# Integrating communities' perspectives in understanding disaster risk

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**Abstract:** This paper reports exploratory research that considers two challenges recognised in the disaster risk reduction (DRR) community in recent years. One is the reinforcement of community-based DRR, and the other is experts' prioritising high-impact/low-frequency hazards. Inquiries into stakeholders' – community members' in particular – understandings of disaster risks have been scarce. The research aimed to address these gaps by investigating communities' perceptions around community-based DRR and disaster risks. The research focused on natural water hazard, such as floods and typhoons generated due to atmospheric forcing factors, as well as tsunamis in four communities in Japan and England. A field survey of major structural mitigation solutions, non-structural measures, and community interviews revealed that community members did not necessarily find the often-used impact/frequency description of hazards helpful in developing and implementing community-based DRR activities. Such hazard-based scientific language does not necessarily correspond with the general public. The paper attempted 'the number of affected people', which was recognised by the research participants, to be applied as a tool for understanding disaster risks.

**Keywords:** community-based DDR; disaster risk; impact; frequency; the number of affected people

## 1. Introduction

This paper reports exploratory research that considers two challenges recognised in the disaster risk reduction (DRR) community in recent years. One is the necessity of 'all of society engagement' emphasised in the UNISR Sendai Framework for DRR 2015-2030, which has led to the reinforcement of community-based DRR. The other is, as the International Federation of Red Cross and Red Crescent Societies' (IFRC) World Disasters Report 2014 criticises, experts 'persist' in prioritising high-impact/low-frequency hazards (Cannon and Schipper, 2014). The research aimed to find out how community-based DRR is perceived and implemented in communities with different disaster risks of both high-impact/low-frequency and low-impact/high-frequency hazards. In using the term 'disaster risk', we refer to UNDRR's (2021) definition; "the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific peri-od of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity".

The research focused on natural water hazards, such as floods and typhoons generated due to atmospheric forcing factors, which have been intensified by climate change, as well as tsunamis. Both Japan and England have had a series of impacts from them in recent years. This paper discusses four cases of water disaster-prone communities in the Oita and

Wakayama prefectures in Japan, and the Essex and Devon Counties in England. The research investigated how four communities have approached DRR against water disasters of different intensities and frequencies by combining the field survey of major structural mitigation solutions and non-structural measures through stakeholder interviews.

Our preliminary findings of the research were that the variations exist amongst multiple stakeholders in their perceptions against community-based DRR. The communities that were struck by high-impact/low-frequency hazards seem to share the necessity for DRR, which is authority-led rather than community-based. The communities of which experiences were low-impact/high-frequency hazards seem to engage in community-based self-help measures. What was common in every community was that the members did not necessarily appreciate the hazard-based scientific language of impact/frequency in interpreting disaster risks. Drawing on community perspective, we hypothetically discuss the possible use of "the number of affected people" in community-based DRR.

## 2. Literature Review

### 2.1. The use of hazard-based scientific language of impact/frequency

Disasters are often described as a product of hazards and vulnerability (Blaikie et al., 2014). Frequency and magnitude/ scale are also employed to elaborate on the hazards. In England, for example, in terms of fluvial floods, frequency is often estimated by the guideline such as the Flood Estimation Handbook compiled by the UK Centre for Ecology and Hydrology (2008). Flow values have a probability in any given year of 1:50 or 1:100, i.e. a 2-year return period to a 100-year return period, or even more scare. In terms of the relationship between frequency and magnitude of hazards, as the Gutenberg–Richter law in seismology shows as an example, smaller magnitude earthquakes, fewer large magnitude ones, high impact hazards are low frequency and vice versa.

Disaster-prone countries such as Japan pay strong attention to high-impact hazards despite of its frequency are low. For the case of Japan, there are some nationwide disaster awareness days such as Disaster Reduction Day on the 1st of September every year and DRR and Volunteers Day on the 17th of January, these are based on the past specific high-impact hazards; The Great Kanto Earthquake in1923 that is 1 in 200-400 years event and the Great Hanshin-Awaji earthquake in 1995 that is 1 in 1000 years event. Japan Meteorological Agency also has a set of rules that naming a high impact hazard (Japan Meteorological Agency, 2018). It is understandable that the society focuses these high impact hazard as in case one of these hazards brings a catastrophe as it might well exceed current countermeasures. This fact is recognized by the academics in Japan. The Science Council of Japan hold a symposium in 2020 titled "Thinking about Low Frequency Catastrophic Disasters" in collaboration with the 57 disaster related academic societies in Japan.

However, some researchers warn this trend that is strongly paying attention to high-impact/ low-frequency hazards. For instance, Burrus et al. (2002) argues that although low-intensity hurricanes bring far less structural damage if business interruption is accumulated, it may be significant. They estimated the interruption losses using three low-intensity hurricanes and find out that the impact is equivalent to between 0.8% and 1.23% of annual regional output in average etc. Aerts et al. (2013) also have the same concern and argue the issues on focusing only on low-probability/high-impact hurricanes using a case of New York City. They pointed out the importance of covering full distribution of possible hurricane storm surge events and develop a new methodology to assess the full distribution of flood risk.

