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Social media within digitalisation for coastal resilience: The case of coastal fisheries in Minamisoma, Fukushima Prefecture, Japan

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A R T I C L E   I N F O

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A B S T R A C T

Attention to digitalisation as a resilience strategy for coastal communities is growing. However, it is critical that digital technologies and approaches are not forced on localities to enable national or regional sustainability goals, and that communities are engaged and empowered in digital approaches to support resilience on their own terms. This is especially so in a coastal context, where marginality may be greater and where communities may already face multiple pressures. In response, we look at how one particular form of digital technology – social media – may support resilience-building for Minamisoma, a fishing community facing complex and ongoing environmental and socio-economic challenges following the 2011 nuclear disaster. We find that social media offers a channel for some community members in Minamisoma to (re)construct a sense of pride and identity through engagement with fisheries, seafood and the coastal landscape, and to challenge negative external perceptions of their locality. Yet we caution that whilst social media as one digital approach is a valuable repository for pride and identity, it may not be so useful for assessing broader consumer or societal trends upon which the economic revitalisation of a coastal community trading on fisheries and tourism may depend. Nonetheless, we conclude that within a wider suite of digitalisation measures, social media can support coastal actors to sustain a narrative of resilience locally, and continually engage with those in other locations. This may be especially important in the face of ongoing environmental challenges, where communities face multiple setbacks over time.

1. Introduction

For coastal communities facing concomitant environmental and societal pressures, digital technologies and digitalisation are increasingly advocated for new economic opportunities (New Economics Foundation, 2016), reducing risks from natural hazards (NOAA, 2020), and facilitating participation and engagement in decision-making (McKinley et al., 2021). The interface between resilient coastal societies and digitalisation is similarly reflected by calls for a new ‘Sustainable Development Goal 18’ focused on the digital age (Luers, 2020) to support the realisation of other SDGs such as SDG14 (Life Below Water) and SDG11 (Sustainable Cities and Communities).

Nonetheless, concerns exist elsewhere in sustainability scholarship about coastal communities having to take up physical infrastructure, such as renewable energy and disaster risk reduction measures, to meet national-level sustainability, resilience and development goals. One hence ought to consider whether digital ‘infrastructures’ bring meaningful benefit to coastal residents, and whether digital approaches can respond to multiple environmental and societal pressures facing coastal areas. These questions are especially pointed given the rising science-policy interest in ‘resilient coasts’, and in the infrastructure and governance interventions that support such resilient coasts (Beatley, 2014; Ellis, 2021; Glavovic et al., 2015). Accordingly, the aim of this paper is to explore how digitalisation can help to create narratives of resilience for coastal communities facing complex social and environmental challenges. We take as a point of departure one specific aspect of digitalisation – social media - and consider it in the context of the revitalisation of fisheries and seafood in a coastal community facing multiple and ongoing challenges: Minamisoma in Fukushima Prefecture, Japan.

2. Academic context: resilient coasts and digitalisation

As well as disproportionate exposure to climate change and associated extreme events (Koks and Haer, 2020); coastal communities are arguably more likely to face socio-economic deprivation, economic dependency on resource industries, and ageing or declining populations...
Complex governance arrangements spanning land and sea, urbanisation and rising pressure on natural resources raise the likelihood of unequal and non-sustainable development in coastal regions (Neumann et al., 2017).

Because of the acute environmental and societal pressures faced on coasts, the idea of resilient coasts has taken on particular significance in scholarship and practice. Such resilience encompasses ability to respond to physical changes in marine and terrestrial environments through infrastructure or management interventions (Morris et al., 2020; Sutton-Grier et al., 2015); and also governance approaches to support communities whose livelihoods and identities may be closely bound up with the coasts and seas (Dunning, 2020). We understand resilience to mean not only being able to continue to function in the face of external shocks and stresses (Walker, 2020); but also to move forwards when the social and natural environment has been fundamentally altered, and hence when ‘returning to normal’ or ‘bouncing back’ is not possible (Mabon et al., 2020).

In response, investment in digital infrastructure is being promoted as a resilience-building strategy for coastal communities, due to its potential to reduce connectivity deficits and attract new young professionals to coastal communities (New Economics Foundation, 2016) as well as enable data-driven responses to coastal environmental hazards (NOAA, 2020). Digitalisation is transforming traditional coastal industries such as fishing which are a source of local pride, identity and economic benefit (Meyer et al., 2022). Digital approaches also up opportunities for new economic activities by enabling operations – for example deep-sea mining or automated maintenance of renewable energy or aquaculture infrastructure – that cannot be undertaken by humans working alone (e.g. Prapti et al., 2022; Santos et al., 2018). Yet existing research shows that coastal communities may disproportionately bear the negative effects of technological and infrastructural innovations such as renewable energy driven by national or international discourses of progress and development (Huang and Mabon, 2021; Lindkvist and Antelo, 2007); or may see negative consequences associated with national climate and sustainability responses, for instance accepting coastal engineering interventions or facing managed retreat (Ellis, 2021). These issues are relevant for digital as well as physical infrastructures. With McKinley et al. (2021) warning in the context of engagement that digital approaches may not be suitable for every community or application in coastal contexts, it is vital to reflect on whether digital infrastructures likewise bring benefits and empowerment to coastal communities, or whether they are forced on coastal communities from above and/or reproduce and enhance existing inequalities. There is therefore an ethical and moral imperative to understand how digitalisation impacts coastal citizens through effects on social relations, quality and nature of work, and the type of knowledge acquired about the environment.

