienceDaily. www.sciencedaily.com/releases/2016/09/160927144248.html

67. World Health Organization (n.d.). *Burden of disease from ambient and household air pollution.* Retrieved January 14, 2121, from http://who.int/phe/health_topics/outdoorair/databases/en/

68. Zhang, J. J., & Smith, K. R. (2007). Household air pollution from coal and biomass fuels in China: Measurements, health impacts, and interventions. *Environmental Health Perspectives*, *115*(6), 848–855. https://doi.org/10.1289/ehp.9479

Chapter 3

Methodology

The first field research for this study was conducted in Ulaanbaatar, Mongolia, from March 3 to 10, 2017. Before visiting Mongolia, the Ministry of Environment and Tourism (MET) and Energy Regulatory Commission (ERC) were contacted, and an initial meeting with MET officials was held on the first day of the field research. At the meeting, the study outline and field research plan were introduced to request their cooperation. After the meeting, the officials introduced other relevant officials and experts in Ulaanbaatar and provided their contact information. These peoples were approached by phone or e-mail, and the time and location for their interviews were confirmed. Four semi-structured or narrative interviews were conducted to investigate their views and responses to the current situation of air pollution in Ulaanbaatar. Through these meetings with stakeholders, documents concerning national air pollution laws and policies and the strategies and plans of Ulaanbaatar toward pollution response were also collected.

This field research also aimed to produce a participatory workshop with the residents of a ger area in Ulaanbaatar to investigate their opinions about air pollution issues and actual conditions in the ger area. During the field research, several local non-governmental organizations (NGOs) were contacted at their e-mail addresses found on websites and meetings were arranged and held to explore collaboration opportunities. In this process, one of the NGOs was selected as a collaborator for the workshop. The NGO facilitated initial communications with a local community and arranged the workshop. The participatory workshop was then conducted utilizing a participatory method. Based on the interviews, workshop, and reviews of the collected documents, the gap between policy and practice was analyzed. More details are described in Chapter 4.

To investigate a different participatory perspective, a second field research was conducted from March 5 to 8, 2019. Prior to visiting Mongolia, through e-mail communications with an officer from MET who was acquainted with the first field research, the purpose and plan of the second field research were conveyed, and cooperation was requested. A director of the ERC was contacted who helped in arranging meetings and interviews with government agencies and NGOs. Five interviews were conducted as semi-structured or narrative interviews to understand the current air pollution situation and perceptions in Ulaanbaatar compared to those of two years before.

In collaboration with the NGO that helped the participatory workshop in the first field research, a

focus group meeting was held with residents to investigate their perspectives and narratives on air pollution issues. The possibility of CBPR and residents' voluntary participation to address air pollution problems was also explored.

The results of interviews, focus group meetings, and participatory workshop from the first field research in 2017 were analyzed to compare different perspectives on air pollution issues in Ulaanbaatar. More details are presented in Chapter 5.

A questionnaire survey was conducted in Reykjavik, Iceland, to study the public awareness and perception of air pollution in a different country. The survey included questions regarding air pollution causes, residents' perceptions of air quality, and environmental and health effects. The survey questions were prepared based on the survey carried out by the author of this thesis in Ulaanbaatar in 2017 by referring to the air pollution perception survey developed by the Clean Air Initiative for Asian Cities and collaborating with the Social Science Research Institute (SSRI) of the University of Iceland. The questionnaire was written in Icelandic to aid the residents' understanding of the questions and obtain more accurate results. The survey was conducted between December 12, 2019, and January 9, 2020, using the internet panel survey of the SSRI. More details are presented in Chapter 6.

Chapter 4

Participatory Approach to Gap Analysis between Policy and Practice Regarding Air Pollution in Ger Areas of Ulaanbaatar, Mongolia

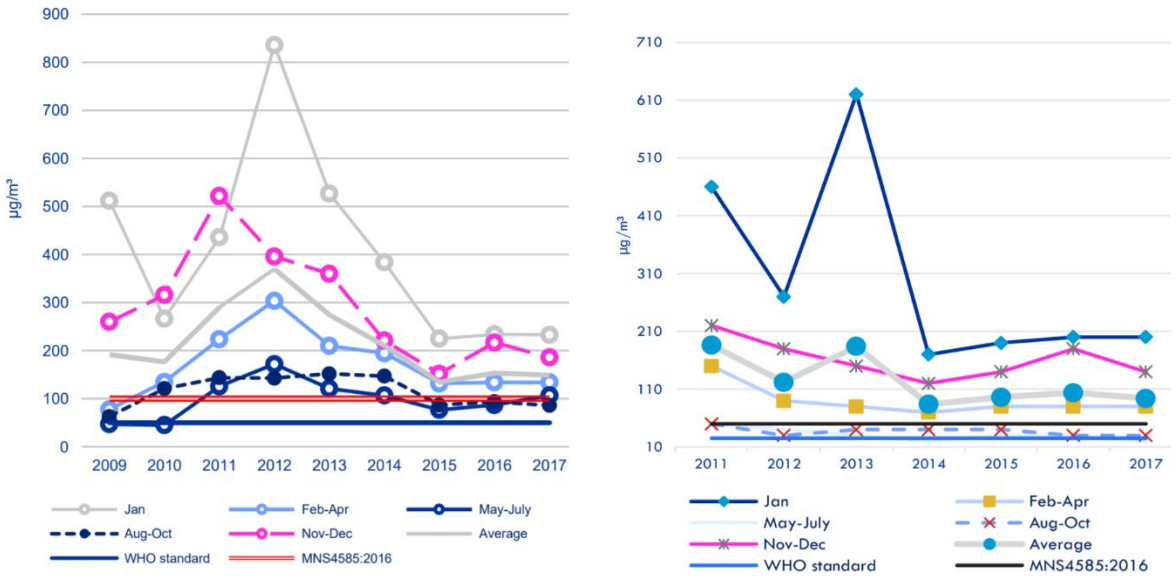
4.1 Introduction

Air pollution is a significant cause of disease and death rates and the greatest health impacts from air pollution worldwide occur among the poorest and most vulnerable populations (Fullerton et al., 2008). According to the 2016 WHO global urban ambient air pollution database, 98% of cities in low- and middle-income countries with a population of over 100,000 do not meet WHO air quality guidelines (WHO, 2016). Developing countries suffer the greatest impact from air pollution in terms of life, economic loss, and environmental degradation. Air pollution is recognized as a pressing sustainability concern and it is directly mentioned in two sustainable development goals (SDG) targets: SDG 3.9 (substantial reduction of health impacts from hazardous substances) and SDG 11.6 (reduction of adverse impacts of cities on people) (Rafaj & Kiesewetter, 2018).

Around three billion people—more than 40% of the world's population, largely in developing countries, still rely on biomass fuels for their domestic energy needs (Mannucci & Franchini, 2017). Biomass and coal smoke contain many pollutants that are hazardous to human health such as particulate matter, carbon monoxide, nitrogen dioxide, sulfur oxides (mainly from coal), formaldehyde, and polycyclic organic matter (including carcinogens such as benzo[a]pyrene) (Bruce et al., 2000). Indoor air pollution, in particular, from the combustion of solid fuels is the cause of many diseases in developing countries such as acute respiratory infections and otitis media (middle ear infection), chronic obstructive pulmonary disease, lung cancer (from coal smoke), asthma, cancer of the nasopharynx and larynx, tuberculosis, perinatal conditions and low birth weight, and eye diseases such as cataract and blindness (Ezzati & Kammen, 2002). Indoor air pollution is a major global public health threat requiring increased efforts in the areas of research and policy-making (Bruce et al., 2000). Therefore, a more systematic approach for the development and evaluation of interventions with a clearer recognition of the interrelationships between poverty and dependence on polluting fuels is desirable (Goyal & Khare, 2020).

Ulaanbaatar, in Mongolia, suffers from severe air pollution. During the long cold season from November to March, air pollution levels in Ulaanbaatar are among the highest in the world (Gheorghe et al., 2018). In the winter of 2017 (Figure 1), the mean concentration of particulate matters was 5–10 times higher than that of the World Health Organization guideline.

During the winter season, especially in the ger areas of Ulaanbaatar, when temperatures are −20 °C or less, the use of coal and wood fuels for heating increases rapidly and the air pollution is aggravated (Asian Development Bank, 2014). Households in the ger areas, named so for the traditional felt tents many live in, account for a considerable proportion of air pollutant emissions of the whole city owing to coal usage for heating (Hill et al., 2017). Since most of the gers are not connected to the central heating system, they use a coal-burning stove (Figure 2).



(a) (b)

Figure 1. Average concentration of (a) PM_{10} in air for the period 2009–2017 and (b) $PM_{2.5}$ for the period 2011–2017 in Ulaanbaatar for different seasons (Source: United Nations Development Programme, 2019).

The ger area is a geographical area on the outskirts of Ulaanbaatar, where a significant percentage of the citizens reside in traditional gers and individual detached houses that are either built with adobe or bricks (Tsevegjav, 2013). After the collapse of the Soviet Union, lack of housing supply owing to rapid urbanization has resulted in an expansion of informal settlements known as the ger areas (Park et al., 2019). The Law of Mongolia on Land and the Law on Allocation of Land to Mongolian Citizens for Ownership allow citizens to privatize land for residential purposes (Bauner & Richter, 2006; Miller, 2017). These policies enable the residents to obtain legal ownership of their occupied land in the ger areas (Park et al., 2019). Combined heat and power (CHP) plants through district heating (DH) networks

provide heat and hot water to Ulaanbaatar's urban centers and smaller cities (Wu et al., 2019). Most of the urban buildings have access to DH. However, most of the ger households are not connected to the DH networks, and hence, they rely on smaller boilers and traditional heating stoves that burn coal and wood inefficiently (Wu et al., 2019). Ulaanbaatar receives electricity from the central energy system (CES) grid, which mainly consists of five coal-fired power plants (Frankfurt School of Finance and Management, United Nations Environment Programme [UNEP], 2018) In the ger areas, around 95% of the homes are presently connected to the grid, which is unable to deal with the load (Frankfurt School of Finance and Management, United Nations Environment Programme [UNEP], 2018).

(a) (b)

Figure 2. (a) Ger, the traditional Mongolian dwelling, is a felt tent (Source: Johannes Eisele /AFP/Getty Images); (b) It is commonly heated using a coal-burning stove (Source: B. Rentsendorj/Reuters, 2017).

In Mongolia, more than 70% of the population lives in urban areas, and as of 2015, approximately 1.37 million people live in Ulaanbaatar (Baasanjav, 2015). Recent statistics estimate that there are 800,000 residents in the ger areas comprising 60% of Ulaanbaatar's total population (Long, 2017). Owing to the fast urbanization rate in Ulaanbaatar, the poor live in gers in the city and use wood, coal, and even garbage as fuel for their cooking and heating. In the city, a large amount of combustion exhaust and particulate matter from the coal-fired thermal power plants also contribute to the severe air pollution (Figure 3a). This results in Ulaanbaatar being covered with smog throughout the winter (Figure 3b). Especially at night, when the temperature falls to −30 °C and temperature inversion occurs during the long and cold winter season from mid-October to April, pollutants stagnate in the city for a long time and the air pollution levels are more than ten times the national environmental standards. Thus, in winter, the citizens suffer from respiratory diseases such as pneumonia, bronchitis, asthma, and emphysema.

Existing studies on air pollution in Ulaanbaatar focus on analyses of trends of air pollution levels, sources (Guttikunda et al., 2013; Amarsaikhan et al., 2014; Takemoto et al., 2015; Sonomdagva et al., 2017), and the health problems of citizens caused by air pollution (World Bank, 2011; Allen et al., 2013;

Jadambaa et al., 2014; United Nations Children's Fund [UNICEF], 2016). The Government of Mongolia (GoM) in collaboration with national and international organizations deals with air pollution and consequent problems in a number of ways including adoption of law and policy regulations on prohibition of coal usage in certain areas (Tsevegjav, 2013). Despite such efforts, air pollution issues in Ulaanbaatar persist. It is argued that the measures have not taken into consideration the needs and living conditions of residents in the ger areas, which are important in solving the air pollution crisis. Therefore, this study reviews the existing laws and policies related to air pollution in Mongolia and analyzes them by taking into account the perspectives of stakeholders and residents through participatory approaches to suggest policy directions that can minimize these gaps.

The importance of participation in fostering social sustainability of communities and places is that it allows for communities to express their needs and aspirations, which subsequently impacts the policy-making processes (Healey, 1999). Furthermore, the setting up of environmental policies based on the concerns of members of a society corresponds to the implementation of a real vision of social transformation, and that of sustainable development in all its dimensions: economic, social and ecological (Faucheux, 1997). Air pollution is one of the most urgent issues for policy making and requires mutual cooperation among various stakeholders. Voluntary and active participation of the public is essential for the implementation of policies aimed at reducing air pollution as these require behavioral changes.

(a)

(b)

Figure 3. (a) Power plant chimneys stand behind a coal-burning neighborhood covered in a thick haze on the outskirts of Ulaanbaatar (Source: B. Rentsendorj/Reuters, 2017); (b) Commuters battle the late-afternoon smog in downtown Ulaanbaatar (Source: Peter Bittner, 2016).

In recent years, there has been a steady flow of literature arguing for a participatory type of policy analysis that emphasizes the need for social interaction in order to be able to change current policies (Geurts Jac & Joldersma, 2001). Practical tools of participatory policy analysis are currently being implemented such as gaming/simulations, consensus conferences, scenario workshops, and computer-

based group decision support systems (Geurts Jac & Joldersma, 2001).

4.2 Methods

Data for this study was obtained through a review of the literature, from government policy and law, and face-to-face interviews. Interviews were conducted with various stakeholders including officials of central and local government agencies, non-governmental organizations (NGOs), international organizations, and academia to identify the current situation of air pollution in Ulaanbaatar and their risk perception as well as the response strategies.

Furthermore, a workshop was conducted with members of a ger area community in Ulaanbaatar. The purpose of the workshop was to collect opinions from the residents and to develop a participatory and community-based action plan to address the indoor air pollution problems that they are faced with.

4.2.1 Interviews with Stakeholders and Data Collection

A series of interviews with central and local government officials, experts from academia, NGOs, and international organizations who work on air pollution issues in Ulaanbaatar was conducted. An officer in charge of environmental assessment and audit in the Ministry of Environment and Tourism was first contacted and interviewed. From this official contact information of relevant officials and experts from the Ministry of Energy, the National Agency for Meteorology and Environmental Monitoring, the Ulaanbaatar City Government, and the National University of Mongolia were obtained. These contact persons were approached directly by phone, e-mail, or arranged meetings to seek interviews. The interviews were conducted for about 30 minutes to an hour by visiting each organization, and the interviewees were either one or two persons, from each organization. For each interviewee, an in-depth interview was conducted with open and follow-up questions on the current practices and interests. Interviewees were encouraged to present their views on Ulaanbaatar's air pollution freely without posing specific questions. Interviews were written without recording because the interviewees were concerned that their personal views would be viewed as representing that of their organization. Through the interviews and additional meetings, eight interviewees shared their expertise and experiences regarding air pollution and air quality management and provided relevant data including polices, regulations, and reports.

Local and international perspectives on the air pollution issue in Ulaanbaatar were also gathered through the interviews and meetings with NGOs and international organizations that were involved in

air pollution and other issues pertaining to the ger areas. They explained their activities on completed and ongoing projects concerning air pollution in Ulaanbaatar and shared relevant brochures and reports. Interviews were also conducted with local government officials on installed air pollution warning and response systems and their effectiveness at the ger area/citizen level.

4.2.2 Community-based Participatory Workshop

A community-based participatory workshop was conducted with the residents of a ger area in Ulaanbaatar to identify current issues, learn about their perspectives regarding air pollution risk management, and develop a collaborative action plan.

Some of the Mongolian NGOs that work with local communities of the ger areas in Ulaanbaatar were contacted by e-mail, and several of those were visited for consultation meetings. Through the meetings, an NGO named People Centered Conservation (PCC) that has conducted community-based conservation practice and research in the ger areas for more than a decade by working closely with the residents was selected to assist in the workshop. Three preparatory meetings were held with PCC to discuss and prepare for the workshop. In the meetings, the purpose of the research and explanation of the concepts and plans of the workshop method applied to the research were provided. PCC had arranged a meeting with the governor of the 7th sub-district of the Songino Khairkhan District, in which the governor promised support to recruit residents and provide a conference room for the workshop.

