

## Article

# The Coastal Future We Want: Implications of Coastal People's Perceptions on Satoumi Actions and Sustainable Development in Northeastern Taiwan

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**Abstract:** Satoumi is advocated for coastal sustainability under the Convention on Biological Diversity (CBD) and the International Partnership for the Satoyama Initiative (IPSI), and has provided a basis for countries around the world to formulate national biodiversity strategies and action plans. Given the significant impact of environmental changes and socio-economic decline, relevant policy directions and practices are urgently required to promote the sustainable development of fishing communities in Taiwan. However, local residents and communities are not sufficiently aware of or involved in this concept to facilitate the development of a holistic Satoumi implementation strategy. Therefore, this study integrates the concepts of Satoumi actions and Sustainable Development Goals (SDGs) and has adopted a questionnaire survey to investigate the perceptions of 202 fishing community residents in the Gongliao District of New Taipei City and Yilan County towards these concepts. The standpoint and perception of the fishing community residents regarding Satoumi actions and SDGs provided a valuable reference. The results of the perception of Satoumi actions revealed that all of the respondents recognized Satoumi actions. However, the ranking demonstrated the urgency for some actions (e.g., clear marine litter), and measures that have been implemented in Taiwan but still need improvement (e.g., fish stocking practices). Satoumi actions were associated with two key factors that affect the perception of residents at Satoumi: “Empowerment through community-based industry and environmental education”, and “Conservation of crucial biological resources and habitats”. For the SDGs perceptions, the two factors were “Marine socio-economic sustainability” and “The sustainable use of marine ecological resources”. This study also adopted cluster analysis and identified three characteristically different groups of residents: The Conservation Priority Group, Industry–Society Priority Group, and Balanced Development Group. According to the major research findings, policies implemented in coastal areas of Taiwan have aligned with global sustainability trends. However, the attitude of the Industry–Society Priority Group, which has the largest sample size, should be changed to that held by the Balanced Development Group, in order to formulate a strategy for a balanced development that secures existing livelihoods and aligns with expectations on environmental sustainability. This study suggests that methodologies that encourage stakeholder interactions, dialogues, and consensus-building should be utilized to develop strategies for future work. Furthermore, policy tools related to coastal management should be analyzed to establish a comprehensive toolkit for coastal governance. Finally, Satoumi requires public–private collaboration to achieve both biodiversity conservation and transformative change towards more sustainably and equitably social, environmental, and economic coastal development.

**Keywords:** Satoumi; Sustainable Development Goals (SDGs); residents’ perceptions; questionnaire survey; segmentation; coastal development; Taiwan



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## 1. Introduction

The adoption of the Convention on Biological Diversity (CBD) at the Earth Summit in 1992 marked a new age, in which countries around the world began working together to promote biodiversity conservation. After nearly two decades, the Aichi Biodiversity Targets were proposed at the Tenth Conference of the Parties to the Convention on Biological Diversity (CBD-COP10) in 2010. CBD-COP10 outlined the specific goal: “By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people”. The Satoyama Initiative was also presented at the CBD-COP10, placing emphasis on the economic, cultural, and natural aspects of sustainable development [1], while also focusing on the concept of Socio-ecological Production Landscapes and Seascapes (SEPLS). The purpose of the Satoyama Initiative was to promote the maintenance and use of SEPLS in various localities (agriculture, forestry, fishery, livestock farming) by improving community resilience to achieve sustainability. For this reason, the United Nations University also launched the International Partnership for the Satoyama Initiative (IPSI) as the centerpiece for reaching the Aichi Biodiversity Targets and achieving the goals of biodiversity conservation, preservation of local traditional knowledge, and community development [2]. In line with the global trend of mainstreaming biodiversity, Taiwan drafted a Biodiversity Promotion Program in 2001 and adopted the Aichi Biodiversity Targets to revise its Biodiversity Sustainable Development Action Plan in 2012.

The hydrosphere (e.g., sea, ocean) is an integral component of the earth’s life support system and also a key asset that creates opportunities for human sustainability. As the Satoyama Initiative garnered increasing attention, the promotion and development of Satoumi became the key approach for coastal fishing communities to live in harmony with the coastal socio-ecological systems. In particular, efforts under Satoumi and the 2015 Sustainable Development Goals (SDGs) are both concerned with the social, economic, and environmental aspects of sustainability with Goal 14 of the SDGs being to conserve and sustainably use the oceans, seas and marine resources for sustainable development. In addition, Goals 8 (sustained and inclusive economic growth), 11 (sustainable society and communities), and 12 (responsible production and consumption patterns) are also aligned with the core concept of Satoumi, which covers ecosystem services, traditional knowledge and modern science, nature conservation, and environmental and economic sustainability through human–nature interaction (management) [3]. Taking Japan as an example, the birth place of the Satoyama and Satoumi concepts, the local residents of Shiretoko Peninsula in Hokkaido have become a vital part of the traditional water ecosystem in the area, positively maintaining the interactive effects between humans and the natural ecosystem [4]. A study of the Sekisei Lagoon in southwest Japan revealed that in the local lagoon socio-ecological systems, all stakeholders are closely connected at the socio-ecological level and completely linked to the lagoon’s ecosystem services, where traditional users have a critical role to play in the sustainability of socio-ecological systems [5]. Therefore, the sea or ocean and coastal ecosystems have a close and complex connection with local users. Furthermore, the Japanese government has been proactive in adopting the SDGs in its National Strategies for Promoting Biodiversity of Japan, and including the Satoumi approach as the main means of integrated coastal management and restoring estuaries and bays to drive benefits for ecosystem services [6].

