Geographical Study on Migration related to the Fukushima Nuclear Accident

Graduate School of Letters, Hiroshima University

Hiroshima University Phoenix Leader Education Program (Hiroshima Initiative) for the Renaissance from Radiation Disaster Radioactivity Social Recovery Course

Student ID: D153219

Name: DO Xuan Bien

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Abstract

1. Research background

The accident at the Fukushima Daiichi Nuclear Power Plant triggered a massive evacuation of about 164,000 from the government-designated evacuation zone and its adjacent areas (Fukushima Prefecture, 2017). People have moved to different destinations with different temporal-spatial patterns. The population displacement has caused significant demographic impacts in the disaster-affected areas, particularly the disrupted population decline and the increasing aging population (Fukushima Prefecture, 2015). The demographic changes then accelerated labor shortage in the affected

municipalities (Higuchi et al., 2012). Thanks to the extensive decontamination and rehabilitation efforts, the Japanese government has gradually lifted the evacuation orders. Seven years after the disaster, evacuation orders have been lifted in most areas of the evacuation zone (METI, 2017). The lifting of evacuation orders allowed tens of thousands of people to return. However, as of December 2017, about 60,000 people remain evacuated (Fukushima Prefecture, 2017). Although previous studies have examined various aspects of the population movement caused by the nuclear disaster, little has been known about geographical features of the disaster migration, particularly the temporal-spatial features of the evacuation as well as factors that influence the return migration.

2. Research questions and research objectives

Understanding the mechanism of the migration caused by the Fukushima nuclear accident is necessary regarding both academic and policy-making domains, especially policies related to the reconstruction of the disaster-affected areas. This research addresses four central questions:

1. What are the demographic impacts of the nuclear accident in the affected areas?

2. What are the temporal-spatial patterns of the Fukushima nuclear disaster-induced evacuation?

3. What factors influenced evacuees' decisions of migration, particularly the selection of evacuation destinations, and decisions of returning or not?

4. What are similarities and differences between a nuclear disaster evacuation and evacuation caused by other forms of disaster?

The overall aim of this dissertation is to examine the geographical characteristics of migration caused by the Fukushima nuclear accident. There are three primary research objectives. First, the research will explore the demographic impacts of the nuclear disaster in the affected areas by examining the changes in demographic characteristics before and after the accident. Second, the research will examine the temporal-spatial features of the migration due to the nuclear accident and the factors that influence the migration decisions of people from the affected areas. Finally, the research will elucidate the geographical characteristics of the Fukushima nuclear accident migration by aligning it with existing migration theories and comparing it with the features of other forms of disaster migration.

3. Research area and research methods

This research selected Minamisoma City as the research location because it shares the majority of primary geographical and demographical features with other affected municipalities. First, the city was profoundly affected by the earthquake, tsunami, and nuclear accident on March 11, 2011. Second, Minamisoma City has the largest number of evacuees among twelve affected municipalities. Third, this municipality spans over different evacuation areas including areas where residents were forced to evacuate and areas where people evacuated voluntarily.

This research adopted the mixed research approach, consisting of quantitative and qualitative research methods. The author first collected and analyzed secondary data including the statistical data about demography and evacuees to capture the general picture of the population movement after the Fukushima nuclear disaster. Statistical data about the population and evacuees is also used to analyze the demographic impacts of the nuclear disaster, the changes in return flow after each lifting of evacuation orders, and the termination of compensation and housing subsidies. In addition, 1,700 questionnaires were randomly distributed to evacuees via post to both returnees and those remain evacuated between May and November 2016. The survey received 289 properly answered the questionnaire. The questionnaires were used to collect primary information from evacuees which is not available in statistical data. The expected information includes information about the characteristics of each evacuee, evacuees' perception of the radiation exposure risk, or evacuees' perceptions regarding how well living conditions have been rehabilitated in affected areas, future intentions of migration, factors that motivate them to return or remain evacuated, and factors about which people are most concerned to return.

In addition to the quantitative method, during fieldwork undertaken from October 2016 to November 2017, the author also conducted 27 semi-structured interviews with returnees, and 15 semi-structured interviews with those who migrated to disaster-affected areas. The purpose of the interviews was to grasp further detailed information that was not adequately obtained from the questionnaire survey. Specifically, the interviews with returnees acquired information about the reasons for returning and returnees' assessment of living conditions at their home location after returning. The responses provided further insight into what motivated evacuees to return home, the challenges those returnees currently face after returning and whether these challenges are different from the hardships perceived by those that remain evacuated. The results add depth to the questionnaire data. The interviews with immigrants aim to capture the primary reasons that motivated immigrants to come to the disaster-affected areas, their assessment of living conditions between Minamisoma City and their previous place of residence, difficulties they faced after moving to a new living environment and their future moving intentions.

4. Structure of the doctoral dissertation

This dissertation is structured in six chapters. Chapter 1 presents the research context, research questions, research aims, methods, research scope and the limitation of this study. This chapter also reviews the literature related to nuclear disaster migration to elaborate the existing knowledge and the research gap in this research domain. Chapter 2 describes the occurrence of the Fukushima nuclear accident, damage caused by the accident, responses to the accident by the Japanese government, and evacuation-related policies following the accident. Besides, this chapter gives an overview of the geographical, socio-economic, and demographic characteristics of the research area. Chapter 3 examines demographic changes before and after the nuclear accident

regarding the population, population structure, and inflow and outflow of migration. The chapter also identifies what pushes people to move out (permanently) and what motivates people from other places to migrate to nuclear disaster-affected areas. Chapter 4 explores the temporal-spatial patterns of the evacuation with an emphasis on evacuation distances. Chapter 5 describes the progress of return migration and discusses factors that influence the decision to return. Finally, Chapter 6 summarizes the main findings of the research and generalizes the geographical features of the Fukushima nuclear accident migration. These features will be compared with the characteristics of migration from other forms of disasters to find similarities and differences. Features of the Fukushima nuclear accident migration will also be examined in light of common migration theories to explore any possible uniqueness migration caused by a nuclear accident.