The workshop was conducted on March 9, 2017, in the conference room of the 7th sub-district of the Songino Khairkhan District. Songino Khairkhan District is evaluated as the most polluted area in Ulaanbaatar according to the air quality monitoring system. The first author of this thesis facilitated the workshop in Mongolian, and a staff member from PCC translated between Mongolian and English for him and the participants when communication difficulties occurred. Refreshments were provided to the participants to encourage them to speak in an informal atmosphere. Twenty residents of the district voluntarily attended the workshop and participated in the discussion for three hours. Utilizing the Yonmenkaigi System Method (YSM), participants identified current issues and perspectives concerning air-quality risk management in Ulaanbaatar and expressed their needs and desired situations. The YSM is a participatory method to support group decision making, which fosters small and modest breakthroughs and/or innovative strategy development (Okada et al., 2012). The YSM has found wider acceptance in terms of both the number of study areas and subjects of application. For example, the method has been applied to both rural and urban areas in Japan as well as in Korea, China, and Indonesia (Okada et al., 2012).

4.3 Results

4.3.1 Results of Interviews with Stakeholders

Stakeholders involved with air pollution issues in Ulaanbaatar agree that the air pollution issue is ongoing for decades and it has not improved. In winter, the sky in Ulaanbaatar is covered in smog and smells of smoke emanating from the burning coal (Figure 3).

A government official from the Ministry of Environment and Tourism said that the GoM regards the air pollution issue in Ulaanbaatar as a key priority and it is making a number of efforts to address this problem. The officer added that the winter of 2017 (study year) was extremely cold when compared with the previous year leading to a high quantity of energy use for heating in each household, which made the air pollution worser. He added that in addition to the increased coal use by residents in the ger areas, they were using inappropriate materials such as rubber, plastic, and garbage as fuels for their heating. According to the officer, the government has prepared countermeasures including policies and regulations, however, these were not effective because of the low levels of consciousness of the citizens. In addition, the GoM, in partnership with national and international organizations has implemented projects to reduce air pollution and improve the air quality in Ulaanbaatar.

According to the head of the Air Quality Monitoring Division of the Air Pollution Reducing Department, an implementing agency of the Governor of Capital City, almost 80% of the air pollution in Ulaanbaatar is caused by coal burning in the ger areas. In spite of the fact that the amount of coal burned in thermal power plants are the largest, their contribution to air pollution in Ulaanbaatar is not high as they have tall chimneys with pollution abatement facilities. There are 14 ambient air quality monitoring stations in Ulaanbaatar, of which 10 belong to the National Agency for Meteorology and Environment Monitoring of Mongolia (NAMEM), which is under the Ministry of Environment and Tourism, and 4 belong to the Air Quality Department of the Capital City. In addition, a fixed-point automatic monitoring system was installed through a project by the Japan International Cooperation Agency (JICA) to strengthen the air pollution control capability.

An officer-in-charge for air quality information and assessment in the Department of Environmental Monitoring of NAMEM explained that an ‘Intelligent Air Quality Management System’ was developed to provide accurate information on air pollution in Ulaanbaatar and it is available online and for smartphones (www.agaar.mn). The website provides up-to-date information on real-time air quality in Ulaanbaatar, sectoral activities including projects, laws and regulations, statistical data, and suggestions for reducing air pollution.

A professor from the National University of Mongolia presented a past project on a smoke filtering device that is applied in thermal power plants and showed a sample of that in the laboratory. The

professor mentioned that the device would be transformed for home use and distributed to households in the ger areas in Ulaanbaatar.

4.3.2 Results of Community-based Participatory Workshop

The workshop focused on understanding residents' perception of air pollution issues and their specific needs, and challenges (or barriers) in adopting air pollution reduction policies proposed by the government. The workshop utilized YSM, which is composed of four main steps: conducting a SWOT analysis, completing the Yonmenkaigi chart, debating, and presenting the group's action plan (Okada et al., 2012). As a facilitator of the workshop, the first author of this thesis explained the purpose of the workshop to the participants and introduced the workshop's agenda, schedule and method (Table 1).

Table 1. Program agenda for the workshop.

No.	Process	Duration	Contents
1	Guidance	10 min	Introduce purpose and process of the workshop
2	SWOT analysis	40 min	Brainstorm and identify the current status of the ger area
		10 min	Determine a topic for the group discussion
3	Group discussion	40 min	Generate and cluster ideas on the chart
		40 min	Enhance and re-cluster ideas, and reflect them to the chart
4	Presentation	20 min	Present the action plans by each group and develop the collaborative action plans by all the groups
5	Wrap-up	20 min	Share impressions and comments from the participants regarding the workshop

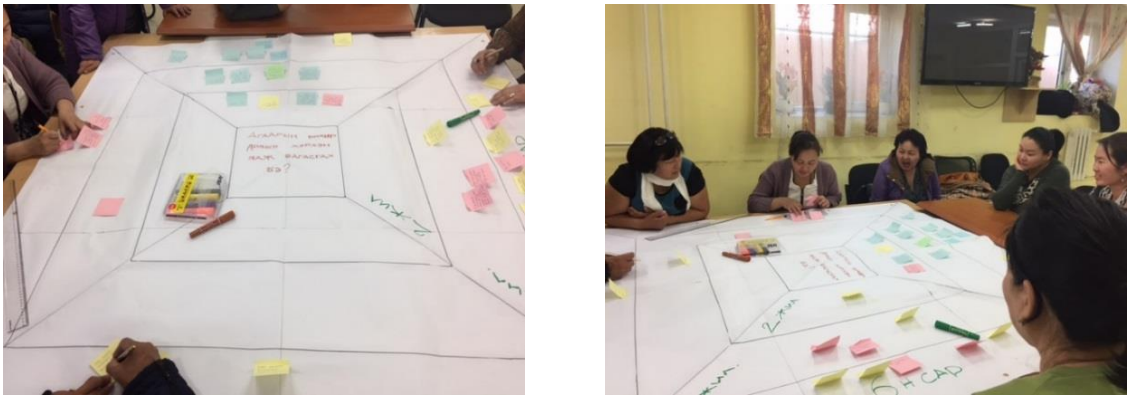
In the SWOT analysis session, participants hesitated to speak first; however, a male participant raised his hand and began to share various ideas about air pollution and the issues pertaining to the ger area. Then, the other participants agreed with most of his ideas, and they began to express their opinions carefully. The workshop ran smoothly, as the active exchange of opinions increased and discussions started. The topic for the group discussion was 'how to reduce air pollution in the ger areas.'

The participants were divided into groups of their choice based on four functions: Management, Information, Human Resources, and Physical Resources. Each group wrote action plans to reduce air pollution in the ger areas on Post-it notes from the point of view of their function. Moreover, they developed the ideas and posted them to the chart (Figure 4). Then, each of the four groups presented

their ideas to all the participants, and based on that, combined collaborative action plans were developed on the chart.

The workshop participants were aware that their area is the most polluted area in Ulaanbaatar according to the air quality monitoring system and hence, they had a keen interest in resolving the air pollution issue. They noted that the air pollution countermeasures proposed by the GoM have not comprehensively considered their needs and real living conditions, and hence, leading to the continuation of the vicious cycle of air pollution in Ulaanbaatar.

The YSM chart developed by the participants was organized as shown in Table 2. The results show that the participants were relatively familiar with ways to reduce air pollution in Ulaanbaatar. Participants expressed opinions stating that the use of clean and renewable energies such as wind power, electricity, and solar heat and the introduction of green technologies should be encouraged. They said that if information on the use of gaseous fuels such as LPG for cooking is provided or facilities for its utilization are built, the use of low-grade coals will be reduced. Interesting comments suggested that providing information on insulation materials and improving the performance of the insulation materials would increase the insulation effect of ger areas and reduce the use of coal. It can be seen that they were aware that the use of coal in their homes for heating and cooking contributed significantly to air pollution in Ulaanbaatar.



(a) (b)

Figure 4. (a) and (b) Workshop participants developing the YSM chart.

In terms of management, the group suggested the need for strict regulations such as population control, closure of wool washing factories, and restrictions on used car imports. In addition, they said that they would like to have educational programs, discussions about the environment, and corporate social contribution to promote public awareness on the environment. They seemed to be concerned about the health problems caused by air pollution, given that the information group, the physical

resources group, and the other participants had a keen interest in the effectiveness of oxygen cocktails and discussed it at some length. Residents revealed that they were buying $1 cans of pressurized oxygen from supermarkets to squirt into their juices, waters, and other drinks to defend themselves from the crippling smog (Culbertson, 2018; Labmate Online, 2018). Advertisements in Ulaanbaatar claim that 'drinking just one oxygen cocktail is equal to a three-hour-walk in a lush forest' (Thompson, 2018).

Among the first 20 participants, 14 participants stayed until the end of the workshop, two of whom were males and the rest were females. Of those who stayed, in terms of the age of the participants, 9 were in their 50s, 1 in the 30s, three in their 40s, and one in the 60s. The workshop was held on a weekday afternoon, and at that time, most men were engaged with work.

Table 2. Collaborative action plans from the workshop.

Roles	Within 6 months	Within 1 year	Within 2 years
Management	• Wind generators • Waste generation • Population control • Electricity and solar heating	• The 5th power plant • Closure of wool washing factories • Restriction on used car import • Integrated heating system	• Coking coal • Water-pipe system • Moving to an apartment • Population control
Information	• Information on LPG for cooking • Educational programs for the disabled and children • Studies on insulation materials	• Various brain storming sessions • Information on oxygen cocktail	• Information and educational programs on waste management • Environmental social contribution activities of corporates
Human Resources	• Investigation of cars • Survey on the outskirts of the city • Promoting awareness through artists, mass media, and students	• Public hearings between government and citizens for the 5th power plant establishment • Heat sharing	• Provide incentives for people to develop clean technologies
Physical Resources	• Development and improvement of various insulation materials • Improved coal • Gas usage for cooking	• Oxygen cocktail • Improvement of reconstruction and urban planning • More monitoring systems • Water heating system • Subsidy for electric charges	• Use of solar panel

4.3.3 Gap Analysis between Policy and Practice

In order to compare air pollution policies of Mongolia and the actual conditions of the ger areas in Ulaanbaatar, the Law on Air Pollution Reduction in the Capital City adopted by the Parliament in 2011 was reviewed (Parliament of Mongolia, 2011). The statute consists of 4 chapters and 14 articles. The core of the decree is well documented in Article 4, which consists of the basic principles for ensuring a phased action plan and implementation for the reduction of air pollution in Ulaanbaatar. Article 4 Protocol 1 provides seven practical steps to reduce air pollution in Ulaanbaatar.

Despite these laws and policies, the air pollution in Ulaanbaatar has not reduced but worsened over the recent years. Based on the results of the interviews and workshop conducted in this study, the reasons for this situation are analyzed and shown in Table 3.

Table 3. Gap analysis between policy and practice.

Policy approaches (2011)	Actual conditions (2017) Results of Interviews	Desired situations (2017) Results of Workshop
• **Expand the energy sources and the network of transmission and distribution and increase the capacity.**	Residents in the ger areas still have a high dependence on coal and wood fuels for their domestic energy. Moreover, the winter of 2017 was extremely cold when compared with the previous year, and hence, the energy use for heating in each household had soared making air pollution worse.	The workshop participants were also looking to expand their energy sources, especially clean/renewable energy such as wind power, electricity, and solar heat. Furthermore, they were expecting the GoM to encourage the use of green technologies to increase energy capacity and efficiency.
• **Designate areas with severe pollution as air pollution improvement areas and distribute stoves that effect complete combustion and use refined fuels that emit less pollutants.**	No special measures were taken to designate the special areas of concern by the GoM. Meanwhile, improved stoves were distributed to several people in the ger areas, but the residents sold them to people in other provinces and used the money for their living expenses.	The workshop participants argued that as air pollutants from the east of Ulaanbaatar are added to their area (the west of Ulaanbaatar) owing to prevailing winds from the east, their area has the highest pollution levels every winter as per the air quality monitoring system. They added that specific and targeted efforts for this highly polluted area are needed and that these efforts have to be in agreement with the requirements of the local ger area residents to be effective.
• **Create an incentive system for reducing the electricity fee to the households.**	The GoM has approved a regulation to cut the electricity tariff at night (from 9 p.m. to 6 a.m.) for the ger area households to zero. This measure is not realistic because residents in the ger area do not have an electric stove as they are not affordable.	The workshop participants need more proactive measures, including, for example, a subsidy system for other energy options that considers their living conditions.
• **Support citizens and companies to introduce advanced technologies and present new initiatives to reduce the air pollution in Ulaanbaatar.**	The National University of Mongolia has developed a smoke filtering device that is utilized in the thermal power plants. This device would be transformed for home use and distributed to households in the ger areas in Ulaanbaatar. However, the government's financial support for academic research and technology development are still insufficient.	The workshop participants expected social contribution activities by corporates to promote public awareness about the environment. They had the idea that fines must be imposed on polluting companies even if they would be damaging to their immediate interests. Moreover, they expressed that the power plants and factories should switch to cleaner processes even if consumer bills and prices go up.

Table 3. Cont.

Policy approaches (2011)	Actual conditions (2017) Results of Interviews	Desired situations (2017) Results of Workshop
• **Provide long-term low-interest loans to the households in the ger areas through land collateral and allow them to build houses.** • **Promote population migration to the provinces through local investment and job creation.** • **Promote development policies for the outskirts of the capital and control localized population concentration.** • **Redevelop and construct apartments for the ger areas and prioritize infrastructure construction such as houses and roads.**	Residents in the ger area are living below the average monthly wage in Mongolia cannot afford to build a new house or move to an apartment. Besides, owing to capital-centered development, social infrastructure is concentrated in Ulaanbaatar, making it difficult to redistribute the population. The infrastructure of the ger areas is still underdeveloped and the city is undergoing redevelopment and construction of new towns including construction of apartments.	The workshop participants expected that infrastructure in the ger areas would expand in the short term and they will be able to move to an apartment in the long term. They also expected improvements to reconstruction and urban planning.
• **Minimize the use of raw coal and other substances that pollute the atmosphere.** • **Use electricity, geothermal energy, gas (including LPG), and other fuels as domestic fuels to reduce the air pollution.**	As the winter had become severe, the use of improper fuels such as rubber, plastic, and garbage, as well as coal, also increased. Government officials pointed out the low level of consciousness of residents in the ger areas. Nevertheless, it appears that appropriate measures were not taken. Currently, households use mainly electricity and coal for cooking, and they still use coal for a considerable proportion of their heating needs.	The workshop participants sought information and facilities for using gaseous fuels, especially LPG, for cooking. Furthermore, they emphasized that if the information on insulation materials for the gers is available and the performance of the insulation materials improves, then, the use of coal for heating at home will be reduced.

4.4 Discussion

In this study, personal interviews with central and local government, agencies, NGOs, international organizations, and academia were conducted to describe the current situation regarding the risk management of Ulaanbaatar's air pollution problems. Through the workshop with the participation of the residents in the ger area, authentic opinions about their air pollution problems were heard and recorded. Based on the results, the gaps between the policy approaches of the government, the actual conditions, and the desired situations of the residents to improve air quality in Ulaanbaatar were analyzed.

Through the field visits during the winter of 2017, it was possible to observe firsthand that the whole city of Ulaanbaatar was covered with smog that was threatening the health of citizens. The main cause of this air pollution is attributed to the combustion of coal for heating in households in the ger areas. The results of this study demonstrate that the reduction of air pollution in Ulaanbaatar requires solutions for fundamental and complex problems that are based on a better understanding of the specific conditions and needs of the residents of the ger areas.

Ulaanbaatar's severe air pollution is a long-standing problem that has been worsening. The GoM considers the air pollution issue in Ulaanbaatar to be a top priority. The GoM is working with local and international agencies to reduce air pollution and improve air quality. However, there is a gap in the communication and understanding between the government officials and the residents of the ger areas. For example, the government officials consider that their policies are ineffective owing to the low level of consciousness of the citizens. This study showed that contrary to this perception, at least among the residents who participated in the workshop, the level of citizens' awareness of the air pollution problem is not low. The ger area residents were well aware of the severity of the air pollution problem and its causes.

According to the results of the interviews and the workshop observations and based on the analysis of air pollution related policies and the needs of the residents in the ger areas, several recommendations concerning air pollution in Ulaanbaatar are proposed.

The use of coal in the ger areas, the main air pollution source in Ulaanbaatar, is unlikely to reduce in the near future unless the ger area residents' poor living conditions and lack of infrastructure are addressed. In addition, though the introduction and utilization of clean or renewable energy is being promoted, its adoption by the community is slow. Thus, providing cleaner methods of using coal, and information and technology for low-cost insulation solutions for the ger area households will help the residents in reducing their use of coal. Furthermore, a cost-benefit analysis supporting cleaner fuel options for the residents by considering their economic situation and provision of energy alternatives for household cooking and heating is required to help alleviate the problem.

