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Social innovation and disaster risk reduction in Japan: challenges and opportunities

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Abstract

In Japan, enhancing resilience towards disaster risk reduction (DRR) has primarily been interpreted as preparing the target population for risks within the built environment to mitigate the impact of the disasters. This approach has prioritized infrastructural safety as the prime focus of disaster management, reflecting societal needs of Japan to secure the evacuation of those affected and their accommodation in safe shelters. The longevity of the population, coupled with the issue of a declining birth rate, has made Japan increasingly vulnerable. Hazardous impacts of climate change demand social innovation in the framework of DRR and the Sustainable Development Goals in consideration of climate change adaptation. This study reviews the role of social innovation in DRR to place Japan's case in a global context for a sustainable, resilient society. The Japanese research works on social innovation that have not been fully introduced so far are examined extensively. It critically evaluates the impact of stakeholder engagement in DRR through active grassroots engagements in Japanese society. Three case examples were examined through semi-structured in-depth interviews to assess the impact of social innovation in engaging stakeholders in civil society towards DRR by elaborating on their means and focusing on organizational, social, and individual spheres of resilience. The study finds that social innovation can be impactful in mitigating risks and enhancing resilience for DRR with a regional focus. This study contributes to the field of disaster science by highlighting the role of stakeholders in creating and ensuring a participatory and sustainable ecosystem for enhanced resilience. The existing framework of social innovation and DRR in society underscores the necessity of human interactions for effective stakeholder involvement. The conceptual framework of the study indicates that engagement of stakeholders in social innovation leads to systemic change and institutionalization of society while harnessing the principle of social inclusion.

Keywords: Social innovation, disaster risk reduction, resilience, civil society, communities, Japan

INTRODUCTION

Overview of Japan's vulnerability to disasters and the importance of disaster risk reduction

Key social themes shaping Japan's social landscape are (1) aging society; (2) disaster reconstruction; and (3) local agricultural revitalization[1]. The Great East Earthquake and Tsunami of 11th March 2011 resulted in 56% of the deaths from the elderly (65 years and older) group[2]. Community social capital is crucial as it mitigates the risk of post-disaster cognitive decline, while informal socializing buffers the impact of disaster experiences. Japan has a strong drive to promote social innovation towards achieving the sustainable development goals (SDGs), especially given its declining birthrate and aging society[3]. The aging population and depopulation in Japan have made it challenging for local communities to maintain sufficient personnel for serving the community during disasters. The 2011 Great East Japan Earthquake and Tsunami served as a major catalyst for the Government of Japan. The powerful 9.0-magnitude earthquake caused widespread damage to Japan's eastern coastal region, and the subsequent tsunami devastated the coastal areas of Tohoku and southern Hokkaido, resulting in the majority of the 15,848 lives lost in the disaster. Following the massive earthquake and tsunami, an accident at the Fukushima nuclear power plant was reported as a potential Public Health Emergency of International Concern, leading the International Nuclear Event Scale to be raised to the highest Level 7[4]. Before 2011, social innovation was primarily considered part of corporate social responsibility, encouraging corporate social innovation.

The safety of the built environment is prioritized to secure the following three basics post-disasters:

1. Infrastructural robustness: In Japan, the concept of disaster risk reduction (DRR) has been predominantly interpreted in terms of enhancing infrastructural resilience.

2. Urgency for reconstruction: At the national level, the ministry of land, infrastructure, transport and tourism (MLIT) considers addressing infrastructural challenges as vital and urgent.

3. Saving human lives: Japan has revised and amended its legislative framework for disaster management primarily to protect human lives against disasters.

This response is driven not only by the significant impact and damage caused by past mega disasters but also by the increasing frequency of climate change-induced regional incidences such as rain-induced disasters in Japan. The Cabinet Office (2022) updates on recent disasters indicate that evacuation advisories and instructions are updated to include river flooding, landslides, storm surges, tsunamis, and volcanic eruptions. Based on lessons learned from the series of floods and landslides in 2004, the "Evacuation Recommendations, *etc*." was introduced in 2005. New information, such as landslide warning information, was developed in 2014, and lessons from disasters such as the Great East Japan Earthquake were incorporated in 2015. The devastating landslide in Hiroshima City (2017), heavy rains damaging elderly care facilities in the Kanto and Tohoku regions (September 2015), and Typhoon No. 10 (2016) led the Cabinet Office to revise the guidelines. Special heavy rain warnings were issued for 11 prefectures in July 2018, causing river flooding and landslides in Okayama, Hiroshima, and Ehime prefectures, with over 200 people dead or missing: this was the first time since the heavy rains of August 1981 when the death toll exceeded 100[5]. The Japan Meteorological Agency (2023) reports extreme weather impacts such as torrential rains of July 2020 and August 2021 and heat waves of June-July 2022 in Japan[6]. In 2012, the Association of Planning Administration in Japan emphasized social innovation as "one of the most important key concepts in rebuilding and improving public policy in current society" to create "a new policy design and conduct planning based on innovative technology"[7].

Conceptual elements of social innovation

The concept of "Innovation" is inherently future-oriented, implying a continuous generation of new ideas and practices aimed at societal transformation, though the concept of innovation itself has a past, a history[8]. Godin (2019) maintains that the concept of innovation has been historically viewed as pejorative and contested, with distinctions made between different types of innovation, regarded as moral by most writers on innovation[9]. Such rhetorical practice persists even today. In the context of social innovation, "innovation" aims to infuse social aspects with innovative elements, while "social" aims to integrate social dimensions into innovation[9]. Thus, "innovation" in "social innovation" equates "social" or societal novelty (socialism) to innovation, potentially categorizing it pejoratively. The "social" aspect in "social innovation" differentiates it from other types of innovation, emphasizing its public or participative nature which is distributive and beneficial.

Van der Have and Rubalcaba (2016)[10] acknowledge that the field of social innovation research is "not yet well integrated and consolidated" but highlight two "core conceptual elements":

1. Social innovation encompasses changes in social relationships, systems, or structures.

2. Such changes serve shared human needs/goals or solve socially relevant problems.

Thus, social innovation aims to find solutions to social challenges, which possibly results in changes in social relationships, systems, or structures.

Positioning "Social" innovation

Schumpeter (1934) defines "innovation" as a new combination of novel elements not previously available in the system, such as new products, production methods, markets, sources of raw materials, and organizational ways[11]. Mumford (2002) describes "social innovation" as innovations that address societal issues, involving the development and dissemination of new ideas that serve social objectives in the form of new, revolutionary activities and services through organizations that primarily focus on meeting social needs[12]. Mulgan (2007) views "social innovation" as innovations generated by society, involving the creation and implementation of new ideas related to the organization of interpersonal activities or social interactions to achieve common goals[13]. This approach of social innovation emphasizes relationships, collaborations, implementation, and execution. Figure 1 summarizes the research framework for this study.

The paper focuses on stakeholder engagement in regional settings in Japan to highlight "innovations generated by society" indicated in Figure 1, with the three case examples: (1) product generated by community; (2) digital process generated by community; and (3) financial approach generated by community.

The problem: adapting SDGs - bridging social innovation and disaster risk reduction

Sustainability becomes a central theme for social innovation when community-based or grassroots initiatives strive to maintain momentum over time through local community participation[14]. The adoption of the United Nation's SDGs in 2015 has underscored the importance of integrating social innovation into DRR, as several SDGs are directly related to achieving DRR. Incorporating SDGs indirectly promotes social innovation as a key component of DRR, where consideration for risk-informed sustainable development will be vital[15,16]. Effective disaster risk management, which addresses both current and future risks, against increasing disaster loss and impacts, can contribute to poverty alleviation and sustainable development through public-private sector partnerships, thereby enhancing resilience[17].

