Evolving Environmental Immigration Policies Through Technological Solutions: A Focused Analysis of Japan and Canada in the Context of COVID-19

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Abstract
This article examines technological solutions that enhance the effectiveness of environmental immigration policies in Japan and British Columbia, Canada. The study identifies problems related to ecological immigration policies in these regions and explores effective technological interventions. Japan and British Columbia (BC) were selected due to their unique environmental challenges and innovative technological implementations. Advanced technologies such as satellite imagery, mobile applications, Geographic Information Systems (GIS), and blockchain have demonstrated success in integrating disaster management and immigration processing. While Japan and BC share similarities in experiences, challenges, and technological solutions, they also exhibit crucial differences in governance approaches and the effectiveness of these solutions. This underscores the need for context-specific strategies. Technological solutions for environmental immigration policies are essential for resilience and responsiveness. Implementing these technologies will enable authorities to effectively prepare for and mitigate the impacts of ecological catastrophes and pandemics. The findings highlight the necessity of adaptive, context-specific approaches in developing and implementing policies.

Keywords: Environmental Immigration Policies, Technological Solutions, Climate Change, COVID-19, Japan

1. Introduction

1.1 Background and Rationale

For the first time in human history, the 21st century faces the intersecting factors of climate change and global pandemics (Berardi et al., 2022). These natural calamities, such as earthquakes, typhoons, floods, wildfires, and heatwaves, call for an immediate review of environmental migration policies by world policymakers (Harima, 2022). Literature asserts that introducing technological solutions, specifically to Japan and BC, enhances the current regime of environmental immigration policy productively (Ohta et al., 2024; Winter, 2024).

The importance of environmental immigration policies has come to the fore with the escalating effects of climate change and global pandemics (Edison, 2023; Koskela & Beckers, 2024). Climate-driven disasters are increasing in intensity and frequency, while pandemics introduce added challenges for affected populations. Well-conceived and flexible immigration policies are essential in guaranteeing the safety and health of migrants (Chatterji et al., 2023; Naik, 2024). These policies act as frameworks for managing displacement through natural calamities by providing support and resources to affected citizens (Irudaya Rajan & Arcand, 2023) and as critical tools for reducing pressure in vulnerable areas by facilitating planned relocations to mitigate long-term effects of climate change (Walton-Roberts, 2023). The effectiveness of these policies can be further enhanced through technology solutions that make disaster management effective and resilient, extending timely support and ensuring the comprehensive needs of the displaced (Collins & Friesen, 2022; Mello et al., 2023).

The geographical locations of Japan and BC expose them to unique environmental challenges (Biswas et al., 2023; Saraswati et al., 2024). As an island nation, Japan is highly prone to earthquakes, typhoons, and floods, which historically result in immense displacement, necessitating well-coordinated emergency response and immigration policies (Garcia-Sitton, 2024; Lacroix et al., 2020). Meanwhile, BC faces wildfires, floods, and heatwaves (Harima, 2022; Missbach & Stange, 2023). The frequency and magnitude of these incidents have grown due to climate change, putting disaster management and migration systems under severe pressure. Policies in BC include measures for emergency response and support of the displaced, but implementation problems persist, similar to those in Japan (Mello et al., 2023; Rychlowska et al., 2015).

1.2 Research Objectives

The primary objectives of this research are:

- RQ 1: To evaluate the integration of satellite imagery, mobile applications, GIS, and blockchain in environmental immigration policies
- RQ 2: To conduct a comparative analysis between Japan and BC, focusing on the effectiveness and integration of these technologies

2. Literature Review

2.1 Theoretical Framework

Environmental immigration refers to the flow of individuals compelled by environmental factors, including natural disasters, climate change, and ecological degradation (Istad, 2023;

Muranaka, 2024). The United Nations High Commissioner for Refugees (UNHCR) refers to "climate refugees" when residents are forced to leave due to catastrophic environmental disturbances. However, international law offers minimal protection for climate refugees, posing significant challenges for policymakers. Suva et al. (2022) explain that environmental migration occurs in the context of economic vulnerability, social networks, and adaptive capacities. Analysts highlight that environmentally-induced factors interact with socio-economic and political contexts in migration decisions (Chamie, 2020; Portes & Rumbaut, 2024). The integration of GIS technology into disaster management significantly improves responses to these migrations, though gaps remain in fully utilizing such solutions. This article aims to address these gaps by examining various technological interventions for environmental immigration (Leung et al., 2023).

Technological advancements provide significant tools for handling disasters and implementing immigration policies, as noted by Ray (2022). Key technologies include satellite imagery, GIS, mobile applications, and blockchain (Walton-Roberts, 2023). Satellite imagery helps evaluate environmental changes and respond promptly to disasters (Dewey-Lambert et al., 2021; Kumar & Ojha, 2024). GIS integrates data from various sources to create descriptive maps useful for disaster management planning and decision-making (Rishworth et al., 2024). Blockchain technology ensures secure migrant documentation (Edison, 2023). These technologies promise better management of environmental migration and increased resilience for affected communities (Adhikari & Plotnikova, 2023).

2.2 Historical Context

Immigration policies in Japan and BC have evolved significantly, influenced by environmental and socio-political contexts (Chamie, 2020; De Haas et al., 2018). Traditionally, Japanese immigration policies were restrictive, primarily recognizing skilled and technical workers for economic purposes. However, recent frequent natural disasters have prompted Japan to address environmental migration issues (Shah et al., 2023). Successive policies have incorporated disaster reduction and response management systems, using technologies such as GIS and mobile applications. In contrast, BC follows an open and inclusive immigration framework, emphasizing multiculturalism and humanitarian support for environmental refugees (Biagioni et al., 2024; Peters et al., 2021). BC policies provide emergency housing, financial aid, and integration programs for rebuilding migrants' lives (Rishworth et al., 2024; Winter, 2024; Parzniewski, 2021; Rychlowska et al., 2015).

