Original Article

Using Instagram data for tourism promotion of fishery villages:
An integrated analysis of images, hashtags and texts

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Abstract
Recently, fishery villages, which have been threatened with decline due to the aging society and depopulation, have begun to consider "blue tourism" as a means of revitalization, taking advantage of the rich marine products, traditions and culture unique to the sea-facing areas. However, it is hard to formulate tourism strategies by systemizing local resources which are diverse and have not originally been recognized as tourism resources. Therefore, this study aims to provide information that contributes to tourism promotion strategies by structuring people's images of fishery villages utilizing big data accumulated on Instagram. After converting the obtained data (images, texts and hashtags) into one structured dataset by hashing, the integrated patterns of the posts related to fishery villages were clarified and visualized by machine learning. The result revealed the diversity of the data and the combination of various types of data can be classified into several major patterns (e.g., a combination of scenery in fishery villages with text to complement to the lifestyle in the villages). The results of this study indicate the potential for a variety of tourism strategies in fishery villages and suggest the importance of considering a combination of the three types of data when developing tourism strategies.

Keywords
SNS, unstructured data, fishery village, text mining, image recognition

1. Introduction

Japan, an island country with diverse and rich grounds for fishery, has approximately 4,000 fishery communities which have fishery ports in front along with coastal areas throughout the country, and fisheries have long been the country's leading primary industry [Fisheries Agency, 2020]. However, since the late Showa period (1926-1989), population decline, falling birth-rates, and an aging population have gradually become social problems in many fishery villages, and many problems have been pointed out, such as the decline of the local economy and the deterioration of village functions [Yamauchi, 2020].

To tackle these problems, the Fisheries Agency of Japan recently published the Basic Plan on Promotion of Exchange for Vitalizing Fishery Ports and Villages [Fisheries Agency, 2021]. This aims to revitalize fishery villages and industry by rediscovering and utilizing the attractiveness of fishery villages through exchanges with urban residents, taking into consideration not only the aspirational natural environmental resources, but also the cultural value of traditional primary industries [Saito, 2020]. This type of tourism, where visitors experience the nature, traditions, and culture unique to the area facing the sea and enjoy exchanges with local residents, is called "nagisahaku (beach-side stay)" or "blue tourism", being promoted in Japan to attract visitors and revitalize the local community [Hayashi, 2013].

Blue tourism, defined by the Blue Tourism Promotion Guide [Ministry of Land, Infrastructure, Transport and Tourism & Fisheries Agency of Japan, 1999], offers a refreshing seaside lifestyle experience through stays in islands and coastal fishing villages, emphasizing the importance of experiencing the local environment. Similar to green tourism in the agricultural sector, blue tourism emphasizes the value of staying and experiencing the local environment. The content of the experience depends on the sea area, coastline, and marine products unique to the region. For example, Torii [2002] presented a case study combining trolling and diving in Onna Village, Okinawa Prefecture, while Wada [2003] offered an octopus basket fishing experience and seafood-related activities in Kumano City, Mie Prefecture. Blue tourism can contribute to both economic and social sustainability of fishery villages. This type of tourism may not only improve the economic sustainability of fishery villages but also promotes social sustainability by encouraging potential new residents to settle in these villages by experiencing their unique attractions and possibilities for living.

While much has been said about blue tourism and its potential, there are also challenges.Unlike traditional tourism, blue tourism emphasizes the experience of the fishing industry and local community interaction, and the process of converting local resources into tourism products, initiated by the stakeholders involved in the local marine industry, is crucial [Takenouchi, 2005]. While this bottom-up co-creation process [Hyytiäinen et al., 2022] can be challenging for locals, it has the potential to revitalize the entire region by strategically integrating blue tourism with other tourism resources in the area.

Of course, it is not easy for locals to reaffirm the attractive-

ness and value of the region, and to develop a tourism strategy by systematizing local resources that were not originally recognized as tourism resources. In addition, there is a lack of general information that can be used as a reference point to create uniqueness, such as the general image of fishery villages held by the people to be attracted and what they perceive as their value.

In recent years, social listening, the practice of collecting and analyzing users' natural expressions, transmissions, conversations, and interactions on social media, has gained attention [Yakata et al., 2020]. In the fields of urban planning and tourism, there are already reported cases of utilizing and analyzing social media (Twitter, Facebook, and Instagram) posts of arbitrary temporal and spatial targets as big data to gauge people's interests (e.g. Yasuhara and Liu [2021]; Sawada [2021]; Shimomukai et al. [2022]; Suzuki et al. [2022]).