Digitalisation and digital infrastructure influence not only coastal communities’ potential for innovation, job creation and economic sustainability, but also the sense of place and identity that can be equally strong drivers for resilience (Colten et al., 2012, 2015). It is well recognised in fields such as geography that the digital is reshaping how place, environment and landscape are produced and experienced (Ash et al., 2016). In a coastal context, there is growing interest in digital spaces and technologies as a site for expressing the values bound up with coastal landscapes. Oteros-Rozas et al. (2018) for instance use Flickr imagery to assess cultural ecosystem services associated with land- and sea-based communities. Teles da Mota et al. (2022) likewise demonstrate how Flickr images from Australian beaches can help to understand use patterns and thus inform coastal management decisions such as zoning and facilities allocation. Yet given the complex social and environmental challenges associated with coastal communities, enquiry into how the digital shapes resilience in coastal societies also necessitates engagement with more challenging dimensions of coastal life. This is especially important for communities suffering societal marginalisation or environmental degradation which may act as barriers to resilience. Bonner-Thompson and McDowell (2021) for instance investigate how digital devices and internet connectivity simultaneously mediate and exacerbate young working class men’s experiences of austerity in declining UK seaside towns; whereas Mabon (2021) explores how residents in the coastal steelmaking town of Muroran in Japan use Twitter imagery and hashtags to counter narratives of industrial decline and depopulation commonly associated with their locality.

The question we address through this paper is therefore: how can social media, as one aspect of digitalisation and digital technologies, help to create narratives of resilience for coastal communities facing complex social and environmental challenges? To do so, we work with an activity in a coastal community that has faced extreme changes to the marine and coastal landscape and significant societal change: fisheries in Minamisoma in Fukushima Prefecture, Japan.

3. Characterising Minamisoma and the north Fukushima coast

Minamisoma City is located on the coast of Fukushima Prefecture in north-east Japan (Fig. 1). As a municipality, it has a population of 57,654 people as of spring 2022 spread across a series of small towns and villages (Minamisoma City Government, 2022b). Minamisoma is in the Soma-Putaba fishing district, which covers the northern coastal waters of Fukushima Prefecture. Fisheries, along with agriculture, are of economic and socio-cultural significance to Minamisoma, and are focused on the Manogawa Fishing Port in the Kashima District of Minamisoma (Minamisoma City Government, 2022a) (Fig. 2).

3.1. Minamisoma, fisheries and the nuclear disaster

The 2011 Great East Japan Earthquake and Tsunami struck north-
east Japan on March 11, 2011. The earthquake and tsunami killed over 15,000 people, and disabled cooling systems at the Fukushima Dai’ichi nuclear power plant 20 km south of Minamisoma City. Subsequent explosions released radioactive material over the land and sea of Fukushima Prefecture and beyond. An estimated 70–80% of this contamination entered the northwest Pacific Ocean, and further contamination entered the sea thereafter due to leakages of highly radioactive material and planned releases of less radioactive material (Wada et al., 2016). An evacuation order was placed on Minamisoma City immediately after the accident, and was gradually lifted across Minamisoma’s districts from 2012 to 2015 as decontamination efforts were completed.

All fisheries in Fukushima Prefecture were suspended immediately after the disaster, with monitoring of fish stocks starting soon after to assess levels of radioactive caesium in marine species. From 2012 onwards, fisheries in Fukushima restarted incrementally on a trial basis, whereby species in which radioactive caesium had not been detected for several months were released for trial operations with the aim of testing whether Fukushima fish could be distributed and sold in the market. In Minamisoma itself, commercial fishing operations in the town’s Manogawa Fishing Port resumed in 2016, however prior to that, fishers from Minamisoma participated in the trial fisheries by operating their vessels out of other ports in the north of Fukushima and shipped their catch to the Haragama fish market in Soma City.

As monitoring has expanded and understanding of marine radioactivity become more precise, more species have been released for trial fishing. As of 2018, just under half (49.2%) of fish landed in Minamisoma ports were Japanese sand lance, and a further quarter (25.9%) were sardines (Ministry of Agriculture Forestry and Fisheries). In 2020, the Fukushima Prefecture Federation of Fisheries Cooperatives moved from ‘trial operations’ to ‘expansion operations’, with the goal of rehabilitating some types of fishing activity towards pre-disaster capacity by 2024. The Soma-Futaba fishing district is a particular focus of these efforts, and produce from Soma-Futaba is distributed across north-east Japan as well as the Kanto region (i.e. Tokyo and environs) and beyond (Table 1). The volume and value of fish landed in the Soma-Futaba fishing district has broadly increased year-on-year since commercial fishing resumed. According to statistics and reporting from the Fukushima Prefecture Fisheries Section (2021), the COVID-19 pandemic and state of emergency declarations in the Tokyo area – the largest buyer of Soma-Futaba seafood – led to a downturn in the prices of Soma-Futaba seafood, however from 2021 onwards, prices and volumes of catch appear to be recovering (Table 2).

Nonetheless, concerns about the long-term revitalisation and sustainability of Fukushima fisheries, including Minamisoma and the Soma-Futaba fishing district, remain. The Fukushima Dai’ichi site is host to large volumes of treated water, which has been used to keep the damaged reactors cool during decommissioning (or recovered from groundwater) and treated to remove the most radioactive substances before being stored in metal tanks on-site. However, plant operator TEPCO plans to release the treated water into the sea from 2023 onwards, arguing that they are running out of space to store treated water on-site. The Japanese Government approved the plan in spring 2022, and the IAEA similarly stated they saw no major issues with the plan during a spring 2022 visit and report. However, fisheries cooperatives in Fukushima and Japan more widely are strongly opposed to the releases, arguing that releases will lead to Fukushima seafood being viewed as ‘contaminated’ and thus undoing the significant effort that has gone into re-establishing consumer trust since 2011 (Nogrady, 2021; Normile, 2021).