Recent natural calamities have significantly impacted immigration policies in both regions. The 2011 earthquake and tsunami in Tōhoku, Japan, spurred a reconsideration of disaster management strategies (Gafter et al., 2022). Modern technologies for accessing and disseminating disaster information were introduced, marking a significant policy shift (Brotherhood, 2020; Triandafyllidou & Yeoh, 2023). These policies now better support displaced residents with temporary housing and financial assistance, showing a dynamic approach toward environmental migration (Matsuoka et al., 2022).

Similarly, the devastating 2017 and 2018 fire seasons in BC prompted policy changes aimed at improving emergency responses to disaster-affected communities. BC has successfully fine-tuned the use of GIS and mobile applications for disaster tracking and communication (Hollifield & Foley, 2022a; Cerna & Chou, 2023). These technological applications are integral to BC's strategy of building resilience and providing timely support to environmental migrants.

Combining the discussions of Japan and BC emphasizes the critical role of technology in facilitating environmental migration (Hollifield & Foley, 2022a). Advanced technological solutions are part of the policies in both regions, though their approaches differ due to unique ecological and socio-political contexts (Cerna & Chou, 2023). Japan integrates technologies, predictive models, and blockchain for secure migrant documentation as part of its national response to recurrent natural disasters and the COVID-19 pandemic (Ang & Tiongson, 2023). In contrast, BC focuses on GIS and mobile apps for disaster response, reflecting its humanitarian view and commitment to multiculturalism (Suva et al., 2022). Adaptive, contextualized approaches are essential for solving complex problems associated with environmental migration (Brotherhood, 2020; Triandafyllidou & Yeoh, 2023). Such approaches ensure disaster preparedness and resilience in adapting to evolving environmental threats (Sabzalieva et al., 2022; Hollifield & Foley, 2022a).

2.3 Current Technological Solutions

- Satellite imagery provides high-resolution real-time changes in the environment, playing a vital role in disaster assessment (Shah et al., 2023). This technology allows for the early detection of disaster-prone areas and facilitates follow-up on damages and relief efforts (Zhan et al., 2022). In Japan, satellite imagery is used to monitor earthquakes, typhoons, and floods. For example, in 2020, it provided insights into the magnitude of floods, aiding in rescue operations (Ang & Tiongson, 2023; Zhan et al., 2022). Similarly, in BC, satellite imagery is crucial for monitoring wildfires and floods, enhancing disaster response and management (McAuliffe & Triandafyllidou, 2021).

- Mobile applications have significantly improved emergency communication and coordination (Missbach & Stange, 2023; Tamine, 2022). These applications enable prompt communication among government agencies, rescue teams, and individuals (Biagioni et al., 2024; Choe, 2024). In Japan, mobile applications provide early warnings, evacuation routes, and coordinated rescues. Elejalde et al. (2024) noted that these applications increased the efficiency of operational responses during the 2021 typhoons. BC also utilizes mobile applications for emergency communication, especially during wildfires and floods. These apps provide updates on disaster status, evacuation orders, and safety measures, ensuring timely and accurate information reaches the affected population (Palattiyil et al., 2022; Abu-Laban & Nath, 2020).

- GIS synthesizes various data sources into detailed maps for tracking and managing disasters (Edison, 2023; Winter, 2024). Irudaya Rajan and Arcand (2023) highlighted that GIS technology empowers the analysis of spatial information, monitoring disaster processes, and preparing response efforts. In Japan, GIS is used to monitor earthquakes and typhoons and assess flood hazards (Patel & Dev, 2023). According to Sabzalieva et al. (2022), GIS aids decision-making by providing detailed maps that identify critical response areas. In BC, GIS is employed to monitor natural disasters such as wildfires and floods, facilitating emergency planning and response (Sorrell & Ferris, 2021). Schinnerl (2021) demonstrated that GIS improves disaster response efficiency by predicting wildfire spread and estimating flood risk, leading to better support for affected populations (Rychlowska et al., 2015; Xia, 2022).

- Blockchain technology offers transparent, secure ways of processing migrant documentation (Hollifield & Foley, 2022b; Saraswati et al., 2024). As a decentralized, tamper-proof system, blockchain maintains data integrity with minimal fraud risk

(Barajas, 2023; Chatterji et al., 2023; Gao, 2023). In Japan, blockchain technology has been applied to enhance migrant document processing, particularly during the COVID-19 pandemic, ensuring secure and accessible records for immigration procedures (Suva et al., 2022; Kwak et al., 2024). BC is evaluating blockchain for similar applications to provide more secure and efficient document handling for migrants (Shah et al., 2023). Garcia-Sitton (2024) emphasized that blockchain facilitates safe data sharing and coordination among stakeholders, integrating various information sources to improve immigration processes and ensure timely support for migrants (Cerna & Chou, 2023; Irudaya Rajan & Arcand, 2023).

3. Methodology

This study analyzes the integration of technological solutions in the environmental immigration policies of Japan and BC through a comparative analysis. The research relies on data collected from a comprehensive literature review of policy documents, academic articles, and case studies related to disaster management and environmental migration in the two regions. The analysis will assess the effectiveness of GIS, mobile applications, predictive models, and blockchain technology, examining their roles in policy formulation, implementation, and outcomes. Comparing the approaches taken in Japan and BC will highlight best practices, gaps, and context-specific strategies for strengthening policy resilience and responsiveness to environmental challenges.

3.1 Research Design

This study employs Qualitative Comparative Analysis (QCA) with secondary data to analyze the role of technological solutions in the development of environmental immigration policies in Japan and BC. QCA is particularly suited for this research because it can cope with complex phenomena and identify patterns across multiple cases. It systematically compares the operations of technological integrations across different policy frameworks, providing insights into their effectiveness and nuances.