Focusing on tourism in particular, the recent development of the information society and the spread of smartphones have encouraged tourists themselves to provide information through blogs and SNS, which in turn stimulates the interest of potential tourists [Živković et al., 2014; Sawada, 2018]. In particular, "Instagram," an application program mainly for sharing images, is positioned as an important SNS in terms of promoting tourist destinations by linking tourists' personal photography with the communication and dissemination of tourist information [Amano and Uenaka, 2021]. This social media is characterized by the accumulation of unstructured data such as hashtags (keywords) and text data associated with image posts [Kuroda et al., 2018].

While above previous studies with SNS analyses often aggregate specific objects (e.g. regions, buildings, etc.) in most cases, there are few cases analyzing the overall concept in the digital world by examining individuals' interests and expressions in their posts. Also, most previous SNS studies have focused on a single aspect, such as text, hashtags, or images, neglecting the importance of 'variety,' 'volume,' and 'velocity' in big data [Callegaro and Yang, 2018]. Current SNS posts contain unstructured data which combine various elements, and there is a growing need to integrate and analyze them in order to better understand the content created by individuals.

This study aims to utilize big data from Instagram posted in Japanese to analyze and visualize people's perceptions of fishery villages and associated information. The goal is to gain valuable insights that can help develop effective tourism promotion strategies for these destinations.

2. Methodology

In this study, the posts with "#fishery village" as a hashtag on Instagram and posted from March 2014 to March 2022 were collected as a study target. 13,623 valid posts were obtained in total excluding those that were private. The basic information of the data is shown in Table 1.

For the text data, morphological analysis [Higuchi, 2020] was first performed on the data without hashtags and Unicode characters. Then, the top 150 most frequent words (morphemes) were extracted, and a frequency matrix was created by taking the number of occurrences of each frequent word for each post.

Table 1: General information of the obtained data

All	Number of Extracted Posts	13,870
	Number of Valid Posts	13,623
Text	Number of Adopted Unique Words (morphemes)	39,937
	Percentage of the summed up number of top 150 frequent words to the total	18 %
Hashtag	Number of Unique Hashtags	1,604
	Percentage of the summed up number of top 150 frequent hashtags to the total	25 %
Picture	Number of Unique Feature Labels	9,605
	Percentage of the summed up probability of top 150 high probability labels to the total	21 %

Then, the hashtag portion was cut out from each post, the frequencies were tabulated, and the top 150 most frequent ones were extracted. Then, for each post, we created a matrix that represented the occurrence of each hashtag as a binary value of 01.

To analyze the image data, we utilized YOLO (You Look Only Once) [Redmon et al., 2015; Redmon and Farhadi, 2018], a deep learning open-source model for general object recognition, to identify the subjects depicted in the images. The model used in this study was trained on a publicly available dataset and is capable of recognizing objects in images and providing the probability of each recognized object. The top 5 most probable labels were selected for each image, and the top unique 150 most probable labels recognized with high probability in multiple photos were extracted. We then constructed a matrix to calculate the probability fit of each label for each post.

To integrate the three datasets, we first extracted principal components (PCs) using principal component analysis (PCA) for each dataset on a post-by-post basis. We set the number of principal components to be extracted to 30, ensuring that the extracted PCs contributed to around 60 % of the total variance for each original dataset. The lower limit of eigenvalue for each PC was set to 1. This resulted in an integrated matrix of principal component scores (13,623 × 90) for each post. Then, to visualize the proximity between data in two dimensions, we employed UMAP (Uniform Manifold Approximation and Projection) [McInnes et al., 2018], a non-linear dimensionality reduction technique. This allowed us to include information from all three datasets and plot similar posts as a group at nearby coordinates on a two-dimensional map. Finally, we used DBSCAN (Density-Based Spatial Clustering of Applications with Noise) [Hahsler et al., 2019] to classify the data plotted in two dimensions. If UMAP indicates the result based on the large

dataset, like in this study of over 10,000 data points, visual classification of subsets is limited. To address this, DBSCAN enabled us to classify posts based on their scatter density of their contents and features in the reduced two-dimensional space while considering outlies.

Rver.4.1.0 was used for data processing and analysis in this study. The main packages used were: tidyverse, UMAP, DBSCAN, RMeCab, magick, image.darknet.