3.2. Demographic and socio-economic profile

Across the wider Soma area and hence fishing district within which Minamisoma is located, fisheries and fisheries-related jobs (e.g. freezing, processing) make up 1.75% of the local labour force. This compares to 1.15% across all Fukushima coastal regions, 0.51% across Fukushima Prefecture as a whole, and 0.74% for all Japan (Ministry of Agriculture Forestry and Fisheries; Ministry of Internal Affairs and Communications). Compared to the averages for Fukushima and Japan as well more widely, fisheries-related activity in the Soma-Futaba fishing district (including fish landed in Minamisoma but processed or sold on outside of Minamisoma itself) is thus a prominent contributor to the local employment base.

Within Minamisoma City, employment in fisheries makes up 0.24% of local employment, again above the prefectoral and national average. Employment in Minamisoma in primary industries (5.6%) is slightly lower than for all of Fukushima Prefecture (6.2%) but higher than for all of Japan (3.8%); whereas employment in secondary industries (32.8%) is higher than in Fukushima Prefecture (29.6%) and all of Japan (23.4%) (Ministry of Internal Affairs and Communications). Besides fisheries, agriculture is also a key economic activity in Minamisoma, with an arable land ratio of 17% in the municipality compared to 10% for all Fukushima Prefecture and 11.5% for Japan as a whole; with 80.4% of this arable land occupied by rice paddies (Ministry of Agriculture Forestry and Fisheries; Ministry of Internal Affairs and Communications). Revitalisation of seafood within Minamisoma hence comes within a wider picture of the importance of local produce (land-based as well as sea-based) to the area.

The proportion of senior citizens (people over 65 years old) in Minamisoma as of 2020 was 38%, compared to 32.9% for Fukushima

### Table 1

<table>
<thead>
<tr>
<th>Location</th>
<th>Percentage of sales (2021)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fukushima Prefecture</td>
<td>9.6%</td>
</tr>
<tr>
<td>Other Tohoku</td>
<td>9.7%</td>
</tr>
<tr>
<td>Kanto</td>
<td>26.1%</td>
</tr>
<tr>
<td>Other Japan</td>
<td>10.3%</td>
</tr>
<tr>
<td>Not known</td>
<td>41.4%</td>
</tr>
</tbody>
</table>

Fig. 2. Significant locations within Minamisoma (source: Geospatial Information Agency of Japan).
Table 2
Volume and value of fish landed in Soma-Futaba fishing district from 2016 to 2021 (source: Fukushima Prefecture Fisheries Office).

<table>
<thead>
<tr>
<th>Year</th>
<th>Volume landed (kg)</th>
<th>Value (Yen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>1,801,132</td>
<td>—</td>
</tr>
<tr>
<td>2017</td>
<td>2,633,166</td>
<td>1,114,207,774</td>
</tr>
<tr>
<td>2018</td>
<td>3,281,383</td>
<td>1,879,097,143</td>
</tr>
<tr>
<td>2019</td>
<td>2,782,564</td>
<td>1,529,543,128</td>
</tr>
<tr>
<td>2020</td>
<td>3,612,125</td>
<td>1,616,691,610</td>
</tr>
<tr>
<td>2021</td>
<td>3,979,632</td>
<td>1,965,402,471</td>
</tr>
</tbody>
</table>

(*Note that value data for 2016 is not available as that year, prices were determined bilaterally rather than via markets."

Prefecture and 29.1% for Japan overall (Ministry of Internal Affairs and Communications). Notably, within Minamisoma City, 65.6% of self-owned fisheries businesses have a successor able to take over the business. This compares to 46.9% for Fukushima Prefecture overall, and 17.0% for Japan as a whole (Ministry of Agriculture Forestry and Fisheries). This illustrates that, whilst Minamisoma has a relatively ageing population compared to elsewhere in Fukushima and Japan, there is significant willingness and capability to continue fishing in the locality into the future. The continued sustainability of fisheries, including having buyers and consumers willing to support locally-landed fish, is thus important to Minamisoma.

3.3. Recovery and the future for Minamisoma fisheries

Minamisoma, especially the revitalisation and resilience of coastal fisheries, is therefore a useful case for understanding the implications of the digital on coastal resilience for several reasons. First, as a coastal municipality which is located close to the Fukushima Daiichi nuclear power plant and where commercial fisheries were suspended in the town’s Manogawa fishing port from 2011, with fishers having to relocate elsewhere before the port re-opened in 2016, Minamisoma represents a locality which has suffered a significant shock to an activity that is both economically important and culturally significant. As commercial fishing activities have restarted for several years, but have faced subsequent setbacks in the form of the COVID-19 pandemic and the likely releases of treated water into the sea, fishing in Minamisoma allows the contours of resilience and its relation to the digital to be tracked over time. Second, Minamisoma as a locality has placed emphasis on the role of digital technologies and digital innovation in its revitalisation, as well as the rehabilitation of fishing and agriculture in the region. Initiatives include co-working spaces aimed at attracting new workers in digital and creative sectors (Koizumi, 2020). Fishers and fisheries cooperatives working in Minamisoma (and indeed across the Soma-Futaba fishing district) have engaged with digital platforms to raise awareness of their work and build markets for their produce, for instance establishing a fishers’ blog (https://www.soso-gyoko.jp/blog/). This reflects broader trends within fisheries in post-disaster north-east Japan, where younger generations of fishers have engaged with IT and digital technologies, especially social media, to enhance the resilience and sustainability of their practice (https://note.com/fishermanjapan/n/n7206e7c48e7b).

