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## 主 論 文 の 要 旨

論文題目

Disaster-Induced Migration After the Great East Japan Earthquake and Tsunami: The Case of Miyagi Prefecture

(東日本大震災後の災害由来移住-宮城県の事例)

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## 論 文 内 容 の 要 旨

### Introduction

This dissertation analyzes the influencing factors of disaster-induced migration in Miyagi Prefecture, the hardest hit prefecture, in terms of the number of the dead and missing caused by the earthquake and tsunami disaster in 2011. The Tohoku region of Japan was severely affected by a 9.0 magnitude earthquake followed by a more than 10-meter-high tsunami on March 11, 2011. The three prefectures in the northeast regions, Iwate Prefecture, Miyagi Prefecture, and Fukushima Prefecture, were the most affected by the earthquake and tsunami disaster, followed by the melt-down of a nuclear reactor in Fukushima Prefecture. The Great East Japan Earthquake drove a total of 386,739 people to evacuate from their homes, over 20,000 of whom were still displaced in Miyagi Prefecture as of 2017, while many have already migrated to other areas. The dissertation makes academic contributions to the conceptualization of disaster-induced migration, social vulnerability, and disaster studies. This research contributes to the shortage of empirical research linking disaster-induced migration to social vulnerability, the scarcity of data or methods for examining migration induced by the disaster, and the lack of case studies exploring the role of post-disaster responses on disaster-induced migration by selecting the most suitable data set and using innovative methodologies. The main objective is to examine the influencing factors that contribute to the out-migration following a natural disaster by employing the concepts of social vulnerability and risk reduction concepts.

The dissertation addresses the following research questions:

What factors contribute to disaster-induced migration following a natural disaster?

- i) What is the relationship between the social vulnerability of the municipalities and disaster-induced migration?
- ii) How do post-disaster responses on evacuation and resettlement of the municipality's

governments influence migration following the disaster?

## **Methodology**

The dissertation is organized into six chapters with two chapters presenting analysis corresponding to each sub-research question. In this study, a novel database was created for the 30 municipalities in Miyagi Prefecture, drawing from various statistical reports and sources. The data includes municipality-level data on migration; proxies to measure the magnitude of the disaster, such as inundated area, the seismic intensity of the disaster, destroyed houses; and social vulnerability indicators, including a financial strength index, municipal income, demographics, unemployment rate, the number of businesses, employment in different sectors, farming population, and fishing population. The data are analyzed first, through an interrupted time-series analysis (ITSA), to establish and quantify the damage of the disaster and out-migration. Subsequently, using the migration trends of the six years before the disaster, three counterfactual simulations for out-migration in the absence of the disaster were estimated using different forecasting methods, including the compound annual growth rates (CAGR) and the Holt-Winters triple-exponential smoothing method. Finally, cross-sectional OLS regression analyses were conducted to regress out-migration before and after the disaster, using the counterfactuals as a quasi-difference-in-difference approach to estimate the correlations with social vulnerability indicators.

In the second chapter of analysis, an explanatory-building qualitative method was implemented, whereby a new conceptual framework was created to extend the existing literature. The author collected primary data for two municipalities, Minamisanriku Town and Onagawa Town, through fieldwork, during which formal interviews with municipal officers were carried out. These two municipalities were selected because they experienced the most migration after the disaster. The data was cross-validated with multiple sources of evidence drawn from various secondary sources, including reports, newspaper articles, official news reports, policy papers, and meeting records from Municipality Officials. The analysis was complemented by an extensive review of policies and recovery plans for the national, prefectural, and municipal governments of each of the 15 municipalities.

## **The Relationship Between Social Vulnerability and Disaster-Induced Migration in Miyagi Prefecture (Chapter 4)**

The results from the interrupted time series analysis (ITSA) show that the earthquake-tsunami hazard induced a significant increase in out-migration by up to 33.3 per cent in 2011. The estimates also suggest that the financial strength index, which represents administrative power, was negatively correlated with disaster-induced migration. Municipalities with greater financial strength produced fewer migrants, while municipalities with lower financial strength had a higher

migration rate. Municipalities with low financial strength and high dependence on budgets from the national government are, therefore, susceptible to higher migration rates. This kind of structural vulnerability remains dormant, not affecting migration in the absence of a disaster but can contribute to migration following a natural hazard. However, municipalities with higher income per capita were likely to have higher migration rates. Higher incomes can be translated to higher mobility, which is more likely to induce migration after the disaster.