### 2.2. What is a community-based approach?

'Community-based' is a common keyword in the field of DRR (Jayaratne, 2020). It describes in different ways, including 'people-centred', 'participatory' and 'all of society's engagement'. Despite variations, the core point is all critiques top-down approaches (Kitagawa, 2019). Based on this understanding, these terminologies are treated as synonyms of 'community-based' in this paper. The shift from 'top-down' to 'community-based' in DRR measures has occurred in the late 1990s not only in the UN strategy but also in academia (Scolobig et al., 2015). Since 2000, many papers have included 'community-based' in their titles (Victoria, 2003; Delica-Willison, 2003; Walia, 2008; Gero et al., 2011; Yi Liu et al., 2016). As Shaw (2012) reviews, community-based approaches have been widely accepted in the field of DRR based on the recognition of the limitations of top-down approaches. Maskrey's (1989) monograph points out that top-down approaches sometimes have even a reverse effect. Some top-down programmes intended to support those who were severely affected did not support the target population but relatively wealthy people. Using critiques against top-down approaches as a driving force, community-based approaches have become mainstream in DRR projects. DRR experts – policy-makers, practitioners and academics – now agree that engaging the community is an essential condition for effective DRR. The Sendai Framework for DRR indicates that DRR requires an 'all of society engagement' and that the importance of partnership is one of the guiding principles. In promoting societal engagement, community-based DRR is reinforced as a methodology (Kitagawa, 2018).

However, the recent indication by Bankoff et al. (2015) should be taken seriously. The authors elaborated on the argument initially presented in the aforementioned IFRC's World Disasters Report. They argue that outsider organisations attempting to support DRR often hold a different conception of disaster risk compared to the priorities of the communities they are trying to help. Even if some interventions recognise the difference in priorities, they do not necessarily act on it as their headquarters determine the priorities. Such practice leads to unsuccessful intervention not being able to enable ownership of the activity in the community (Bankoff et al., 2015). The authors continue to point out unfair power relations, which remain undetected by the outsiders. Under the name of 'participatory approaches', it is often the local elites who decide what the priority concerns are (Bankoff et al., 2015).

It is also important to consider the term 'community' itself. Titz et al.'s (2018) critically revisit the concept, pointing out that the word became the default when referring to the local level or working with the people. They go on to raise doubts about the usefulness of 'community' in disaster-related work. Their position is that the root causes of vulnerability and livelihood insecurity can barely be unpacked and addressed because the haziness of 'community' disguises what is relevant in understanding and improving livelihoods. Agreeing with their point about the need to clarify the use of 'community', this paper utilises 'community-based' to indicate the approach that emphasises inclusive and collaborative working relationships with outsiders and also within the community. Moreover, the paper argues that this approach is fundamental in minimising communication gaps to allow DRR planning and implementation.

## 3. Methodology

The above discussion has led the authors to the following research question: *How community members perceive and respond to their disaster risks?* This exploratory research looked at Japan and England, which have both been severely affected by water disasters in recent years. Communities in different parts of the countries have experienced both pluvial and fluvial floods, storm surges and tsunami. We selected the fieldwork sites to include communities with varying water disasters with the use of our existing networks. The four fieldwork sites studied were Hita City in Oita Prefecture, Inami Town in Wakayama Prefecture in Japan, and Sturmer in Essex County, Slapton in Devon County in England. Within these four sites, we visited in total six communities (Jogucho and Suzurecho in Hita City, Inami Town, Sturmer and Halstead in Essex, Slapton). The sample size was small due to limited resources, but we designed our fieldwork to study the under-researched communities with different hazard profiles to allow insights into communities' diverse perceptions and practices. We investigated authorities' countermeasures as well as communities efforts against water disasters of different intensities and frequencies.

Three data collection methods were deployed: documentary analysis, site visits, and semi-structured interviews. The interrogated sources include some official websites of disaster risks provided by international organisations (e.g. "How can we measure the impact of natural disasters?" World Economic Forum, 2021), national and regional DRR policies in Japan and the UK (e.g. "Creating community-based disaster management plans" Cabinet Office, Government of Japan, 2021; "Flood risk management" Devon County Council, 2021), as well as academic literature on community-based DRR. Empirical data were collected through the site visits of the authorities' and communities' countermeasures and the semi-structured interviews of three to five participants per municipality. For the latter, the purposive sampling technique was used to identify the following groups of interviewees to obtain the information we needed: community members and/or activists, local government officers and academics. We intended to speak with community members, who are often activists themselves in a sense they engage in DRR activities. We also aimed to talk to local government officers to fill the gaps of publicly available information regarding regional/local policies and countermeasures. Interviewing academics was for triangulation purposes to discuss our preliminary findings, although we were able to interview only one academic. We requested our contacts to nominate possible participants in those groups, 'who can and are willing to provide information (Rivera, 2019) related to the above research question. We then approached them directly in advance of the visits to arrange meetings. As Rivera (2019) points out, selection bias can be one of the challenges in purposive sampling. By hearing the views from different groups of interviewees, we intended to obtain as unbiased an understanding as possible about the hazard situations of the communities. Table 1 summarises the details of four fieldwork results.