3. Results

3.1 Frequent words, hashtags and labels

Table 2 shows the top 50 most frequent words, hashtags, and

Table 2: Top 50 frequent words, frequent hashtags and high probability labels

Text			Hashtag			Picture		
ID	Word	Frequency	ID	Hashtag	Frequency	ID	Label	Summed Probability
1	fishery village	3136	1	#sea	2525	1	seaside	512.55
2	sea	2056	2	#japan	1407	2	dock	440.79
3	I	1685	3	#fishery port	1289	3	seashore	405.40
4	fisheries	1096	4	#seaside	1083	4	breakwater	330.23
5	reached	809	5	#Hong Kong	1022	5	boathouse	290.41
6	fish	777	6	#travel	991	6	promontory	249.25
7	see	767	7	#local life	870	7	sandbar	124.30
8	exist	734	8	#Tai O	850	8	aircraft carrier	114.70
9	time	732	9	#photography	736	9	wreck	112.35
10	today	722	10	#Japan sea	720	10	pier	94.96
11	fishery port	654	11	#fishing boat	695	11	container ship	83.22
12	life	650	12	#countryside	677	12	dam	76.97
13	leave	634	13	#share-house	629	13	cliff	75.04
14	think	630	14	#regional vitalization	623	14	valley	75.00
15	go	597	15	#scenary	623	15	web site	72.15
16	now	595	16	#fishing	620	16	tiger cat	65.61
17	moon	584	17	#nature	585	17	suspension bridge	62.67
18	village	554	18	#trip	581	18	alp	58.95
19	picture	549	19	#I-turn	572	19	crane	58.91
20	people	542	20	#journey	563	20	amphibian	58.36
21	Hong Kong	531	21	#fishers	562	21	volcano	55.06
22	find	530	22	#fishing	534	22	gondola	54.76
23	thought	526	23	#sunset	532	23	patio	53.54
24	scenary	514	24	#taiwan	518	24	submarine	49.94
25	fisher	498	25	#village	509	25	castle	49.42
26	view	490	26	#love photography	509	26	menu	49.38
27	group	486	27	#sky	465	27	canoe	48.24
28	before	468	28	#landscape	464	28	envelope	47.73
29	sky	460	29	#nature	455	29	paddlewheel	44.98
30	come	442	30	#taio	451	30	tile roof	44.04
31	eat	435	31	#port-town	441	31	prison	41.06
32	return	428	32	#seaside life	425	32	drilling platform	40.97
33	obtain	428	33	#harbor	414	33	lumbermill	40.54
34	fishing	427	34	#trip-around	410	34	plate	40.02
35	seaweed	419	35	#migration	407	35	greenhouse	37.78
36	island	401	36	#renovation	401	36	beacon	36.69
37	good	385	37	#Yamagata	394	37	fountain	36.56
38	scene	384	38	#Kobato	391	38	stone wall	34.43
39	flourish	379	39	#renovation girl	388	39	maze	33.93
40	post	376	40	#Taiwan	387	40	restaurant	33.75
41	summer	369	41	#Tsuruoka	384	41	barn	32.96
42	laugh	365	42	#Katanorizawa	382	42	grocery store	32.77
43	student	361	43	#isolated island	382	43	swing	31.72
44	run	359	44	#fish	381	44	monastery	30.90
45	travel	343	45	#sunset	377	45	sliding door	30.52
46	place	339	46	#ship	376	46	pirate	29.94
47	share	337	47	#community building	371	47	apiary	29.85
48	expression	335	48	#life with sea	367	48	mobile home	28.03
49	shop	334	49	#fishery	366	49	lifeboat	27.95
50	house	331	50	#Wakayama	361	50	bell cote	27.90

labels with the highest probability of being assigned to image data. Overall, all of the data was found to include a wide variety of natural elements such as sea, sky, and coastline; man-made elements related to fishing ports such as docks and fishing boats; and tourist behaviors such as seeing, eating, and traveling.

Looking at the data individually, we identified several characteristic words that are commonly used in text data, such as "go," "think," and "find." These words suggest that the pictures were taken at a particular location and provide information about the actions taken by people there. We also found that the text data contained unique adjectives, such as "calm," "flourish," and "delicious," which provided additional context about the location and activities happening there.

Furthermore, we observed that hashtags in the data were frequently associated with lifestyle-related keywords, including "country life," "seaside life," "local life", "I-turn," and "migration." We also found hashtags related to Tai O, a famous tourist destination that is known for its fishery village. These findings suggest that the pictures were taken in a coastal area and that the people who took them were interested in a particular lifestyle or activity.

Regarding the feature labels of the pictures, we extracted several objects that are related to fishery villages, such as "dock," "breakwater," "seashore," "container ship" and "boathouse." We also identified geographic features of coastal areas, including "cliff," "valley," and "alp," as well as animals such as "amphibian" and "tiger cat." These features provide further context about the location where the pictures were taken and the natural environment surrounding it.