The government's reduction of electricity charges and zero-cost policy for electricity from 9 p.m. to 6 a.m. is not realistic because the residents of the ger areas do not have electric stoves as they are unaffordable. Therefore, policymakers need to gather extensive opinions from the residents such that their policies better reflect the ger area residents' living conditions and needs.

Residents of Ulaanbaatar realize the seriousness of air pollution and that it is a threat to their lives. The government should pay more attention to the voices of the residents and implement measures that are more in line with the needs and capacities of the residents. Furthermore, knowledge and experience sharing sessions for the residents in the ger areas, for example, on insulation materials and clean energy options, would lead to actions that can be implemented by citizens to reduce air pollution. Thus, the country may be able to escape the vicious cycle of long-standing air pollution in Ulaanbaatar.

4.5 Conclusion

The objective of this study was to identify important challenges and barriers that have limited the success of various government policies that tackle air pollution problems in the ger areas of Ulaanbaatar, Mongolia. The study illustrated how a participatory approach was used in air pollution research to investigate the public discourse and community preferences, thereby providing support for policy directions that can increase adoption rates of proposed strategies, therefore moving towards more effective air pollution risk management.

Through the resident workshop, this study demonstrated that community-based participatory approaches could be effective in the cultural context of Mongolia. Residents voluntarily participated without compensation or expectation of future compensation/benefits and showed creative ideas that could be considered in policymaking. These types of approaches can be applied in the ger areas in Mongolia to raise awareness and empower residents to act appropriately. Thus, second field research was planned in order to investigate the stories and counterstories of various stakeholders regarding indoor air pollution in ger areas in Ulaanbaatar.

References

1. Allen, R. W., Gombojav, E., Barkhasragchaa, B., Byambaa, T., Lkhasuren, O., Amram, O., Takaro, T. K., Janes, C. R. (2013). An assessment of air pollution and its attributable mortality in Ulaanbaatar, Mongolia. *Air Quality, Atmosphere & Health,* 6(1), 137-150. doi:10.1007/s11869-011-0154-3

2. Amarsaikhan, D., Battsengel, V., Nergui, B., Ganzorig, M., & Bolor, G. (2014). A Study on Air Pollution in Ulaanbaatar City, Mongolia. *Journal of Geoscience and Environment Protection, 02*(02), 123-128. doi:10.4236/gep.2014.22017

3. Asian Development Bank. (2014). *Mongolia: Coal to Cleaner Fuel Conversion for Heating in Ger District and Power Generation*. Mandaluyong, Philippines: Asian Development Bank. Retrieved February 24, 2021, from https://www.adb.org/sites/default/files/project-document/150799/48029-001-tar.pdf.

4. Baasanjav, B.-E. (2015). *Research on Air Pollution in Mongolia Ulaanbaatar City: Focusing on the 'Ger' Areas*. Gangwon University.

5. Bauner, S., & Richter, B. (2006). *Real estate market, mortgage market and cadastre in Ulaanbaatar and Darkhan-city, Mongolia*. Gebhard, Heusenstamm: Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH.

6. Bruce, N., Perez-Padilla, R., & Albalak, R. (2000). Indoor air pollution in developing countries: a major environmental and public health challenge. Bulletin of the World Health Organization, 78(9), 1078–1092.

7. Culbertson, A. (2018, May 01). Mongolians drink oxygen cocktails to cope with smog in world's most polluted capital. Retrieved April 2, 2020, from https://news.sky.com/story/mongolians-drink-oxygen-cocktails-to-20cope-with-smog-in-worlds-most-polluted-capital-11354476

8. Ch, S., Ch, B., & Batdelger, B. (2017). Assessment of air pollution of settlement areas in Ulaanbaatar city, Mongolia. IOP *Conference Series: Earth and Environmental Science,* 67, 012029. doi:10.1088/1755-1315/67/1/012029

9. Ezzati, M., & Kammen, D. M. (2002). The health impacts of exposure to indoor air pollution

from solid fuels in developing countries: Knowledge, gaps, and data needs. *Environmental Health Perspectives, 110*(11), 1057-1068. doi:10.1289/ehp.021101057

10. Faucheux, S. (1997). The Multi-Stakeholder Paradigm, ESEE Newsletter, No. 2. In European Society for Ecological Economics (pp. 1–2). Paris, France.

11. Frankfurt School of Finance and Management, United Nations Environment Programme (UNEP). (2018). *Financing Household Clean Energy Solutions*. Paris, France: Climate and Clean Air Coalition (CCAC). Retrieved February 24, 2021, from https://ccacoalition.org/en/resources/financing-household-clean-energy-solutions.

12. Fullerton, D. G., Bruce, N., & Gordon, S. B. (2008). Indoor air pollution from biomass fuel smoke is a major health concern in the developing world. *Transactions of the Royal Society of Tropical Medicine and Hygiene, 102*(9), 843-851. doi:10.1016/j.trstmh.2008.05.028

13. Geurts, J., & Joldersma, C. (2001). Methodology for participatory policy analysis. *European Journal of Operational Research, 128*(2), 300-310. doi:10.1016/s0377-2217(00)00073-4

14. Gheorghe, A., Ankhbayar, B., Nieuwenhuyzen, H. V., & Sa, R. D. (2018). *Mongolia's Air Pollution Crisis: A Call to Action to Protect Children's Health* Ulaanbaatar, Mongolia: UNICEF Mongolia.

15. Gurjar, B. R., Molina, L. T., & Ojha, C. S. (2010). *Air pollution health and environmental impacts*. Boca Raton, FL: CRC Press.

16. Guttikunda, S. K., Lodoysamba, S., Bulgansaikhan, B., & Dashdondog, B. (2013). Particulate pollution in Ulaanbaatar, Mongolia. *Air Quality, Atmosphere & Health, 6*(3), 589-601. doi:10.1007/s11869-013-0198-7

17. Healey, P. (1999). Institutionalist Analysis, Communicative Planning, and Shaping Places. *Journal of Planning Education and Research, 19*(2), 111-121. doi:10.1177/0739456x9901900201

18. Hill, L. D., Edwards, R., Turner, J. R., Argo, Y. D., Olkhanud, P. B., Odsuren, M., Guttikunda, S., Ochir, C., & Smith, K. R. (2017). Health assessment of future PM2.5 exposures from indoor, outdoor, and secondhand tobacco smoke concentrations under alternative policy pathways in Ulaanbaatar, Mongolia. *Plos One, 12*(10). doi:10.1371/journal.pone.0186834

19. Jadambaa, A., Spickett, J., Badrakh, B., & Norman, R. E. (2014). The Impact of the Environment on Health in Mongolia. *Asia Pacific Journal of Public Health, 27*(1), 45-75.

doi:10.1177/1010539514545648

20. Long, P. (2017, May 31). Mongolia's Capital Copes with Rapid Urbanization. Retrieved March 19, 2020, from https://asiafoundation.org/2017/05/31/mongolias-capital-copes-rapid-urbanization/

21. Mannucci, P., & Franchini, M. (2017). Health Effects of Ambient Air Pollution in Developing Countries. *International Journal of Environmental Research and Public Health, 14*(9), 1048. doi:10.3390/ijerph14091048

22. Miller, R. (2017). Settling between Legitimacy and the Law: At the Edge of Ulaanbaatar's Legal Landscape. *Traditional Dwellings and Settlements Review, 29*(1), 7-20. Retrieved February 23, 2021, from http://www.jstor.org/stable/44779826

23. Okada, N., Na, J., Fang, L., & Teratani, A. (2012). The Yonmenkaigi System Method: An Implementation-Oriented Group Decision Support Approach. *Group Decision and Negotiation, 22*(1), 53-67. doi:10.1007/s10726-012-9290-x

24. Park, H., Fan, P., John, R., Ouyang, Z., & Chen, J. (2019). Spatiotemporal changes of informal settlements: Ger districts in Ulaanbaatar, Mongolia. *Landscape and Urban Planning, 191*, 103630. doi:10.1016/j.landurbplan.2019.103630

25. Parliament of Mongolia. (2011). *Law on Air Pollution Reduction in the Capital City*. Ulaanbaatar, Mongolia: Parliament of Mongolia.

26. Pollution Solutions. (n.d.). What Is an Oxygen Cocktail? Retrieved April 2, 2020, from https://www.pollutionsolutions-online.com/news/air-clean-up/16/breaking-news/what-is- an-oxygen-cocktail/46054

27. Rafaj, P., Kiesewetter, G., Gül, T., Schöpp, W., Cofala, J., Klimont, Z., Purohit, P., Heyes, C., Amann, M., Borken-Kleefeld, J., & Cozzi, L. (2018). Outlook for clean air in the context of sustainable development goals. *Global Environmental Change, 53*, 1-11. doi:10.1016/j.gloenvcha.2018.08.008

28. Takemoto, Y., Takahashi, M., Awaya, K., Ito, K., & Takeuchi, S. (2015). Numerical Simulation of Air Pollution in Ulaanbaatar City, Mongolia. *Journal of Materials Science and Engineering B, 5*(6). doi:10.17265/2161-6221/2015.5-6.001

29. Thompson, A. (2018, May 03). Mongolians drink ‘oxygen cocktails’ and ‘lung tea’ to cope with air pollution that is more than 130 times above safe levels. Retrieved April 2, 2020, from

https://www.dailymail.co.uk/health/article-5676859/Mongolians-sip-oxygen-cocktails-cope-smog.html

30. Tsevegjav, B. (2013). *Assessment of urban air pollution abatement policy implementation vis-a-vis the role of household energy use in ger areas of Mongolia*. University of Twente. Retrieved February 24, 2021, from https://essay.utwente.nl/65055/1/Final_version_-_BulganmurunTsevegjav-Thesis.pdf.

31. United Nations Children's Fund (UNICEF). (2016). *Understanding and Addressing the Impact of Air Pollution on Children's Health in Mongolia*. Ulaanbaatar, Mongolia: UNICEF Mongolia.

32. United Nations Development Programme. (2019). *Air Pollution in Mongolia: Opportunities for Further Actions*. Dublin, Ireland: AARC Consultancy. Retrieved February 24, 2021, from https://www.mn.undp.org/content/mongolia/en/home/library/air-pollution-in-mongolia--opportunities-for-further-actions.html.

33. World Health Organization. WHO Global Urban Ambient Air Pollution Database (update 2016). (2017, June 26). Retrieved March 17, 2020, from https://www.who.int/phe/health_topics/outdoorair/databases/cities/en/

34. World Bank. (2011). *Air Quality Analysis of Ulaanbaatar: Improving Air Quality to Reduce Health Impacts*. Washington, D.C., USA: World Bank.

35. Wu, Y., Nuorkivi, A. E., Salminen, P. K., Johansen, P., & Cui, R. (n.d.). *Paving the Way to a Sustainable Heating Sector: A Roadmap for Ulaanbaatar Urban Heating (English)*. Washington, D.C.: World Bank Group. Retrieved February 24, 2021, from http://documents.worldbank.org/curated/en/361331554753311754/Paving-the-Way-to-a-Sustainable-Heating-Sector-A-Roadmap-for-Ulaanbaatar-Urban-Heating

Chapter 5

Using a Narrative Approach to Understand Views on Air Pollution: Stories from Communities in Ulaanbaatar, Mongolia

5.1 Introduction

According to a report of the United Nations Children's Fund (UNICEF), the air pollution levels during the long cold winters in Ulaanbaatar are among the highest in the world (Gheorghe et al., 2018). The mean concentrations of particulate matter are 5–10 times higher than the WHO standards (United Nations Development Programme, 2019). For decades, Ulaanbaatar citizens have suffered from air pollution-induced diseases. The primary sources of air pollution in the city are coal combustion used for heating in households of ger areas (Figure 5 (a)) that are not connected to a central heating system, which account for 80% of the pollution (WHO, 2019). Figure 5 (b) shows the photograph of a ger, which is a traditional Mongolian dwelling, commonly heated using coal-burning stoves.

Since the early 2000s, the Government of Mongolia (GoM), in collaboration with national and international organizations, has been making efforts to address air pollution and subsequent issues through the adoption of laws and policy regulations. Despite such efforts, residents in the ger areas have difficulties in adopting the laws and policy regulations introduced to reduce the air pollution problem (Tsevegjav, 2013). For example, several stove replacement projects have been promoted to reduce air pollution. Both the GoM and private sector focused on replacing traditional Mongolian stoves with more efficient technology but did not consult the residents in the process. Residents were not familiar with the new technology, and most of them sold the new stoves and kept the old ones (Bello, 2019; Economic Policy and Competitiveness Research Center [EPCRC], 2020). Current air pollution data for Mongolia shows that air pollution has not decreased as expected, and most projects designed to improve living conditions and reduce household air pollution have failed (Bello, 2019).

This failure may be attributed to the lack of public participation and support of proposed policies. The ger areas are crucial in solving the air pollution crisis. As the public health crisis increases, national and municipal policymakers should take an aggressive approach to combat air pollution by targeting the ger areas (Bittner, 2016). Socially disadvantaged or culturally diverse communities often have no

or restricted access to decision-making processes (Sarokin & Schulkin, 1994). In this regard, participatory approaches can ensure that the public needs and demands are considered during policy-making and implementation (Masango, 2001).

(a) (b)

Figure 5. (a) Ger areas of Ulaanbaatar outskirts; (b) Ger – traditional Mongolian dwelling.

Public participation methods and research on public participation must accommodate the cultural and social needs of residents and enable them to participate fully in the discussions (Hampton, 2004). Through a narrative approach and its analysis, which is regarded as a way to enhance public participation, this study attempts to collect and organize public discourse and community preferences on air pollution issues in Ulaanbaatar, Mongolia.

5.1.1 Previous Studies

Although national and international concerns for severe air pollution issues in Ulaanbaatar can be easily observed in research articles and reports, studies on air pollution in Ulaanbaatar are limited. Previous studies on this topic focus on related health effects (Enkhjargal & Burmaajav, 2015; Enkhbat et al., 2016; Enkhjargal et al., 2020; Nakao et al., 2017; Olkhanud et al., 2018; Yoshihara et al., 2016), causes of air pollution (Enkhbat et al., 2020; Wang et al., 2018), and air quality analyses (Ariunsaikhan et al., 2020; Dashnyam et al., 2015; Enebish et al., 2020; Franklin et al., 2018; Lim et al., 2018; Nishikawa et al., 2015; Prikaz et al., 2018; Sonomdagva et al., 2016; Wang et al., 2017).

Researchers are interested in the issues of ger areas, as they are recognized as the most significant social problem in Ulaanbaatar. Because of the variety of issues in the ger areas, such as environmental pollution, public health, infrastructure, and crime, the related study topics are also diverse. As discussed above, government measures have not considered the needs and living conditions of residents in the ger

areas, which negatively affects air pollution. Therefore, in addition to analyzing existing studies on air pollution issues in Ulaanbaatar, the differences between the perception of residents and policy makers regarding the actual needs and conditions of ger areas should be investigated. By doing so, policy directions to minimize these gaps can be suggested.

5.1.2 Narrative Analysis

Narratives are an essential aspect of public discourse as they contain evaluations and preferences critical to the participation process. Hampton (2004) explains that the narrative form is likely to indicate particular statements of value or preference, reflecting the speakers' moral judgments concerning a particular policy or project alternative. The narrative method, applied to interview techniques, focus groups, ethnographic observations, or other forms of data collection, is based on the preservation of the entire story (beginning, middle, and end) (Harper et al., 2004).

Bruner (1987) wrote that "we organize our experience and our memory of human happenings mainly in the form of narrative—stories, excuses, myths, reasons for doing and not doing." Accordingly, communities, organizations, and individual people have stories, and there is a mutual influence process between these communities and the organizational and personal stories (Wittmayer et al., 2015). These stories have significant effects on human behavior. Mostly, community narratives can be a powerful force for personal and social change, and they can be used to understand the views of ger residents toward household air pollution and identify possible solutions. According to Rappaport (1995), helping people to identify, create, and tell their own stories, individually and collectively, is an endeavor consistent with empowerment development.