**Table 1.** Fieldwork sites

| **JAPAN** | **Hita City (Jogucho and Suzurecho), Oita Prefecture** | **Inami Town, Wakayama Prefecture** |
|---|---|---|
| Total Population | 63,200 | 7,671 |
| Recent/expected disasters at the time of the fieldwork | Torrential rain in 2017 | Typhoon 21 and 24 in 2018, Nankai trough earthquake and tsunami (Expected) |
| Duration of the fieldwork | $30^{th}$ – $31^{st}$ October 2018 | $1^{st}$ – $2^{nd}$ November 2018 |
| Type of interviewees | Two city government officers (J-officer-1,2); two community members (J-community-3,4); one activist from a local NGO (J-activist-5) | Two community members (J-community-6,7); one town government officer (J-officer-8) |

| **ENGLAND** | **Sturmer, Essex County** | **Slapton, Devon County** |
|---|---|---|
| Population | 492 | 434 |
| Recent/expected disasters at the time of the fieldwork | Torrential rain (every year) | Storm surge/extreme waves (since 2000/01) |
| Duration of the fieldwork | $8^{th}$ – $9^{th}$ April 2019 | $10^{th}$ – $11^{th}$ April 2019 |
| Type of interviewees | Three activists and community members | Three activist and community members |

| | | |
|---|---|---|
| | (E-community-1,2,3); one local government officer (E-officer-4) | (E-community-5,6,7); one academic (E-academic-8) |

Semi-structured interviews allowed us to investigate individuals' perceptions and identify the differences between experts' (government officers, academics) perceptions and those of laypersons (community members, activists). It should be noted that the authors are also experts on DRR and outsiders. This means the authors have identified and classified the communities investigated by frequency and impact of recent water-related disasters. Perception gaps were identified both inside the communities and between the authors and the communities.

Interview questions were kept broad as shown in Table 2 so that interviewees could choose what to expand. The authors translated the interview questions into Japanese for interviews in Japan. From the interviews in Japan, it was found that the terms used in the original questions were not understood well by the interviewees, the questions were revised after the fieldwork in Japan. The collected information was analysed thematically, considering the above theoretical underpinning. The participants are anonymised, and their quotes are referred to as 'J-community-1, 2, 3…' or 'E-officer-4…', as indicated in Table 1 above.

**Table 2.** List of Interview Questions

| Original Questions | Revised Questions |
|---|---|
| 1. Which natural water disasters are of concern in this municipality? | 1. Can you talk us through the experience of the recent disaster in this community? |
| 2. To what extent are different return periods and magnitudes taken into consideration in the measures against those disasters? | 2. Which natural water disasters are of concern in this community? |
| 3. What is the focus/emphasis in the measures for the disasters which are high-impact but low-frequency? | 3. What measures were in place before the recent disaster? |
| 4. What is the focus/emphasis in the measures for the disasters which are low-impact but high-frequency? | 4. What measures have been developed after the disaster? |
| 5. How are 3 and 4 communicated to the population? (What are the methods of risk communication for 2 and 3?) | 5. How are those measures communicated to the residents? |
| 6. How do you perceive community-based/participatory DRR; how do you think the population perceives community-based/participatory DRR? | 6. How do you perceive community-based/participatory DRR; how do you think the population perceives community-based/participatory DRR? |
| 7. How far have community-based/participatory DRR approaches been implemented for high-impact but low-frequency disasters? | 7. How far have community-based/participatory DRR approaches been implemented for high/low-impact but low/high-frequency disasters? |
| 8. How far have community-based/participatory DRR approaches been implemented for low-impact but high-frequency disasters? | |

### 3.1. Field surveys and damage due to recent disasters

The following section describes damage profiles to the coastal / riverine defence structures and other civil engineering infrastructure due to disasters in four communities examined in Japan and UK during time of the field survey.

#### 3.1.1. *Hita City, Oita Prefecture, Japan*

In Hita City, Oita Prefecture, the authors visited two communities that were severely affected by torrential rainfall in 2017. Suzurecho which is located in the mountainous Hita City, was badly hit by a 1:50 year torrential rain in

2017, and massive landslides occurred in the mountains of the local neighbourhood, disrupting the major transportation links (Fig. 1a). Seven out of 16 houses were damaged, and 30 residents were affected (J-3). Similarly, Jogucho which is also located in Hita City was also affected by the same torrential rain in 2017, as well as regular typhoons, severely blocking the streams with sediment and debris (Fig. 1b). This caused raising flood water levels and eventually inundating houses in the downstream.