4. Method

Tweets from the microblogging site Twitter were analysed to observe the role of social media – as one facet of digitalisation – in the recovery of Minamisoma fisheries and its link to coastal resilience. Japan’s Ministry of Internal Affairs and Communications reported that as of 2021, Twitter was the fourth most-common social media site in the country (behind instant messaging service LINE, Instagram and YouTube), with 46.2% of sampled Japanese residents using Twitter over a broadly even split between men and women. Furthermore, 16% of those sampled said they posted content on Twitter. As of 2021, Twitter was used most by those in their 20s (78.6% of people in this age bracket reported using Twitter), followed by those in their teens (67.4%), their 30s (57.9%), their 40s (44.8%) and 50s (34.3%), 14.1% of people in their 60s and 5.9% in their 70s reported using Twitter (Ministry of Internal Affairs and Communications, 2021). Minamisoma has a high proportion of elderly people in its population, who may thus be under-represented in a Twitter sample. Nonetheless, the comparatively high proportion of fishing businesses in Minamisoma who have a nominated successor, combined with the municipality’s drive to build a digital workforce and the growing interest of the regional fisheries sector in tapping into social media channels (see Section 3.3) means that the views of younger age groups who are well-represented on Twitter are significant in shaping the future trajectory of fisheries in the locality. Moreover, the strong penetration rates of Twitter into younger age brackets means the platform has the potential to engage with seafood consumers from Fukushima Prefecture and beyond, whose custom the future of Minamisoma fisheries also relies on.

The value of using Twitter is hence that it is (a) widely used within Japan across gender and age brackets, and hence likely to yield a breadth of responses; (b) publicly-available content, allowing a diverse range of viewpoints to be accessed that are in the public domain; and (c) operational for over a decade with content remaining online and publicly available permanently (unless deleted by a user), thus allowing attitudes and responses to be traced over time.

Although Twitter is often associated with quantitative and/or computational analysis on thousands or even millions of data points, there is also precedent – including in environmental change and disaster research – for working qualitatively and in-depth with smaller datasets. For example, Newman (2017) selected a sub-sample of 100 tweets from a larger dataset for in-depth analysis through descriptive statistics and qualitative interpretation, to research which users, sectors and themes attracted the most attention when commenting on the release of the Summary for Policymakers from Working Group 1 of the IPCC’s Fifth Assessment Cycle. Jacques and Knox (2016) similarly undertook manual coding on a sub-sample of 360 tweets to understand individuals’ rationales for rejecting climate change science in the aftermath of the 2012 Hurricane Sandy in the USA. Jacques and Knox produced a summative content analysis, using descriptive statistics and quotes (alongside statistics from their overall larger dataset) to identify common themes among users who reject climate science. Our study similarly employs a combination of statistics and qualitative analysis to understand the ways in which consumers and coastal residents discuss Minamisoma fish, and justify their consumption choices.

Tweets were analysed for the period covering 1 January 2016 to 31 December 2021. This covers the time period from the recommencement of trial commercial fishing operations at Minamisoma’s Manogawa Fishing Port in Kashima in spring 2016, through the main period of the COVID-19 pandemic in 2020 and 2021, and also the time period from mid-2020 to early 2021 when discussions over the release of treated water from Fukushima Daiichi into the Pacific Ocean were at their most intense. Our sample thus allowed attitudes and viewpoints to be traced over the time when more and more species were being released for trial operations in Minamisoma and significant efforts were being made by local, regional and national governments to support the revitalisation of Fukushima fisheries, but also when the Minamisoma fishery faced subsequent setbacks in the form of COVID-19 and the emerging issue of treated water releases.

Twitter’s archive was searched for Tweets containing the keywords 南相馬 (Minamisoma) and 魚 (fish). Search words were determined on the basis of the lead researcher browsing the Tweet archive to understand the language being used to talk about Minamisoma fisheries, and thereby selecting search terms that would encompass as many Tweets as possible on the topic of Minamisoma fish, seafood and fisheries.
During this initial search, it was also determined that virtually all of the Tweets about Minamisoma fisheries were in Japanese, hence English-language (or other non-Japanese) Tweets were excluded from the sample.

For each Tweet, the date, user location (if stated), text content of the tweet, number of retweets, number of likes, number of comments, any included images, and any linked articles were noted. The rapid pace at which content on Twitter updates means that issue-attention cycles last hours or days, or weeks at most (Wang and Guo, 2018). Data collection was completed on 17 May 2022 owing to staffing availability and project timelines. As this collection date was more than four months after the last Tweet in the dataset, it was hence assumed that the number of engagements would be unlikely to increase significantly and that the engagement numbers for each Tweet were representative of its overall impact. A final manual sort removed any Tweets that were not relevant to Minamisoma or the marine and coastal landscape. After this sort, 317 Tweets were determined to be in scope for analysis.

### Table 3

Overview of codes developed for analysis.