The research design is based on secondary data from various policy documents, academic literature, and case studies related to disaster management and environmental migration. This approach ensures a comprehensive and in-depth study while mitigating some limitations associated with primary data collection. Utilizing secondary data provides a rich context for comparative analysis, enabling a systematic comparison of how different policy contexts integrate various technologies. This method aims to evaluate best practices, identify gaps, and develop strategies for effective environmental immigration policies.

3.2 Data Collection and Analysis

- The first step involves conducting a Systematic Literature Review (SLR) to comprehensively review existing literature on technological solutions in environmental immigration policies. The SLR methodology ensures the process is comprehensive, unbiased, and reproducible by searching all relevant sources for candidate studies, theories, and findings. The complete procedure of data screening is illustrated in Figure 1 as a PRISMA flowchart. The database search yielded 189 records, with 140 unique records remaining after duplicates were removed. Of these, 78 records were screened, and 111 full-text articles were assessed for eligibility. Quality assessment resulted in 72 studies included in the systematic review, with 117 studies excluded for documented

reasons. Fifty-eight studies were included in the qualitative synthesis, ensuring a thorough and unbiased selection of relevant studies.

- Secondary data will be collected from numerous other sources to provide broad exposure to the Secondary data will be collected from various sources to provide a broad understanding of the current state of technological solutions in environmental immigration policies. These sources include policy documents, governmental.

- The comparative analysis framework involves identifying variables related to policy effectiveness, internal technological integration, and disaster management efficiency; analyzing these variables between Japan and BC to capture the similarities and differences in their application; and measuring the outcomes of technological solutions concerning policy effectiveness, integration, and disaster management efficiency to determine the overall impact.

3.3 Evaluation Criteria

The assessment of technological solutions for environmental immigration policies will focus on policy effectiveness, integration of technology, and disaster management efficiency. Policy effectiveness evaluates how well policies achieve their objectives, support affected populations, facilitate planned relocations, and incorporate health protocols during pandemics. Indicators include the clarity and comprehensiveness of policy objectives, the alignment of technological solutions with policy goals, and the tangible effects on affected populations. Technological integration assesses how smoothly solutions are embedded within existing frameworks and operational processes, considering acceptance and use levels, interoperability with existing systems, and organizational preparedness to implement and manage technologies. Disaster management efficiency examines the timeliness and accuracy of disaster assessments, the effectiveness of mobile applications for communication and coordination, the security and transparency of migrant documentation using blockchain, and overall improvements in disaster preparedness, response, and resilience through technology integration. This evaluation will demonstrate how technologies can enhance the implementation of environmental immigration policies, identifying lessons learned and areas for improvement to develop more effective and resilient policy settings in Japan and BC.

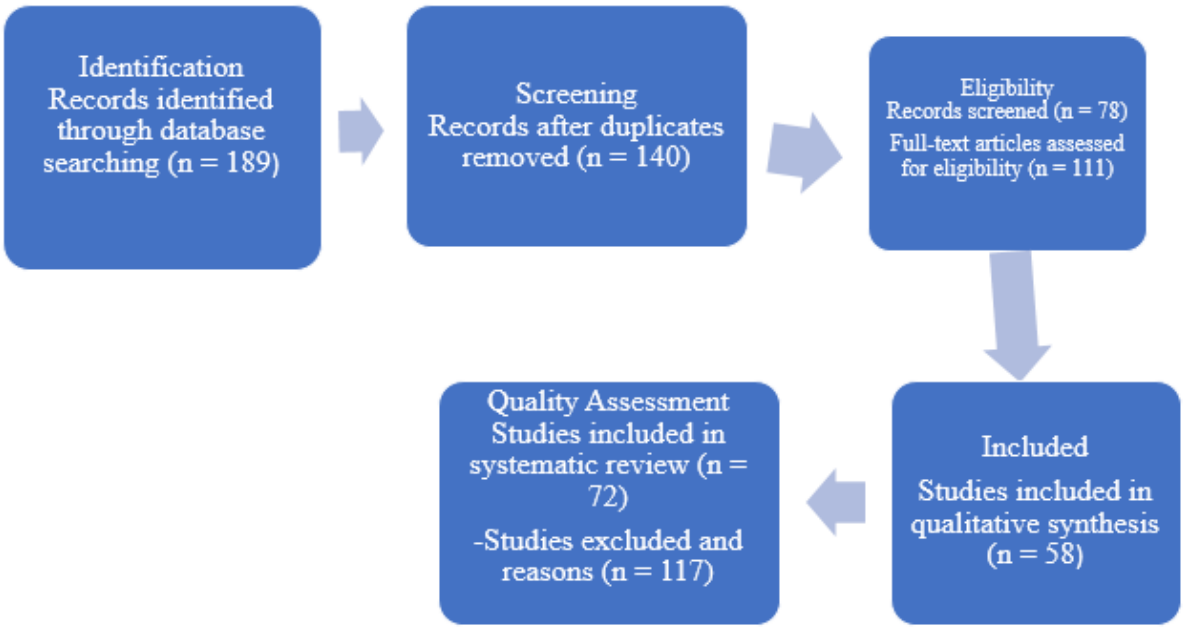

Figure 1: PRISMA Flowchart: Self Made/Assessed

4. Japan

4.1 Current Immigration Policies

Japan's immigration policy for environmental refugees focuses on managing forced displacements due to frequent natural disasters such as earthquakes, typhoons, and floods (Matsuoka et al., 2022). These policies emphasize prompt response and recovery to safeguard the population and enhance welfare (Gurung et al., 2021). They include provisions for emergency shelters, reimbursement assistance, and mitigation relocation (Kwak et al., 2024). Additionally, Japan's disaster risk reduction approaches aim to mitigate the spread of vulnerabilities among affected populations (Harima, 2022). However, these policies face challenges in adopting advanced technologies and addressing emerging environmental threats (Lacroix et al., 2020; Leung et al., 2023).