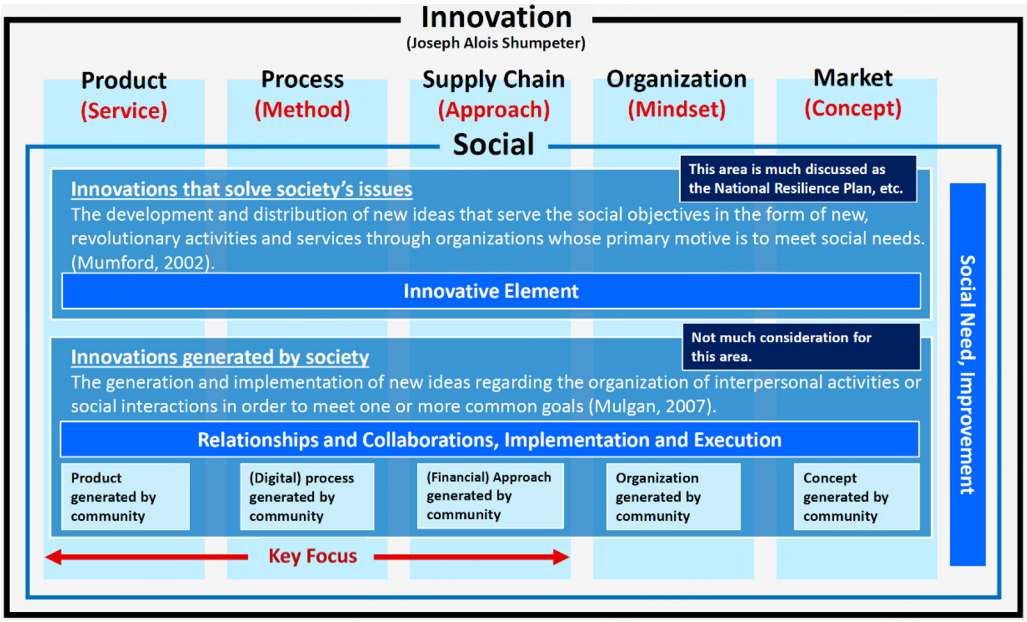

Figure 1. Positioning "Social" innovation. Source: Authors.

Yamazaki-Honda (2022), in her review article titled "Promoting Coherence Among Disaster Risk Reduction, Climate Change Adaptation, and Sustainable Development for Disaster Resilience", points out that DRR, SDGs, and climate change adaptation could be observed to be interrelated in the global agendas post-2015[18]. The goals set by the United Nation's Sendai Framework for Disaster Risk Reduction 2015-2030[19], the Paris Agreement[20], and the 2030 Agenda for Sustainable Development[21] urged all nations to focus on combating climate change by accelerating and intensifying the actions and investments for a sustainable low carbon future for all nations[22].

In Japan, significantly, Local Disaster Management Plans have been updated at every level while the Cabinet Office oversees regular monitoring of disaster damage and policy progress as well as collecting and compiling disaster-related information from various ministries and local governments of 47 prefectural governments and more than 1,700 municipalities[22]. Anticipating one-third of the population in Japan in 2036 to be over 65 years old, individual evacuation plans for the elderly population have been developed while improving the living conditions of evacuation shelters to make sure "no one is left behind"[23] embodying the global pledge of the SDGs. Significantly, "coherence of disaster risk reduction and sustainable development policies, plans and practices and mechanisms, across different sectors" (p.35)[19] is one of the Guiding Principles of the Sendai Framework for Disaster Risk Reduction 2015-2030.

Research gap

Japanese experiences towards DRR highlight the importance of multiple stakeholders with technological innovation with interdisciplinary or transdisciplinary approaches[18]. It should also be acknowledged that social innovation so far has been discussed in view of effectiveness in technological intervention and digitalization. Grassroots and community-based aspects have not been extensively discussed in the context of social innovation in DRR in Japan. It is important to distinguish social innovation from Community-Based Disaster Risk Reduction (CBDRR). The impact of stakeholder involvement in DRR needs to be considered as the beneficiaries could also contribute to enhancing DRR through active grassroots engagements at various community levels. The role of social innovation should be examined through the

following phases, addressing the question, "How can social innovation be utilized for DRR issues in Japan?"

This study explores the missing link of the role and effectiveness of the public in the broad framework of DRR exemplified as community engagement and citizen participation in Japan.

This study identifies two significant research gaps:

RG1: Practical steps for DRR with elements of social innovation in Japan

The literature reveals a scarcity of studies on social innovation for DRR[24]. Discussions on innovation tend to be about products applied to advanced technology, but they could also center around approaches to DRR. A survey of 228 experts from academia, government, non-governmental organizations (NGOs) and the private sector, conducted by Izumi *et al.* (2019), resulted in the collection of 30 innovations, where Community-Based Disaster Risk Reduction (CBDRR), an approach to DRR, was chosen as the most effective innovation, indicating that enhancing DRR leads to a people-centered inclusive approach[25].

This study aims to analyze how elements of social innovation are integrated into the practical steps taken towards DRR by various social actors in Japan.

RG 2: Social innovation as community-based project management

Given Japan's status as a disaster-prone, aging society, social innovation in DRR is particularly crucial in technologically less-developed rural areas[26]. This study primarily focuses on community-based or grassroots social innovation which is less discussed in Japan. Community-based project management can be considered as an embodiment of social innovation in DRR.

Contributions to the scientific community

Hulgård and Ferreira (2019) assert that "social innovation is ultimately a change in power relations" (p.29) and argue that (1) New Public Governance (state-society relations); (2) volunteerism; (3) social movement; and (4) privatization could be taken into consideration in the study of contemporary cases of social innovation[27]. This study reviews preceding studies on social innovation in the field of DRR and outlines the focus of recent research works in the light of sustainability in Japan. The three case studies from Japanese civil society illustrate how positioning "social innovation" has enabled civil society organizations to co-create innovative services, methods, and approaches by engaging stakeholders.

THE LITERATURE REVIEW ON SOCIAL INNOVATION IN DISASTER RISK REDUCTION

Several benefits of social innovation in enhancing disaster preparedness are noted in the study of social innovation in DRR in Japan. First, it is essential to recognize that the concept of social innovation has been defined in various ways. Second, the body of published work on social innovation and DRR to enhance disaster preparedness is relatively limited. Third, because of the above two reasons, further research on the anticipated social aspects and effects of social innovation in DRR will be meaningful. This section aims to reveal major discussion points to be reflected upon in the context of social innovation and DRR in Japan.

Social innovation and community engagement

Kusakabe (2013) explores the concept of achieving local agendas through citizen participation, known as *Machizukiri*, where Japanese citizens engage in community planning exercises[17]. Innovation, identity-building, and networking are crucial dimensions for understanding and addressing societal needs.

Social innovation in Japan as entrepreneurial activities

Ito (2017) points out the role of social enterprises and non-profit organizations (NPOs) in Japan as sources of social innovation, creating "systemic changes in society such as new social systems, legal systems, and business models" that could serve as "models for third-sector entities in other Asian countries with developed welfare states"[28].