<table>
<thead>
<tr>
<th>Category</th>
<th>Code</th>
<th>Indicative phrases representing code/how code identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tone</td>
<td>Positive</td>
<td>Content that presents situation of fisheries and marine environment of Minamisoma, positively by showing quality of produce and recovery of fisheries, e.g. “first step towards reconstruction”, “we hope that delicious fish will be landed”, “of course it’s delicious!”</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>Content that presents situation of fisheries and marine environment of Minamisoma negatively by raising safety concerns or arguing that fishing has not recovered, e.g. “radioactive fish”, “you can’t eat it, can you?”, “We haven’t put out any fish from Fukushima since before the nuclear accident.”</td>
</tr>
<tr>
<td></td>
<td>Factual/descriptive</td>
<td>Factual descriptions of events (e.g. news headlines); Tweets that simply contain URLs linking to a webpage; or purely descriptive Tweets (e.g. menu lists). E.g. “flathead flounder [at Minamisoma City Museum]; “sea raven and dobu soup; boiled sea raven and round radish.”</td>
</tr>
<tr>
<td>Topic</td>
<td>Daily life</td>
<td>Content about daily actions and the lived/built environment in Minamisoma, e.g. “fishmongers, hat and bag shops, clothing shops and other shops have reopened for business”, “Most of the houses have been rebuilt or cleared.”</td>
</tr>
<tr>
<td></td>
<td>Environment</td>
<td>Content about the general quality of the marine and coastal environment in Minamisoma, not specific to commercial fishing, e.g. “Salmon return to their hometown rivers”, “It was a pleasant beach and sea.”</td>
</tr>
<tr>
<td></td>
<td>Fisheries</td>
<td>Content about the status of commercial fishing activities in Minamisoma, e.g. “The government has ordered the restriction of shipments of black rockfish”, “promote the restoration of the fishing port.”</td>
</tr>
<tr>
<td></td>
<td>Food</td>
<td>Content about produce in Minamisoma, including both seafood and food produced on land, e.g. “This is a traditional way of eating anglerfish here”, “ice cream, dairy, meat, fish and miso are all delicious, Minamisoma!”</td>
</tr>
<tr>
<td></td>
<td>Tourism and culture</td>
<td>Content about visiting Minamisoma or socially and culturally meaningful events: “Fukushima by car […] I visited Minamisoma City”, “a friend took me to Minamisoma”</td>
</tr>
<tr>
<td>Location</td>
<td>Minamisoma</td>
<td>Determined from self-reported location in user’s bio on their Twitter profile page.</td>
</tr>
<tr>
<td></td>
<td>Fukushima Prefecture other</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tohoku region other</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kanto region other</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Japan other</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not stated</td>
<td></td>
</tr>
</tbody>
</table>

Each Tweet was coded to allow further analysis for tone; topic; and location of the account (Table 3). Codes were developed iteratively, following the hybrid inductive and deductive thematic analysis approach outlined by Fereday and Muir-Cochrane (2016). Under this approach, initial codes were developed prior to data analysis, based on the overarching research question of the study and the researchers’ prior knowledge of the subject, with these codes then being refined or augmented as new themes were identified during analysis. Each Tweet was assigned an initial code, and these diverse codes were then grouped into overarching topic areas which allowed both basic statistical analysis of the dataset (Sections 5.1. to 5.3) and further qualitative analysis through identification of themes (Section 5.4.). The use of thematic coding as a basis for statistical and qualitative analysis has been adopted to understand argumentation and rationales for other environmental issues (Jacques and Knox, 2016; McComas and Shanahan, 1999). Coding was conducted on original Japanese language Tweets, but to prevent reverse identification of users, only the English translations of indicative phrases and quotes are reported. To allow further analysis and comparison, fisheries data for the destination of produce landed in the Soma-Futaba fishing district and the annual volume and value of produce landed in the Soma-Futaba fishing district were obtained from Fukushima Prefecture Fisheries Section.

Descriptive statistics were then produced as outlined in Section 5. These were supplemented by Chi-Squared Testing and Pearson’s Product Moment Correlation Coefficient Testing to statistically assess the relationship between variables in the dataset, again as outlined in Section 5. Themes relating to the resilience of fisheries and the Minamisoma coast were identified qualitatively based on the codes assigned to the individual Tweets plus in-depth reading of the content of the Tweets themselves.

All data collected and analysed was in the public domain at the time of collection. However, to preserve the anonymity of those posting the initial tweets and mitigate any ethical concerns about Tweets posted from personal accounts being re-produced and/or shared out of context with a wider audience, following the methodological recommendation of Butler et al. (2018), no direct quotes or references that may make individual Tweets identifiable are included.

Tweets were coded by a single researcher. Whilst checking for intercoder reliability may have enhanced the rigour of the analysis, it was concluded that the codes were distinct enough as to be unlikely to vary significantly from coder to coder. It should also be acknowledged that, due to the case study area being geographically limited, the sample size is quite small. In the Discussion, we reflect on what can – and what cannot – be learned from a social media sample of this size, and on the value of digital methodologies in understanding issues of resilience in smaller coastal communities.

### 5. Results

#### 5.1. Descriptive statistics

Fig. 3 shows the number of Tweets about Minamisoma fish per season, from January 2016 to December 2021. The figure shows that the number of Tweets per season about Minamisoma fish has declined gradually over time, however occasional peaks in interest remain. The peaks in Tweets generally relate to major news events in the revitalisation of coastal fisheries, such as the reopening of the Manogawa Fishing Port in spring 2016, the reopening of the Mikami Fish Store in the town in spring 2017; and the discovery of a black sea bream containing levels of radioactive caesium above the regulatory limit, plus progress in plant operator TEPCO’s plan to release treated water into the north-west Pacific Ocean, in summer 2021.