Recently, Japan has revised its immigration rules to better address frequent and intense natural disasters (Dewey-Lambert et al., 2021). This includes the use of satellite imagery, predictive models developed through artificial intelligence (AI) and machine learning, and mobile applications for real-time communication during emergencies (Muranaka, 2024). The COVID-19 pandemic further prompted Japan to utilize blockchain technology for secure migrant documentation, ensuring data integrity amid health and security challenges (Cerna & Chou, 2023). These changes aim to enhance Japan's ability to manage calamities and ensure that immigration policies are disaster-resilient (Peters et al., 2021).

4.2 Case Studies

- In 2020, severe floods in Japan displaced thousands of residents. Istad (2023) and Mensah and Williams (2022) noted that the government used satellite imagery to evaluate the extent of the damage effectively. This technology facilitated real-time monitoring, allowing for organized resource allocation and evacuation efforts (Hollifield & Foley,

2022a). The data obtained through satellite images enabled a speedy assessment of the damage, providing timely support and relief to the affected populations (Suva et al., 2022; Sabzalieva et al., 2022). This highlights the importance of technologies in disaster management to enhance response effectiveness (Sorrell & Ferris, 2021).

- The 2021 typhoons in Japan demonstrated the potential of AI and machine learning in disaster prediction. Elejalde et al. (2024) explained that these technologies, supported by extensive datasets on weather patterns and past typhoon data, helped predict the pathways and intensities of upcoming typhoons. This enabled authorities to issue early warnings, arrange evacuations, and coordinate pre-mobilization efforts (Irudaya Rajan & Arcand, 2023). The models identified potential impact locations, ensuring sensitive and coordinated response efforts (Collins & Friesen, 2022; Patel & Dev, 2023). AI and machine learning significantly improved preparedness and mitigation of adverse effects on communities (Saraswati et al., 2024).

- The 2022 earthquake in Japan underscored the critical role of mobile applications in disaster communication. Ray (2022) and Brotherhood (2020) highlighted that the government deployed several mobile applications to provide real-time information and connect authorities with the public. These apps offered emergency alerts, evacuation routes, shelter locations, and first aid tips (Santos & Mourato, 2022). Users could report their status and request assistance, facilitating coordinated recovery operations (Esses et al., 2021). The widespread use of mobile technology during the earthquake response demonstrated its effectiveness in timely and efficient information dissemination (Dewey-Lambert et al., 2021; Koskela & Beckers, 2024). This case also highlighted the need for continued development and deployment of mobile applications within disaster management frameworks (Chamie, 2020).

- The COVID-19 presented new challenges for Japan's immigration policies, particularly in securely processing migrant documentation. Mensah and Williams (2022) noted that Japan applied blockchain technology to enhance the security and transparency of migrant records. Blockchain ensured that sensitive information was stored on a decentralized, tamper-proof ledger accessible only to authorized personnel (Schinnerl, 2021). This facilitated easier document verification, streamlined immigration processes, and ensured compliance with health protocols (Shah et al., 2023). The use of blockchain during the pandemic underscored its potential for improving efficiency and security in migration processes, suggesting further policy enhancements (Rishworth et al., 2024).

Through these case studies, it is evident that technological solutions in Japan encompass a range of applications, from disaster assessment using satellite images to AI-driven disaster predictions, mobile applications for emergency communication, and blockchain for secure documentation (Brunner, 2022; Edison, 2023). These technologies are shaping disaster management and policy implementation, demonstrating that integrating advanced technologies into environmental immigration policies enhances their resilience and effectiveness (De Haas et al., 2018; Sabzalieva et al., 2022).

5. BC, Canada

5.1 Current Immigration Policies

Policies in BC regarding the immigration of environmental refugees emphasize disaster relief mechanisms for natural disasters such as avalanches, wildfires, earthquakes, landslides, and floods (Cruz et al., 2020). These policies adopt a community-based disaster risk reduction framework, which emphasizes public awareness campaigns and reducing exposure to environmental hazards (Kwak et al., 2024; Sabzalieva et al., 2022). Despite these efforts, BC, like Japan, faces significant challenges due to the rapidly changing nature of environmental threats, necessitating advanced technological solutions and adaptive policies (Biagioni et al., 2024).

Recent reforms in BC's immigration policies address the increasing frequencies and intensities of natural disasters. Walton-Roberts (2023) highlighted that these reforms include integrating advanced technologies for disaster prediction and management (Biswas et al., 2023). Mobile applications have been developed to streamline emergency communication and real-time coordination during crises (Matsuoka et al., 2022). Additionally, blockchain technology has been adopted for migrant documentation to enhance security and efficiency, particularly in response to health and security hazards like the COVID-19 pandemic (Soroka, 2022). These technological enhancements aim to make BC's immigration policies ecologically resilient and improve the province's readiness and response capabilities (Harima, 2022).

5.2 Case Studies

- The 2019-2020 wildfire season in BC, one of the worst on record, highlighted the importance of Geographic Information System (GIS) solutions for real-time disaster tracking. Garcia-Sitton (2024) explained that GIS technology provides comprehensive and current information on wildfire movement, aiding emergency services in resource distribution and decision-making (Biagioni et al., 2024; Muranaka, 2024). This technology also enhances coordination among agencies, ensuring timely and accurate communication (Leung et al., 2023). The integration of GIS within BC's emergency management framework proved vital for situational awareness and response during the wildfire crisis (Esses et al., 2021; Rychlowska et al., 2015).

- The 2021 floods in BC caused significant infrastructure damage and community displacement. Peters et al. (2021) noted that satellite imagery was crucial in assessing the disaster's scale. High-resolution images provided detailed overviews of the affected areas, facilitating prompt allocation of rescue services and relief materials (Dewey-Lambert et al., 2021). This technology also supports long-term planning and rehabilitation by offering valuable insights into flood patterns and vulnerabilities, informing future policy adjustments (Biswas et al., 2023; Zhan et al., 2022).