3.2 Dimension reduction of the data by PCA

The results of the principal component analysis (PCA) for the text data, hashtag data, and image feature label data are

Table 3: Results of dimension reduction on text data

PC	Composing Major Words	Eigen Value	Prop. of Var.	Cumulative Var.
TXT_PC01	place, port, creation, group, art	11.042	0.074	0.074
TXT_PC02	holiday, together, welcome, meat, alcohol	10.682	0.071	0.145
TXT_PC03	mission, outgoing, fishery, student, days	9.814	0.065	0.210
TXT_PC04	life stage, start living, one, share house, Hirato	7.556	0.050	0.261
TXT_PC05	good, view, back, comfortable, eat	4.596	0.031	0.291
TXT_PC06	fishing, village, fishers, with, life	2.066	0.014	0.305
TXT_PC07	anchor, fishers, enjoy, come, friends	1.967	0.013	0.318
TXT_PC08	individual, leave, local, calm, reach	1.807	0.012	0.330
TXT_PC09	seaweed, world, seashore, experience, sea	1.805	0.012	0.342
TXT_PC10	myself, cause, benefit, house, inside	1.631	0.011	0.353
TXT_PC11	photo shooting, picture, place, moon, scenary	1.614	0.011	0.364
TXT_PC12	day, rocky shore, beautiful, introduce, go	1.612	0.011	0.375
TXT_PC13	people, love, go, say, town	1.605	0.011	0.385
TXT_PC14	culture, Hong Kong, fine art, trip, again	1.601	0.011	0.396
TXT_PC15	delicious, eat, food, dish, fish	1.548	0.010	0.406
TXT_PC16	Japan, think, many, fishery moon	1.485	0.010	0.416
TXT_PC17	morning, today, little, sky, see	1.446	0.010	0.426
TXT_PC18	community, house, enter, island, place	1.409	0.009	0.435
TXT_PC19	ship, port, island, fishery, fishers	1.405	0.009	0.445
TXT_PC20	nature, go, Hong Kong, scenary, sea	1.339	0.009	0.454
TXT_PC21	fishery port, fishing boat, vision, sky, coastal line	1.313	0.009	0.462
TXT_PC22	beautiful, scenary, mountain, sky, sea	1.313	0.009	0.471
TXT_PC23	cooking, make, use, fish, eat	1.308	0.009	0.480
TXT_PC24	summer, instagram, fine art, sky, leave	1.295	0.009	0.488
TXT_PC25	village, photogenic, flower, fine art, scenary	1.288	0.009	0.497
TXT_PC26	laugh, good, feel, fish, go	1.260	0.008	0.505
TXT_PC27	Ine, region, town, ship, Japan	1.256	0.008	0.514
TXT_PC28	cat, go, island, many, house	1.235	0.008	0.522
TXT_PC29	southern, island, beautiful, trip, light	1.218	0.008	0.530
TXT_PC30	city, enter, say, east, feel	1.211	0.008	0.538

Table 4: Results of dimension reduction on hashtag data

PC	Composing Hashtags	Eigen Value	Prop. of Var.	Cumulative Var.
HTG_PC01	Tsuruoka, life with sea, migration, community development, Jturn	22.295	0.149	0.149
HTG_PC02	Hirato, local, share house, DIY, local migration	16.586	0.111	0.259
HTG_PC03	house lease, fishery experience, BBQ, Iseshima, extraordinary	8.388	0.056	0.315
HTG_PC04	Tottori, Iwami, Sannin region, local life, nature	3.809	0.025	0.341
HTG_PC05	Saikazaki, wakayama, naturephotography, ocean, happy	3.008	0.020	0.361
HTG_PC06	photoshooting, port, photography, beach, sunset	2.753	0.018	0.379
HTG_PC07	picture, photography, photooftheday, myworldthroughaviewfinder	2.704	0.018	0.397
HTG_PC08	Ine, boat-house, kyoto, Japan, Superb-view	2.678	0.018	0.415
HTG_PC09	love-sea, fish, fishery, fishing, regional vitalization	2.670	0.018	0.433
HTG_PC10	TaiO, Hong Kong, hut, hkig, discoverhongkong	2.558	0.017	0.450
HTG_PC11	fish, fishing, fisherman, ocean, nature	2.215	0.015	0.464
HTG_PC12	trip, travel, travelphotography, village, seashore	2.048	0.014	0.478
HTG_PC13	travel, travelphotography, travelgram, trip, instagood	2.034	0.014	0.492
HTG_PC14	seaside, sea, happy, love, sky, beach	1.924	0.013	0.504
HTG_PC15	scenary, photography, landscape, Japan, island	1.908	0.013	0.517
HTG_PC16	photooftheday, photo, instagood, malaysia, beautiful	1.865	0.012	0.530
HTG_PC17	Mie, Toba, community, Ishe-shima, fishery	1.863	0.012	0.542
HTG_PC18	naturephotography, nature, seashore, beautiful, canon	1.837	0.012	0.554
HTG_PC19	port-town, fishery-port, scenary, fisheryman, fishing-boat	1.754	0.012	0.566
HTG_PC20	sky, cloud, sunset, healing, instagood	1.669	0.011	0.577
HTG_PC21	japantrip, japan, love, Japanese scenary, local life	1.664	0.011	0.588
HTG_PC22	isolated-island, island, cat, community, alley	1.613	0.011	0.599
HTG_PC23	nikon, boat, landscape, village, fishing boat	1.605	0.011	0.610
HTG_PC24	Japanese scenary, alley, streetphotography, superb-view, landscape	1.584	0.011	0.620
HTG_PC25	sunset, Kenting National Park, gourmet, port, seafood	1.572	0.010	0.631
HTG_PC26	cat, love, happy, island, Saikazaki, port	1.548	0.010	0.641
HTG_PC27	Taiwan, fishery port, streetphotography, seashore, photoshooting	1.539	0.010	0.651
HTG_PC28	seafood, gourmet, ship, sea, sunset	1.397	0.009	0.661
HTG_PC29	fishery-port-town, fishers, alley, trip, fish	1.338	0.009	0.669
HTG_PC30	healing, scenary, nature, trip, superb-view	1.283	0.009	0.678