Fig. 3 also shows that the ratio of Tweets with a positive tone to those with a negative tone remains largely consistent over time. In seasons where there is a higher proportion of Tweets with a negative tone, these tend to be related to news events about change in the coastal
environment. These include scientific consultations on high levels of radioactivity in Minamisoma’s rivers (2017 Q1); the effects of Typhoon Hagibis on availability of fish due to inability of fishers to go out to sea (2019 Q4); and the discovery of a black sea bream with radioactive caesium concentrations above the regulatory limit, plus progress in the plans to release treated water into the Pacific Ocean (2021 Q2).

Of the sampled tweets, 18.6% (n = 59) were from accounts which identified themselves as being from Minamisoma. 16.4% (n = 52) were by accounts with reported location in the Kanto area, 13.9% (n = 44) from wider Fukushima Prefecture, 5.4% (n = 17) from the broader Tohoku area, and 5.0% (n = 16) from elsewhere in Japan. 40.7% (n = 129) were from accounts where the user did not state their location. When compared to the destination of seafood landed in ports in the Soma-Futaba fishing district (Table 4), accounts from Fukushima Prefecture (both Minamisoma and elsewhere in Fukushima) made up a disproportionate share of Tweets in comparison to the volume of seafood sold there; whereas accounts from wider Tohoku, Kanto and elsewhere in Japan were under-represented in comparison to the volume of Soma-Futaba seafood sold to these regions.

In terms of theme, 47.6% (n = 151) of Tweets were about food; 18.3% (n = 58) about fisheries; 15.1% (n = 48) about environmental quality; 13.2% (n = 42) about daily life; and 6.0% (n = 19) about tourism and culture. 76.3% (n = 242) of Tweets had a positive tone, 22.1% (n = 70) had a negative tone, and 1.6% (n = 5) were of a purely descriptive or factual nature.

Table 5 shows the number of engagements (retweets, likes, replies) per Tweet according to different categories. Tweets with a negative tone had a higher mean number of engagements than those with a positive tone, albeit with a larger standard deviation (meaning a relatively small number of negative Tweets may have had very large engagement). Tweets from accounts in Fukushima Prefecture, the Tohoku Region and Minamisoma itself had the highest mean number of engagements; however the Fukushima mean had a very high standard deviation which again suggests a small number of Tweets may have had very high engagement. Conversely, Tweets from Minamisoma had a lower standard deviation than Fukushima or Tohoku, suggesting Tweets from Minamisoma generally had high engagement. By theme, the highest mean engagements were for Tweets on food or environmental quality, with the lower standard deviation for food-related Tweets suggesting they generally received high engagement.

5.2. Relationship to fisheries data

Table 2 showed the volume and value of fish landed in the Soma-Futaba fishing district from 2016 to 2021 (note that value data for 2016 is not available as that year, prices were determined bilaterally rather than via markets). Figs. 4 and 5 respectively show the number of Tweets annually in comparison to the volume of catch landed in the Soma-Futaba fishing district, and to the value of catch landed in the Soma-Futaba fishing district. From 2016/2017 to 2019, the trend in the number of Tweets almost mirrors the volume and value of the catch, whereby an increase in the volume and value of catch corresponds to a decrease in the number of Tweets and vice-versa. From 2020 onwards, however, the number of Tweets rises in accordance with the volume and the value of the catch.

5.3. Statistical tests

A chi-squared test showed a statistically significant relationship between the location of the user and the tone of their Tweets ($\chi^2 = 38.268, df = 5, p<0.001$). The relationship remained statistically significant when removing Tweets where the location of the account was not stated ($\chi^2 = 22.576, df = 4, p<0.001$). Accounts from Minamisoma,
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4. Qualitative insights

A first theme is that particular locations and activities represent spaces in which the revitalisation of Minamisoma fisheries and coastal life happens. As above, a sizeable proportion of the Tweets are authored by accounts in Minamisoma, Fukushima Prefecture or the wider Tohoku region, and nearly half of the Tweets are on the topic of food. Accordingly, ‘conspicuous consumption’ of Minamisoma fish – whereby people post text and images about visiting famous local fish shops or restaurants and buying fish to eat or cook – forms a large proportion of the more positive Tweets about Minamisoma fish. Within these Tweets, there is particular desire to be seen to be supporting the revitalisation of Minamisoma fisheries by, for example, posting about visits to newly-reopened fish shops or port facilities, or about eating the first or last catch of a certain breed of fish for the season landed in Minamisoma ports.

A second theme is the role that those promoting the recovery narrative give to data and scientific evidence to justify the safety of Minamisoma fish. Notable here is the use of the phrase ‘ND’ in several Tweets without explanation. ‘ND’, which stands for ‘not detected’ in the context of Caesium-137, becomes shorthand for the fact that marine produce does not contain harmful radioactive substances to a detectable level and is hence considered, in the view of those posting, safe for consumption. It is also significant that citizens themselves share, discuss and comment on high-level scientific assessments of remaining radiation risk in the marine environment, often with reference to images of monitoring or screening data for marine species. Conversely, Tweets with a more negative tone towards fisheries and the marine environment in Minamisoma tend to draw less on underpinning empirical evidence, and instead ground their arguments in hyperbolic language such as ‘bathe in radiation’ and ‘like sushi made in a toilet.’