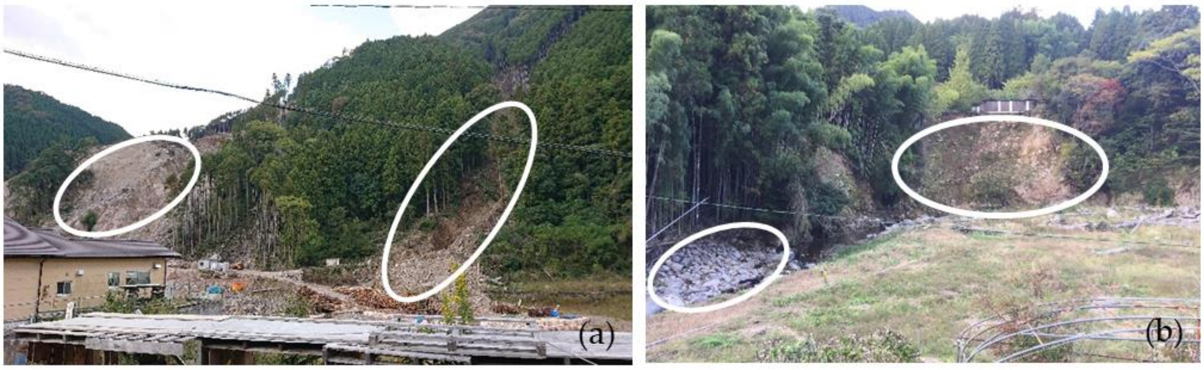


**Figure 1.** a) Landslides in Suzurecho and b) landslides and blocking of streams in Jogucho, in Hita City following the torrential rain in 2017 (while circles indicate the damage).

3.1.2 *Inami Town, Wakayama Prefecture, Japan*

In recent years, torrential rain and typhoons have become the most common natural disasters in Inami Town in Wakayama Prefecture. The central town with houses, small-scale industries, and schools was flooded due to the Inami River overflow and its tributaries caused by Typhoons 21 and 24 in 2018. The 1946 Showa Nankai tsunami was categorised as a 1:100 year catastrophic event that damaged over 550 houses and caused 17 casualties in the town. One of the interviewees, a retired headteacher, recalled that the record of the tsunami indicates a few people from the local school who lost their lives (J-6). A large 207 m long concrete seawall fronted by artificial armour units was constructed in 1995 to protect the coastal community from tsunami waves and mega typhoons. It was noticed that some of the sections of the seawall toe were damaged and exposed, and some armour units were displaced during Typhoon 24 in 2018. Figure 2 illustrates some damage to hard coastal defence structures in Inami Town due to Typhoon 24 in 2018.


**Figure 2.** a) Displacement of artificial armour units, and b) damage to the landward toe of the seawall in Inami Town due to Typhoon 24 in 2018 (white circles indicate the damage).

3.1.3 *Sturmer, Essex County, England*

Sturmer is located in the county of Essex and close to the border of Suffolk in England. Based on the field survey, it was reported that approximately 400 properties and about 200 families live in this village. Pluvial floods in 2001 and 2014, as well as floods from catastrophic storm surges such as the 1953 floods, impacted the population in Sturmer. Seventeen properties were flooded in 2001, whereas no damage occurred in houses in 2014, although some gardens and garages were flooded. It was believed that the major causes of floods were the insufficient flow depths of streams running across the village and their infrastructure, such as overhead bridges (Fig. 3a,b).


**Figure 3.** Some civil engineering infrastructure (concreted open channel) and natural stream running across the village.

3.1.4 *Slapton, Devon County, England*

The southwestern coast of England is prone to extreme waves entering the Atlantic Ocean. The 2001 flash floods and 2013-14 winter storms are two of the major examples of damage to several coastal defence structures in Devon and

Cornwall counties of England. As part of the field investigation, the authors explored the impact of storm surges and their damage to flood defences at Slapton Sands, located midway between Kingsbridge and Dartmouth. There were several flood events and road closures due to overflowing shingles in Slapton Sands in 2001 and every year from 2014 to 2018 (Fig. 4).


**Figure 4.** Removal of shingle from A road from Kingsbridge to Dartmouth in Devon.

## 4. Findings

From our case studies, the variations in the DRR approaches among the communities were found in several aspects. From the published information and the empirical study, we classify the investigated four cases into two types by impact and frequency as shown in Figure 5. Inami (Tsunami) and Slapton are the communities with high-impact/low-frequency hazards; Hita, Inami (Typhoon) and Sturmer are the communities with low-impact/high-frequency hazards. As for Inami, they face both tsunami and typhoon risks. There should be no community facing high-impact/high-frequency hazards or low-impact/low-frequency hazards. Historical accumulated data of natural hazards shows that these cases are the exception. For example, the Gutenberg–Richter law in seismology shows the relationship between magnitude and frequency i.e., smaller magnitude earthquakes, fewer large magnitude ones.

| | | Frequency | |
|---|---|---|---|
| | | High | Low |
| Impact | High | | Inami (Tsunami); Slapton (Storm surge/extreme waves) |
| | Low | Inami (Typhoon); Hita (Torrential rain); Sturmer (Torrential rain) | |

**Figure 5.** Proposed classification of the investigated communities by impact and frequency.

### 4.1. Communities with high-impact/low-frequency hazards

It was found that local councils and prefectural governments in both counties have constructed and implemented comprehensive state of the art hard and soft engineering counter measures to minimise damage due to high-impact/low-frequency disasters. The following section explains some of the major DRR implementations in Inami and Torcross.

Since people in Inami could remember the devastation of the 1946 Showa Nankai tsunami, as well as the return period of this event has exceeded, the local council has taken many soft measures such as identifying and setting up tsunami evacuation routes and high ground spots, tsunami alert transmission towers with loudspeakers, constructing tsunami shelters, well-organised mock drills, and instantaneous state-of-the-art aerial mapping systems using drones and a set of high-resolution digital video cameras to monitor their entire coastline 24/7. It is also interesting to note that the Inami Town Council was itself constructed on an earthquake-resistant rubber footing. It was clear from the study that the Inami Town Council is closely working with local activists and community groups to protect their people from natural hazards. Figure 6a-g shows various soft and hard countermeasures implemented by the Inami Town council with the community leaders.