Narrative knowledge is created and constructed through the stories of life experiences and the created meanings, which help clarify the ambiguity and complexity of human lives. According to Etherington (2013), the following can be obtained through narrative knowledge:

- Memorable and interesting knowledge that clarifies the characteristic of people, their culture, and how they have created change
- Tools to understand the past and create meanings as people narrate their stories
- Information on how people interpret events; the values, beliefs, and experiences that lead to those interpretations; and their hopes, intentions, and future plans
- Intricate patterns, descriptions of identity construction and reconstruction, and evidence of social discourses that impact individual knowledge creation from specific cultural perspectives
- Situated, transient, partial, and provisional knowledge characterized by multiple voices, perspectives, truths, and meanings

Narratives have the power to shape policy and action because they exhibit different viewpoints, define the framing of a relevant system and the critical dynamics of interest, and suggest appropriate responses (Dry & Leach, 2010). Therefore, narratives can be crucial for air pollution policy consensus.

5.1.3 Role of Narratives in Shaping Policy Consensus

Several narrative research cases have been applied to "consensus building" in public policy, but not as a well-organized approach. Narrative communication is useful in situations where complex problems must be solved for an uncertain future, especially in promoting consensus. Yoshikawa (2004) stated that policies have aimed to reduce environmental risks induced by economic development from the 1960s to the 1970s, but differences in risk perceptions between experts and the public have been problematic. Yoshikawa added that more sophisticated risk communication techniques are needed, rather than an "enlightenment model," in which experts provide knowledge to the public.

Air pollution is an urgent policy issue that requires cooperation among various stakeholders. Solutions to air pollution problems are diverse, complex, and controversial. Voluntary and active participation of the public is essential for implementing policies to reduce air pollution because such policies often require behavioral changes.

This study intends to illustrate how a narrative approach and its analysis can be used to collect and organize public discourse and community preferences on air pollution issues in Ulaanbaatar, Mongolia. The results will contribute to a better understanding of controversial topics and show that vulnerable communities can engage on discussions for improved policy consensus. The potential of voluntary participation of residents in improving air quality at the local level was also explored.

5.2 Methods

Data were collected through narrative interviews with various stakeholders, workshops, and focus groups with ger area residents. The interviews and discussions of the workshop and focus group meetings were analyzed using a narrative inquiry process.

5.2.1 Narrative Interviews

Narrative interview techniques let the interviewee control the direction, content, and pace of the interview without setting a fixed agenda. A narrative interview usually starts with open questions, and

the skills of a good narrative interviewer include the ability to build rapport and trust early in the interview and being a good listener while avoiding interruptions (Anderson & Kirkpatrick, 2016).

The interviews involved open and follow-up questions about the stakeholders' views on air pollution in Ulaanbaatar. During the interviews, hand notes were taken without recording because the stakeholders had concerns about the representation of their interviews. Non-verbal encouragement, such as smiles and nods (that were genuine given the cordial environment), was used to encourage the interviewees to talk freely, and the interviewees were not interrupted until there were clear signs that they had finished their story.

An officer responsible for environmental assessment and audit in the MET and the director of the Energy Market Research and International Cooperation Division in the ERC facilitated communication with other stakeholders and provided their contact information. Meetings and interviews were smoothly arranged with them upon direct contact by phone or e-mail. Interviews with government agencies (MET, ERC, Ulaanbaatar City Government) and NGOs, namely PCC and Parents' Association Against Smog) were conducted to examine the current situation of air pollution in Ulaanbaatar, their perception, and response strategies. These interviews were conducted in two different periods. The MET interviews were conducted in March 2017, and interviews with ERC, Ulaanbaatar City Government, PCC, and Parents' Association Against Smog were conducted in March 2019. In both cases, the target organizations for the meetings and interviews were those involved in the formulation of air pollution policies or engaged in regional development activities to improve residents' lives in the ger areas. Two or three officials and staff from each organization attended the meetings/interviews at their offices or downtown cafés and lasted for 1 to 1.5 h.

5.2.2 Workshop and Focus Group

The workshop and focus group were held in the Songino Khairkhan District, where the highest pollution levels are recorded every winter by the air quality monitoring system called "agaar.mn." The Songino Khairkhan District is one of the nine districts of Ulaanbaatar and is divided into 32 sub-districts (Khoroo). It is located in the west part of the city and has a high proportion of ger households.

The workshop and focus group meeting were conducted in Mongolia to encourage the residents' active participation. The workshop was held on March 9, 2017, with twelve female and two male residents in the conference room of the 7th sub-district office in the Songino Khairkhan District. As the workshop was held on a weekday afternoon, most men were engaged with work at that time. The focus group meeting was organized on March 7, 2019, in the 24th sub-district of the Songino Khairkhan District at one of the resident's homes with another six female and four male residents who had migrated

to the ger area approximately 10 years before.

The proceedings of the workshop and focus group meeting were analyzed using a narrative inquiry process.

5.2.3 Narrative Inquiry Process

The inquiry design of a narrative analysis includes seven steps of narrative inquiry as presented by Clandinin & Connelly (2000) and Cresswell (2002), or five steps as presented by Riessman (1993). In this study, the seven steps of the narrative inquiry process were simplified into six steps, as shown in Figure 6. The narratives were analyzed using a simplified process as follows.

Step 1 is to explore the phenomenon to be studied. The subject of the story for the workshop was "how to reduce air pollution in the ger areas," and in the focus group meeting, it was "the overall life in the ger area."

Step 2 is to select the study participants who provide the story of the experience. Initial contacts and communication with the sub-district office and residents for the workshop and focus group meeting were facilitated by the Mongolian NGO, PCC. The focus group target area was discussed and selected in collaboration with PCC, which had been implementing community-based conservation practices and research in the ger areas for more than a decade, working closely with the residents. The collaboration with the PCC also helped the author understand the local culture and create a friendly atmosphere where the residents could speak comfortably about potentially sensitive issues, including air pollution.

Step 3 is to talk. Before the discussions, the author presented a self-introduction, and the purpose of the visit was explained to the participants. To create an open communication atmosphere, the authors did not approach the air pollution topic. During the workshop, the discussion topic centered on their perception of how air pollution could be reduced. In the focus groups, the author asked residents about their life in the ger area and tried to sympathize with their difficulties. The air pollution issue was soon brought up by participants themselves as one of their main concerns. The discussions were recorded as written documents and not as recorded audio or videos to respect the participants' dignity and privacy and ease the discussions.

Step 4 is the retelling stage, in which the author reviews the topic that have already been discussed and confirm what the participants said.

Step 5 is the writing stage, in which the entire process was recorded as a study report. The notes and observations of the workshop and focus group meeting were analyzed using Labov's evaluation model (Labov, 1972), which is the most used model for narrative analysis (Langellier, 1989). The Labov approach enables the analysis of a community's concerns or preferences on specific issues within a

participatory process. In the Labov's evaluation model approach, the components of each narrative are categorized as abstract, orientation, complication, evaluation, result, and coda. Abstract refers to an abstract or summary of the narrative. Orientation refers to the time and space of the story; it provides the context of the story. Complication or complicated action refers to the story's sequence of events, that is, how one event or action led to another. Evaluation refers to how the speaker views the events, and why it is told, thereby conveying the narrative's point. Result is used to represent the conclusion of the narrative, that is, the outcome of the story. Finally, coda refers to the relevance to daily life or other events or issues.

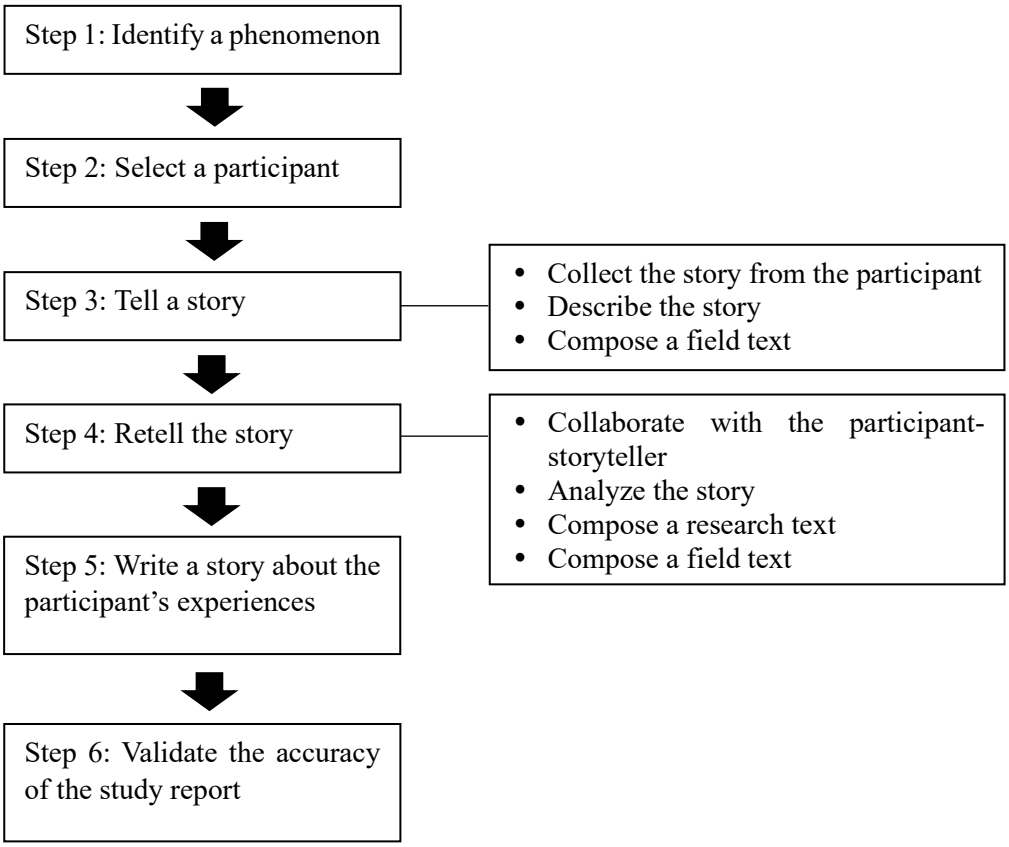


Figure 6. Narrative inquiry process.

Step 6 presents the study report, which conveys the participant's experience. The meaning of the experience was reviewed with the help of a PCC staff member in the same way as in Step 4.

5.3 Results

5.3.1 Interviews with Officials from Government Agencies

Interviews were conducted at three government agencies. The interviews of officials provided insights into the implementation of current policies to reduce air pollution in Ulaanbaatar and ger areas, particularly the related challenges.

Ministry of Environment and Tourism (MET)

The overall goal of the MET is to promote green and sustainable development. Among its responsibilities, the MET oversees air quality management, policy-making, and implementation. The MET interview indicated that they believe they are making significant efforts to introduce air pollution policies and countermeasures and are very frustrated with ger area residents. For instance, one officer from the MET explained she was engaged every winter because there are many meetings and extensive preparation for air pollution measures. She believed that despite their efforts, the residents' low consciousness aggravates air pollution. She explained that the winter of 2017 was extremely cold compared to previous years, which led to a sharp increase in the use of coal for heating by residents in the ger areas, and some residents were burning inappropriate materials, including waste tires, plastics, and garbage. Further in the interview, the author asked about the project concerning improved stoves for the ger areas. Another MET official expressed her view that ger residents sell the stoves for profit. She argued that regardless of the good value, policies will not be effective unless the awareness of residents on air pollution improves.

Energy Regulatory Commission (ERC)

The director of the Energy Market Research and International Cooperation Division was asked to discuss the air pollution problem in Ulaanbaatar and ger areas. Initially, the ERC activities were introduced, and then the discussion focused on the overall activities of the Division and informal conversation. When asked about air pollution, the focus of the conversation shifted to a planned ban on coal use. According to the interview, the use of coal in Ulaanbaatar, except for the operation of thermal power plants, was banned from May 2019 as part of a national plan to reduce air pollution by 80%. The author expressed the concern that the sudden measure without the consultation of residents would lead to dissatisfaction and possibly to black markets for coal transactions. The director partially agreed that this could be a problem and added that the GoM encourages residents to use refined coal. According to

the director, air quality in Ulaanbaatar is improving and will be better if these measures are implemented. The director introduced the author of this thesis to an officer of the Ulaanbaatar City Government. He explained that the department in the Ulaanbaatar City Government has several projects concerning the development of ger areas.

Ulaanbaatar City Government

An officer in charge of the ger area development in the Ulaanbaatar City Government was interviewed. The author wanted to learn about the development projects in the ger areas, e.g., how air pollution issues and reconstruction or relocation plans were addressed. The officer reported that improving infrastructure in the ger areas, including heating systems, has been a slow process. According to the city development plan, 5,000 households in the ger areas should have been connected to the central heating system by November 2017. However, financial difficulties and conflicts of interest among the construction companies interrupted these plans. The municipal housing corporation has invested billions of dollars in implementing a public housing plan to construct 6,000 rental apartments for residents in the ger areas. However, this project was not implemented. In addition, the officer noted that the ban on coal use would not be effective considering Mongolian habits.

5.3.2 Interviews with NGOs

Interviews were conducted with two Mongolian NGOs working directly with ger area residents to understand their views on air pollution issues at the local level.

People Centered Conservation (PCC)

The PCC executive director was asked about the NGO's view on the air quality in Ulaanbaatar, considering that the government claims that air quality has improved compared to previous levels. The executive director said that the air quality in Ulaanbaatar has worsened in recent years, which requires more sensible policies, considering the ger residents' real circumstances. The author was also interested in understanding their views on the "free nighttime electricity policy" in the ger areas. According to the executive director, most ger areas do not benefit from the free nighttime electricity policy because only 11% of households have electric stoves, with a limited electricity generation capacity. Furthermore, she explained that in preparing policies, the GoM should consider the residents' opinions to encourage their participation in reducing air pollution. She added that the participation of residents in ger areas is

essential to solve the air pollution problem, and for this, participatory approaches and research are necessary and significant.

Parents' Association Against Smog

The MET officer introduced the author to a new NGO called Parents' Association Against Smog, which strives for a healthy smokeless future in Ulaanbaatar. The representants introduced their activities, including a ger insulation training workshop conducted in 2018, for approximately 1,500 residents to reduce coal use. The scope of their activities is expected to expand in the future. They explained that green loans are offered in ger areas where sustainable energy use, organic farming, solar technologies, and other practices are promoted. Green loans cover house improvements and heating from electric heaters. However, the interest rates are exceedingly high for residents. Commercial banks provide green loans to residents at an annual interest rate of 17–19%. Each household needs to loan at least 10 million tugriks to purchase insulation and electric stoves and have electrical wiring installed. With such high-interest rates, a 10 million tugrik loan carries 6 million tugriks in interest for three years. Interest rates for green loans are significantly lower in other countries. For example, the annual and monthly average rates in Germany are 1.7% and 0.04%, respectively. The Parents' Association Against Smog emphasized that the GoM needs to consider lowering the interest rates for green loans.

5.3.3 Workshop with Residents

Two narrative stories emerged from the workshop. The analysis of the two narratives is presented below.

Views of Air Pollution Issues and Their Causes

The residents provided narratives on air pollution issues and their area.

Abstract: Residents are aware they live in the most polluted area in Ulaanbaatar.

Orientation: Due to geographical characteristics and wind direction, air pollutants are trapped in their area, thereby recording the highest pollution levels every winter. Residents know that the use of coal in their homes significantly contributes to the air pollution.

Complication: Several projects have been conducted, including the supply of improved stoves, but

they have not helped the residents. Such projects and policies are not realistic.

Evaluation: The government should consider the residents' opinions and develop policies tailored to the characteristics of the ger areas. Special measures targeting their area, such as designating it as a special area, should be prepared and implemented urgently.

Result: For decades, the air quality in Ulaanbaatar has not improved at all, and the vicious cycle of air pollution has continued.

Coda: Residents are fully aware of the seriousness of air pollution and have a keen interest and willingness to solve the issue.

Desire for Better Information and Willingness to Help Mitigate Household Air Pollution

The residents suggested some interesting ideas to reduce air pollution.

Abstract: Residents need more diverse and accurate information about clean energy options, green technologies, and health.

Orientation: The winter of 2017 was extremely cold compared to that of the previous year, and therefore, residents were forced to use more coal. As they still rely on coal as their home energy fuel, fuel diversification is needed to reduce air pollution caused by coal combustion.

Complication: The use of renewable energies encouraged by the government is limited because of concerns about the related economic burden. Although residents have tried using LPG for cooking, they lack knowledge and information regarding installation and use. Residents buy 1 US dollar cans of pressurized oxygen called oxygen cocktails to pour into their drinks to protect themselves from the smog.

Evaluation: The advertisement for the oxygen cocktail product promotes that drinking a glass of oxygen cocktail has the same effect as walking three hours in a dense forest, but this claim has not been proved. Residents believe that information on insulation materials with improved performance would reduce the overall coal use in ger areas.