A third theme is that Tweets carrying a more positive tone, especially on the topic of food and fisheries, emphasise the idea that Minamisoma seafood is not only safe, but also delicious. What is significant is the creation by accounts from Minamisoma and Fukushima Prefecture of hashtags and phrases supporting their assertions on the quality of Minamisoma seafood, and Fukushima produce more widely, as a counter to perceived stigmatisation following the nuclear disaster. These include #美味福島 (Yummy Fukushima) and 南相馬 #飯を食べる (Minamisoma food tourism). It is notable that these hashtags arise and gain traction organically among individual users, rather than being created and promoted by governmental or industry accounts.

A fourth and final theme comes from a small but notable number of Tweets which engage with the effects of climate change and weather extremes on Minamisoma fisheries. This was especially so after the 2019 Typhoon Hagibis, which led to a temporary shortage in locally-landed fish due to the inability of fishers to fish in the storm and immediately afterwards, but also in citizens’ observations of how extreme weather affects riverine and estuarine landscapes in their daily lives. This reminds us that the recovery and revitalisation of Minamisoma fisheries takes place against a backdrop of climate change, which may be starting to impact on local fisheries.

6. Discussion

To structure the discussion, we return to our question of how social media, as one aspect of digitalisation and digital technologies, can help to create narratives of resilience for coastal communities facing complex social and environmental challenges, as explored through the revitalisation of fisheries in Minamisoma in Fukushima Prefecture.

Our first insight is the role of local accounts and individuals within geographically-bounded communities in constructing a digital narrative of resilient Minamisoma fisheries. Tweets from Fukushima Prefecture and Minamisoma in our dataset gained high levels of engagement, as did those from the wider Tohoku area. The tone of Tweets from these localities was positive to a statistically significant degree (Section 5.2.). Qualitatively too, the use of hashtags and imagery relating to high-quality high-value produce by accounts local to the fishing port supports the idea that the most vocal supporters of Minamisoma fish are those living in the community. This positivity encompasses not only the culture and taste of the fish, but also the scientific processes around assessment and monitoring for radioactivity, as illustrated through the sharing of imagery of monitoring data and the repetition of the acronym ‘ND’ to show the undetectability of radioactive caesium in Minamisoma fish (Section 5.4.).

It is perhaps to be expected that people living closest to the fishing ports and markets will take a prominent role in shaping a digital narrative of the revitalisation of Minamisoma fisheries. Section 3 showed the comparatively high employment that fisheries-related activity brings to the Soma-Futaba fishing district, and also the much stronger succession plans for Minamisoma fisheries compared to the rest of Fukushima Prefecture and indeed Japan. Section 3 also illustrated the prominence that local produce from both the land and sea has in Minamisoma’s economy, society and landscape. Even if they themselves are not employed within the local fishing industry, some coastal residents in Minamisoma may therefore see the recovery and resilience of fisheries as being vital to the future of their locality, and take to social media to...
voice their support accordingly. At the same time, the geographical
diversity of accounts engaging with Minamisoma fisheries demonstrates
how these narratives can be supported and amplified by consumers or
supporters located outside of Minamisoma or Fukushima Prefecture.

Research on landscapes associated with undesirable infrastructure
and environmental radioactivity has suggested ‘landscapes of risk’
characterised by powerlessness, environmental degradation and a cul-
ture acceptance (Blowers, 1999); or even ‘nuclear seascapes’ (Huang
and Rapongan, 2021). By contrast, what we see is a set of users who are
closest to the Minamisoma fishery who use social media to present a
more diverse set of images of consuming the produce and the seascapes
of Minamisoma. Similar to the finding of Parkhill et al. (2014) that
communities can create their own, alternative and sometimes more
positive narratives around undesirable infrastructure, the case of Min-
amisoma fisheries shows the potential of the digital to allow community
members, or at least groups of people within a community, to construct
alternative seascapes. Digital spaces such as Twitter, aided by the use of
hashtags and amplification from a wider geographical network of con-
sumers or supporters, can be sites for the community or local
government-led actions to rebuild resilience, which Dunning (2020)
argues are so important in the immediate aftermath of shocks and
stresses. Such spaces can also become repositories for local pride and
identity (and hence inherent resilience (Colten et al., 2012, 2015))
through the sharing of imagery of locally-lived fish and fishing land-
scapes, thereby contributing to a sense of place and identity for a coastal
community under ongoing environmental and societal change.

However, although Twitter provides an outlet for some active coastal
residents to support the revitalisation of coastal fisheries as an
interestingly and culturally significant activity for the Soma-Futaba fishing
district, this may not lead to an increase in the volume of fish
sold and consumed. Accounts from Fukushima Prefecture were over-
represented in the sample compared to where Soma-Futaba fish sold
(Section 5.1.). This leads into our second insight. Namely, the limitations
of digital platforms – especially social media – as sites for supporting
coastal resilience, and the limitations of what can be known through
digital research methodologies that rely on social media. Section 5.1.
shows that the biggest destination location for Soma-Futaba seafood is
the Kanto region. Yet Sections 5.3. and 5.4. show that the Kanto region
also had a higher proportion of negative responses than the localities
closest to Minamisoma; and also comparatively fewer Tweets and en-
gagements than accounts in Minamisoma, Fukushima Prefecture, and
Tohoku within our sample. Likewise, no significant statistical relation
was observed between the proportion of negative tweets and the value of
the fish landed in Soma-Futaba waters, and we found only a weak
relation between the proportion of negative tweets and volume of fish
landed (Section 5.4.).