Kaneko (2013) notes that the concept of social innovation gained mainstream attention at the beginning of the 21st century. Entrepreneurial activities emerged as countermeasures when government responses to societal problems post-disaster were insufficient[29]. Notable characteristics of these activities can be observed in the three phases of the time period as follows:

1. In the first half of the 20th century: cooperatives and neighborhood associations.

2. At the end of the 1970s: community and social businesses.

3. In the 2000s: non-profit and for-profit organizations[29].

Furuzawa (2015) surveyed the cohort of 6,854 enterprises, finding that 1,618 were initiated in the past year, out of which 424 were identified as social enterprises. Furuzawa highlights the challenges in managing social enterprises in Japan and questions the observation of Kaneko (2013)[29] who asserts that the level of innovation in social enterprises is increasing. Furuzawa notes that many projects remain financially unsustainable, relying on subsidies, donations, and other sources of project income to maintain their operations. Collaborations with corporate entities, nurturing and securing human resources, and producing innovative products and services can help social enterprises achieve their project goals[30].

Aoo (2019) emphasizes that many social innovators in Japan may not necessarily use the term "social innovation", although their focus is on specific issues, creating real social impact[31].

Fujisawa *et al.* (2017) connect the theoretical basis of "social innovation" with "social aspects of innovation", "social entrepreneurship" and "social capital", emphasizing that preceding research in Japanese contexts found that "bridging" social capital has a greater positive impact than "bonding" social capital for fostering creativity in regional innovation, which is crucial for understanding how Japanese society has responded to disasters[32].

Emergency relief post-mega disasters and community social capital

The Disaster Countermeasures Basic Law (Act No. 223) was enacted in 1961, with the primary focus "to protect human life or body from disaster" and mandating that the mayor of a municipality shall, if necessary, "instruct it to leave for evacuation"[5].

Avenell (2013) emphasizes that it is important to note that the post Hanshin-Awaji Earthquake period marked the year 1995 as "Year One of the Volunteer Age (*Borantia Gannen*)". The disaster of January 1995 mobilized unprecedented 1.3 million volunteers by December 1995, including many young people traveling from all over Japan, referred to as the "Revolution of Volunteers (*Borantia Kakumei*)"[33]. This development significantly created a great impetus for participatory approaches to post-disaster reconstruction, filling the gaps where administrative bodies could not adequately respond during the emergency relief, rehabilitation, and reconstruction stages.

Hikichi *et al.* (2020) argue that the major impetus for incorporating the concept of social innovation in DRR in Japan manifested in 2011 due to the Great East Japan Earthquake and Tsunami in the Tohoku region. In the aftermath of the triple disasters - earthquake, tsunami, and nuclear power plant incidents - it was observed that *community social capital* reduced the risk of cognitive decline, and community informal socializing buffered the impact of disaster experiences. In the context of an aging society, disaster reconstruction should be planned with regional revitalization in mind. The potential transition from nuclear to renewable energy has also become part of the post-3.11 dialogue in Japan[2].

Trejo-Rangel *et al.* (2023) claim that reduction of vulnerability and susceptibility against increasing disasters should be prioritized as apparent impact of climate change while still "a lack of adequate public policies towards disaster risk reduction (DRR)" is acknowledged. This could be addressed by social innovation, defined as "a process for changing the relationships, positions, and rules between the involved stakeholders through an open process of participation, exchange, and collaboration, crossing organizational boundaries and jurisdiction, to address social problems" (p.2)[24].

Policy directions of Japan: Society 5.0 and technological intervention

The following four aspects are critical in reviewing how policy changes have marked thresholds in the ecosystem of social innovation in Japan.

1. Law on promoting NPOs (1998)

2. Social Business Promotion Initiative (2007)

3. Reconstruction Agency (2012)

4. Society 5.0

This implies that region-specific interpretation of social innovation in Japan is vital.

The key idea behind Japanese Society 5.0 is to develop a human-centric society, balancing economic advancement and resolution of social issues and a meaningful flow of information from cyberspace into physical space. Society 5.0 broadly deals with technology-mediated relationships between individuals and society, conceptualized at the Japanese policy level through the implementation of the 5th Science and Technology Basic Plan (2016-2020) to make Japan "the most innovation-friendly country in the world" where the Comprehensive Strategy on Science, Technology, and Innovation (2017) is part of this basic plan[34].

Rojas *et al.* (2021) maintain that Society 5.0, envisioned as a superintelligent society, aims to enhance the potential of the individual-technology relationship through sustainable digital innovation, thereby improving the quality of life[35].

Godin (2018) identifies market ideology, legitimization by public authorities, and consumerism as three fundamental pillars underpinning technological innovations. In the context of Disaster Risk Management (DRM) policies within Society 5.0, technological interventions are prioritized for disaster mitigation and prevention. The Government of Japan established the Reconstruction Agency as a preliminary body to expedite disaster reconstruction and revitalization efforts[8].

Deguchi *et al.* (2020) explain that data accumulated in cyberspace are selected and processed for specific purposes or actions[36]. This information transforms into knowledge - generalized observations derived from individual cases - "that enables you to make a decision, allows you to surmise the causes of a problem, and it also helps you to derive solutions to address these causal factors" and "the more knowledge you have, the more equipped you are to derive a judicious information-based decision" (p.11)[36]. A significant challenge of Society 5.0 is achieving an optimal balance between societal and individual needs in policy proposals or technological developments.

Society 5.0 primarily leverages new digital technologies. Social innovation in the context of DRR focuses on disaster mitigation and prevention through human-centric transformation, aiming to achieve economic growth, technological development, and sustainability as common goals.

Kanbara and Shaw (2021) maintain that proper synchronization and customization of open data and use of emerging disruptive technologies for DRR necessitate consensus building and coordination with the citizens and stakeholder participation in data gathering; data management, analysis and interpretation require transparency and ownership of the data; and the governance mechanism of the data management, usage, and analysis is essential for rapid response and decision-making before, during, and after a disaster[37].

Ghinoi and Omori (2023) find the relationship between top-down decision-making led by expert knowledge and bottom-up initiatives in civil society is not necessarily mutually exclusive. In Japan, expert knowledge values bottom-up approach, which is not merely a manifestation of support for neo-liberal policies[38]. Expert knowledge in Japan serves two distinct functions: (1) as the foundation of a technocratic paradigm that justifies neoliberal policies; and (2) as a bridge between institutions and civil society in the policymaking process.

Given Japan's aging society, political parties must consider perspectives beyond their traditional political lineage. This context fosters social innovation as a positive phenomenon and encourages political parties to share similar policy visions to address social issues. Although the Liberal Democratic Party traditionally favors market-oriented approaches, it supports expanding social benefits for specific social groups to cope with population aging, leading to increased policy similarities across political parties.

The actors and the role of institutions in DRR

Social entrepreneurship and sustainability have emerged as crucial themes for the reconstruction of society and the economy in affected regions. The United Nations Office for Disaster Risk Reduction (UNDRR) (2015) explored the links between DRR and development in the context of the 2030 Agenda for Sustainable Development and the Sendai Framework for Disaster Risk Reduction 2015-2030. They offered four perspectives: (1) understanding what DRR means for SDGs; (2) highlighting opportunities to reduce disaster risk; (3) building a resilient future; and (4) achieving goals and targets through the implementation of both the 2030 Agenda for Sustainable Development and the Sendai Framework[16].

In Japan, the discourse on social innovation in DRR involves NPOs, local and national authorities, for-profit organizations, universities (social innovation clusters), sole proprietors, and unions. Initiatives such as planning sustainable cities, establishing renewable energy products, and revising local systems through active intervention by municipal/prefectural administration, such as the Hokkaido Green Fund, emphasize citizen participation with the help of administrative apparatus.