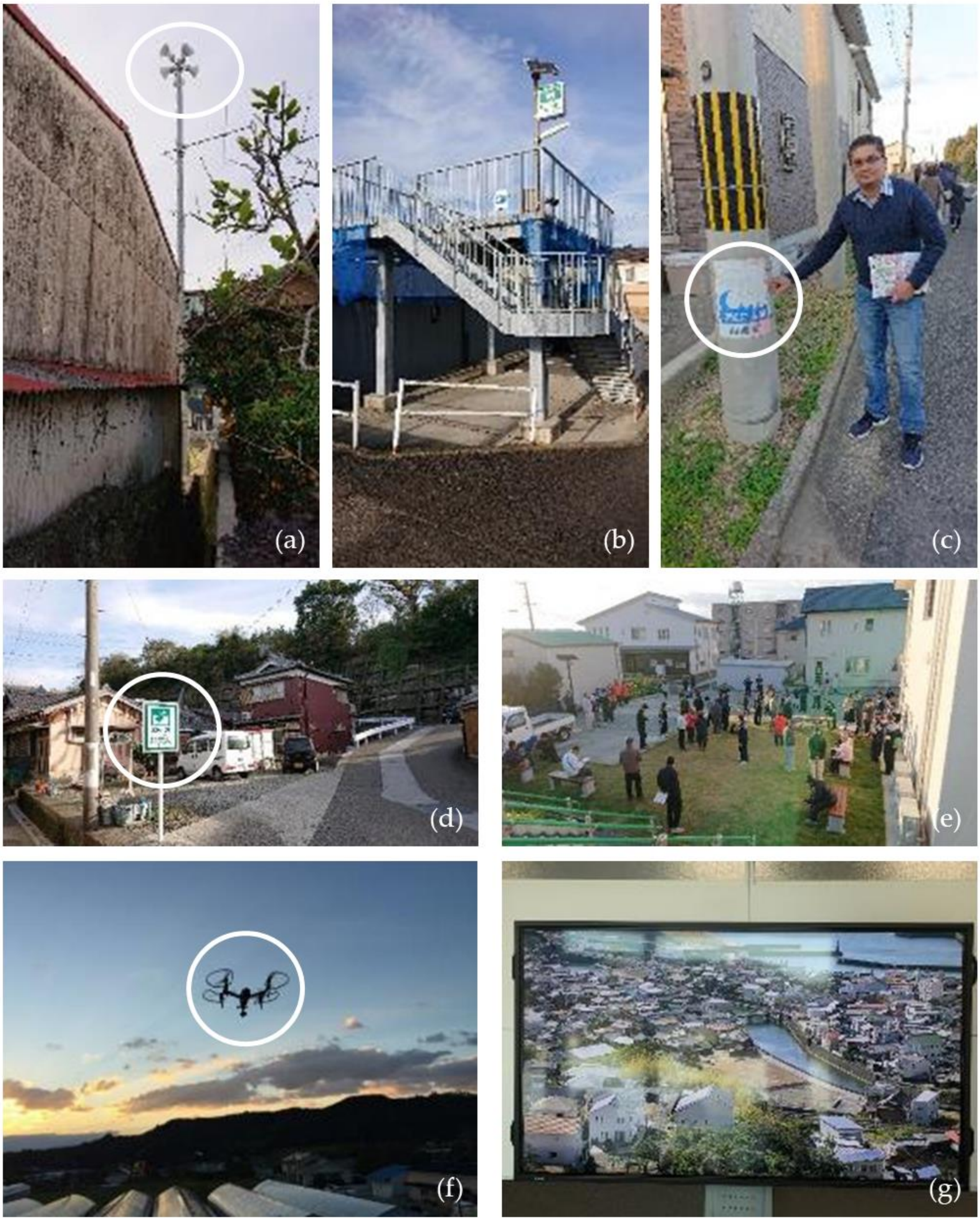


**Figure 6.** Examples of soft solutions and collective effort of the local council to protect the people of Inami Town; a) Tsunami alert transmission tower, b) Elevated tsunami shelter/meeting place; c) Expected tsunami inundation depths and routes, d) Signboard of tsunami evacuation routes, e) Tsunami evacuation area following the mock tsunami drill was announced in October 2018, f) Deploying a drone to map entire Inami Town, and g) Digital visualisation of Inami River and Town from drone mapping and monitored at the Inami Town Council.

Following the storm damage to the A-road in Slapton Sands in 2001, the Slapton Line Partnership was formed to help manage its future. It was reported that the Torcross seawall in Slapton (Figure 7) was damaged due to storms in 2016, and the Environment Agency has stepped into its reconstruction as it serves 51 properties to reduce flood risk. The breach of the A-road meant that every resident in Slapton was affected one way or an-other. After the 2018 breach, for example, all community members attended a meeting in which immediate needs caused by the breach were discussed and debris removal action was taken by the councils.


**Figure 7.** a) Torcross concrete seawall fronted by quarry stones to reduce wave overtopping, and b) vicinity of residential houses protected by the concrete seawall.