One reading of these findings could be that the sheer size of the
population – and thus the number of consumers in absolute terms – is
enough in the Kanto region to ensure good sales in the face of negative
perceptions. Another reading, however, is that social media data may
not be so useful for understanding wider social attitudes to specific
coastal localities, or for assessing likely sales and consumption patterns
for produce from coastal communities who are seeking to enhance their
resilience under continuing environmental and social pressures.
McKinley et al. (2021) argue that digital approaches are not suitable for
every form of engagement with coastal communities on resilience. We
too would argue that digital methodologies grounded in social media are
more valuable for understanding expressions of identity and sense of
place for coastal communities at a local level (similar to e.g. Oter-
os-Rozas et al., 2018), than for assessing attitudes to produce or to
so-socio-environmental change at a regional or national level. Moreover, it
should be remembered that what people present on social media does
not necessarily correspond to the full range of emotions or experiences
they experience in daily life. Users may be less willing to share the less
positive or less successful aspects of coastal recovery, for example. We
also acknowledge that when it comes to the relation between sales and
social media attitudes, we are working with a small sample and short
time series, so would caution against over-interpreting from our data
points.

Our third and final discussion point is that ‘digitalisation’ relates to a
much wider suite of processes than we are able to touch on in this paper.
Digital methodologies may extend far beyond social media and could,
for example, encompass participatory approaches which directly engage
eastal community members and stakeholders in creating knowledge
about resilience in their locality. Similarly, digitalisation may relate to
many processes which can create and sustain resilience in the physical
world, such as hazard mapping and alerts, data-driven approaches to
fisheries, and digital sales and marketing. All of these lie beyond the
scope of this paper, yet are important components of how the ‘digital’
may support resilience for coastal communities facing ongoing envi-
nmental stresses and socio-economic change. Nonetheless, based on
our findings we would argue that social media offers an important
channel for coastal communities to sustain and enhance a sense of pride
and local identity in the coastal environment, especially in cases such as
Minamisoma where the marine environment has previously been viewed
as degraded and the community has suffered significant disruption due to external shocks.

7. Conclusion

In this paper, we took the case of social media usage for fisheries and
seafood in Minamisoma City, Fukushima Prefecture, Japan as a point of
departure for reflecting on how digitalisation and digital technologies
may support the creation of narratives of resilience for coastal com-
munities facing complex social and environmental challenges. This
question is significant given growing interest across environmental so-
cial sciences in the role that the digital can play in supporting resilience
for coastal communities, especially those facing environmental risk or
degradation and socio-economic challenges. This topic also reflects
increasing attention to how digitalisation may interface with the Sus-
tainable Development Goals (Luers, 2020), especially SDG14 (Life
Below Water) and SDG11 (Resilient Cities and Communities) in the
context of our study.

Our findings show that within digital technologies, social media can
be an important space for residents of coastal communities to (re)
construct a shared sense of pride in their coastal landscapes and to create
a narrative of resilience for economically and socially meaningful ac-
tivities such as fishing. In the context of resilience, this ability for
community members to connect and participate in consumption of
spaces and produce that matter to them is important, in terms of being
able to retain core functions and adapt in the face of a major shock with
subsequent long-term disruptions and setbacks like the Fukushima
Dai’ichi nuclear accident. Our results also suggest that social media
platforms may be spaces where residents can challenge negative per-
ceptions of the coastal landscapes in which they live, and create alter-
native narratives about living in environments facing complex societal
and environmental challenges. The digital may also allow consumers
and supporters from geographically distant locations to amplify mes-
sages or participate virtually in meaningful consumption practices.

Our results also indicate, however, that over small geographical
areas, social media data may be less well-suited to assessing the eco-
omic or quantitative recovery and resilience of a coastal community.
This is especially so where data sets are small, and where the time pe-
riods over which data is available may not allow trends to be assessed
in depth. It should also be remembered that digital technologies, especially
social media, are not necessarily representative of the breadth of de-

graphies and socio-economic statuses within a locality. In coastal
contexts where economic marginalisation may be more pronounced, it is
especially important to consider who may be excluded or under-
represented in digital communities or digital responses to resilience
challenges (Bonner-Thompson and McDowell, 2021). For communities
that aspire to use digital technologies to promote resilience, whether
through social media or otherwise, due consideration must be given to ensuring the most vulnerable and marginal in the community are given opportunity to access technologies and have their voices heard. In this regard, the initiatives within Minamisoma to promote digital innovation by and for senior citizens and school pupils (e.g. Koizumi, 2020; Odaka Workers’ Base) stand as a positive example.

Online technologies, and especially social media, are only one aspect of digitalisation in coastal communities. Likewise, fisheries are just one component, however significant, of sense of place and identity on coasts. However, our findings from fisheries and seafood in Minamisoma indicate one way that digitalisation can support resilient coastal communities is through the ability it gives to community members to illustrate the cultural, social and economic significance of local produce. Social media also allows potential consumers or opinion-shapers (e.g. news media) who may be spatially distant to understand the lived experience of sustaining fisheries under challenging conditions in a locality, and even to participate in conspicuous consumption themselves via the use of hashtags and photographs. This ability to sustain a narrative of resilience locally and to continually engage with those in other locations may be especially important in times of ongoing environmental challenges, where communities may face multiple setbacks over time and may hence need to support local fishing and coastal activities over a timeframe that transcends conventional news cycles.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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