presented in Tables 3-5. For each dataset, 30 principal components were extracted using PCA; then the eigen values and the cumulative proportion of variance for these components was calculated.

We found that the cumulative proportion of variance (cumulative variance × 100) was 53.8 %, 67.8 %, and 65.6 % for the text data, hashtag data, and image feature label data, respectively. This indicates that dimensionality reduction was efficiently conducted while preserving a significant amount of the original data's information content.

3.3 Projection plot of posts and clustering

Figure 1 presents a two-dimensional projection of data that was dimensionality-reduced by PCA-UMAP. The figure also shows 10 clusters as the result of DBSCAN with considering outliers based on scatter density. Cluster 4 is the largest and neighbors Clusters 8 and 10. Clusters 1 and 3 are the third and fourth largest, respectively, with noticeable distinctions from the others. Moderately sized Clusters 2, 7, and 9 surround Cluster 1. While Clusters 5 and 6 are isolated from the others, the data points within each cluster are closely grouped.

Figure 2 displays a heat map of the components of each cluster, while Table 6 provides a summary of the main principal components that make up each cluster. Instagram requires users to add hashtags to their posts to show relevance or originality to other posts, and this feature is utilized significantly in Clusters 1, 6, and 9, with specific hashtags. Cluster 1 includes some specific region names as hashtags to promote the regions, while Clusters 6 and 9 are hashtagged in a way that publicly identifies them as a photography enthusiast activity and travelogue, respectively. Also, taking advantage of the function that allows users write text as well as hashtags in posts, Cluster 4 combines introspective descriptions of trips with photos of