Conversely, poorer municipalities and communities had lower migration, suggesting that low-income communities are less likely to migrate but more likely to remain displaced. Municipalities with a higher number of natural resource-dependent livelihoods and larger elderly populations were likely to have fewer migrants. The results suggest that vulnerable people have less mobility after a crisis. However, the result for the indicator for the elderly population is interestingly only significant in the subsequent years of the natural hazard. The overall results on the vulnerable population are consistent with the existing studies indicating vulnerable population groups are not subject to higher disaster-induced migration while rejecting the arguments that social vulnerability leads to higher migration.

### **The Relationship Between Post-Disaster Responses and Disaster-Induced Migration in Miyagi Prefecture (Chapter 5)**

The purpose of this chapter is to understand disaster-induced migration as a phenomenon that may have been influenced by the post-disaster reconstruction and Takadai-Iten resettlement strategies carried out after the tsunami at the municipality level. The findings reveal two major influential factors of out-migration: first, the out-of-town and out of prefecture evacuation; second, the delay in the housing recovery. The delay in housing recovery was rooted in the issues of costly and time-consuming buffer-zones and relocation projects, which resulted from policy-driven standardized planning. Moreover, the projects were highly dependent on the national government's budget allocation, whose amount was not precise at the beginning of the planning stage, and it led to confusion among local governments and residents. The ambiguity and frequent changes in regulations led to a decrease in social cohesion between the local authorities and the residents, which influenced the residents' decision to remain in their municipalities to migrate.

### **Conclusion**

This dissertation offers several findings regarding effects of the natural hazard on migration, confirming that disaster-induced migration did occur. First, the different models and scenarios fortified arguments regarding the different mechanisms between migration in the presence and absence of disaster. Second, the municipalities' fragile administrative capacity promoted migration after the disaster. And third, the most accepted arguments that vulnerable populations contribute to more migration were rejected, but essential insights were found. The

policies and plans formulated by the national and local governments tend to be well-intended, emphasizing risk reduction. However, given the magnitude of the hazard and the extensive damage on the residents, the time-consuming projects lead to dismantling among communities, disaster-induced migration, and depopulation. The predominant concept of risk reduction emphasized reducing the physical aspect of the vulnerability to hazards. The new paradigm of natural disasters views disasters and the outcome of the disasters as the result of political, economic, and social structural issues that existed before the hazard. This study's findings contribute to strengthening municipalities against natural disasters and better managing migration after a disaster. The policy recommendations are to formulate vulnerability indicators; therefore, the vulnerable municipalities can be identified, and the capacity of local government can be strengthened through institutional improvements. Also, community-led/participation in Shelter/Resettlement planning as a disaster mitigation practice should be encouraged. To avoid communities being dismantled, communities and residents shall prepare plans for evacuation and relocation before the disaster. Lastly, the research findings revealed that implementing a mitigation process in the aftermath of a disaster can cause a delay in the housing recovery, which can become a driving force for migration after the disaster. The research findings suggest that some of the crucial factors reducing disaster-induced migration are social connectedness, traditional livelihoods, identity, and the availability of employment. Bottom-up risk reduction and planning and disaster town development (*machizukuri*) should be promoted as an everyday scenario before the disaster.

The case of Miyagi Prefecture highlights the rural social vulnerability, which may have different components from the other urban cities in Japan. Therefore, in future research, social vulnerability to disaster in Japanese megalopolises with racial, cultural and economic diversities can be an interesting case to explore. Even though insights from the tsunami-resilience case may not apply to other cities globally, other risk reduction scenarios can be applied to examine patterns of vulnerability dynamics through the conceptual lens of social vulnerability.