- The 2022 heat dome event over BC brought record-setting temperatures, leading to health crises and numerous deaths. Mensah and Williams (2022) highlighted that BC used customized mobile applications for emergency communication to address this challenge. These applications provided real-time updates on heat conditions, health advisories, and cooling center locations (Peters et al., 2021). They also facilitated direct communication, allowing residents to report emergencies, receive help, and learn about protective

measures in a timely manner (Brunner, 2022; Istad, 2023). The use of mobile applications proved essential for public safety during the heat dome emergency, ensuring critical information was promptly and efficiently disseminated (Kwak et al., 2024; Saraswati et al., 2024).

- The COVID-19 pandemic posed unprecedented challenges for immigration processes in BC and globally. Sorrell and Ferris (2021) noted that BC adopted blockchain technology to securely manage migrant documentation. Blockchain's decentralized and immutable nature provided a safe platform for processing and verifying migrant documents, preventing fraud and tampering (Walton-Roberts, 2023). This technology fast-tracked documentation processes, ensuring the verification of migrant credentials and integrating health protocols to comply with COVID-19 safety measures (Schinnerl, 2021). The adoption of blockchain technology improved document processing efficiency, enhancing the security and reliability of BC's immigration system at a critical time (Cerna & Chou, 2023).

- In summary, British Columbia has effectively integrated advanced technological solutions to address environmental challenges and respond to natural disasters. These case studies illustrate how the inclusion of technology in disaster management and migration policies can offer best practices applicable to other regions facing similar challenges (Collins & Friesen, 2022; Shah et al., 2023). BC continues to innovate and adapt, striving to build resilient and efficient systems capable of supporting displaced populations while mitigating environmental crises (Gurung et al., 2021; Patel & Dev, 2023).

6. Comparative Analysis

6.1 Similarities

Both Japan and BC face significant environmental challenges due to their geographical locations, with Japan being prone to earthquakes, typhoons, and floods, and BC experiencing wildfires, floods, and heatwaves (De Haas et al., 2018; Ohta et al., 2024). These natural disasters have led to considerable migration and necessitate robust disaster control and immigration strategies. The increasing frequency and severity of climate change events further complicate timely and effective responses in both regions (Ray, 2022).

Advanced technological solutions have been incorporated into disaster response management and immigration policies in both Japan and BC (Garcia-Sitton, 2024). Technologies such as GIS, satellite imagery, mobile applications for emergency communication, and blockchain for secure migrant documentation enhance disaster response and management by providing real-time data, improving communication, and maintaining integrity and efficiency in the immigration process (Gao, 2023; Muranaka, 2024; Rishworth et al., 2024).

Both regions face similar gaps in the integration of advanced technologies. Adhikari and Plotnikova (2023) noted that the adoption and implementation of these technologies are not uniform across different administrative levels. Challenges related to resources, technical expertise, and interoperability often result in non-seamless integration of technological solutions within policy frameworks (Edison, 2023; Brunner, 2022; Mensah & Williams, 2022). Additionally, policies in both regions require regular updates to keep pace with technological advancements and evolving environmental threats (Naik, 2024; Walton-Roberts, 2023).

6.2 Differences

Despite facing significant environmental challenges, the nature and context of these challenges differ between Japan and BC. Japan requires exceptional preparedness and response techniques for earthquakes and typhoons due to its geographical location (Soroka, 2022). Conversely, BC's challenges are more related to wildfires and heatwaves, necessitating distinct adaptation and mitigation measures. These unique challenges result in different focuses and designs in their respective environmental immigration policies (Lacroix et al., 2020; Sabzalieva et al., 2022).

The technological implementation also differs between the two regions. Japan has a more centralized structure, with significant involvement from the national government in coordinating technological integration into disaster management mechanisms (Hollifield & Foley, 2022a). In contrast, BC's structure is more decentralized, with substantial activity occurring at the provincial and local government levels (Peters et al., 2021). This difference affects the efficiency and effectiveness of technological deployments and integrations in each region.

The effectiveness of technological solutions varies between Japan and BC. Technologies like AI and machine learning for disaster prediction show great promise in Japan for improving preparedness and response capabilities (Berardi et al., 2022). However, challenges such as public acceptance and integration into existing systems persist (Parzniewski, 2021). In BC, GIS and mobile applications have been effectively used for real-time disaster management and communication (Shah et al., 2023). Nevertheless, issues such as resource allocation and equitable access to technology for different communities remain problematic (Shah et al., 2023).

7. Discussion

7.1 Implications of Findings

The current research findings play a significant role in developing future immigration policies, particularly those addressing environmental migration (Hollifield & Foley, 2022a). Technological solutions that streamline disaster management and immigration processes must be prioritized in investments in technology and innovation to effectively address the significant challenges posed by climate change and pandemics (Santos & Mourato, 2022; Winter, 2024). Integrating technology into immigration frameworks can fundamentally enhance system efficiency, transparency, and security (Missbach & Stange, 2023; Patel & Dev, 2023). Lessons learned from successful implementations in regions like Japan and British Columbia can better shape the design and execution of policies in other jurisdictions facing similar environmental threats (Smith & Wesselbaum, 2020). Collectively, these findings support an adaptive, forward-looking approach to immigration policy development, positioning technology as a primary driver of resilience and responsiveness (Istad, 2023).

Beyond the case studies in Japan and British Columbia, the findings have broader implications for managing climate migration worldwide (Choe, 2024; Triandafyllidou & Yeoh, 2023). Integrating technological solutions provides invaluable lessons and best practices applicable globally (Esses et al., 2021). As environmental threats grow worldwide, there is an increasing need for policies and strategies to manage migration induced by climate change (Matsuoka et al., 2022). This study identifies key success factors for integrating

technological solutions, offering valuable lessons for global application (Hollifield & Foley, 2022b). Governments and international organizations should consider environmental disaster preparedness, response, and post-disaster recovery (Chamie, 2020). Additionally, regional cooperation and knowledge exchange can foster the global adoption of innovative strategies for climate migration management, promoting resilience and sustainability (Biswas et al., 2023).