Table 5: Results of dimension reduction on picture feature data

PC	Composing Labels	Eigen Value	Prop. of Var.	Cumulative Var.
PIC_PC01	shop, restaurant, confectionery, grocery, bakery	1.980	0.113	0.113
PIC_PC02	church, monastery, bell cote, palace, castle	1.879	0.093	0.206
PIC_PC03	valley, alp, criff, promontory, hill	1.832	0.062	0.268
PIC_PC04	boathouse, dock, amphibian, gondola, dam	1.728	0.052	0.319
PIC_PC05	bookshop, library, tobacco shop, barber, restaurant	1.682	0.041	0.361
PIC_PC06	plate, mashed potato, meat loaf, ice cream, soup	1.665	0.031	0.392
PIC_PC07	motor scooter, moped, bicycle, mountain bike	1.659	0.031	0.423
PIC_PC08	barracouta, gar, coho, sarang, fish, truck	1.652	0.021	0.444
PIC_PC09	envelope, packet, handkerchief, book jacket	1.632	0.011	0.455
PIC_PC10	pier, suspension.bridge, steel.arch.bridge, viaduct	1.605	0.011	0.465
PIC_PC11	trimaran, catamaran, speedboat, submarine, dock	1.604	0.011	0.476
PIC_PC12	drilling.platform, pirate, crane, fireboat, container.ship	1.592	0.011	0.487
PIC_PC13	wheel, bicycle, mountain.bike, jinrikisha, moped	1.570	0.010	0.497
PIC_PC14	sliding.door, shoji, window.screen, four.poster, bannister	1.557	0.010	0.508
PIC_PC15	tabby, tiger cat, doormat, crane, window screen	1.544	0.010	0.518
PIC_PC16	canoe, speedboat, paddlewheel, lifeboat, amphibian	1.527	0.010	0.528
PIC_PC17	Dungeness.crab, king crab, crayfish, plate	1.514	0.010	0.538
PIC_PC18	flagpole, pole, parachute, balloon, swing	1.458	0.010	0.548
PIC_PC19	mobile.home, barn, patio, yurt, thatch	1.455	0.010	0.558
PIC_PC20	worm.fence, picket.fence, park.bench, bannister	1.417	0.009	0.567
PIC_PC21	menu, paper, website, book, brass	1.416	0.009	0.576
PIC_PC22	mailbox, ashcan, gas.pump, brass, birdhouse	1.379	0.009	0.586
PIC_PC23	factory, bannister, crate, lumbermill, tank	1.371	0.009	0.595
PIC_PC24	streetcar, passenger car, mobile home, truck	1.340	0.009	0.604
PIC_PC25	stone wall, wall street, megalith, worm fence, tile roof	1.338	0.009	0.613
PIC_PC26	barrow, shovel, plow, swing, wreck	1.324	0.009	0.621
PIC_PC27	scoreboard, street sign, cinema, traffic light, stage	1.313	0.009	0.630
PIC_PC28	hill, geyser, wing, alp, beacon, valley	1.295	0.009	0.639
PIC_PC29	restaurant, patio, carousel, greenhouse, fountain	1.283	0.009	0.647
PIC_PC30	snorkel, bathing cap, coral reef, sarong, paddle	1.245	0.008	0.656

coastal and fishery village elements such as cats and fishing port scenery, while Cluster 7 describes emotional subtleties, particularly during sunrise and sunset. Clusters 2, 3, and 5 showcase buildings and natural landscapes in fishery ports/towns/villages through photos and supplement them with relevant hashtags and text to communicate the attractions. Moreover, Clusters 8 and 10 primarily use impressive photos to showcase the richness of life and traditions, including special seafood cuisine particularly found in fishery village communities, supplemented by relevant text and hashtags.

4. Conclusion

The aim of this study is to gather insights that can aid in the development of tourism promotion strategies for "fishery villages," which have gained attention as a hub for "blue tourism" in Japan. To achieve this, we examined Instagram, a social media known for image-sharing, and conducted a structured analysis of the vast amount of unstructured data available on "fishery villages." Through this analysis, we sought to identify the public's interest in fishery villages, uncover the elements that make them appealing, and ascertain the significance of these communities in the larger context of tourism in Japan.

The consequence of this study demonstrates that, on Instagram which has approximately 10-year history since the start of the service, there are diverse and complex posts about "fishery villages," combining photos of life and culture in fishery villages, natural scenery, attractive marine products, cats, fishing ports, and other symbolic things, along with text describing feelings and impressions, keywords, and hashtags that create links within/between communities.

The analysis revealed that many people not only enjoy the material attractions and tourism recreation [Maruta, 1996] of fishery villages, such as marine products, port buildings,