4.1.1 *DRR led by authorities, followed by community actions*

The communities with high-impact/low-frequency hazards, authority-led DRR as a large-scale public work was implemented initially, followed by the development of grass-roots approaches. This point was also confirmed in the interviews. In Inami town, it was described by interviewees as a lack of ties in the community. A community member (J-6) mentioned: 'As for my area, people keep moving in and out; thus the ties of the community gradually become weak.' He added, 'The autumn festival is the day that most people join. However, the number of participants in other events is decreasing, I guess.' The underlying reason seems to be that:

> *people's sense of value has become diverse. There has been a decrease in the number of residents who run their own businesses, including farmers and fishermen. Most are working outside of the town, which contributes to the diverse values that the residents hold.*

The understanding of the current situation of Inami Town by a policy-maker (J-8) is similar to that of a community member (J-6). The policy-maker interviewed was a person in charge of disaster management in the town. He pointed out the same issue and reason:

> *I feel the ties of our community weakened …. Many people have become employees. Before, most people were self-employed farmers and fishermen. The sense of community was also weak.*

Although many urban areas in Japan have already lost such a culture, they still maintain the culture of local festivals. He indicated that 'the annual festival is the only means for maintaining the ties of the community.' In Inami Town, both the policy-maker and the community members think that a sense of community is the key to DRR. It is usually stated that rural areas have a stronger sense of community than urban cities in Japan. Inami is a rural town; however, people feel the weakening of the community.

4.2 Communities with low-impact/high-frequency hazards

It was interesting to note that community-based DRR initiatives have been taken in both countries if these communities subject to low-impact/high-frequency disasters. Two good examples from Hita and Sturmer are described below.

It was reported that there were no hard defensive structures constructed in Suzurecho to avoid landslides that had been taking place for six years before the torrential rain in 2017. The local council had taken measures to reinforce steep mountain slopes that were prone to future avalanches. Slope stability measures include sensor-fitting to the slope faces for early detection of slope movements, anchoring bolts to the ground to reinforce topsoil cover, installing PVC pipes to absorb excessive pore pressure from the saturated soil etc. Similarly, In Jogucho, no specific hard measures were constructed until 2017, although the local council initiated a sediment/debris-controlled concrete dam in the high ground at the foot of the mountains to block the water flowing through the valleys into the households downstream (Figure 8). Deepening open channels across households have proven to be a sound engineering solution to cope with excessive flood water. It was noted from the interviews that there was no effective communication between the local council and both communities at the time of proposing and constructing the above hard measures.

A simple handmade rain gauges and online weather forecast alerts were used by the community in Suzurecho. They monitor the frequent rainfall events (magnitudes) as an early preparedness strategy (Figure 8). With the help of local council officials, the evacuation drills, regular focus group meetings to discuss the preparedness DRR activities of future disasters are planned by the community leaders. The Hichiku Volunteer Centre is identified and designated as a flood relief shelter for residents.

**Figure 8 .** A simple low-cost rain gauge produced by Jogucho community in Hita City as an early disaster preparedness strategy.

Following the recent disaster in 2014, the Sturmer Village Flood Action Group was formed by two couples (four residents) who were flood victims. Since then, the group has been actively engaged in protecting residents in the village, communicating flood activities through parish council meetings, magazines, and flyers. To send flood warning alerts to the residents, some key members of the group continuously check the daily weather forecast websites (e.g. Met Office, BBC News and Google Maps) and flood depth gauges deployed in the nearby local stream (Figure 9a). The houses prone to flooding were owned with portable flood gates as a shield/barrier, as shown in Figure 9b. The Flood Action Group has prepared a map locating all brooks that are running across the village, which could help to understand the vulnerable areas of flooding in case of large rainfall event (Fig. 9c).


**Figure 9.** a) Flood depth gauge mounted in the stream across Sturmer by the residents, b) an example of a typical portable flood barrier owned by the residents, and c) ordinary water courses in Sturmer mapped by the Flood Action Group.

4.2.1 *Engagement in community-based DRR out of necessity*

In these communities with low-impact/high-frequency hazards, grassroots DRR measures were already implemented by the residents before the introduction of authorities' large-scale hardware countermeasures. In the case of Hita, despite the different views on 'Jishubo' (voluntary DRR association) between experts and residents discussed in the following section, in practice, the residents were proactive in preparing for future heavy rains. In Sturmer, some members have been keen on flood risk management, although the level of involvement in activities varies among the residents. The activist residents (E-1, 2, 3) indicated that,

*maximum 10% of the community members were flooded, and those who were flooded were interested in the group's activities.*

They also said, 'High-risk households know the risk because of high insurances'. People seem to realise their flood risk indirectly, not directly. Another point the activists raised was that,

*Sturmer has no strong sense of community, maybe because people drive via the main road through the village.*

They also pointed out the present community issues such as 'the lack of school, less mix of younger people, housing prices.' Not all people were affected by the flood, and DRR does not matter to everyone in Sturmer. They are 'trying to look at broader community problems' to get more people's attention to their flood risk reduction-related activities. This point was also endorsed by the policy-maker E-4 from the Essex Council. He pointed out,

> *usually, people who experienced flooding are the ones who engage in community activities.*

People's DRR actions seem to derive from their necessity for the continuity of their livelihood.