7.2 Limitations

One limitation of this study is its reliance on secondary data sources, which may have limitations in terms of reliability and consistency (Abu-Laban & Nath, 2020; Cerna & Chou, 2023). Although efforts were made to ensure quality and relevance in selecting sources, the inherent constraints of secondary data influence the depth and comprehensiveness of the analysis (Gao, 2023; Walton-Roberts, 2023). Additionally, using qualitative comparative analysis based on secondary data limits the scope of findings and the ability to draw causal conclusions (Leung et al., 2023). Future research could elaborate on this approach by combining it with primary data collection methodologies to bring out more realistic and specific dynamics of the effects of technological solutions in environmental immigration policies (Chatterji et al., 2023; Lacroix et al., 2020).

Another limitation is the potential biases in secondary data sources, such as selective data, publication bias, and the perspectives of data creators or researchers (Kumar & Ojha, 2024; Tamine, 2022). Although rigorous checks were conducted during the review and selection process to minimize biases, secondary data sources remain subjective and potentially incomplete (Barajas, 2023; McAuliffe & Triandafyllidou, 2021; Portes & Rumbaut, 2024). Interpretation of findings should be transparent and mindful of potential biases and limitations that could affect the validity and reliability of research outcomes (Hollifield & Foley, 2022a; Ray, 2022). Triangulating findings from multiple data sources and different viewpoints can help reduce bias and enhance the robustness of the analysis (Kwak et al., 2024).

8. Conclusion

This research on technological solutions for environmental immigration policies in Japan and BC, Canada, highlights several critical points. First, both regions face significant environmental challenges due to natural disasters and climate change, necessitating robust immigration policies (Matsuoka et al., 2022). Second, integrating modern technologies such as satellite imagery, mobile applications, GIS, and blockchain can significantly improve disaster management and immigration processes (Suva et al., 2022). Third, while Japan and BC share similar technological solutions and approaches, the effectiveness of these implementations varies, underscoring the importance of context-specific strategies (Chatterji et al., 2023).

The findings emphasize the necessity of incorporating technological solutions into environmental immigration policies to enhance resilience and responsiveness. Technologies like satellite imagery for forecasting migration trends, mobile applications for real-time communication, GIS for disaster management, and blockchain for secure document processing streamline administrative processes, improve data accuracy and transparency, and facilitate communication and coordination among stakeholders (Gurung et al., 2021). These

interventions enable governments to better prepare for and mitigate the impacts of environmental catastrophes and pandemics (Hollifield & Foley, 2022a).

Future research should focus on several key areas to further develop the understanding and effectiveness of technological solutions for environmental immigration policies. Longitudinal studies are needed to track the implementation and outcomes of techno-fix interventions over time, providing insights into their long-term impacts and effectiveness (Ray, 2022). Comparative analysis across different regions and countries facing environmental issues can reveal cross-cutting trends and best practices (Esses et al., 2021). Additionally, interdisciplinary research that integrates insights from environmental sciences, public policy, and technology innovations can offer holistic approaches to addressing complex migration challenges in a changing climate and during pandemics (Biswas et al., 2023).

By continuing to explore and innovate in this field, policymakers and researchers can contribute to developing more adaptive, equitable, and effective environmental immigration policies in an increasingly interconnected and dynamic world (Chamie, 2020).

References

Abu-Laban, Y., & Nath, N. (2020). Citizenship, multiculturalism, and immigration: Mapping the complexities of inclusion and exclusion through intersectionality. *The Palgrave handbook of gender, sexuality, and Canadian politics*, 507-527.

Adhikari, R., & Plotnikova, E. (Eds.). (2023). *Nurse Migration in Asia: Emerging Patterns and Policy Responses*. Taylor & Francis.

Ang, A., & Tiongson, E. R. (2023). Philippine Migration Journey: Processes and Programs in the Migration Life Cycle. *Background paper prepared for World Development Report 2023*.

Barajas, J. M. (2023). Perceptions, people, and places: influences on cycling for Latino immigrants and implications for equity. *Journal of Planning Education and Research*, *43*(1), 196-211.

Berardi, C., Lee, E. S., Wechtler, H., & Paolucci, F. (2022). A vicious cycle of health (in) equity: Migrant inclusion in light of COVID-19. *Health Policy and Technology*, *11*(2), 100606.

Biagioni, B., Annesi-Maesano, I., D'Amato, G., & Cecchi, L. (2020). The rising of allergic respiratory diseases in a changing world: from climate change to migration. *Expert Review of Respiratory Medicine*, *14*(10), 973-986.

Biswas, U. N., Leach, B., Jijina, P., & Niraula, A. (2023). Lived Experiences of Skilled Indian Women Immigrants (SIWI) Navigating the COVID-19 Pandemic: Immigration Trajectories to Canada. *Journal of International Migration and Integration*, 1-25.

Brotherhood, T. (2020). *Considering agency in the education-migration nexus: A temporal analysis of structure-agency relations with student-migrants* (Doctoral dissertation, University of Oxford).

Brunner, L. R. (2022). *The ethics of edugration: Canada's higher education-migration nexus* (Doctoral dissertation, University of British Columbia).

Cerna, L., & Chou, M. H. (2023). Talent migration governance and the COVID-19 pandemic: Comparing Germany and Singapore. *Journal of Immigrant & Refugee Studies*, *21*(1), 73-88.

Chamie, J. (2020). International migration amid a world in crisis. *Journal on Migration and Human Security*, *8*(3), 230-245.

Chatterji, M., Luterbacher, U., Fert, V., & Chen, B. (Eds.). (2023). *International Migration, COVID-19, and Environmental Sustainability*. Emerald Publishing Limited.