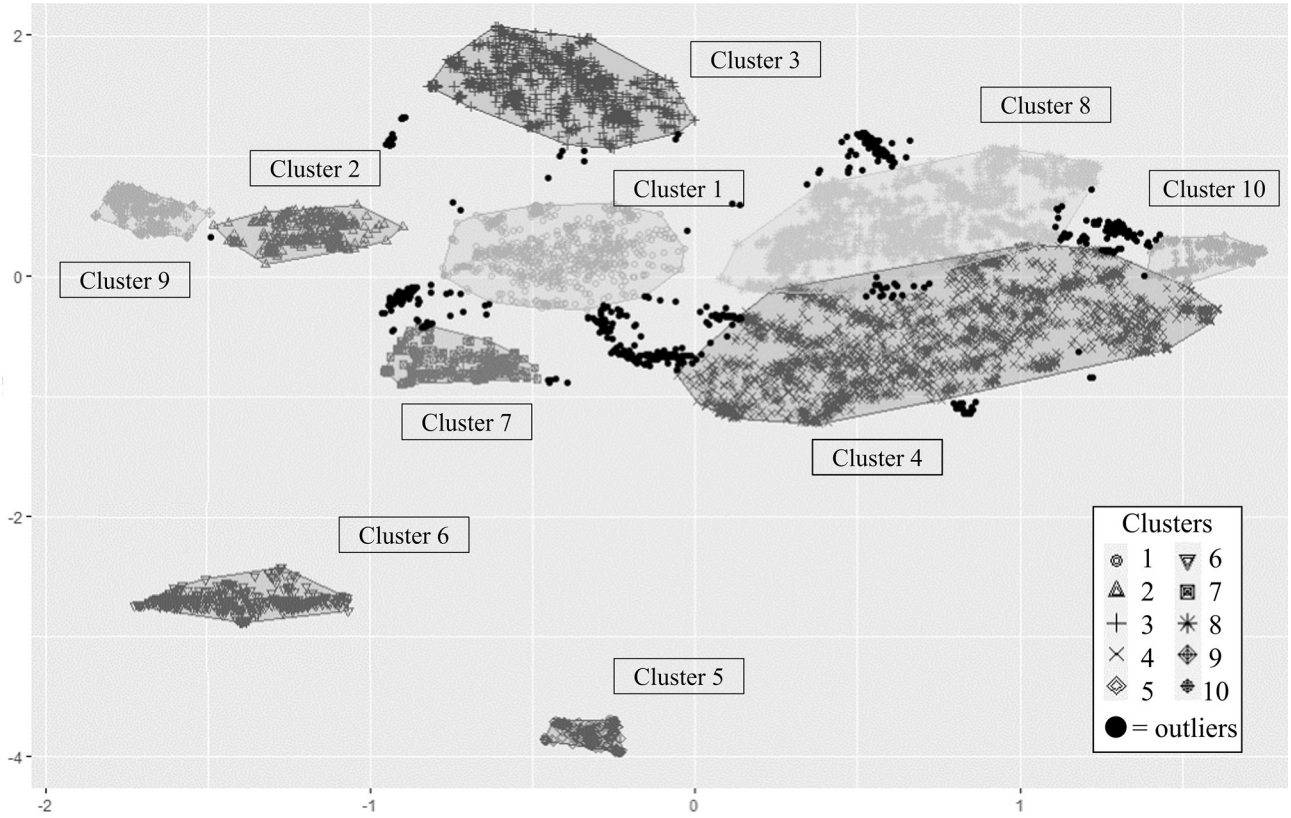

Figure 1: Projection plot of posts by UMAP and clustering results by DBSCAN

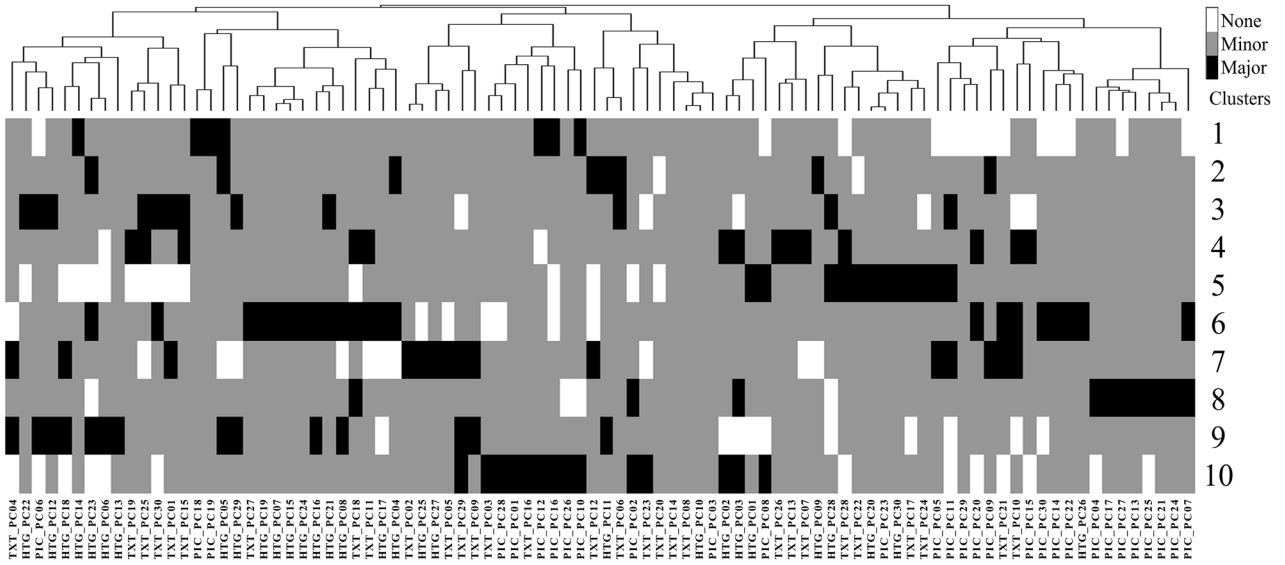

Figure 2: 2 dimensional heatmap of clusters features

and natural scenery, but also find the unique lyricism of visiting a fishery village, which cannot be experienced in urban areas, and the attraction of the village as a place that generates introspective thinking. This is strongly associated with twilight, magic hours, and sunrise moment, which are created by the coastal landscape overlooking the sea and horizon, and is considered to be significant factors that promote tourism that involves overnight stays rather than just day trips.