### 4.3 Perception variations for effective community-based DRR

Mainly from interviews, we found two kinds of views around community-based DRR.

#### 4.3.1 *Variation within a community*

The results of the interviews in Hita show the difference in the understanding of 'Jishubo' between experts and the members of the community. Jishubo is a Japanese word that can be translated as voluntary neighbourhood associations for DRR. As the Japanese government has encouraged the formation of a Jishubo in each community, currently, more than 80% of Japan's communities have founded an association. According to policy-makers J-1 and J-2, there are 258 Jishubo in Hita City. This number covers all the communities in the city. They believe that to strengthen the Jishubo more, it is necessary to foster at least one 'Bosaishi' in each Jishubo. Bosaishi is a privately qualified, nationwide leader of DRR. It requires training and passing an examination to qualify as a Bosaishi. Hita City began fostering Bosaishi in 2012. It seemed the government officials were proud of Jishubo led by Bosaishi. They mentioned,

> *it was an achievement that people could evacuate under the leadership of Bosaishi (during the torrential rain in 2017).*

They added the volunteer fire brigade ('Shobodan' in Japanese) which also performed well during the 2017 disaster.

While government officials mainly commented on the 'system' for DRR congratulating its positive outcomes, community members in the city had different views. A community member from Suzurecho (J-3) said,

> *Jishubo is a pie in the sky. Every year, we make a list of the members of Jishubo be-cause of a request from the city government. Making this name list is the only activity of Jishubo.*

He then asserted,

> *Jishubo should be "self-organised" (as that is what 'jishu' means). If it is top-down, is it really "self-organised"? It should be bottom-up. We do not think we need disaster drills. We have the confidence to be able to evacuate when necessary. We organise annual events (festivals) by ourselves and discuss the DRR.*

Another community member from Jogucho (J-4) mentioned the same point:

> *We have a strong tie, as we have several annual events. This includes four festivals, three events at a shrine, and one sports festival. However, we did not have any disaster drills. Do we really need drills, such as going to an evacuation place with a go-bag on Sunday? Instead, there are a few real disaster days every year.*

The community members in Hita City developed their own DRR strategies based on their reality rather than following the authority system. Their activities should be described as 'Jishubo', given their voluntary and community-led nature. The community has its own style of Jishubo that enables them to deal with water-related disasters, even though it is not appreciated as the Jishubo in the local government's eyes.

4.3.2. *Gap concerning hazard-based scientific language*

The Slapton Line Partnership (SLP) includes members from the South Hams District Council, the South Devon area of outstanding natural beauty, Devon County Council, Natural England, Environment Agency, Field Studies Council representing the Whitley Wildlife Trust, and community representatives from the area. This is one of this community's main features and is different from the other communities investigated in this re-search. In other communities, participants were divided into two main groups: experts including policy-makers and others. Although both groups work for DRR, it is rare for the groups to collaborate as there is no substantial organisation to amalgamate both groups. This bears a perception gap between government officials and others. This problem does not necessarily apply to Slapton, given the partnership entails effective communication channels amongst diverse participants.

However, in the interview, the community members identified the relationship between the community and science as the main issue for SLP. The interviewees were the residential members of Slapton (E-5, E-6, E-7). Two of the three members were also members of the SLP. They doubted the usefulness of coastal science and did not consider im-pact or frequency. One member (E-5) put it succinctly.

> *Experts have terminologies and laypeople have a grievance.*

They also agreed that:

> *Return periods – 1:100 – is not helpful; it is just arithmetic.*

We saw a large distance between academic studies and the community's understanding.

> *This is "trouble" because people want the answer, the future prediction, but research is about history. Our problem is "social", a social problem about the road – only the road. We want to know how to maintain the road.*

Their concern was obvious; it was the road.

## 5. Discussion

In the Sendai Framework, it is stated that public and private sectors, civil society organisations, scientific and research institutions and communities need to work more closely and create opportunities for collaboration in addressing future challenges. Nevertheless, discussion on concrete ideas as to 'how' it could be pursued has been limited. The above findings have also revealed a lack of devices for effective community-based DRR. Our study found that in the communities with high-impact/low-frequency hazards, DRR measures were implemented through authority-led large-scale public initiatives. Following experts' prioritisation of the countermeasures against high-impact/low-frequency hazards, communities did not necessarily need to engage in voluntary DRR actions. On the other hand, low-impact/high-frequency hazards seemed to be tackled by community-based approaches. However, even in these cases, collaboration between experts and communities was not always fluent. We therefore undertook a trial as to how mutual understanding of disaster risks could be developed. This is a worthwhile attempt provided the hazard-based scientific language of impact and frequency was not fulfilling such a role as clearly pointed out in Slapton.

Given that 'the number of affected people' was mentioned by both experts and community members in our interviews, we decided to explore the use of 'the number of affected people' as a tool for understanding the disaster risk which would facilitate community-based DRR. We propose 'the number of affected people' (people who have been affected directly or indirectly to do any form of day-to-day activities, injuries or casualties) as a common indicator utilising the quantitative and qualitative data collected through the field investigations in Japan and England, as detailed below.