And it is important to note that key trends of social innovations include:

(a) Transitioning from Corporate Social Responsibility (CSR) to Corporate Social Innovation (CSI)

(b) Promoting social finance and citizen funds

(c) Fostering regional revitalization, and

(d) Adopting people-centric and sustainability-oriented approaches

Ishigaki and Sashida (2013) examined the social innovation process through four case studies, introducing the following two concepts:

1. A community-based value chain for fostering new relationships to solve social problems.

2. A participatory smart community for achieving new forms of mutual assistance among residents through Information and Communication Technology (ICT)[39].

Engaging social actors in Japan is challenging due to depopulation, which results in a shortage of young individuals who can serve as resource persons and volunteers. However, Japanese social innovation offers several distinctive qualities that can contribute to regional revitalization.

Aoo (2019) highlights the following distinctive features of social innovation in Japan:

1. Provision of diverse services tailored to community needs.

2. Frequent successful multi-sectoral collaborations, particularly at local and municipal levels.

3. Implementation of innovative fundraising methodologies, including crowdfunding, collective investment by the general public, and taxation diversion schemes to support specific projects, albeit in a limited number of cases.

4. Initiation of small-scale projects with a specific geographical or a limited number of stakeholders, targeting particular beneficiary groups with specific issues[31].

The role of project management in positioning social innovation

It is important to note that most cases focusing on social innovation involve the "utilization of advanced technological innovations" to address social issues. In a survey of companies listed on the first section of the Tokyo Stock Exchange (CSR White Paper) in 2020, more than 80% of companies reported that they have achieved social innovation[40]. However, the results were skewed, emphasizing technological development and collaboration with external organizations as their achievements. Larger companies were more likely to report having "realized" social innovation. This contrasts sharply with reports by the Japan International Cooperation Agency (JICA) on DRR, namely, *Disaster Resilient Society for All-JICA's Cooperation for Disaster Risk Reduction* (2017)[41] and *JICA Handbook for Mainstreaming Disaster Risk Reduction (DRR)* (2015)[42], which do not mention "innovation" at all. Involving communities within the framework of Community-Based Disaster Risk Management (CBDRM) often positions them as beneficiaries rather than

active stakeholders in society who could also make some contributions.

The 2011 disaster prompted corporate entities to initiate social innovation to address social problems identified in specific regions or communities, thereby generating new value for the community and cultivating new business opportunities. Some examples include:

(1) ICT-enabled machibata.net for community participation: Fujitsu led a community-based value chain, particularly involving elderly people and other local stakeholders, to foster mutual assistance in solving social problems, with ICT playing a key role[43].

(2) Sustainability transformation (SX): Following the COVID-19 pandemic, Fujitsu shifted its focus to collaboration with academia, supporting projects of labs from leading universities, both national and private, across Japan. This initiative promotes "sustainability transformation (SX)" among industry leaders as "change makers", emphasizing the nurturing of in-house talents as intrapreneurs who innovate and create new business opportunities through digitalization. The goal is to contribute to the environment, the economy and societal well-being[44,45].

(3) Corporate fundraising for disaster reconstruction: Yamato Group, a logistics and consumer-to-consumer service, developed an innovative donation program where 10 yen from every parcel is donated towards disaster restoration efforts. By the end of the year, this amounted to 40% of the yearly net income of the Yamato group, a significant corporate donation sum that was so huge and unheard of before[46].

It is significant to note that corporate entities consider social innovation to be achieved by nurturing in-house talents who can innovate and initiate new businesses. They aim to work towards a sustainable society by nursing intrapreneurs within the organizations who also consider market values and impacts. This has marked the transition from CSR to CSI.

How is it possible to involve the civil society in DRR? The authors attempt to examine three case examples of social innovation in Japan to formulate a potential framework dedicated to social innovation with policy implications.

METHODS

The case examples from Japan are anticipated to show the role of stakeholders in creating and ensuring a participatory and sustainable ecosystem for enhanced resilience. Thus, the concept of social innovation necessitates focusing on the actors who enhance DRR in society. The study employs a qualitative research method based on case studies, as indicated by prior scholarly works[47]. Bearman (2019) emphasizes that semi-structured interview schedules generating "rich, thick description…could illuminate phenomena of interest" (p.10)[48]. The case examples are selected based on criteria outlined in Figure 1. Drawing from a particular theoretical framework on social innovations has allowed the authors to craft a suitable interview schedule[48].

Relationships and collaborations, as well as implementation and execution, are considered as elements of social innovation across five spheres: service, method, approach, mindset and concept. This study specially focuses on (1) service: products generated by the community; (2) method: digital processes generated by the community; and (3) approach: financial approach generated by the community. The semi-structured interview methodology employed in this study ensures that the questions' objectives were clearly articulated to the interviewees, facilitating more effective cross-case comparisons. Furthermore, by eschewing a fully

structured format, the authors could highlight unique characteristics and areas of interest specific to each case. As Lareau (2021) emphasizes, listening to the interviewees is planned to refine the research focus[49].

Participants for the interviews are chosen from the organizations that have been initiated in their locality and are working for social needs of the local community for whom they have created elements of social innovation in the form of new services, methods, and approaches while preserving local knowledge and experiences.

The interviewees for this study were selected based on the following criteria:

(1) Criteria for selection

(a) Focus on disaster prevention and mitigation: The service or product must be aimed at disaster prevention and mitigation.

(b) Innovative approach: As this study focuses on social innovation, the approach should involve novel combinations of existing elements.

(c) Social creation: The innovation should be created by society, such as through community approaches or citizen interactions, aligning with the context of social innovation.

(2) Selection method

Based on the aforementioned criteria, the authors conducted a search of case examples using internet-based desktop research. In Japan, case studies meeting all criteria are scarce and challenging to identify using common search terms. Consequently, we selected the following cases that demonstrate potential as examples of social innovation in DRR, evaluating them against our established criteria:

(a) Somanobase: This project repurposes ornamental saplings to raise awareness about sediment-related disasters among citizens and private companies.

(b) Data cradle: Their technological platform has been developed as a citizen-participation disaster prevention and mitigation data platform, incorporating open data principles. This could be considered as "technological innovation embedded in the planning and design of resilient built environments…supporting disaster preparedness and effective response" (p.5)[50].

(c) Sanpoyoshi fund: By implementing a social impact bond, a results-linked system, this fund has established a relationship between supported citizen groups and supporting citizens, aiming to enhance disaster prevention and mitigation capabilities in local communities.

(3) Selection of interviewees: For each case, we conducted interviews with four individuals (12 people in total) knowledgeable about all aspects of the initiatives from their inception.

Prior to the interviews, the authors provided participants with a set of predetermined questions. During the interviews, the authors adhered to these questions while maintaining flexibility: whenever interviewees' responses diverge from the initial queries, the authors would not curtail their narratives but rather chose to

delve deeper into their statements, aiming to reveal nuanced details of each case.

Questions for the interviewees consist of the following:

A. Perspectives on engagement

a. How members of civil society to be engaged in DRR?

b. How can communities be effectively involved in DRR processes?

c. What are the challenges and opportunities for Japanese society in enhancing DRR?

B. Perspectives on platforms

a. What kind of collaboration will the initiative create?

b. What is the envisioned scope of this collaboration, and how will it be expanded?

c. What is the role of each actor in the initiative?

C. Perspective on innovation

a. What outcomes does the initiative aim to achieve?

b. What impact will it have on society?

The theme of DRR has been discussed according to the timeframe, namely,

(1) Before disasters: Enhancing disaster preparedness through disaster drills and community shelters that reflect local community needs.