Blue tourism emphasizes unique experiences in coastal areas and fishery villages that utilize the landscape and natural resources. Landmarks in coastal fishing communities can be created not only through visual elements but also by auditory, olfactory, and time-varying elements, as they play a crucial role in shaping the landscape based on the viewer's awareness through the senses (Cosgrove, 1984: 33-40; Sunada et al., 2020). As shown in this study, microblogs such as Instagram provide valuable information about the

Table 6: Major PCs of each cluster

Cluster No.	Major Text PCs	Major Hashtag PCs	Major Picture Label PCs	Characteristics
1		5, 14	10, 12, 16, 18, 19	Promote local attractions by showcasing natural scenery through photos and relevant hashtags.
2	6, 12	4, 5, 9, 11, 23	9	Use hashtags and text to provide detailed descriptions of fishery villages and their attractions.
3	1, 6, 15, 25, 30	12, 21, 22, 28, 29	6, 11	Show the richness of life and food in fishery villages through a combination of descriptive text and relevant hashtags.
4	7, 10, 13, 26, 28	2, 3,	15, 20	Combine photos of cats and fishing port scenery with engaging travel narratives and introspective descriptions.
5	17, 22, 24, 28	1, 20, 28, 30	5, 8, 11, 23	Showcase port, town, and village architecture with photos, and highlight natural beauty with relevant hashtags and descriptive text.
6	11, 20, 21, 27, 30	7, 15, 19, 23, 24	7, 14, 22, 30	Connect with a community of photography enthusiasts by using a specific hashtag and a distinctive photo.
7	2, 4, 5, 21, 29	18, 25, 27	5, 9, 11	Capture the beauty of fishery villages and harbors at various times of day, including sunrise and sunset, using photos, hashtags, and text.
8	18	3	2, 4, 17, 24, 25	Provide evidence of village life by combining photos of scenery in fishery villages with relevant and descriptive text.
9	4, 9, 29	12, 16, 18, 23, 29	6	Use Instagram as a platform to document your travel experiences and share them with your followers.
10	3, 16, 23, 29	2, 3	1, 8, 10, 16, 28	Promote fishery villages by showcasing their traditional buildings and local cuisine through photos and relevant descriptive text.

landscape, not only visual pictures but also including experiences, movements, and emotions, and integrated analysis of photographs, keywords, and text data can offer much clearer and three-dimensional information. By combining the information provided in this study and specific activities/experiences that individual fishery village can provide, blue tourism and its strategies can be developed for each fishery village. Also, with the fact that "community-based tourism," which emphasize "regional characteristics" such as individuality and unique attractions, is attracting attention as a tourism promotion measure [Suganuma, 2015], blue tourism can be one of the methods to revitalize coastal regions and fishery villages by creating a regional tourism network. It is noteworthy that the images and memories shared on Instagram we investigated in this paper are derived from unique "regional characteristics" and local resources that differentiate them from other areas, and their supply coms at almost no cost by making the most of natural resources. This is considered a beneficial aspect for fishery villages, which are at a disadvantage due to insufficient inputs of production such as labor and capital.

To ensure the future sustainability of fishery villages, it is crucial to engage in value-added fishing practices that cater to the needs of consumers, and this involves obtaining feedback from consumers collaborating with local tourist services, including guest houses, restaurants, and fishing boats, to apply such feedback to the fishing industry [Sugimoto, 2020]. By doing so, fishery villages can adapt to changing consumer demands, increase their economic viability, and foster a mutually beneficial relationship between the fishing industry and the tourism sector.

While this study analyzed data without focusing on a specific village, it will be necessary to clarify the tourism resources of a target fishery village for application to actual promotion. In this case, it is necessary to analyze how much differentiated and unique value the resources of the target village have compared to those of neighboring villages. The approach of this study will serve as a steppingstone toward such future issues.

In addition to Instagram, it is expected that other media for disseminating information on tourism and leisure activities will emerge in the future, thus it is also important to consider the appropriate way to disseminate information about tourist attractions by comparing the characteristics of each SNS with the characteristics of the tourist destination.

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