Choe, D. (2024). Challenges in psychological wellbeing for korean newcomer immigrant adolescents during the COVID-19 pandemic. *Current Psychology*, 1-14.

Collins, F. L., & Friesen, W. (2022). Excess aspirations: Migration and urban futures in post-earthquake Christchurch. *Urban Studies*, *59*(16), 3253-3270.

Cruz, C. J. P., Ganly, R., Li, Z., & Gietel-Basten, S. (2020). Exploring the young demographic profile of COVID-19 cases in Hong Kong: Evidence from migration and travel history data. *PLoS One*, *15*(6), e0235306.

De Haas, H., Natter, K., & Vezzoli, S. (2018). Growing restrictiveness or changing selection? The nature and evolution of migration Policies1. *International Migration Review*, *52*(2), 324-367.

Dewey-Lambert, P., Gattinger, M., Hobbs, J., Kerr, W., Lilly, M., & Moroz, A. (2021). *Canada's Fluid Borders: Trade, Investment, Travel, Migration*. University of Ottawa Press.

Edison, E. (2023). Exploring the Migration Policies and Dependency Patterns among G20 Nations: From Global Financial Crisis to Global COVID-19 Crisis. *India & the G20: Legacy & Prospects for Multilateralism amidst a Polycrisis*, 109.

Elejalde, E., Ferres, L., Navarro, V., Bravo, L., & Zagheni, E. (2024). The social stratification of internal migration and daily mobility during the COVID-19 pandemic. *Scientific Reports*, *14*(1), 12140.

Esses, V. M., Sutter, A., Bouchard, J., Choi, K. H., & Denice, P. (2021). North American attitudes toward immigrants and immigration in the time of COVID-19: the role of national attachment and threat. *The ANNALS of the American Academy of Political and Social Science*, *697*(1), 148-173.

Gafter, L., Tchetchik, A., & Shilo, S. (2022). Urban resilience as a mitigating factor against economically driven out-migration during COVID-19: The case of Eilat, a tourism-based city. *Cities*, *125*, 103636.

Gao, Z. (2023). The politics of Chinese immigrants' double unbelonging and deglobalization. *Theory & Psychology*, *33*(2), 266-283.

Garcia-Sitton, I. (2024). Policy Making in Times of Crisis: The Case of Immigration and International Students in Canada During the COVID-19 Pandemic.

Gurung, T. W., Amburgey, E., & Craig, S. R. (2021). Unsettling the American Dream: Mobility, Migration and Precarity among Translocal Himalayan Communities during COVID-19. *Development and Change*, *52*(6), 1277-1300.

Harima, A. (2022). Transnational migration entrepreneurship during a crisis: Immediate response to challenges and opportunities emerging through the COVID-19 pandemic. *Business and Society Review*, *127*, 223-251.

Hollifield, J. F., & Foley, N. (2022a). Migration interdependence and the state. *Understanding global migration*, 3-28.

Hollifield, J. F., & Foley, N. (Eds.). (2022b). *Understanding global migration*. Stanford University Press.

Irudaya Rajan, S., & Arcand, J. L. (2023). COVID-19 return migration phenomena: experiences from South and Southeast Asia. *Journal of Ethnic and Migration Studies*, *49*(20), 5133-5152.

Istad, F. (2023). Rethinking Migrant Hierarchies: Non-Citizen Political Engagement and Policy Cycles in South Korea. *Korea Observer*, *54*(1).

Jolivet, D., Fransen, S., Adger, W. N., Fábos, A., Abu, M., Allen, C., ... & Zickgraf, C. (2023). COVID-19 responses restricted abilities and aspirations for mobility and migration: insights from diverse cities in four continents. *Humanities and Social Sciences Communications*, *10*(1), 1-13.

Koskela, K., & Beckers, P. (2024). Typologizing Digital Nomad Visas: Comparing Policy Rationales from Tourism to Wealth Accumulation to Immigration. *Journal of Comparative Policy Analysis: Research and Practice*, 1-19.

Kumar, B. N., & Ojha, S. (2024). Migration policy and global health: past, present, and future. In *Handbook of Migration and Globalisation* (pp. 88-108). Edward Elgar Publishing.

Kwak, M. J., Kwon, E., Lo, L., & Jung, G. (2024). Transculturality, Anti-Asian Racism and Student Mobility: A Case Study of Chinese International Student Experiences during the COVID-19 Pandemic 1. *Sociological Inquiry*, *94*(2), 425-452.

Lacroix, T., Hombert, L., & Furri, F. (2020). Migration and municipal militancy in the Mediterranean.

Leung, D., Lee, C., Wang, A. H., & Guruge, S. (2023). Immigrants' and refugees' experiences of access to health and social services during the COVID-19 pandemic in Toronto, Canada. *Journal of Health Services Research & Policy*, *28*(1), 34-41.

Matsuoka, S., Kharel, M., Koto-Shimada, K., Hashimoto, M., Kiyohara, H., Iwamoto, A., ... & Fujita, M. (2022). Access to Health-Related Information, Health Services, and Welfare Services among South and Southeast Asian Immigrants in Japan: A Qualitative Study. *International Journal of Environmental Research and Public Health*, *19*(19), 12234.

McAuliffe, M., & Triandafyllidou, A. (2021). Word migration report 2022.

Mello, R., Erro-Garcés, A., Dickmann, M., & Brewster, C. (2023). A potential paradigm shift in global mobility? The impact of the COVID-19 pandemic. *International Business Review*, 102245.

Mensah, J., & Williams, C. J. (2022). Socio-structural injustice, racism, and the COVID-19 pandemic: A precarious entanglement among Black immigrants in Canada. *Studies in Social Justice*, *16*(1), 123-142.