(2) During disasters: Relying on social networks and community bonds to facilitate timely rescue and evacuation interventions.

(3) After disasters: Assessing social engagement in rehabilitation and reconstruction programs with a focus on citizen participation.

This study focuses on the case examples that could cover all the phases by building sustainable community engagement. The three cases are to exemplify social innovation in the context of civil society through community engagement and citizen participation in mitigating risks and enhancing resilience for DRR with a regional focus, with the aim of contributing to suggesting future directions of research on social innovation in linking DRR, SDGs and climate change adaptation[50].

CASE STUDY

The following sections will examine the case examples of social innovation in Japan. By exploring the background of their genesis and their operational mechanisms involving various stakeholders (organizational, social, and individual), the authors aim to highlight how these cases design social innovation to address DRR challenges in the local context.

Case A: Solution-driven SI platform in DRR

Somanobase (https://somanobase.com[51]) engages citizens and businesses in addressing landslide issues by facilitating effective interventions with nature through their products. Their product, *Modorinae*, which translates to "the saplings returning to the earth", is an innovative ornamental plant that matures into a tree over approximately two years. This product provides customers with the opportunity to participate in the nurturing process of a tree sapling, ultimately contributing to forest rejuvenation.

Organizational background: Somanobase, a social venture based in Tanabe City, Wakayama Prefecture, focuses on utilizing forestry as a countermeasure against landslides. The founder's interest in disaster countermeasures was sparked by experiencing torrential flooding during her student years in the 2011 Kii Peninsula disaster. Her involvement in community revitalization activities as a university student led her to explore the relationship between forests and disasters. After gaining experience with a forestry company and an NPO, she established Somanobase. The organization's forestry initiatives aim to improve forest health while simultaneously developing strategies to mitigate landslides. According to the 2017 White Paper of the MLIT, 92% of Japan, consisting of 1,606 out of 1,742 cities/towns/villages at 525,000 locations, has been marked as Sediment Disaster Prone Areas[52].

Goals of their project/product: One of Somanobase's distinctive initiatives is the *Modorinae* product. This program involves customers in a two-year process of nurturing saplings and subsequently planting them in the forest. The objective is to cultivate a sense of disaster preparedness and foster a personal connection to the trees throughout the experience.

Social challenge: Traditional disaster prevention education often fails to generate widespread interest in disaster preparedness. The reduction in interpersonal engagement weakens community bonds, thereby impeding effective disaster prevention measures at the local level. To address this issue, Somanobase seeks to promote the dual message of "taking care of others" and "valuing the presence of others".

Social innovation: The concept of *Modorinae* emerged from collaborative discussions among staff members with diverse backgrounds, including designers and programmers. This initiative aims to foster a commitment to forest conservation through active citizen participation. By 2023, more than 1,000 saplings have been sold, expanding the base of social engagement[53].

(1) Building a community: *Modorinae* focuses on not only growing saplings but also building a community throughout the process. During the sapling-growing period, the company offers seedling consultations and disseminates information via social networking services, simultaneously providing disaster prevention information.

(2) Nurturing trees: The program includes opportunities for participants to visit actual forestry work sites, enhancing their sense of commitment to nurturing saplings.

(3) Financial sustainability: *Modorinae* is priced relatively high to encourage a deeper financial commitment from customers, beyond merely raising seedlings.

(4) In tune with natural environment and culture: The company aims to be deeply rooted in the region's natural environment and culture. Seedlings available in Wakayama are not planted in other areas, ensuring that seedling circulation remains within the region.

(5) Expanding the two-year nurturing process to other regions: *Modorinae* allows locals to engage in a two-year nurturing process. While Somanobase is active in Wakayama and Hokkaido, it seeks partners in other regions to replicate this business model.

For DRR: At the national level, Somanobase seeks to eliminate siloed operations between ministries and agencies. For instance, the MLIT, which oversees disaster prevention and infrastructure development, and the Forestry Agency, which manages forestry, are encouraged to collaborate. Local governments are recognized as essential partners in promoting these initiatives. The private sector is envisioned as a key player in future DRR efforts, while individual citizens are expected to take responsibility for disaster preparedness. Somanobase aims to achieve "zero human casualties from landslides" by enhancing the profitability of the forestry industry through improved mountain management, thereby making the support cycle more resilient against disasters. They raise funds for the forestry industry by creating new value for lumber and increasing public engagement with mountain environments.

a. Engagement perspective: The company is enhancing its commitment to *Modorinae* throughout its growing season by providing buyers with opportunities to learn about disaster prevention and engage with forest conservation efforts.

b. Platform perspective: *Modorinae* serves as a platform that bridges the gap between forests, companies and citizens. The model emphasizes localization by finding regional partners and creating a supportive network as it evolves.

c. Innovation perspective: *Modorinae* integrates the forestry business with landslide mitigation efforts by raising awareness of social issues among citizens and connecting them through the product. Somanobase has created a new revenue stream for the forestry industry while establishing a cycle that enhances the resilience of mountain management against disasters. Their annually renewable corporate product of the set of 24 *Modorinae* saplings has a one-year nurturing period, unlike usual 5-10 years commitment required for corporate forestation projects, enabling them to conduct annual review of corporate accountability towards environmental protection and enhanced carbon neutrality for each financial year. Their employees are invited to join the plantation drive of grown *Modorinae* saplings[54].

Case B: technology-driven SI platform in DRR

Data cradle, Inc. (https://d-cradle.or.jp[55]): This company has developed *MachiCare* (https://machicare.jp[56]), an open data citizen platform for disaster management. *MachiCare* is an information platform that rapidly collects and disseminates essential information from various sources during the recovery and reconstruction phases of towns affected by the disasters.

Organizational background: Data Cradle is a civic tech organization based in Kurashiki City, Okayama Prefecture, dedicated to accumulating data and developing human resources for effective data utilization in the region. Established approximately ten years ago at the request of Kurashiki City, amid concerns about

the impact of artificial intelligence (AI) developments on employment. The organization has since been working to improve data literacy and address data shortages. The organization's predecessor was an NPO that supported the use of technology in the Internet of Things (IoT) era. Over time, they have expanded their activities to specialize in data, leading to the establishment of the current Data Cradle.

The two main pillars of the original project: The project focuses on accumulating local data and developing human resources capable of utilizing that data. It also emphasizes conducting educational activities through data utilization to address various local issues, with the belief that the process of data collection and analysis based on hypotheses and issues is crucial for effective data utilization.

Challenge: The community's slow response to these efforts did not yield the desired effect.

Turning point: The torrential rain disaster in July 2018, later named as the 2018 Western Japan Floods, marked a significant turning point. The experience of supporting data usage in the affected areas underscored the importance of disaster preparedness. The company recognized the residents' awareness and keenness of the residents towards the significance of sharing and utilizing data, not only in disaster responses but also in community activities.

Social innovation: Data Cradle supports community-based activities, such as creating advanced area-specific disaster prevention and individual evacuation plans, and assisting those involved in problem-solving with the help of data, from government policy-making to specific actions by residents.

(1) Enhancing data literacy among the public: Initially focused on training data scientists to initiate regional business in the region, Data Cradle now trains the public to incorporate data utilization into their daily work, providing ongoing support to these individuals.

(2) Data utilization to connect people beyond the community: Data Cradle promotes data utilization not merely for convenience. Recognizing that disaster prevention cannot be achieved solely through government-led initiatives, they strive to create an environment where every resident acts proactively; they motivate the public to engage with the community through data, strengthening community ties beyond geographical boundaries.