The Food and Agriculture Organization (FAO) of the United Nations reported that small-scale fisheries can generate sufficient income to support fishing families, but income stability and sustainability will be a major challenge in sustainable development [7]. The coast of Taiwan is typically bustling with fishing activities, providing a source of protein and job opportunities for Taiwanese citizens along the coast. Previously, there were over 250 fishing harbors in Taiwan, forming fishing settlements in nearby areas. However, fishing communities are mostly located in rural areas, which have been affected by a multitude of sustainability problems, such as an exodus of young people, aging of residents, job scarcity, aging of labor population, and a lack of public facilities and infrastructure

services [8,9]. In addition, coastal fisheries are facing climate change, overfishing, and depletion of resources, among other problems, all of which not only influence the economic development of fisheries but also worsen the decline of fishing communities. Thus, new policy directions and practices are urgently required to drive the sustainable development of fishing communities. There has been a dearth of research in Taiwan exploring how fishing community residents perceive public affairs, the development of fishing communities, and sustainability issues [8–10]. There still is, nevertheless, limited or a lack of comprehensive understanding of the perception of fishing community residents. Numerous policies have been enforced to date, providing a basis for policy makers and decision makers to slowly understand the needs of local communities. However, the Satoumi approach is a concept based on the international Satoyama Initiative for promoting coastal sustainability. The local residents and communities are not sufficiently aware or involved to facilitate the development of a holistic Satoumi implementation strategy. For this reason, the objectives of this study were to adopt a questionnaire survey and quantitative analysis methods to investigate the perceptions of fishing community residents in the Northeast Coast of Taiwan, regarding Satoumi initiatives and SDGs, and to analyze the diverse characteristics of fishing community residents. Subsequently, by reviewing coastal development policy trends in Taiwan and relevant research findings in this study, suggestions were provided for the formulation of specific coastal development strategies for sustainable coastal management in northeastern Taiwan.

## 2. Satoumi Development in Taiwan

As mentioned in the introduction, Satoyama and Satoumi were advocated under the CBD and provided a basis for countries around the world to formulate their national biodiversity strategies and action plans. Japan, as the birthplace of Satoyama and Satoumi, has accumulated many cases since the Aichi Biodiversity Targets. Taiwan and Japan are both located in East Asia with similar social environments, industry patterns, and fishing villages along their coastlines. Taiwan has also referred to Japan's related policies in the past [11]. Therefore, fishing villages in Taiwan's coastal areas that are facing unsustainable development conditions, in terms of socio-economy and ecological environment, need to consider corresponding strategies. The guidance and case studies provided by Satoumi have the potential to be applied in Taiwan. This section will introduce the concept of the Satoumi in more detail and how it can influence Taiwan's related policies.

### 2.1. Satoumi Concept

Satoumi can be understood to be landscapes and seascapes formed by human–nature interaction (i.e., between houses, settlements, or communities and estuaries, lagoons, coasts, bays, and other ecosystems). The Satoumi concept originated from the concept of Satoyama. Satoyama refers to mosaic landscapes composed of various ecosystems including wetlands, grasslands, woodlands, farmlands, paddy fields, and settlements resulting from the long-term interaction between rural residents and their surrounding environment [12]. As the Satoyama Initiative garnered increasing attention since the CBD-COP10, the promotion and development of Satoumi became the key approach for coastal sustainability. Yanagi [13] proposed the concept of Satoumi, defining it as a coastal area with high productivity and biodiversity due to human activities or human–nature interaction. Satoumi is considered a multifaceted concept. In simple terms, Satoumi represents the ideal relationship created between humans and the sea or ocean. It is also a coastal management system, combining traditional knowledge, modern science, and the contributions of varying stakeholders to sustain the desired state of coastal zones through adaptive management. Finally, Satoumi reflects a socio-ecological context that changes with time and place [1,14]. In light of this, Satoumi can serve as a new approach to promoting sustainable fishery management [15].