Missbach, A., & Stange, G. (2023). The COVID-19 pandemic,(im) mobilities, and migration in Southeast Asia. *Advances in Southeast Asian Studies*, *16*(1), 1-16.

Muranaka, A. (2024, January). Being a Foreigner During the COVID-19 Pandemic: Researcher Positionality in Online Interviews. In *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research* (Vol. 25, No. 1).

Naik, M. (2024). Tracing Internal Migration Governance in India Through a 'Mainstreaming'Lens. *Urbanisation*, 24557471241234973.

Ohta, R., Yakabe, T., & Sano, C. (2024). Addressing health challenges in rural Japan: a thematic analysis of social isolation and community solutions. *BMC Primary Care*, *25*(1), 26.

Palattiyil, G., Sidhva, D., Seraphia Derr, A., & Macgowan, M. (2022). Global trends in forced migration: Policy, practice and research imperatives for social work. *International Social Work*, *65*(6), 1111-1129.

Parzniewski, S. (2021). *The role of migration and diversity in building disaster resilience: a case study of Birmingham (UK) and Toyama (Japan)* (Doctoral dissertation, University of Birmingham).

Patel, I., & Dev, A. (2023). What is prenatal stress? A scoping review of how prenatal stress is defined and measured within the context of food insecurity, housing instability, and immigration in the United States. *Women's Health*, *19*, 17455057231191091.

Peters, M. A., Hollings, S., Zhang, M., Quainoo, E. A., Wang, H., Huang, Y., ... & Green, B. (2021). The changing map of international student mobility. *ACCESS: Contemporary Issues in Education*, *41*(1), 7-28.

Portes, A., & Rumbaut, R. G. (2024). *Immigrant America: a portrait*. Univ of California Press.

Ray, D. (2022). *Federal policy evolution, newcomer integration and data reporting: the strengths and weaknesses of Canadian immigration policy* (Doctoral dissertation).

Rishworth, A., Wilson, K., Adams, M., & Galloway, T. (2024). Landscapes of inequities, structural racism, and disease during the COVID-19 pandemic: Experiences of immigrant and racialized populations in Canada. *Health & Place*, *87*, 103214.

Rychlowska, M., Miyamoto, Y., Matsumoto, D., Hess, U., Gilboa-Schechtman, E., Kamble, S., ... & Niedenthal, P. M. (2015). Heterogeneity of long-history migration explains cultural differences in reports of emotional expressivity and the functions of smiles. *Proceedings of the National Academy of Sciences*, *112*(19), E2429-E2436.

Sabzalieva, E., El Masri, A., Joshi, A., Laufer, M., Trilokekar, R. D., & Haas, C. (2022). Ideal immigrants in name only? Shifting constructions and divergent discourses on the international student-immigration policy nexus in Australia, Canada, and Germany. *Policy Reviews in Higher Education*, *6*(2), 178-204.

Santos, C., & Mourato, J. M. (2022). Voices of contention: the value of development narratives in the age of climate (change) migration misconceptions. *Climate and Development*, *14*(1), 13-24.

Santos, R. V. P. D. S., Cruz Neto, J., Bacelo, S. R., José, O. Y. F., Vergara-Escobar, O. J., Machuca-Contreras, F., ... & de Sousa, A. R. (2024). Migrant Men Living in Brazil during the Pandemic: A Qualitative Study. *International Journal of Environmental Research and Public Health*, *21*(1), 109.

Saraswati, D. P., Darmastuti, S., & Raharjo, P. (2024). Migrant Workers and Policy Implication within the G20 Framework. *Journal of Social and Political Sciences*, *7*(1).

Schinnerl, S. (2021). *The influence of higher education on immigration policy in Canada* (Doctoral dissertation, University of British Columbia).

Shah, S., Sindakis, D. S., & Kaur, D. J. (2023). Reimagining global talent management for talented migrants in a post-Covid-19 World. *Available at SSRN 4600110*.

Smith, M. D., & Wesselbaum, D. (2020). COVID-19, food insecurity, and migration. *The Journal of nutrition*, *150*(11), 2855-2858.

Soroka, T. (2022). Canada's Temporary Labor Migration Policy: The Case of Mexican Seasonal Agricultural Workers. *Politeja-Pismo Wydziału Studiów Międzynarodowych i Politycznych Uniwersytetu Jagiellońskiego*, *19*(81), 279-303.

Sorrell, E. M., & Ferris, E. (2021). The impacts of pandemics on migration. *The societal impacts of COVID-19: A transnational perspective*, 113-132.

Suva, C., Liu, J., Sigurdson, E., Torio, J. E., & Benson, O. G. (2022). A case study of community-based, cross-sectoral crisis response to the COVID-19 pandemic: serving racialized immigrant communities. *Global Social Welfare*, *9*(3), 193-202.

Tamine, S. (2022). *WHAT IMPACT HAD THE COVID-19 ON THE INTERNAL MIGRATION AND ON THE REAL ESTATE PRICES?* (Doctoral dissertation, Politecnico di Torino).

Triandafyllidou, A., & Yeoh, B. S. (2023). Sustainability and resilience in migration governance for a post-pandemic world. *Journal of Immigrant & Refugee Studies*, *21*(1), 1-14.

Walton-Roberts, M. (2023). The future of health care work and the place of migrant workers within it: internationally educated nurses in Ontario Canada during the COVID-19 pandemic. *Journal of Immigrant & Refugee Studies*, *21*(1), 59-72.

Winter, E. (2024). Middle class nation building through immigration?. *Journal of Ethnic and Migration Studies*, 1-30.

Xia, R. (2022). A Review of Trade, Finance, Migration Openness and Environmental Quality under Globalisation. *Journal of Sociology and Ethnology*, *4*(10), 34-49.

Zhan, S., Huang, L., & Zhou, M. (2022). Differentiation from above and below: Evolving immigration policy and the integration dilemma in Singapore. *Asian and Pacific Migration Journal*, *31*(1), 3-25.

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