(3) Taking charge of one's own data: Data Cradle encourages each resident to adopt a technology-driven approach within the community context. Each citizen learns to own his or her own data and chooses with whom to share it, contributing to the community's well-being.

For DRR: Today, data is stored in various places, and individuals own data in multiple layers. Data Cradle believes that if individuals share his/her data with society as part of bottom-up information sharing, it will ultimately contribute to disaster prevention. The traditional one-size-fits-all approach has limitations due to the diverse lifestyles and work styles of the public. Even in the context of DRR, creating district-based education plans alone will not fully address the needs of various communities with different demographics, such as parents of differently abled children.

a. Engagement perspective: Data Cradle focuses on data usage and ownership by ordinary citizens rather than highly skilled personnel such as data scientists. This activity is designed to enhance citizens' ability to participate in decision-making processes.

b. Platform perspective: Through trials and errors, Data Cradle has developed *Machicare*, a platform to support data sharing among citizens post-disaster, acting as a catalyst.

c. Innovation perspective: Data Cradle aims to establish a system where each citizen can "master data" in anticipation of situations where cooperation among local communities may not suffice for comprehensive disaster prevention due to their geographical proximities with other regions.

Case C: collaboration (finance/funds)-driven SI platform in DRR

Higashiomi Sanpo Yoshi Kikin (https://3poyoshi.com[57]): This organization bridges NPOs and civil society through platforms that facilitate donations and investments. It is a community fund/citizen foundation in Higashiomi City, Shiga Prefecture, Japan, working to establish a citizen-led fund circulation. "Sanpo Yoshi" in Japanese refers to the spirit of successful Omi merchants during the Edo period, who valued three-way satisfaction, namely, benefits to the seller, the buyer and the local community, attributing business success to the communities and giving back to the society. In the six years from 2016-2022, 240 billion Japanese Yen was raised with the support from 772 people, either through donation or social impact business investments[58]. In August 2024, the number of supporters reached 1,000[59].

Organizational background: Higashiomi Sanpo Yoshi Kikin is a community fund that supports civic activities based on two themes: increasing connections among people and between people and nature. The Executive Director views these themes as essential for disaster prevention and mitigation.

Social challenge: In the event of a disaster, vulnerable groups such as the elderly, differently abled individuals, single mothers and their children face considerable difficulties.

Social innovation: Strengthening and fostering good relationships among the residents enables them to care for each other during regular times and emergencies. Nurturing interest in nature and cultivating public sensitivity to environmental changes will help residents prepare for disasters.

(1) Encouraging self-governance: A recent discussion with a researcher on green infrastructure led to the realization that "ultimately, self-governance saves people when disasters beyond the imagination of engineers occur". While acknowledging the importance of technological innovation, "reconstruction of self-governance" is taken as equally or more critical. Residents must take an interest in each other and their community in their daily lives.

(2) Rebuilding autonomy: Higashiomi Sanpo Yoshi Kikin promotes mutual understanding and cooperation among the various actors in the community, acting as an intermediary between funders and fund seekers. This fosters a sense of ownership and a desire to "build a livable community with our own hands" rather than waiting for "somebody else to do it for us".

(3) Donor-beneficiary connection: Unlike public funds such as grants, private funding raises awareness of the importance of connections among people. The feelings of both supporters and beneficiaries become more visible. Expressing empathy towards the recipient becomes much easier while fostering a sense of mutual support. While the recipients realize that their efforts have been made possible by the support of the donors, the donors feel gratitude for the existence of the person they have supported and the fact that they can carry out these activities. The donors feel assured that the fund is being used for a good cause regardless of the amount of a donation. Higashiomi Sanpo Yoshi Kikin facilitates good communication and self-reliance through developing activities and funding those in need.

For DRR: Rather than solely focusing on disaster prevention and mitigation, Higashiomi Sanpo Yoshi Kikin aims to enhance community resilience by fostering interactions between people and the nature. The recent spate of disasters made them realize the need for initiatives with a more explicit focus on disaster prevention and mitigation. With climate change causing more frequent and severe damage, the importance of "self-governance" has become increasingly evident.

a. Engagement perspective: Higashiomi Sanpo Yoshi Kikin is a community fund that supports citizen activities aimed at "strengthening connections among people" and "increasing connections between people and nature".

b. Platform perspective: The fund motivates donors to support beneficiaries by facilitating designed communication between both parties.

c. From the innovation perspective: The fund is committed to acting as an intermediary between donors and beneficiaries to re-establish self-governance by promoting mutual understanding and cooperation among various local entities. This approach fosters a sense of ownership and co-existence within the community. Local governments and other agencies can also contribute to these efforts.

FINDINGS

The three case examples have revealed that their interventions aim to solve social issues through inclusive, sustainable, and participatory methods involving civil society. "Social" aspects of DRR primarily reflect human interactions aimed at fulfilling societal needs. "Social innovation" in DRR refers to interventions by social actors using innovative means (such as products, platforms, and systems) and positively impacting human relationships, social systems, and organizational structures.

Characteristics of social innovation and DRR in Japan

The case examples of social innovation in this study exemplify collaborative efforts between the public and private sectors and civil society, collectively transforming social practices. Ensuring sustainability is a crucial factor in these initiatives. The following two vital characteristics signify social innovation.

1. Participatory: A fundamental difference between social innovation and traditional innovation lies in the active involvement of civil society. This participation promotes co-creation and collaboration among diverse groups and stakeholders[60].

2. Availability of platforms: The significance of "platforms" in facilitating such collaboration has also been discussed[61,62].

Social innovation as social investment for DRR

The case studies of social innovation examined in this research have revealed that social investment through social innovation is crucial for DRR, as it fosters community bonding and encourages individuals to reconsider their relationship with nature. Watanabe (2016) examines the intricate processes of post-disaster reconstruction in Japan by interviewing stakeholders and analyzes civic engagement with local communities. This analysis highlights the reconstruction of local economies and the rehabilitation of communities, revealing "*the blurring boundaries between traditional business cooperatives and charities in the social enterprise ecosystem with "varying degrees of social impact and profit motivation*" [emphasis ours] (p.7)[63]. This observation can be further elaborated in terms of the types of social innovation platforms as follows:

Case A: solution-driven SI platform in DRR facilitates interactions

Modorinae promotes the nurturing of life and proactive actions among clients and stakeholders, extending beyond *infrastructural products* rooted in indigenous knowledge. The development of practical and locally tailored innovative products for disaster risk mitigation surpasses the potential aspirations of disaster management anticipated such as securing housing against natural hazards, building local infrastructure, and constructing small-scale hazard mitigation structures[64].

Case B: technology-driven SI platform in DRR complements technical change

The emergence of socio-technical innovations, particularly with the advent of social media in disaster communication, has introduced new dimensions such as citizen reporting, community-oriented computing, collective intelligence, distributed problem solving, and digital volunteers[65]. These innovations support the integration of digital platforms in DRR for effective information dissemination, community engagement, and real-time coordination during disaster scenarios.

Case C: solution-driven SI platform in DRR enhances community collaboration

Mobilizing resources for both immediate and long-term disaster mitigation, fostering community empowerment, and enhancing overall resilience in disaster-prone communities are crucial. These efforts, including infrastructural development activities, help communities reduce disaster risk. Enhanced community capacity enables resilience against disasters, empowering individuals to become self-reliant[66]. The Village Fund can finance the community action plans and attract larger funding for small-scale mitigation projects, such as the development of water reservoirs and smart agriculture[67].

The three cases are summarized in Table 1 below.