Result: Residents would like to have educational programs and sessions to share knowledge and experience, which would lead to actions which they could implement on their own to reduce air pollution.

Coda: The residents hope to have opportunities to contribute in improving air quality by acquiring more

transparent and accurate information on air pollution, even if the required actions would be damaging to their immediate interests.

5.3.4 Focus Group Meeting with Residents

The analysis of the three narratives that emerged from the focus group meeting is presented below.

Difficulties of Living in Ger Areas

The residents provided narratives about air pollution and its impacts on their health.

Abstract: Air pollution is the most severe problem affecting the lives of residents in ger areas.

Orientation: Residents migrated to the ger area where there was no infrastructure approximately 10 years ago. They suffer from chronic respiratory diseases every winter, which causes various diseases and affect their health throughout the year. They have experienced complex symptoms for years, including difficulty in breathing, tingling eyes, and stuffy chest. They were mostly concerned about the health of their children.

Complication: The residents go to the hospital regularly, and they often use medicines. However, as hospital appointments are limited, expensive, and time-consuming, they mostly depend on over-the-counter drugs, although they are skeptical about the efficacy of these drugs.

Evaluation: Residents need more accurate information and knowledge about preventing health problems from air pollution. The provision of health care services at the local level should be expanded.

Result: Winter air pollution in Ulaanbaatar has been severe for decades, and measures to solve this issue should continue.

Coda: Residents believe the air quality is not improving, and they need more information on air pollution and its health impacts.

Government Policies and Practices

The residents presented the reasons why they could not take advantage of government policies which they believe are unrealistic.

Abstract: Policies and measures to address air pollution issues do not match the living conditions and

practices of residents.

Orientation: Residents are familiar with the "free nighttime electricity policy" that has been in effect since 2017. They also heard that the government planned to prohibit the use of coal from May 2019.

Complication: The provision of free electricity from 9 pm is not useful because most residents sleep before that time, and hence, they burn coal in the early evening to warm the entire house. Refined coal promoted by the government is rarely used because of its perceived low thermal efficiency.

Evaluation: The sudden policy to ban coal, which they have been using for decades in their daily lives, within just a few months is unrealistic, and they are not prepared for it. Residents may struggle to secure coal or affordable alternative fuels.

Results: Residents expect the free electricity application time to be adjusted considering their lifestyle. Soil pollution is also threatening their health.

Coda: More realistic plans and measures considering the circumstances of residents in the ger areas are required. Policymakers should consider the concerns and opinions of the residents.

Possibility of Public Participation at the Local Level to Address Air Pollution Issues

The residents provided narratives on their community and expressed expectations for future collaborations.

Abstract: The community has a keen interest in environmental issues, including air and soil pollution, and they expressed their willingness to collaborate.

Orientation: Residents have been working together to cultivate vegetables for self-sufficiency. They grow different kinds of vegetables in each household, and they have regular meetings twice a month to share cultivation information and learn techniques.

Complication: Residents formed a community called Bumbat Bayalag (spring abundance), consisting of 14 households with members aged between 35 and 67 years. They are willing to change and take actions such as planting trees to improve air quality.

Evaluation: Several NGOs work closely with residents in ger areas to try to improve their lives. They realize the importance of addressing air pollution issues with public and community participation.

Results: Residents use Facebook frequently, and they suggested the creation of a Facebook page to secure the next steps for my study and continue collaboration in the future.

Coda: Residents have also collaborated with foreign organizations, especially Korean ones, and visited Korea for training. They expressed their willingness to collaborate with the author to improve the living conditions of the town and expect their community to be a good example to other ger areas.

5.4 Discussion

The narrative analysis conveyed the community's concerns about air pollution and provided a structure and context for understanding and presenting the stories communicated during the workshop and focus group meeting. Participants in the workshop and focus group meeting communicated their views and preferences through stories (recorded as handwritten notes by the author) in a narrative form. Participants were given ample opportunity to present and elaborate their stories, which enabled the community story to be identified and communicated.

Labov's evaluation model was used to analyze the interviews and narratives to identify the stories and counterstories. Table 4 shows the differences in the views of the various groups (interviewees, and participants of the workshop and focus group) concerning several issues.

Table 4. Summary of different perspectives and stories on air pollution issues.

Issue	Perspectives from interviews with officials from government agencies	Perspectives from interviews with NGOs	Perspectives from workshop participants	Perspectives from focus group participants
Views on the current situation of air pollution	"I think the air quality in Ulaanbaatar is improving, and it will be better if measures initiated by the government are implemented."	"I do not agree at all with the government's claim. Air quality in Ulaanbaatar has not improved at all over the past few years and even worsened in recent years."	"Air quality in Ulaanbaatar has not improved at all over the past few decades. Its vicious cycle has repeated, and air pollution is ongoing. We know that our area is the most polluted because of its geographical characteristics and wind direction."	"For decades, winter air pollution in Ulaanbaatar has been at a severe level and has not improved at all."
Views on government measures, including policies	"We have distributed improved stoves in the ger areas, but residents sold it for money. I am very busy every winter. Even today, we continue to hold meetings all day long to prepare measures to address air pollution. No matter how hard we try, the policies do not work because the residents' consciousness is low." "As part of a national plan to reduce air pollution by 80%, the government will implement a policy to regulate the use of coal in households from May 2019 and encourage residents to use refined coals." "As you know, Mongolians do not listen very well. So, will the policy to ban the use of coal work for the residents?"	"The free nighttime electricity policy is ineffective because only 11% of households have electric stoves due to their economic conditions and limited electricity generation capacity of the power plants. The GoM should pay more attention to the opinions of the residents when preparing policies to encourage their participation in reducing air pollution."	"The distributed improved stoves are not suitable for our living conditions. Projects and policies that the government has pursued so far are not realistic. The government should listen to us and make policies tailored to the circumstances of the ger areas."	"We know the free nighttime electricity policy. However, it does not fit our lifestyle. The government is encouraging the use of refined coals, but its low thermal efficiency forces us to use existing coals." "We are not prepared at all for the sudden ban on the use of coal. Is that realistic? Some residents will try to get coals at all costs, and if they cannot, they might burn anything visible."

Table 4. Cont.

Issue	Perspectives from interviews with officials from government agencies	Perspectives from interviews with NGOs	Perspectives from workshop participants	Perspectives from focus group participants
Need for better information	N/A	"We held a ger insulation training workshop for 1,500 residents in 2018 and plan to expand its scope in the future."	"We want to use LPG as fuel when we cook, but we do not have any information about it. If we can get that information, we are thinking of converting cooking fuel to LPG. We also wonder if oxygen cocktails are good for health. We believe information about insulation materials would help reduce the use of coal at home."	"Our health is threatened due to air pollution, and we are concerned about the health of our children. We hope to have more accurate information and knowledge on air pollution and health."
Public participation in solving air pollution problems	"Residents burn other harmful materials such as waste tires, plastics, and garbage to save on coal costs. The level of consciousness of the residents needs to be improved."	"To reduce air pollution, the participation of residents in the ger areas is essential, and in that respect, participatory approaches and research like this are necessary."	"We worry about our economic burden due to the government's encouraging transition to renewable energy. If we know actions that we can practice in our daily lives to reduce air pollution, we are willing to join them even if they would be damaging to our immediate interests."	"We have experience working with external agencies and look forward to continue collaborations with to improve our environment, including soil and air pollution. We hope that our activities will be considered good practices and disseminate to other communities, thereby contributing to improve the ger areas."

As shown in Table 4, a government official reported that air quality was improving, whereas NGOs and residents claimed that it has worsened. Although the policy of free nighttime electricity has been implemented for two years, it does not reflect the residents' lifestyles. Moreover, although the government officially declared that implementing a ban on coal use from May 2019 would drastically improve air quality, the effectiveness of this ban was questioned even among government officials. Local NGOs and residents expressed concerns over the sudden implementation of the policy. The government officials consider that policies are not working despite their continuous efforts due to the low level of consciousness of residents. However, the residents' level of consciousness is not low, and they are well aware of the causes of air pollution and are willing to implement measures to improve air quality. The residents criticize the government's impractical policies without sufficient research and investigation, such as banning coal use. As such, there is a large gap in the air pollution perception between the national and local level.

This study shows that ger residents are aware of the health effects of air pollution. They suffer from health problems throughout the year, especially in winter, due to coal combustion for heating in the ger areas. Therefore, they aspire to have more accurate information and education programs on clean energy options, green technologies, air pollution, and health problems.

These organized narratives could contribute to the discourse on air pollution and lead to changes in the community, which would enable stakeholders, including the government, to promote more effective air pollution reduction measures. In any case, as the main causes of air pollution in Ulaanbaatar are observed in the ger areas, the air quality can be improved by genuinely reflecting the residents' interests, listening to their stories, and considering their views in policy-making.

In addition to air pollution, residents believe that other pressing problems need to be addressed. For example, residents reported that soil pollution is an urgent environmental issue in the ger area that threatens their health. The use of squat toilets are causing soil pollution. They urge urgent countermeasures from government against soil pollution. The knowledge and possible willingness of local ger residents to take action were evidenced through these narrative stories. Residents stated that tree planting, waste management, and improved toilet systems are essential to improve air and soil quality in the ger area. Furthermore, they believe that the development of their activities to improve air quality at the local community level would prove the best practice and can be disseminated to neighboring communities. They will contribute to a cleaner environment if they are provided with information on small actions that they can practice at home or in their daily lives to reduce air pollution.

5.5 Conclusion

The study explored the use of narratives to collect public discourse and convey community preferences for consensus making. Based on the workshop and focus group meeting, the records were categorized by applying Labov's evaluation model to organize their oral narratives. This study also describes how to approach and communicate with vulnerable communities to address controversial environmental issues.

This research was possible because stakeholders and residents actively shared their knowledge and experiences without expecting anything in return. Although the author did not introduce the air pollution topic, which might be sensitive to residents, the participants recognized air pollution as the most critical problem in their lives and expressed their keen interest in improving the environmental quality of their community. The study results provided a deeper understanding of a local community in Mongolia and identified the potential of community-based approaches to address local issues in Mongolia's cultural context. To ensure collaboration with the focus group participants, the author agreed to continue communicating with them via Facebook. The community has shared the photos of their regular meetings on several occasions (Figures 7). Based on the community that they formed voluntarily and have been continuing for years, I could secure future collaboration opportunities and the possibility of their continued participation in addressing air pollution issues at the local level.

(a) (b)

Figure 7. (a) Regular meeting on April 30, 2019 (Source: Tuya, 2019); (b) Regular meeting on May 15, 2019 (Source: Tuya, 2019).

The air quality in Ulaanbaatar had not significantly improved in 2019 (focus group meeting) compared to 2017, when the first workshop was held. The residents' dissatisfaction increased, and there were protests in the city center, Sukhbaatar Square. Since May 2019, the use of raw coal at homes has

been banned as scheduled, and the government has been supplying improved coals, but the complaints from residents continue. There is a growing concern regarding the increasing number of deaths in the path to solve air pollution issues, as fatalities from gas poisoning have occurred due to a lack of guidance and publicity on improved coal use (Bayartsogt, 2019). The results of this study can help fill the gap between the viewpoints of government and residents so that they can have tools to solve the long-standing air pollution problem in Ulaanbaatar.

As discussed in Chapter 2, air pollution does not just affect one city or one country but affects many countries around the world, both developing and developed countries. To solve the air pollution problem, researchers and members of the society concerned with the problem from various aspects must communicate and collaborate with each other to learn from each other's experiences. Furthermore, as this chapter has shown, it is important to understand the needs and challenges faced by the public, as well as their awareness and perception regarding air pollution. Following the author's previous study on air pollution awareness and perceptions of ger residents in Ulaanbaatar in 2017, another study was conducted in Reykjavik, Iceland, in 2019 to investigate differences in awareness and perception with regard to air pollution problems between a developed and a developing country as described in the next chapter.

References

1. Anderson, C., & Kirkpatrick, S. (2016). Narrative interviewing. *International Journal of Clinical Pharmacy*, *38*, 631–634.

2. Ariunsaikhan, A., Chonokhuu, S., & Matsumi, Y. (2020). Mobile measurement of PM2.5 based on an individual in Ulaanbaatar City. *International Journal of Environmental Research and Public Health*, *17*, 2701.

3. Bayartsogt, K. (2019, November 19). *Mongolia's new 'cleaner' fuel linked to deaths, illness.* Phys.org. https://phys.org/news/2019-11-mongolia-cleaner-fuel-linked-deaths.html

4. Bello, D. L. (7 March 2019). *Feature/Mongolian slums offer lessons for tomorrow's sustainable cities.* Rethink. https://rethink.earth/mongolian-slums-offer-lessons-for-tomorrows-sustainable-cities/

5. Bittner, P. (18 March 2016). *Clearing the air: Why Mongolia's 'Ger' districts are key to solving its air pollution crisis.* Earth Journalism Network. https://earthjournalism.net/stories/clearing-the-air-why-mongolias-ger-districts-are-key-to-solving-its-air-pollution-crisis

6. Bruner, J. (1987). Life as narrative. *Social Research*, 11–32.

7. Clandinin, D. J., & Connelly, F. M. (2000). *Narrative inquiry: Experience and story in qualitative research.* Jossey-Bass.

8. Creswell, J. (2002). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research.* Merrill Prentice Hall.

9. Dashnyam, U., Warburton, N., Brugha, R., Tserenkh, I., Davaasambuu, E., Enkhtur, S., Munkhuu, B., Lodoysamba, S., Dashdendev, B., Grigg, J., & Warburton, D. (2015). Personal exposure to fine-particle black carbon air pollution among schoolchildren living in Ulaanbaatar, Mongolia. *Central Asian Journal of Medical Sciences*, *1*, 67–74.

10. Dry, S., & Leach, M. (2010). *Epidemics: Science, governance and social justice.* Routledge.

11. Economic Policy and Competitiveness Research Center (EPCRC). (6 May 2020). *Ulaanbaatar fights back against pollution.* Green Economy Coalition. https://www.greeneconomycoalition.org/news-analysis/ulaanbaatar-fights-back-against-

pollution.

12. Enebish, T., Chau, K., Jadamba, B., & Franklin, M. (2020). Predicting ambient PM2.5 concentrations in Ulaanbaatar, Mongolia with machine learning approaches. *Journal of Exposure Science and Environmental Epidemiology,* 10.1038/s41370-020-0257-8.

13. Enkhbat, E., Geng, Y., Zhang, X., Jiang, H., Liu, J., & Wu, D. (2020). Driving forces of air pollution in Ulaanbaatar City between 2005 and 2015: An index decomposition analysis. *Sustainability*, *12*, 3185.

14. Enkhbat, U., Rule, A. M., Resnick, C., Ochir, C., Olkhanud, P., & Williams, D. L. (2016). Exposure to PM2.5 and blood lead level in two populations in Ulaanbaatar, Mongolia. *International Journal of Environmental Research and Public Health*, *13*, 214.

15. Enkhjargal, A., & Burmaajav, B. (2015). Impact of the ambient air PM2.5 on cardiovascular diseases of Ulaanbaatar residents. *Geography, Environment, Sustainability*, *4*, 35–41.

16. Enkhjargal, A., Oyun-Erdene, O., Burmaajav, B., Tsegmed, S., Suvd, B., Norolkhoosuren, B., Unurbat, D., Batbayar, J., Narantuya, D., & Enkhtuya, P. (2020). Short term impact of air pollution on asthma admission in Ulaanbaatar. *Occupational Diseases and Environmental Medicine*, *8*, 64–78.

17. Etherington, K. (2013). *Narrative approaches to case studies.* Keele University. https://www.keele.ac.uk/media/keeleuniversity/facnatsci/schpsych/documents/counselling/conference/5thannual/NarrativeApproachestoCaseStudies.pdf

18. Franklin, M., Chau, K., Kalashnikova, O. V., Garay, M. J., Enebish, T., & Sorek-Hamer, M. (2018). Using multi-angle imaging spectroradiometer aerosol mixture properties for air quality assessment in Mongolia. *Remote Sensing*, *10*, 1317.

19. Gheorghe, A., Ankhbayar, B., Nieuwenhuyzen, H., & Sa, R. (2018). *Mongolia's air pollution crisis: A call to action to protect children's health*. National Center for Public Health and UNICEF.

20. Hampton, G. (2004). Enhancing public participation through narrative analysis. *Policy Sciences*, 261–276.

21. Harper, G. W., Lardon, C., Rappaport, J., Bangi, A. K., Contreras, R., & Pedraza, A. (2004). Community narratives: The use of narrative ethnography in participatory community research. In L. A. Jason, C. B. Keys, Y. Suarez-Balcazar, R. R. Taylor, & M. I. Davis (Eds.), *Participatory*

community research: Theories and methods in action (pp. 199–217). American Psychological Association.

