

**Geographical Study on Migration related to  
The Fukushima Nuclear Accident  
(Summary)**

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The accident at the Fukushima Daiichi Nuclear Power Plant triggered a massive evacuation of about 164,000 from both evacuation zone and its adjacent areas. The population displacement has caused significant demographic impacts at the disaster-affected areas. As of December 2017, thanks to the extensive decontamination and rehabilitation efforts, the Japanese government has lifted evacuation orders in most areas of the evacuation zone. The lifting of evacuation orders allowed tens of thousands of people to return. Seven years after the disaster, about 60,000 people remain evacuated. Although many studies have examined different aspects of the disaster, geographical features of the disaster migration, particularly the temporal-spatial features of the evacuation as well as return migration have not been explored.

The overall aim of this dissertation is to examine the geographical features of migration caused by the Fukushima nuclear accident, focusing on four primary objectives. First, the research explores the demographic impacts of the nuclear accident in the affected areas by examining the changes in demographic characteristics before and after the accident. Second, the research examines 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. Third, this study discusses the return progress and identifies the impacts of institutional factors and the socio-demographic characteristics of evacuees on the return migration. Finally, the research elucidates the geographical features of the Fukushima nuclear accident migration by aligning it with existing migration theories and comparing it with the geographical features of other forms of disaster migration.

This research selected Minamisoma City as the research location because the city was heavily affected by earthquake, tsunami, and nuclear accident on March 11, 2011. Minamisoma City has the largest number of evacuees among twelve affected municipalities. It also shares the majority of primary geographical and demographical features with other affected municipalities such as spanning in different evacuation areas including areas where residents were forced to evacuate and location that people evacuated voluntarily. This city had all the attributes required to be the best location for this research.

This research adopted two primary methods: statistical data analysis and a questionnaire survey. First, the research uses statistical data population to analyze the demographic impacts of the nuclear disaster, the spatial distribution of the evacuation, and the progress of return. Also, to show the impacts between different institutional interventions on the return migration, the researcher analyzed the statistical data about the evacuees to see the changes in return flow after each lifting of evacuation orders, the terminating of compensation and housing subsidies. Statistical data is collected from the National Census, Fukushima Prefectural Office, and Minamisoma City Office.

Second, a questionnaire survey was conducted between May and November 2016 in Minamisoma City; the research site of this study. The survey received 289 valid questionnaires from evacuees which provided information about where each evacuee moved and the reasons for selecting a specific evacuation destination. The questionnaire also acquired information about 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. Besides, this research also collected additional qualitative information via semi-structured interviews with 29 returned evacuees and 15 immigrants in Minamisoma City were also conducted to collect information about the reasons for migrating to disaster-affected areas and their perception of radiation exposure risk as well as their assessment of living conditions in the disaster-affected areas.

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 about 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-afflicted 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 features 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.

There are four key findings from this research. First, the research found that the nuclear accident has caused an increased outflow of migration, profoundly in 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 trends 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 also found that 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. 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. 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 insignificant impact on evacuees' decision of evacuation destinations.

Third, the study elucidated how the institutional and individual factors affect the return of evacuees. The results of this study reveal that the lifting of evacuation order had a minimal impact while the termination of compensation and housing subsidies show a significant impact in pushing people to return. A sense of home attachment, job obligations, family reunification, and the ownership of house or business are also driving people to return, while 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.

Lastly, the Fukushima evacuation's spatial features are also consistent with the migration distance decay law and the gravity model of migration as people tended to move to locations a short distance away from the disaster and to large metropolitan regions. The study suggests that evacuation after a nuclear accident shares some major spatial aspects with other kinds of disasters, including natural and technological disasters. However, the economic consideration among the Fukushima nuclear accident's evacuees seems less than that of displaced people from natural disaster. This is possibly because the Fukushima nuclear accident evacuees received monetary compensation and housing subsidies, which displaced people from a natural disaster, do not normally have. There was also a unique temporal-spatial interaction briefly after the accident when people attempted to increase their distance from the reactor and reached their furthest evacuation distance due to the influence of a fear of radiation exposure.