In sum, social innovation for DRR strives to achieve enhanced awareness, commitment, and engagement of stakeholders for DRR in civil society through a unified platform that facilitates the exploration of bonding opportunities, thereby enhancing resilience via sustainable products and processes. Figure 2 below highlights the processes involved to enhance stakeholder engagement, keeping the goal of DRR as an integral part of Society 5.0 necessitates commitment towards enhancing stakeholder engagement involving governance, civil society, enterprises, and digitalization, where civil society and enterprises would show different kinds of interactions and interventions on their parts.

DISCUSSIONS

Key findings

The effectiveness of DRR is contingent upon the actors engaged in social innovation. Addressing social problems through social innovation requires a multi-faceted approach involving multiple stakeholders, necessitating the creation of linking opportunities. To achieve social impact, it is essential for innovation to be connected to these opportunities.

1. Networking and multi-stakeholder communication are equally crucial for making social innovation impactful.

Table 1. Three case examples of social innovation platforms for disaster risk reduction in Japan

Case study	Case A	Case B	Case C
Name	**Somanobase**	**Data Cradle Inc.**	**Higashiomi Sanpo Yoshi Kikin**
Type	Non-profit organization	General Incorporated Association	Public Interest Incorporated Association
Location	Tanabe city, Wakayama prefecture	Kurashiki city, Okayama prefecture	Higashiomi city, Shiga prefecture
Project areas	Wakayama and Hokkaido	Multiple municipalities/prefectures	Higashiomi city, Shiga prefecture
Origin of ideas and motivation	**People-driven** Discussion with the founders and members with diverse backgrounds including designers and programmers led to the idea of *Modorinae*	**Municipality-driven** Enhancing tech skills (e.g., IoT) **People-driven** Residents' increased awareness of the importance of data sharing post the rain disaster of July 2018	**People-driven** Reconstruction of self-governance is considered critical after discussion with a researcher on green infrastructure
Type of social innovation platform	**Solution-driven** Citizens nurture forest as a countermeasure against landslides	**Technology-driven** Specialized in data management as a civic tech organization	**Collaboration-driven** **(Finance/funds-driven)** Community fund for local needs
Risks/issues	**Disaster-triggered** • Landslides	**Technology-driven** AI-induced unemployment **Disaster-triggered** • High precipitation caused disasters	**Disaster-triggered** • Overall disaster prevention and mitigation
DRR goals	• Zero human casualties from landslides • Developing a circle of support by revitalizing community	• Data-supported problem solving and community-based activities • Advanced area-wise disaster prevention and evacuation plans	• Enhancing community resilience through interaction with nature and people
DRR means	*Modorinae* (tree saplings) Giving tree saplings back to the forest in the time span of 2 years	MachiCare as an open data citizen platform where citizens can share information and own data stores in multiple layers at different places	Bridging non-profit organizations and civil society through platforms to facilitate donations and investments
	• Participatory process to grow tree saplings for disaster mitigation	• Human resource development for effective data utilization	• Enhanced connection among people and connecting people with nature for disaster prevention and mitigation
	• Higher priced saplings support financial stability, while local seedling quotas help preserve the natural environment	• Residents proactively offer one's own data for the benefit of community, contributing to accumulate data	• Establishing a citizen-led fund circulation
DRR stakeholders	Collaborations: private sector with local government; ministries with government agencies	The policy making of government facilitates this process	Donors and beneficiaries develop activities and fund the needy. Local governments and other agencies can chip in
	→ **Decision making** Citizens are empowered to take active part in disaster prevention measures	→ **Decision making** Bottom-up information sharing by residents enhances awareness of the importance of DRR with their own information sharing	→ **Decision making** Citizen-led funds for social and environmental cause empowers people to take decisions for DRR
	→ **Disruptiveness** Innovative ideas with simple, reachable and sustainable means	→ **Disruptiveness** Civic tech method will have much wider reach, involving both municipality and the citizens	→ **Disruptiveness** Creating opportunities for self-governance with the active participation of people with financial viability
	→ **Marketability** Region specific product marketed at a premium price to secure (1) commitment for the cause and (2) consideration for supporting own environment	→ **Marketability** Replicability is high, possibly implemented in other regions to enrich the pooled data for DRR	→ **Marketability** Connecting people and environment in a financially viable manner
Social challenges	• Conventional disaster prevention education is not attractive enough • Lack of interaction with others has weakened community bonding, hindering disaster prevention measures	• Diversified life and work styles of the public needs to think beyond the traditional one-size-fits-all approach • Kurasaki-city needed help in imparting technology training such as IoT to data scientists to initiate business in the region	• Disasters render vulnerable section of society (the elderly, people, the differently abled, single mothers and their children) into difficulties • Self-governance of residents required to counter climate change-induced disasters
Engagement	• Growing *Modorinae* saplings enhances disaster prevention. • Participation in nurturing forest	• Data usage and ownership by ordinary citizens. • Enhancing citizens' ability to take part in the	• Supporting citizens' activities for strengthening connections among people

	enhances the sense of belonging among community members	process of decision-making	• Increasing connections between people and nature
Platform	• Connecting forests with companies and citizens • Localization by finding regional partners	• MachiCare supports data sharing among citizens post-disaster during recovery and reconstruction phases	• The fund motivates donors to support beneficiaries through designed communication between people and nature
Social innovation	• Forestry business as countermeasures against landslides. • New source of revenues for forest industry aids resilient mountain management	• Citizens "master data" can be prepared against disasters impacting beyond boundaries • Data utilization to connect people beyond the community	• Encouraging self-governance • Rebuilding of autonomy
Impacts	→ Environmental protection → Disaster mitigation → Citizen participation → Finding consumers in local economy	→ Improving data literacy → Alleviating data shortages → Using data in the affected areas made people aware of disaster preparedness	→ Residents' cordial relationship → Nurturing the public' interest in nature → Sensitive public cares for changes in the environment

Source: Authors.

Figure 2. Social innovation and Society 5.0: envisaging disaster risk reduction. Source: Authors.

2. Opportunities can be found by seeking expert knowledge and receiving new ideas from individuals across various sectors, which serve as key drivers for the innovation process.

These points underscore the necessity for actors involved in social innovation within Japanese society to be maintain connection with both national and local administrations while preserving their innovative capacities.

Contribution of the study

The study has elucidated the characteristics of social innovation in regional settings in Japan, highlighting notable contributions of social innovation in DRR:

(1) Connecting the target population with required resources and knowledge: The study highlights the significance of local-based organizations in enhancing resilience by linking people with opportunities, including local resources.

(2) Giving meaning to local knowledge in the context of DRR: The study emphasizes that local knowledge of the community and the area can provide essential support to effectively reach affected communities, particularly in rural areas.

(3) A possible policy framework with social innovation for DRR: The study highlights that community involvement is a key factor in managing DRR at local levels in Japan. Recent excessive precipitation and water-related inland disasters have promoted Japan to reconsider the administrative setup in local settings in response to climate change. Notably, past unpreparedness at the community level has led to significant casualties.

Kuramochi (2020) points out that structural analysis of social challenges is significant considering regional characteristics and the degree of severity of issues do differ (p.82) and emphasizes that when the enterprise and external organizations share the mission to solve certain social issues, the projects anticipating collaborations where the organizations can offer their strength could be called as "open innovation for resolving social challenges" (p.84)[68]. Social innovation in DRR, when considered regionally, can effectively connect resources, knowledge, policy makers, practitioners, and communities to address the needs of localities in disaster management.