22. Labov, W. (1972). *Language in the Inner City: Studies in the Black English Vernacular.* University of Pennsylvania Press.

23. Langellier, K. (1989). Personal narratives: Perspectives on theory and research. *Text and Performance Quarterly*, *9*, 243–276.

24. Lim, M., Myagmarchuluun, S., Ban, H., Hwang, Y., Ochir, C., Lodoisamba, D., & Lee, K. (2018). Characteristics of indoor PM2.5 concentration in gers using coal stoves in Ulaanbaatar, Mongolia. *International Journal of Environmental Research and Public Health*, *15*, 2524.

25. Masango, R. (2001). *Public participation in policy-making and implementation with specific reference to the port Elizabeth municipality.* University of South Africa.

26. Nakao, M., Yamauchi, K., Ishihara, Y., Omori, H., Ichinnorov, D., & Solongo, B. (2017). Effects of air pollution and seasons on health-related quality of life of Mongolian adults living in Ulaanbaatar: Cross-sectional studies. *BMC Public Health*, *17*, 594.

27. Nishikawa, M., Matsui, I., Mori, I., Batdorj, D., Sarangerel, E., Ohnishi, K., Shimizu, A., & Sugimoto, N. (2015). Chemical characteristics of airborne particulate matter during the winter season in Ulaanbaatar. *Earozoru Kenkyu*, *30*, 126–133.

28. Olkhanud, P. B., Odsuren, M., Gansukh, S., Sereenendorj, D., Davaadorj, M., Ochir, C., & Warburton, D. (2018). Association between ambient air pollution and birth weight among term infants in Ulaanbaatar, Mongolia. *Pediatrics*, *141*(1), 484.

29. Prikaz, M., Fang, C., Dash, S., & Wang, J. (2018). Origin and background estimation of sulfur dioxide in Ulaanbaatar, 2017. *Environments*, *5*, 136.

30. Rappaport, J. (1995). Empowerment meets narrative: Listening to stories and creating settings. *American Journal of Community Psychology*, 795–807.

31. Riessman, C. K. (1993). *Narrative analysis.* SAGE Publishing.

32. Sarokin, D. J., & Schulkin, J. (1994). Environmental justice: Co-evolution of environmental concerns and social justice. *Environmentalist*, 121–129.

33. Sonomdagva, C., Batdelger, B., & Chuluunpurev, B. (2016). Characteristics of PM10 and PM2.5 in the ambient air of Ulaanbaatar, Mongolia. *International Journal of Environmental*

Science and Development, *7*(11), 827–830.

34. Tsevegjav, B. (2013). *Assessment of urban air pollution abatement policy implementation vis-à-vis the role of household energy use in ger areas of Mongolia.* University of Twente.

35. United Nations Development Programme. (2019). *Air pollution in Mongolia: Opportunities for further actions.* AARC Consultancy.

36. Wang, M., Kai, K., Jin, Y., Sugimoto, N., & Dashdondog, B. (2017). Air particulate pollution in Ulaanbaatar, Mongolia: Variation in atmospheric conditions from autumn to winter. *SOLA 13*, 90–95.

37. Wang, M., Kai, K., Sugimoto, N., & Enkhmaa, S. (2018). Meteorological factors affecting winter particulate air pollution in Ulaanbaatar from 2008 to 2016. *Asian Journal Of Atmospheric Environment*, *12*, 244–254.

38. Wittmayer, J. M., Backhaus, J., Avelino, F., Pel, B., Strasser, T., & Kunze, I. (2015). *Narratives of change: How social innovation initiatives engage with their transformative ambitions* (TRANSIT working paper, 4). http://www.transitsocialinnovation.eu/resource-hub/narratives-of-change-how-social-innovation-initiatives-engage-with-their-transformative-ambitions.

39. World Health Organization. (2019). Air pollution in Mongolia. *Bulletin of the World Health Organization*, *97*, 79–80.

40. Yoshihara, S., Munkhbayarlakh, S., Makino, S., Ito, C., Logii, N., Dashdemberel, S., Sagara, H., Fukuda, T., & Arisaka, O. (2016). Prevalence of childhood asthma in Ulaanbaatar, Mongolia in 2009. *Allergology International*, *65*, 62–67.

41. Yoshikawa, H. (2004). リスクコミュニケーション [*Risk Communication*]. (ed.) Editorial Committee on Journal of Japan Society of Civil Engineers, 合意形成論：総論賛成・各論反対のジレンマ [Consensus Building Theory: The Dilemma of Pros and Cons]. Japan Society of Civil Engineers.

Chapter 6

Public Awareness and Perception of Air Pollution in Reykjavik, Iceland

6.1 Introduction

Air pollution is the most severe single environmental health risk globally, linked to approximately 9 million deaths every year (Manisalidis et al., 2020). Ambient air pollution contributes to approximately 4.2 million of deaths through stroke, heart disease, lung cancer, and chronic respiratory diseases (World Health Organization, n.d.). Ambient air pollution has been increasing due to the rapid expansion of megacities, globalization of industrial production, widespread use of pesticides and toxic chemicals, and increasing use of motor vehicles (Molina, 2021).

In both developed and developing countries, the major threat to clean air arises from traffic emissions (Kumar et al., 2020). Air pollution in Organisation for Economic Co-operation and Development (OECD) countries has decreased in recent years due to stricter control of vehicle emissions (OECD, 2014). Nevertheless, road transport accounted for 50% of the cost of the health impacts of air pollution, both premature mortality and selected illness, in OECD countries in 2010 (approximately US$1 trillion) (Book, 2014; Gouldson et al., 2018).

Although air quality in Iceland is typically good, some pollutants surpass the official health limits several times a year (Prime Minister's Office, 2019). In Reykjavik, the capital of Iceland, the high traffic density is the main contributor to air pollution (Carlsen et al., 2013; Finnbjornsdottir et al., 2015), and pollutants, such as nitrogen dioxide (NO_2) and particulate matter (PM_{10}), often exceed health limit values (City of Reykjavik, 2012).

Road transport is the main source of NO_2, and it is typically highest during the morning and afternoon due to heavy traffic. Iceland has the highest per-capita car ownership rates, and the capital area occasionally experiences high levels of traffic pollutants (Carlsen et al., 2013). According to Statistics Iceland (n.d.), the number of automobiles per 1,000 inhabitants of Iceland reached 746 in 2019 (Figure 8). Approximately 94% of Reykjavik households have at least one car, and 50% have two cars or more (Heinonen et al., 2021; Thorkelsdottir, 2010). Therefore, Reykjavik citizens have been encouraged to reduce the use of private cars, prioritizing walking, cycling, or public transportation (City of Reykjavik, 2012).

Studded tires are one of the main contributors to particulate matter (PM) in Iceland (Finnbjörnsdóttir, 2010). The annual mean concentration of PM_{10} has declined since 2000 (Figure 9) but continues to exceed the WHO Air Quality Guidelines (20 μg/m^3) (OECD, 2014). The weather in Iceland is often harsh over the winter months and contributes to poor driving conditions. Therefore, car owners commonly use studded tires even though they adversely affect the roads by tearing up the asphalt (Finnbjörnsdóttir, 2010).

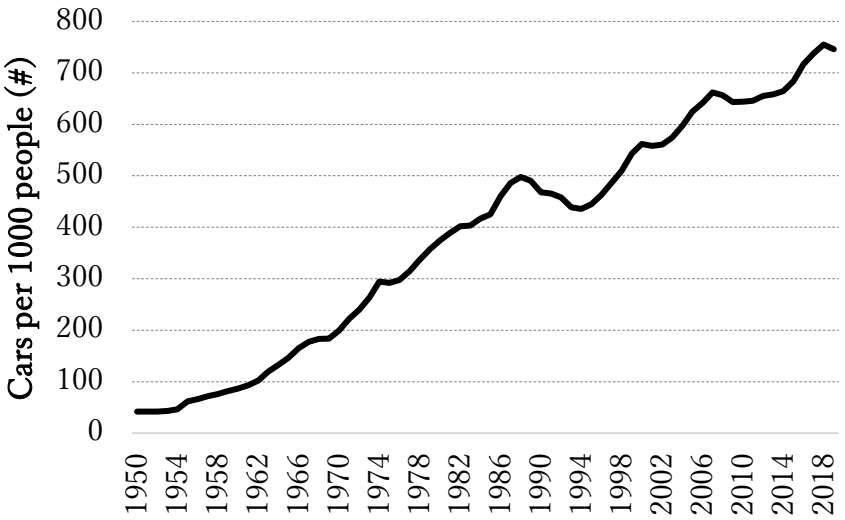


Figure 8. Passenger cars (1–8 passengers) registered in Iceland (Source: statice.is).

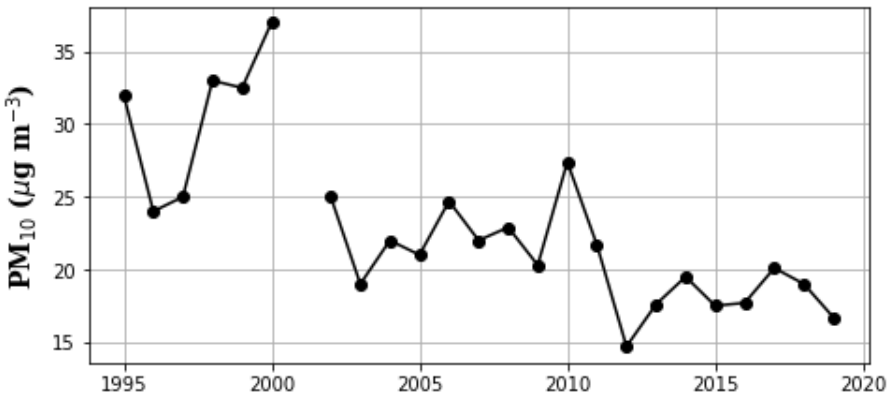


Figure 9. Annual mean concentration of PM_{10} measured at Grensás station (GRE), one of Reykjavik's two fixed stations.

In recent years, researchers from various disciplines have tried to understand public perceptions of air pollution in both developed and developing countries (Li & Tilt, 2018). When studying the relationship between transportation, air pollution, and health, it is necessary to obtain not only

"objective" information, but also to understand people's perceptions and the relationship between them (Gatersleben & Uzzell, 2000). Understanding public knowledge and perception on air pollution and the drivers and obstacles to behavior change is important to formulate and implement effective health promotion strategies and health policies (Sivaraja et al., 2016).

Despite the presence of several natural pollutants and a significant car fleet in the capital area, air pollution has not been extensively studied in Iceland (Carlsen, 2014). Although several studies have focused on the association between air pollution and health of the Icelandic population (Gudmundsson et al., 2019), there is little research about the public perception toward air pollution from traffic. Therefore, this study explores the public awareness and perception regarding air pollution in Reykjavik, including their perception of air quality, pollution sources, and environmental and health effects. The study questions include the following: (i) How do the residents in Reykjavik perceive air quality in the city? (ii) To what extent do residents understand the causes of air pollution and the resulting environmental and health effects? (iii) How and to what extent do personal characteristics such as age, gender, education, economic, and social conditions influence their perception of air quality?

6.2 Methods

The methodology for this study was a questionnaire survey conducted between December 12, 2019, and January 9, 2020. The survey was run by the SSRI of the University of Iceland (Félagsvísindastofnun) using their internet survey panel, which was selected to represent the demographics of the nation. The survey was limited to Iceland's capital area, and weights were calculated to ensure even representation based on gender, age, and education. The survey was prepared in Icelandic for better public participation.

The questionnaire contained questions on personal characteristics that are related to risk perception, including age, gender, educational level, and residence. Furthermore, the questionnaire contained statements about environmental and health effects, use of air quality information for risk communication, familiarity with pollution sources, and personal knowledge about the effects of transport activities, including studded tires.

6.2.1 Sample Characteristics

The survey panel included 1,986 people, among which 872 (44%) answered the survey (Table 5). The distribution of gender and age among respondents was relatively even. The age of the respondents ranged from 18 to 92, with an average of 45.8. Most respondents (88.2%) had a college degree or higher

education level.

Table 5. General demographic characteristics of the study participants.

Characteristics	*Number of respondents (#)*	*Percentage (%)*
Gender		
Male	439	50.3
Female	433	49.7
Age		
18–25	133	15.2
26–35	160	18.4
36–45	158	18.1
46–55	147	16.9
56–65	129	14.8
66–75	84	9.6
≥76	61	7.0
Education Level		
Elementary	58	6.7
College	299	34.3
University	470	53.9
No answer	45	5.2
Main Mode of Transport		
Car	692	79.5
Bike	15	1.7
Electric bike	10	1.1
Bus	78	8.9
Walk	76	8.7

6.3 Results

6.3.1 Causes of Air Pollution in Reykjavik

According to the residents' perception of the main causes of air pollution in Reykjavik, "traffic" is the major cause of pollution, followed by "other," "industry," "dust storms," "fireworks," and "construction" (Figure 10). More than half of the residents (67%) believe that studded tires have "rather much" or "very much" effect on air quality (Figure 11).

Moreover, residents who use transportation modes with relatively less environmental effects, such as bike, e-bike, walking, and bus, were more aware of the air pollution causes (Figure 12). The percentage of residents who perceive studded tires as having significant effects on air quality was lower among those who travel by car than those who travel by other modes of transport (Figure 13).

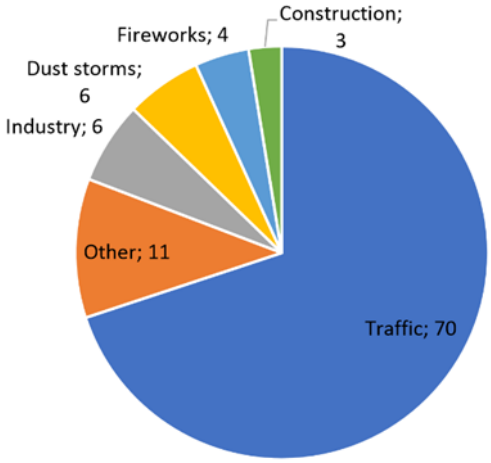


Figure 10. Responses to the main causes of air pollution.

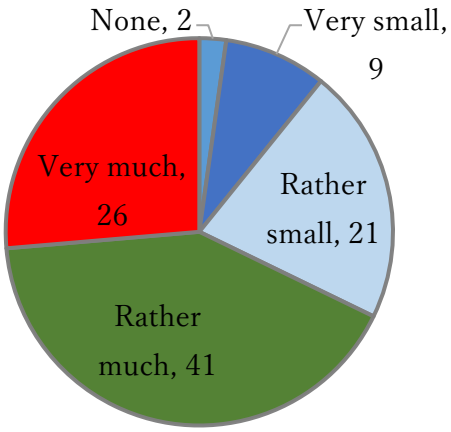


Figure 11. Response to the effects of studded tires on air pollution.

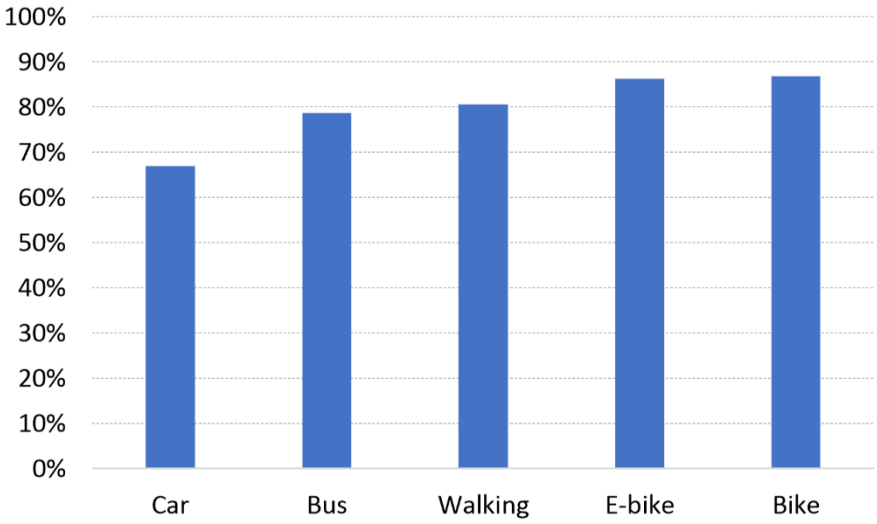


Figure 12. Residents that consider traffic as the main source of pollution according to their main travel mode.