Natural hazards represent the interaction between nature and population (Eshghi and Larson, 2008). As the population continues to grow, people interact with more spatial extent, leading to costlier and deadlier hydro-meteorological disasters exacerbated by climate change. There are different numerical systems for categorising hazards based on their physical strengths, such as the Saffir Simpson scale, the Fujita scale, the Richter scale and the volcano explosivity index. This paper suggests that for frequent water disasters such as floods, the intensity of these models gives the same scale, although the loss of damage to the infrastructure or lives is different. Meanwhile, the interviewees, both experts and laypersons, frequently referred to 'the number of affected people/fatalities' when asked to describe their experiences of disasters (J-1, J-3, J-6, E-1, E-5). In this light as well as UNDRR's article, drawing on 'the number of affected people/fatalities' would mean incorporating stakeholders' perspectives of both experts and communities, thus enabling a 'common' indicator in DRR activities. Therefore, we decided to apply the number of affected people as an indicative parameter to depict the disaster risks more concretely.

Table 3 lists the types of disasters experienced in the target communities. Ten water-driven disasters experienced in Japan and England's six communities were considered in terms of the affected number of people. The ratio (r) between the number of affected people and/or fatalities by a given disaster over the total population of the town or village are calculated and used to support the outcome of interviews. The number of affected people and fatalities in each community was collected during the interview stage with the community leaders. The total population was gathered from the government officials in Japan's prefectural governments and UK's County councils, and the Office of National Statistics (ONS), UK. The larger the value of r, the greater the damage to the community. The r value is equal to 1.0, indicating that the entire community is affected by a hazard. It can be observed from Table 3 that there are three different orders of magnitude, such as $10^{-1}$, $10^{-2}$, and $10^{-3}$ of the calculated r value. The Showa Nankai tsunami (1946) in Inami Town and the winter storms (2014) in Torcross, which were categorised as high-intensity, low-frequency events, have caused significant damage to the people; hence, both r values have achieved the same order of magnitude ($10^{-1}$) and relative values of 0.565 and 0.5, respectively. The torrential rain (2017) in Jogucho and Suzurecho and the storm Emma (2018) in Slapton were considered as disasters of moderate intensity and moderate frequency; however, the r values were of the same order of magnitude (10-1) as the Showa Nankai tsunami and the winter storms (2014). This reflects that non-high-intensity hazards such as torrential rain and storms are equally important as high-intensity, low-frequency events. The typhoon (2018) in Inami Town and the pluvial floods (2001 and 2014) in Sturmer achieved low r values. This could result in early community preparation for typhoons and hard engineering measures by the Inami Town Council. In Sturmer, it is believed that the low category value may be due to the topography change, various geo-logical features, and civil engineering infrastructure between the affected and non-affected communities.

Combining the impact/frequency scale of hazards and the r value would reinforce the significance of low/moderate impact and high-frequency hazards for prioritising DRR activities. More quantitative and qualitative data of various hydro-meteorological disasters in vulnerable communities are necessary to consolidate the benefits of the r value.

**Table 3.** Calculated r values against the number of affected people/fatalities for various water disasters in communities of Japan and England.

| Community | Type of disaster | Affected number and/or fatalities | Total population | r value |
|---|---|---|---|---|
| Jogu-cho town (Oita) | Torrential rain (2017) | 49 | 106 | 0.462 |
| Suzure-cho town (Oita) | Torrential rain (2017) | 47 | 295 | 0.159 |
| Inami town (Wakayama) | Showa Nankai Tsunami (1946) | 2,286 | 4,045 | 0.565 |
| | Typhoon 21 (2018) | 32 | 8,068 | 0.004 |
| | Typhoon 24 (2018) | 44 | 8,068 | 0.005 |
| Sturmer village (Essex) | Pluvial flood (2001) | 34 | 464 | 0.073 |
| | Pluvial flood (2014) | 8 | 492 | 0.016 |
| Slapton village (Devon) | Winter storms (2001) | 473 | 473 | 1.000 |
| Torcross village (Devon) | Winter storms (2014) | 75 | 150 | 0.500 |
| Slapton village (Devon) | Storm Emma (2018) | 347 | 434 | 0.800 |

## 6. Conclusion

This study commenced with the question that DRR experts over-emphasise high-impact/low-frequency hazards taking for granted the general public have the same understanding. The findings of the study raised another question as to whether this initial question was feasible. This was because the hazard-based scientific language of impact/frequency was not fully appreciated by the participants being interviewed as per a resident’s statement in Slapton ‘return periods – 1:100 – is not helpful, it is just arithmetic'. Community members evaluate hazards by neither impact nor frequency of hazards. This fact indicated that most government officials, activists and community members did not perceive disaster risks through impact or frequency. The interviewees indicated they did not find the hazard categories studied from the past useful; instead, they wanted to understand disaster risks to inform the future. This makes total sense given disaster risks are determined by both hazards and vulnerability.

The number of affected people for a given hazard over the total population of the town/village (r value) enables evaluating an event as a disaster risk rather than a hazard. Combined with the conventional categorisation of impact/frequency of hazards, the r value could be beneficial in developing community-based DRR that integrates communities' perspectives. As a further study, a robust measure aligning with r value needs to be developed in collaboration with the general public and assessed whether it works for the wider applicability of describing vulnerabilities in a community.

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