Limitations of the study

Micelli *et al.* (2023) emphasize the critical need for in-depth analytical empirical research of the planning-social innovation nexus in marginalized rural contexts. This necessity arises because social innovation at the municipality level exacerbates the marginalization of rural settings, primarily due to the scarcity of resources and expertise[69]. This study focuses on Japan, examining how social innovation within civil society contributes to preparing local communities for disaster situations. This preparation is seen as a manifestation of the combined resilience of individuals, society, and administrative structures in local settings. Further detailed studies on social innovation in DRR are required in various local contexts. Additionally, comparative studies in other regions and countries could provide valuable insights into common parameters for effective social innovation in DRR.

Challenges to social innovation in DRR in Japan

(1) Limited scope of funding social innovation initiatives in DRR: Social innovation may not necessarily be able to draw attention of the funders and end up its attempts only at a local level[70].

(2) Still evolving conceptual framework: It is important to recognize that the concept of social innovation is still evolving and being continually reviewed in the context of regional priorities and SDGs. The theoretical framework and empirical case studies of social innovation applied to DRR require further exploration and study.

CONCLUSIONS

In Japan, enhancing resilience towards DRR has been interpreted mainly as the risk preparedness of the target population in the context of the built environment against the impact of the disasters. This approach has prioritized infrastructural safety as the primary focus of disaster management. Evacuating the affected and accommodating them in safe shelters are top priorities, particularly in Japan's aging society. Local authority-led evacuation and reconstruction plans, with active citizen engagement, have remained the major focus of research in social innovation for DRR. However, despite the prevalence of community efforts in the Japanese DRR scenario, social inquiry on the aspect of social innovation is largely absent.

Social innovation factors for DRR in Japan

The three case examples of social innovation illustrate how engaging stakeholders in civil society through dedicated platforms can enhance social bonding, thereby strengthening societal resilience towards DRR. The study identifies three critical factors for impactful social innovation:

(1) Decision-making: Involving decision makers and opinion leaders in policy, economic, and cultural sectors, and engaging them in questioning the strategic context of their decisions.

(2) Disruptiveness: Recognizing local and "front line" innovations that have the potential to disrupt existing institutional frameworks.

(3) Marketability: Promoting these innovations to decision makers and opinion leaders when opportunities arise, not necessarily relying solely on market mechanisms.

Impactful social innovation practices for DRR in Japan

The authors identify two major impacts of social innovation practices observed in this study:

(1) Inclusion of vulnerable populations in social innovation processes for DRR: It is significant to note that resilience factor can be enhanced when vulnerable populations are given opportunities to participate in societal change. Crucially, social innovation not only serves vulnerable populations but is also enriched by their involvement[70].

(2) Civil society as a nurturer of social actors: Social innovation seeks to balance societal needs with individual needs. Achieving this optimal balance is a key aspect of Society 5.0, where policy makers and technologists must ensure that each policy proposal or technological development contributes towards the goals of Society 5.0[36].

DRR in the context of global resilience and innovation

Addressing environmental challenges is inevitable for enhanced DRR since climate change and disasters need to be considered in global context. On the other hand, it is pertinent to consider that hazardous impacts could greatly differ in regional settings. We live in the era where we need to reflect upon the community resilience in the contest of global resilience and innovation. CBDRR's approach focuses primarily on traditional ways of disaster risk preparedness. With the evolving risk landscape in Japan, the traditional approach alone will not suffice, and new ways of social innovation need to be explored. Therefore, the authors propose to define social innovation as the emergence of new types of individuals, social patterns, and behaviours through new forms of organized groups of people to address social issues with innovative ideas and approaches.

When the stakeholders could also be the beneficiaries of the engagement, they could contribute to the processes of connecting actions and the goals. This will result in significant changes in terms of decision making. It could also enhance local knowledge and nurture community resilience. This study aims to position the three case examples in the framework of social innovation by paying attention to social inclusion, systemic change and institutionalization with active involvement of stakeholders and through collaborations.

Figure 3 indicates the conceptual framework of steps required for social innovation in the context of stakeholder engagements. Once social needs are identified, efforts are made to find solutions for these

Figure 3. Conceptual framework of social innovation and its implications. Source: Authors.

needs. Local inputs are necessary to facilitate effective intervention, so building on existing community assets consists vital part of the process. Further, new social practices are created to work as better means to find answers to concerned social issues. Finally, intervention of social innovation could entail changes in social and power relations of multiple stakeholders. Social innovation engages stakeholders inclusively, entailing systemic change and institutionalization while harnessing the principle of social inclusion.

As Aoo (2018) points out there has not been much academic exchange between Europe and Japan when the trend on research works on social innovation is in tandem with social situation and policy makers and funders' interest: Europe focuses on social inclusion and scaleup of successful cases of social innovation, the USA aims at multi-sector collaboration, and Japan and other Asian countries specialize in social business and social investment reflecting each region's policy focus (pp.115-6)[71]. This review article tries to fill the lacune with Japanese case examples that have not been highlighted in research published in English. Japan's experience with social innovation would throw light on how social innovation could contribute to social inclusion beyond business-led or technology-led innovation that would offer macro-level impacts, namely, systemic change or institutionalization.

FUTURE RESEARCH DIRECTIONS

As innovation becomes more "social", "responsible", "sustainable", and "disruptive", it is imperative for researchers to delve deeper into community-level and region-focused engagements[72] to develop a more effective and enhanced framework of DRR in Japan and beyond. This is particularly important globally, as societies face disasters not only from major calamities but also from climate change. The Intergovernmental Panel on Climate Change (2023) has explicitly differentiated between "climate change attributable to human activities altering the atmospheric composition" and "climate variability attributable to natural causes"[73].

a. Grass-roots regional studies: Further studies on various case examples from different regions of Japan will help highlight emerging social issues and innovative solutions offered by civil society.

b. Expanding areas of case studies: Region-specific studies involving respondents from civil society will provide deeper insights into the characteristics of regional settings.

c. Increasing the number of case studies: Larger sample sizes will aid in classifying existing social innovation case examples in Japan.

d. Integrating community cases into local support systems: Social innovation in Japan could be integrated into the local support system framework to enhance community engagement against climate change.

e. Deepening the research theme: Future case studies could explore themes such as state-society relations, volunteerism, the influence of social movements through political processes, and privatization.

Social innovation in DRR in Japan could be studied further to explore the possibilities of changes in social and power relations through inclusive and sustainable engagement of stakeholders to help mitigate challenges posed due to Japan's demographic, socio-economic, and environmental decline. These suggestions of future research directions are increasingly relevant as the frequency of localized hazardous emergencies rises, necessitating social innovation for DRR in other countries as well.

DECLARATIONS

Authors' contributions

Made substantial contributions to conception and design of the study: Kawane T, Ozaki Y, Suresh D
Performed data analysis and interpretation: Kawane T, Ozaki Y
Performed data acquisition and provided administrative and material support: Kawane T, Zhang Y, Mazumdar S
Writing: Kawane T
Supervising the research and edited the final manuscript: Kawane T, Shaw R

Availability of data and materials

The research involves ethical/legal/commercial data of the persons who gave interviews. Therefore, data is not available.

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None.

Conflicts of interest

All authors declared that there are no conflicts of interest.

Ethical approval and consent to participate

The research was conducted as per the research ethics guidelines of Keio University (https://www.sfc.keio.ac.jp/gsmg/en/docs/14_ResearchEthics_en_2024S.pdf). All participants provided informed consent prior to their inclusion in the study. They were fully informed about the study's purpose, procedures, risks, and benefits, and their participation was voluntary.

Consent for publication

Not applicable.

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