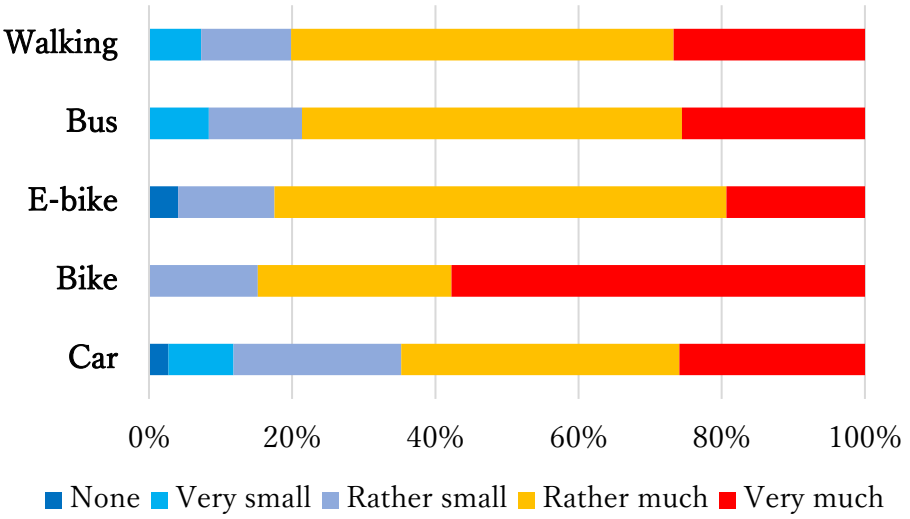


Figure 13. Respondents' views on the impact of studded tires on air quality.

6.3.2 Means of Travel in the City

The percentage of car dependence was higher in older age groups (Figure 14). More than half of all age groups commuted by car, and the percentage that commuted by bus was higher in the lower age groups.

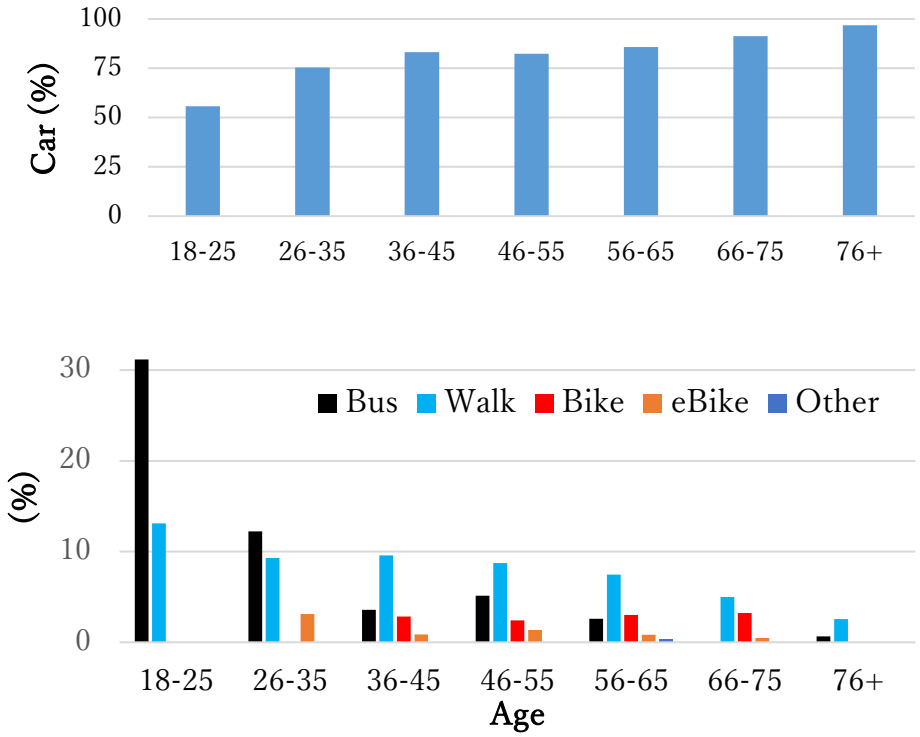


Figure 14. Means of travel by age group considering car (top) and other modes of transport (bottom).

6.3.3 Use of Air Quality Information

Most residents (83.6%) do not check information on air quality in the capital area (Figure 15). Moreover, despite the general assumption that women or families with children or elderly which are more vulnerable to air pollution would be more interested in air quality and seek information on the subject, no such significant relationship was observed. In contrast, residents using transportation means with less environmental impact consumed more air quality information (Figure 16).

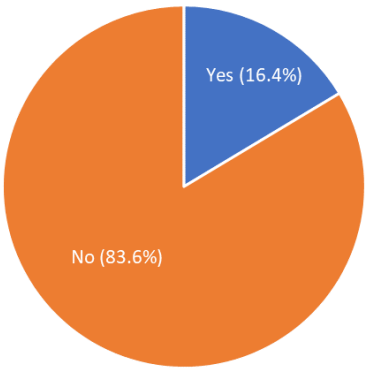


Figure 15. Residents' use of air quality information.

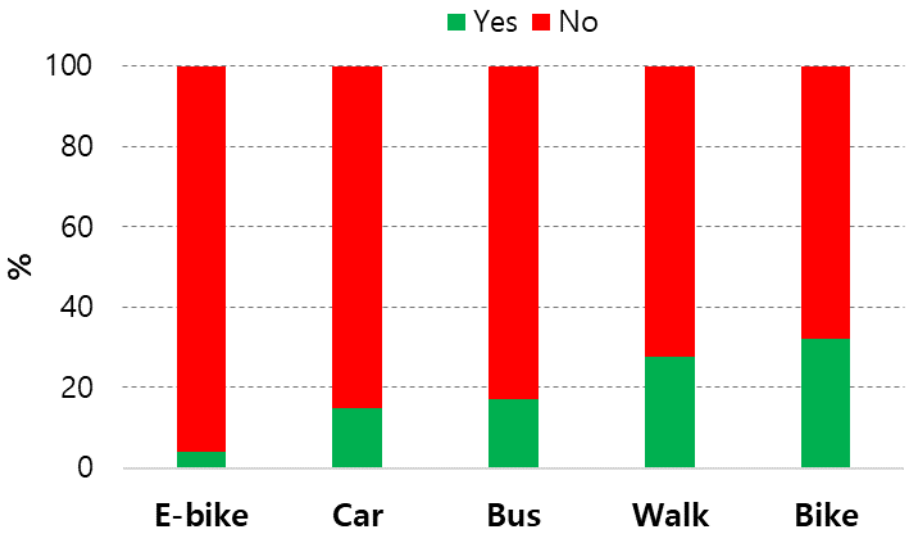


Figure 16. Use of air quality information according to travel mode.

6.3.4 Demographical and Social Factors of Residents and Perception Differences

The respondents were asked in how many days the air quality limit was exceeded in 2018 to investigate the extent to which they perceived air quality in Reykjavik. They believed that the air quality

limit was exceeded during 31 days on average. The actual number of days exceeding the health limit was 18 days at GRE in 2018, 24 days in 2017, and 8–9 days from 2012 to 2016.

Effect of Gender on Perception

Independent-samples t-test was used to determine the differences in air quality perception by gender (Table 6). The results (t = −4.425, p = 0.000) indicated a statistical significance at the 0.001 level. Therefore, the null hypothesis was rejected, and the alternative hypothesis was adopted, thereby indicating that gender has a significant effect on air quality perception. Females (41 days) have a relatively higher perception than males (23 days) regarding the average number of days in which the health limit for air quality was surpassed in 2018.

Table 6. Differences in perception of air quality by gender (N = 613).

		Number of days that exceeded the health limit for air quality in 2018			*t*(*p*)
		N	M	SD	
Gender	Male	326	23.44	34.808	−4.425(0.000)***
	Female	287	40.57	56.902	

*p < 0.05, **p < 0.01, ***p < 0.001

Effect of Age on Perception

To determine the differences in the air quality perception of different age residents, the one-way analysis of variance (ANOVA) was used (Table 7). The results of the ANOVA analysis (F = 7.612, p = 0.000) indicate a statistical significance at the 0.001 level. Therefore, there is a difference in the perception of air quality between at least two age groups. The mean number of days that air quality exceeded the health limit in 2018 as perceived by 18–25 group (49.54 days) is relatively higher than that perceived by the over 66 group (19.08 days).

Table 7. Differences in the perception of air quality by age (N = 613).

		Number of days that exceeded the health limit for air quality in 2018					
		N	M	SD	F	p	Games–Howell
Age	18–25[a]	100	49.54	64.347	7.612	0.000***	n/a
	26–35[b]	126	46.65	57.989			
	36–45[c]	104	24.22	23.264			
	46–55[c]	109	23.96	44.079			
	56–65	88	19.16	32.224			
	≥ 66	86	19.08	30.455			

*p < 0.05, **p < 0.01, ***p < 0.001

Effect of Educational Level on Perception

One-way ANOVA was adopted to examine whether air quality perception differs across varying education levels (Table 8). The robust ANOVA analysis (F = 2.716, p = 0.029) indicated statistical significance at the 0.05 level. Therefore, there was a difference in perception of air quality between at least two groups of educational level. The mean number of days that air quality exceeded the health limit in 2018 perceived by the group "theoretical studies at upper secondary school" (42.50 d) was relatively higher than that perceived by "practical learning at upper secondary school" (22.31 d).

Table 8. Difference in the perception of air quality by educational level (N = 591).

		Perceived number of days that exceeded the health limit for air quality in 2018					
		N	M	SD	F	p	Games–Howell
Education	Primary school	153	30.85	30.761	2.716	0.029*	n/a
	Practical learning at upper secondary school	103	22.31	45.954			
	Theoretical studies at upper secondary school	105	42.50	61.187			
	Undergraduate	118	26.64	42.634			
	Postgraduate	112	34.91	54.743			

*p < 0.05, **p < 0.01, ***p < 0.001

Effect of Transport Mode on Perception

Independent-samples t-test was adopted to examine the differences in air quality perception according to main transport mode (Table 9). The results (t = −2.517, p = 0.013) showed statistical significance at the 0.05 level. Therefore, transport mode had a significant effect on air quality perception. The perception of other transport modes (bike, electric bike, bus, walking) was (43 d) relatively higher than that of the car group (28 d) regarding the average number of days that exceeded the health limit for air quality in 2018.

Table 9. Difference in the perception of air quality by transport mode (N = 613).

		Number of days that exceeded the health limit for air quality in 2018			*t*(*p*)
		N	M	SD	
Mode of Transport	Car	486	28.49	42.594	−2.517(0.013)*
	Non-car	127	42.93	60.801	

*p < 0.05, **p < 0.01, ***p < 0.001

Environmental and Health Effects

The viewpoints about possible environmental and health effects of air pollution were ascertained with five statements: 1) air pollution in Reykjavik degrades the quality of life for many citizens; 2) air pollution in Reykjavik contributes to premature deaths of citizens; 3) air pollution in Reykjavik threatens the biosphere; 4) air pollution in Reykjavik hinders children's development; and 5) air pollution in Reykjavik creates a dirty environment. Respondents rated the statement with the choices of strongly agree, agree, neutral, disagree, and strongly disagree, which were numbered from 1 to 5, respectively.

More than half of the respondents believed that air pollution in Reykjavik creates a dirty environment, threatens the biosphere, and degrades the quality of life (Figure 17). However, respondents were divided over other statements regarding the effects of child development and premature deaths.

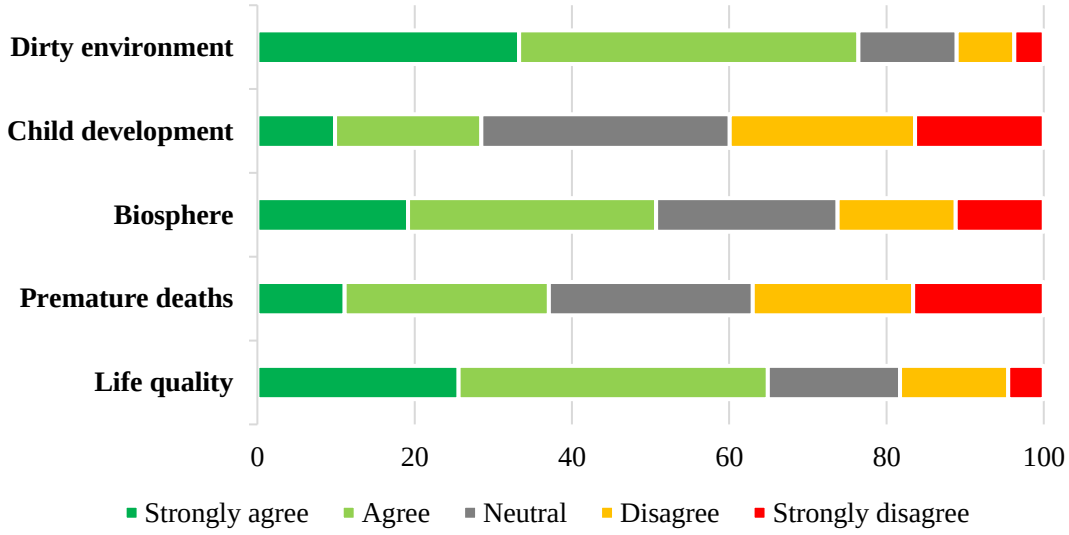


Figure 17. Perception of environmental and health effects.

The Pearson correlation analysis was used to identify the relative influence of five statements on the possible environmental and health effects of air pollution and the correlation between them (Table 10). The correlation between premature death and development of children was r = 0.792, p = 0.000, indicating the highest positive correlation. The correlation between development of children and dirty environment showed the lowest positive correlation, with r = 0.515 and p = 0.000.

Table 10. Correlation between five statements regarding viewpoints about possible environmental and health effects of air pollution.

	Quality of life	Premature death	Biosphere	Development of children	Dirty environment
Quality of life	1				
Premature death	0.707***	1			
Biosphere	0.708***	0.721***	1		
Development of children	0.685***	0.792***	0.719***	1	
Dirty environment	0.667***	0.568***	0.629***	0.515***	1

*p < 0.05, **p < 0.01, ***p < 0.001

Independent-samples t-test was adopted to determine if gender affects the perception of environmental and health effects of air pollution (Table 11). The results of t = 4.175, p = 0.000 (quality of life), t = 5.494, p = 0.000 (biosphere), and t = 5.417, p = 0.000 (dirty environment) were statistically significant at the 0.001 level. Therefore, for these three statements, the null hypothesis was rejected, and the alternative hypothesis was adopted. Accordingly, there are differences in the perceptions of quality of life, biosphere, and dirty environment depending on gender. Based on the mean values, men have a higher perception of the environmental and health effects of air pollution than women.

Table 11. Difference about the perception of environmental and health effects of air pollution according to gender.

	Gender	N	M	SD	*t*(*p*)
Quality of life	Male	414	2.48	1.197	4.175***
	Female	390	2.15	1.032	
Premature death	Male	378	3.10	1.260	0.950
	Female	343	3.01	1.247	
Biosphere	Male	387	2.91	1.309	5.494***
	Female	368	2.42	1.145	
Development of children	Male	357	3.26	1.238	1.779
	Female	328	3.09	1.155	
Dirty environment	Male	405	2.24	1.106	5.417***
	Female	392	1.85	.933	

*p < 0.05, **p < 0.01, ***p < 0.001

Another independent-samples t-test was used to examine whether the perception of environmental and health effects of air pollution differ according to the residents' main mode of transport (Table 12). The results of t = 9.186, p = 0.000 (quality of life); t = 6.201, p = 0.000 (premature death); t = 8.523, p = 0.000 (biosphere); t = 6.119, p = 0.000 (development of children); and t = 7.527, and p = 0.000 indicate statistical significance at the 0.001 level. Therefore, there are differences in the perceptions according to the mode of transport. According to the mean values, car users have a higher level of perception than the users of other transport modes.

Table 12. Difference between user of car and other transport modes on the perception of environmental and health effects of air pollution.

	Mode of Transport	N	M	SD	$t(p)$
Quality of life	Car	638	2.47	1.158	9.186^{***}
	Bike, E-bike, Bus, Walk	165	1.76	0.805	
Premature death	Car	577	3.20	1.235	6.201^{***}
	Bike, E-bike, Bus, Walk	143	2.49	1.174	
Biosphere	Car	598	2.85	1.246	8.523^{***}
	Bike, E-bike, Bus, Walk	156	2.01	1.055	
Development of children	Car	549	3.31	1.170	6.119^{***}
	Bike, E-bike, Bus, Walk	135	2.63	1.171	
Dirty environment	Car	631	2.16	1.084	7.527^{***}
	Bike, E-bike, Bus, Walk	164	1.63	0.724	

*p < 0.05, **p < 0.01, ***p < 0.001

6.4 Discussion and Conclusions

Reykjavik residents are well aware of the significant contribution of transportation to air pollution and the negative impacts of the use of studded tires on air quality. Reykjavik residents perceive the environmental and health effects of air pollution as a problem. However, they heavily rely on private cars rather than public transportation. Residents who use a transport mode with a relatively lower impact to the environment are more aware of air pollution causes. Car users are less likely to perceive that studded tires affect air quality.