5. Main findings of the study

Four key findings have been explored. First, the research has explored that the nuclear accident has caused an increased outflow of migration, profoundly in the young population due to concerns about radiation exposure and the deteriorated quality of life in the disaster-affected areas. This consequently accelerated depopulation and aging population in disaster-affected areas, particularly in Minamisoma City. Although there is also an in-flow of migration driven by a high labor demand related to the intensive decontamination and reconstruction work, and the sense of supporting disaster-stricken areas, it seems more temporary and much smaller in scale compared to the outflow of migration. This suggests the aging population and labor shortages in disaster-affected areas will be prolonged.

Second, the study has elaborated the temporal-spatial patterns of the Fukushima nuclear accident evacuation. Evacuees have increased their evacuation distance from the nuclear power plant and reached their furthest evacuation destinations shortly after the accident due to the fear of radiation exposure. Spatially, most people evacuated to areas a short distance away from their home location and less of them moved a long distance away. This spatial pattern shows the consistency with Ravenstein's Law of Migration (Ravenstein, 1889) which commonly applies to all forms of migration: the number of evacuees is inversely proportional to the distance to the destination. Evacuees also highly concentrated in major urban centers, especially in Tokyo and Fukushima City. This suggests the consistency with the Gravity Model in Migration (Zipf, 1946) wherein the number of evacuees is proportional to the size of destinations.

Third, regarding the factors that influenced the decisions on evacuation destination, the results from this study reveal that choosing an evacuation location is strongly driven by social networks and recommendations of local government officials and acquaintances. It is influenced less strongly by job-related matters, accommodation availability, and the accessibility of social amenities. The fear of radiation exposure only had an impact on selecting evacuation destinations briefly after the accident while economic consideration shows an insignificant effect on evacuees' decision of evacuation

destinations. Evacuees whose home location was in the restricted areas, those engaged in a permanent job, and those who had young children at the time of the nuclear accident tended to evacuate shorter distances.

Fourth, although nearly two-thirds of the Fukushima nuclear accident evacuees have returned, most returnees were voluntary evacuees from areas outside the government-designated mandatory evacuation zone. The return rate of evacuees from the forced evacuation zone remains low even though it has been more than six years since the accident occurred, and evacuation orders have been lifted. The study has elucidated how the institutional and individual factors affect the return of evacuees. The results indicate that the lifting of evacuation order had a minimal impact while the termination of compensation and housing subsidies show a significant impact on people's decision to return. A sense of home attachment, job obligations, family reunification, and the ownership of house or business are also driving people to return. Meanwhile the persist concern about the low-dose radiation exposure risk and the inconvenience of living conditions in the home location reduce the likelihood that evacuees will return home.

6. Conclusions

This research has achieved its primary objectives in elucidating the geographical characteristics of the Fukushima nuclear accident migration and factors that influenced evacuees' decisions of migration. The study suggests that evacuation after a nuclear accident shares some major spatial aspects with other kinds of disasters, including natural and technological disasters. The Fukushima evacuation's spatial features and the migration from the other forms of disasters are also consistent with the migration distance decay law (Ravenstein, 1889) and the gravity model of migration (Zipf, 1946) as people tended to move to locations a short distance away from the disaster and to large metropolitan regions. Social networks are found to be a significant factor in selecting evacuation destination in both the Fukushima nuclear accident and natural disaster evacuations (Boyd, 1989; Faist, 1997; Haug, 2008). Quality of life in the destination, particularly schools, healthcare facilities, and social amenities such as shops, banks, and public transportation are common concerns for evacuees when they select their evacuation destination and whether to return. Selectivity in socio-demographic characteristics of evacuees is shown in both types of disaster. Younger people are predominantly involved in out-flow migration with very few in inflow migration while the elderly are less likely to evacuate and return with a higher rate than that of the younger age group.

The outcome of this research suggests that the key difference between the Fukushima nuclear evacuation and evacuations caused by natural disasters are economic considerations. In natural disaster evacuations, economic conditions in both origin and destination are among the most influential factors that shape the evacuation decision. With the Fukushima nuclear accident, evacuees considered the economic and employment opportunities or cost of living at their evacuation destinations insignificant. This is possibly because the Fukushima nuclear accident evacuees received

monetary compensation and housing subsidies which displaced people from natural disasters do not normally have. However, it could also be said that the risk of receiving low dose radiation was higher than economic concerns. The results also point to the unique temporal-spatial interaction of the evacuation in the early phase of the aftermath of the Fukushima nuclear accident when people tried to increase their distance from the NPP and reach their furthest evacuation distance due to the influence of the fear of radiation exposure.

Regarding policy implications, the findings from this research suggest that although seven years have passed since the nuclear accident, low-dose radiation exposure risk in the Fukushima nuclear accident-affected areas is still a strong concern among evacuees. Although the Japanese government confirmed the evacuated areas are safe to return to, and sufficient social services and facilities have been rehabilitated when it lifted the evacuation orders (NRA, 2013), it seems that from the residents' viewpoint, these criteria have not been met. The conflicting viewpoints suggest that there is a need for the government and affected people as well as the general public to have a more effective mechanism or platform which enhances mutual dialogue so viewpoints regarding appropriate policies for the return of people and the rehabilitation of the affected areas can become more closely aligned.

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