Although Iceland is regarded as a clean country, the results of the air quality perception survey indicate that Reykjavik residents perceive air pollution in the city as a problem. There are differences in perception depending on gender, age, education level, and main mode of transport. The results also indicate that females, younger age groups, and residents who use modes of transport other than cars have a more negative perception of air quality.

Most residents do not check air quality information; however, residents who use transportation with relatively lower impacts to the environment use such information.

Air pollution caused by transport could be reduced by efforts such as changes in residents' perceptions and behavior. Air pollution could also be reduced by strengthening vehicle regulations and promoting the use of public transport. The results showed that both Iceland and Mongolia residents are well aware of the air pollution problem and its main cause. However, the use of coal in Mongolia and studded tires in Reykjavik, which most contribute to air pollution, are significant parts of their daily lives, limiting adoption of risk management strategies. Thus, similar to the case of Mongolia, it is necessary to understand the barriers and challenges that residents in Iceland could face when adopting proposed air pollution reduction strategies.

References

1. Book, U. Y. (2014). *Emerging issues update air pollution: World's worst environmental health risk.* United Nations Environment Programme.

2. Carlsen, H. K. (2014). *Health effects of air pollution in Iceland: respiratory health in volcanic environments* (Doctoral dissertation, Umeå universitet).

3. Carlsen, H. K., Forsberg, B., Meister, K., Gíslason, T., & Oudin, A. (2013). Ozone is associated with cardiopulmonary and stroke emergency hospital visits in Reykjavík, Iceland 2003–2009 *Environmental Health*, *12*, 28. https://doi.org/10.1186/1476-069X-12-28

4. City of Reykjavik (2012). *European Green Capital Application 2012–2013 Reykjavík, Iceland.* https://reykjavik.is/sites/default/files/graen_skref/reykjavik_application_round_2ny2.pdf

5. Finnbjörnsdóttir, R. G. (2010). *Air pollution in Reykjavík and dispensation of drugs for angina pectoris.* https://skemman.is/bitstream/1946/6358/1/Air%20Pollution%20in%20Reykjavik%20and%20Dispensation%20of%20Drugs%20for%20Angina%20Pectoris_LOKAEINTAK.pdf

6. Finnbjornsdottir, R. G., Oudin, A., Elvarsson, B. T., Gislason, T., & Rafnsson, V. (2015). *Hydrogen sulfide and traffic-related air pollutants in association with increased mortality: A case-crossover study in Reykjavik, Iceland.* https://bmjopen.bmj.com/content/5/4/e007272.full

7. Gatersleben, B., & Uzzell, D. (2000). The risk perception of transport-generated air pollution. *IATSS Research*, *24*, 30–38. https://doi.org/10.1016/S0386-1112(14)60015-7

8. Gouldson, A., Sudmant, A., Khreis, H., & Papargyropoulou, E. (2018). The economic and social benefits of low-carbon cities: A systematic review of the evidence. Coalition for Urban Transitions. New Climate Economy. http://newclimateeconomy.net/content/cities-working-papers

9. Gudmundsson, G., Finnbjornsdottir, R. G., Johannsson, T., & Rafnsson, V. (2019). Air pollution in Iceland and the effects on human health: Review. *Laeknabladid, 105*(10), 443–452. https://pubmed.ncbi.nlm.nih.gov/31571607/

10. Heinonen, J., Czepkiewicz, M., Árnadóttir, Á., & Ottelin, J. (2021). Drivers of car ownership in a car-oriented city: A mixed-method study. *Sustainability*, *13*, 619.

https://doi.org/10.3390/su13020619

11. Kumar, P. S. P., Kumar P. S. R., Vazhacharickal, P. J. (2020). *Economics of energy use in crop production under irrigated situations of Raichur district, Karnataka*. Independently published.

12. Li, X. Y., & Tilt, B. (2018). Perceptions of quality of life and pollution among China's urban middle class: The case of smog in Tangshan. *China Quarterly*, *234*(234), 340–356.

13. Manisalidis, I., Stavropoulou, E., Stavropoulos, A., & Bezirtzoglou, E. (2020). Environmental and health impacts of air pollution: A review. *Frontiers in Public Health*, *8*, 14. https://doi.org/10.3389/fpubh.2020.00014

14. Molina, L.T. Introductory lecture: Air quality in megacities. Faraday Discuss 2021.

15. Organisation for Economic Co-operation and Development (OECD). (2014). *The cost of air pollution health impacts of road transport: Health impacts of road transport.* OECD Publishing.

16. Prime Minister's Office (2019). *Iceland's Implementation of the 2030 Agenda for Sustainable Development, Helsinki, Iceland.* https://sustainabledevelopment.un.org/content/documents/23408VNR_Iceland_2019_web_final.pdf

17. Sivaraja, L., Chamberlain, A., Ju, Y., Loeffen-Gallagher, T., Al-Busaidi, H., Barrett, F., Boothman-Burrell, L., Dalzell, F., Felderhof, J., Hailes, A., Midgley, C., On, N., Peebles, M., Pittar, H., Sarfarazi, A., Unka, N., Upton, L., Weerasekera, K., & Yuan, H. (2016). *Traffic related air pollution: Perceptions in Wellington.* University of Otago.

18. Statistics Iceland. (n.d.). Vehicles. Retrieved February 24, 2021, from https://www.statice.is/statistics/environment/transport/vehicles/

19. Thorkelsdottir, M. S. (2010). *Transport demand management in Reykjavik – A study of potential measures* (Publication No. 214) [Master's thesis, Lund University].

20. World Health Organization. (n.d.). Air pollution. Retrieved February 17, 2021, from http://www.who.int/airpollution/en/

Chapter 7

Discussion and Conclusions

7.1 Discussion

This study was initiated with the question "why has the air pollution problem in Ulaanbaatar persisted for decades despite the numerous efforts of various stakeholders to address the problem?" In this regard, the following questions were addressed: (a) What are the views and perceptions of stakeholders and residents on air pollution issues? (b) How are stakeholders responding to these issues? (c) What are the challenges that the community faces when participating in air pollution policies? (d) What solutions does the community propose to reduce the burden of air pollution? By collecting and analyzing data using participatory methods, these research questions were elucidated. The main findings are summarized as follows.

During the interview survey in 2017, all stakeholders involved in air pollution risk management in Ulaanbaatar agreed that the air pollution issue has persisted for decades, and it has not improved. However, in 2019, government officials and other stakeholders presented different views and perceptions on air pollution issues. Although a government official stated that the air quality had been improving in recent years, other stakeholders, including NGOs and residents, affirmed that the air quality has worsened. Data from the Ministry of Environment and Tourism of Mongolia, IQAir, PurpleAir, U.S. Department of State, and AirNow collected over the last few years indicate that pollution levels had exceeded annual average levels, especially from 2018 to 2019, which presented an increase in $PM_{2.5}$ levels. In 2017, the average $PM_{2.5}$ level in Ulaanbaatar was 66.5 μg/m³, which was slightly worse than the previous year, and in 2018, it had effectively improved to 58.5 μg/m³. This value was low enough to be classified as "unhealthy for sensitive groups," and it increased again to 62 μg/m³ in 2019. These results indicate that further actions are needed to improve the pollution levels in Ulaanbaatar.

The GoM has classified air pollution in Ulaanbaatar as a critical issue and has been preparing countermeasures, including policies and regulations, to address it. The GoM has been working with national and international organizations to implement projects to reduce air pollution and improve air quality in Ulaanbaatar. A fixed-point automatic monitoring system was installed through a project with the JICA to enhance air pollution control capabilities. The "Intelligent Air Quality Management System" was developed to provide information on real-time air quality in Ulaanbaatar, sectoral activities

(including projects, laws, and regulations), statistical data, and suggestions to reduce air pollution. This system is available online and on smartphones. The government has also distributed improved stoves in the ger area in collaboration with international organizations and encouraged residents to use refined coal.

The Ulaanbaatar City Government has initiated several projects for the ger area development, including connecting 5,000 households in the ger areas to a central heating system and establishing plans to build 6,000 rental apartments. Efforts to address air pollution by NGOs have also been implemented. For example, the NGO Parents' Association Against Smog held a ger insulation training workshop for approximately 1,500 residents to reduce coal use in 2018 and plan to expand its scope in the future. They suggest that the government should reduce the high rates of green loans offered to residents to promote sustainable energy use, organic farming, and solar technologies in the ger areas. In another project, the National University of Mongolia developed a smoke filtering device for thermal power plants and has plans to transform the device for domestic use and distribute it to households in the ger areas.

Despite these efforts by stakeholders, the communities face several challenges regarding air pollution policies because the policies do not reflect their living conditions. For example, the residents have not benefited from the free nighttime electricity policy because only a few households have electric stoves due to economic conditions and limited electricity generation capacity in the ger areas. The application time, from 9 pm to 6 am also does not fit their sleeping habits. They burn coal before that time so they can heat the house and sleep. Moreover, they rarely use the government-promoted refined coal as they perceive it as less thermally efficient. In fact, refined coal generally has high thermal efficiency and reduces pollutant emissions. Residents also fear the risk of suffocation because refined coals require more oxygen than raw coal to burn. Therefore, it seems necessary to convey the correct knowledge and information about refined coal to residents to educate them about its safety.

Although redevelopment policies for the ger area are being pursued, the residents live below Mongolia's average monthly wage, and hence, they cannot afford to build a new house or move to an apartment. Therefore, a realistic alternative would be to lower the interest rate on green loans provided to ger residents with the aims of promoting sustainable energy use, and improving and insulating ger houses. Furthermore, a cost-benefit analysis concerning cleaner fuel options for the residents by considering their economic situation and energy alternatives for household cooking and heating is required to ensure that residents can properly use green loans. The results also indicate a high concern among residents that the soon-to-be-implemented ban on coal would cause difficulties in their lives because it would be difficult for them to suddenly change their coal-oriented lifestyle, and they are not prepared for that.

In terms of solutions proposed by the community to reduce the burden of air pollution, the participants of the 2017 workshop suggested:

- Residents would reduce coal use if they obtained sufficient information on efficient insulation materials and on the use of gaseous fuels such as LPG for cooking, in addition to the installation of proper facilities.
- Education programs, discussions about the environment, and corporate social contributions should be developed to raise public awareness about environmental issues.
- The availability of energy sources, especially clean energies such as wind power, electricity, and solar heat, should be expanded, and the use of green technologies should be encouraged to increase energy capacity and efficiency.
- Specific and targeted efforts are required for highly polluted areas, and these efforts should be consistent with the needs of the residents to be effective.
- More proactive measures are needed, such as a subsidy system for other energy options that consider the residents' living conditions.
- Polluting companies must be fined even if that would damage the immediate interest of residents, and power plants and factories should be converted to cleaner technologies as consumer bills and prices rise.
- The infrastructure of ger areas should be expanded in the short term through improvements such as reconstruction and urban planning, and the residents of ger areas should be able to relocate to apartments in the long term.

The focus group meeting participants in 2019 suggested the following:

- Accurate information on air pollution and health impacts and medical services provision at the local level should be expanded.
- The free electricity time should be adjusted considering the residents' lifestyle.
- Soil pollution in the ger areas is also a severe problem that should be addressed.
- Activities such as planting trees should be encouraged to improve air quality.

This study showed that through semi-structured and narrative interviews, interviewees can share their diverse and rich knowledges and experiences in a more proactive manner, regardless of the research direction. The narrative approach allows researchers to observe the participants while they narrate their personal stories with minimum intervention, as researchers only ask simple questions to encourage the narration of the interviewees. Compared to a structured interview in a question-and-answer format, these interview methods eased the burden on interviewees and allowed them to spare their time for the researcher. Many interviewees, especially government officials, were concerned about what they should prepare for the interview and that their interviews might be problematic as they were representing the

organization's position.

Finally, in this study, we also investigated the awareness and perception of residents concerning air pollution in a developed country, Iceland, which differed greatly from the situation in Mongolia. The questionnaire survey on air pollution awareness and perceptions conducted in the author's previous study was applied in Reykjavik, Iceland. The survey results in Reykjavik showed that the residents have a high level of awareness concerning air pollution and its primary causes. The perception level of air pollution among residents was higher among women than men, and younger than older age groups. Moreover, people who use public transport perceived the air pollution level as higher than people who drive their own cars. Even in Reykjavik, where air pollution and its effects are not significant, the level of awareness and perception of air pollution among residents were relatively high.

Both Mongolia and Iceland residents have a high level of awareness and perception of air pollution and were relatively well aware of the causes of air pollution and how to solve the problem. However, the use of coal in Mongolia and studded tires in Iceland, which contribute the most to air pollution, are a significant part of their daily lives. Therefore, adequate interventions are needed to implement effective measures. In addition to reducing coal and studded tires, various activities should be developed and provided for residents to continuously engage them in environmental improvement. In the case of Mongolia, capacity-building programs to promote cleaner fuels, such as LPG for cooking, and ger house insulation to reduce heat loss should be developed. In addition, accurate information on refined coal and training to use it safely should also be provided. In Iceland, it would be beneficial to reduce the number of cars on the road through traffic control and to use harder minerals in road surfaces. In the short term, proposed measures include restricting the use of cars by half on days of poor air quality or wetting roads and reducing traffic speeds.

This study has some limitations. For instance, the sample size was small and might not be representative. For a more representative study, this work should be replicated in other communities and socio-economic groups of other areas of the city. More CBPR should be conducted in different neighborhoods. Morgan et al. (2002) observed that in individual interviews on environmental risks, the majority of new data were produced in the first five to six interviews, and as the sample size approached 20 interviews, little new information was obtained. Accordingly, approximately 80–92% of concepts were identified within the first 10 interviews in this study. Opinions on optimal sizes of focus groups and workshops differ. Some studies suggest between 8 and 12 people (Robson, 2002), and others argue that smaller groups of 5 to 7 participants might be better suited for an in-depth conversation (Krueger, 1994). In addition, the use of two or more groups increases the chances of success (Krueger, 1994). In this study, eight semi-structured and narrative interviews with stakeholders were conducted in addition to one community-based workshop and one focus group conducted with two different groups. Future

studies, could determine if there are marked differences in districts in Ulaanbaatar that could result in very different outcomes due to their education and income levels for example, and carry out focus groups in the different areas.

Other limitations of the study included the possibility that there was not clear communication or understanding between the researcher and participants regarding the workshop's purpose and methods which could have resulted in some unintended results. Therefore, researchers should provide sufficient explanation to the participants in consideration of the fact that the workshop method may feel more unfamiliar and complicated to the general public. Moreover, even if these community-based participatory workshops are led by participants, appropriate interventions during the workshop by the researcher are essential.

7.2 Conclusions

The main purpose of this study was to elucidate the opinions of stakeholders and residents on air pollution issues through a participatory approach and to identify important challenges and barriers that limit the acceptance of government policies. For that, air pollution policies were reviewed and compared with data collected through participatory methods to analyze gaps between policy approaches, current situation, and residents' needs. In addition, through narrative approaches and analysis, public discourse and preferences of residents were collected and organized. Based on the results, policy directions and recommendations were suggested.

In dealing with environmental issues such as air pollution, interdisciplinary studies spanning natural sciences, engineering, humanities, and social sciences are required. The importance of collaboration with various stakeholders in society is also important. In this respect, this study shows that methods to promote stakeholder and public participation in discussions on air pollution issues could help elucidate the gaps and challenges faced by local residents in the adoption of public policies. The myriad of policies that have been adopted, and the fact that air pollution levels have not declined, resulting in continued health problems for residents indicate that current air pollution risk management strategies have not been effective. By identifying methods to understand the views of all stakeholders, policies can be better designed, leading to more effective air pollution risk management strategies.

References

1. Krueger, R. A. (1994). *Focus groups: A practical guide for applied research* (2nd ed.). Sage.
2. Morgan, M., Fischoff, B., Bostrom, A., & Atman, C. (2002). *Risk communication: A mental models approach.* Cambridge University Press.
3. Robson, C. (2002). *Real world research.* Blackwell Publishing.