Under the guidance of national policies, the Ministry of Environment (MOE) of Japan devised a three-year plan in 2008 to support the creation of Satoumi. They called for applications from local governments and launched a series of community-based projects

aimed at protecting the marine coastal environmental system and realizing the vision of humans in harmony with the sea or ocean. Small-sum subsidies are also provided to support local activities that align with the Satoumi concept. The MOE surveyed the diverse range of Satoumi activities in Japan, subsequently releasing the Satoumi Manual of Japan in 2011. The manual details of various Satoumi activities, including the restoration of seaweed forests, clearing of marine litter, environmental survey and monitoring, fish stocking, marine or fishery experience activities, removal of alien species, and collection of data on educational activities. The Satoumi creation initiative by the MOE of Japan is focused on five elements: (1) substance circulation (nutrient salts, water quality, and bottom sediment), (2) ecosystems (diversity, productivity, resource management), (3) contact with people (regional cooperation, coexistence with nature), (4) activity spheres (fishing villages, cities, watershed), and (5) entities that perform activities (fishers, residents, or relevant stakeholders). The first three elements are diversity elements that require preservation and regeneration, and the last two elements are related to Satoumi activities that are key to ensuring the sustainability of Satoumi creation [16]. Further investigation of activities that support Satoumi creation shows that 65% of Satoumi activities are performed mainly by local entities, which included residents (23%), fishers (17%), and local public organizations (25%), while 35% are performed by educational organizations (12%), research institutions (6%), the state (8%), and others (9%) [17]. These statistics highlight not only the importance of the local involvement in Satoumi practices [18], but also the need to design a “mechanism” consisting of the aforementioned elements to promote Satoumi creation. Therefore, solving the accelerated loss of biodiversity and ecosystem services requires a community-based approach to sustainably use and manage natural resources and linking diverse stakeholders, as well as making collaborative decisions during the process [19]. Satoumi is an initiative which advocates for a stakeholder-engaged approach to performing activities under a socio-ecological view. Because the linkages and interactions of local life, local industries, local culture, biodiversity, and environmental sustainability must be considered, the standpoint and perception of local entities regarding Satoumi activities will provide a valuable reference.

## 2.2. Relevant Policy in Taiwan

Taiwan currently has 222 fishing harbors along the coast. The construction of fishing harbors has attracted fishers to settle nearby, thus forming fishing settlements and communities. Traditionally, fishing communities are mostly located in remote or rural areas. In 1949, the Taiwan government began making construction and policy plans for rural communities, but these plans never came to fruition. It was only until 1993—the year a government-funded fishing community development project was launched—that policy planning for the construction of fishing communities was carried out to beautify fishing communities as a whole and build a fishing settlement that is characterized by special landscapes, unique customs, and fishery culture. Under the notion of community development, the development of fishing communities slowly shifted from a government-dominated top-down approach to a bottom-up approach that consolidates the collective awareness and value concepts of local residents on the basis of farming/fishing settlements or communities. In 2010, the Taiwan government launched the Rural Rejuvenation Program and enforced the Rural Rejuvenation Act, empowering community residents to propose plans that improve community environment, boost industry economy, and retain local characteristics in a regulated manner. To address the exodus of rural farming and fishing populations, the National Development Council implemented the local placemaking policy in 2019, hoping to facilitate balanced urban–rural development and promote local prosperity. According to the policy, 134 areas are prioritized for placemaking promotion due to their severe population loss and relative disadvantages; 41 of these areas are coastal regions, which implies that coastal fishing communities are in dire need of development.

The sustainable development of fishing communities involves diverse stakeholders [10]. Coastal management in Taiwan is assigned across various ministerial departments

with each paying increasingly more attention in recent years to the adoption of the Satoumi approach for coastal zone management and sustainable development. For example, in 2020, the Ocean Conservation Administration launched the community-based marine conservation program, which aims to guide local organizations on marine conservation measures and help them use localization methods to protect the sea and ocean. In the same year, the National Academy of Marine Research launched a Satoumi settlement support program, uniting local youths in coastal areas to boost industrial development. Additionally, the Construction and Planning Agency of the Minister of the Interior initiated a locally integrated coastal management program; the Soil and Water Conservation Bureau of the Council of Agriculture launched a rural rejuvenation program to guide farming and fishing communities on autonomous planning; the Forestry Bureau and Fisheries Research Institute of Council of Agriculture promoted the regional development of Satoumi by using socio-ecological systems to consolidate perspectives; and the Fisheries Agency focused on the development of fishing industries and hardware infrastructure.

Based on the above reviews of relevant policies, Taiwan has seen a large number of coastal residents involved in community affairs, local development, industrial promotion, and sustainable development policies. This trend reveals the spirit of the Satoumi concept that advocates a stakeholder-engaged approach. However, the conservation of the marine and coastal ecosystems should be considered under Satoumi development, and a holistic, integrated thinking approach should also be more actualized.

### 3. Research Method

#### 3.1. Research Scope

The scope of this study included the Gongliao District and Yilan County on the north-eastern coast of New Taipei City in Taiwan. Coastal fisheries are particularly prosperous in these areas, leading to the formation of many fishing settlements. As of March 2023, the local population is as follows: approximately 11,177 people in the Gongliao area, and a total of 137,483 people in the coastal towns and villages of Yilan County, including 28,409 people in Toucheng, 24,445 people in Zhuangwei, 40,774 people in Wujie, 37,760 people in Su'ao, and 6095 people in Nan'ao [20]. Fishing harbors and communities in the Gongliao District include Longdone, Hemei, Meiyanshan, Aodi, Longmen, Fulong, Mao'ao, and Magang. Those in Yilan County include Shihcheng, Tongpanku, Dali, Daxi, Fanshuliao, Gengfang, Wushi, Wuweigang, Nanfang'ao, Fenniaolin, and Nan'ao (Figure 1).

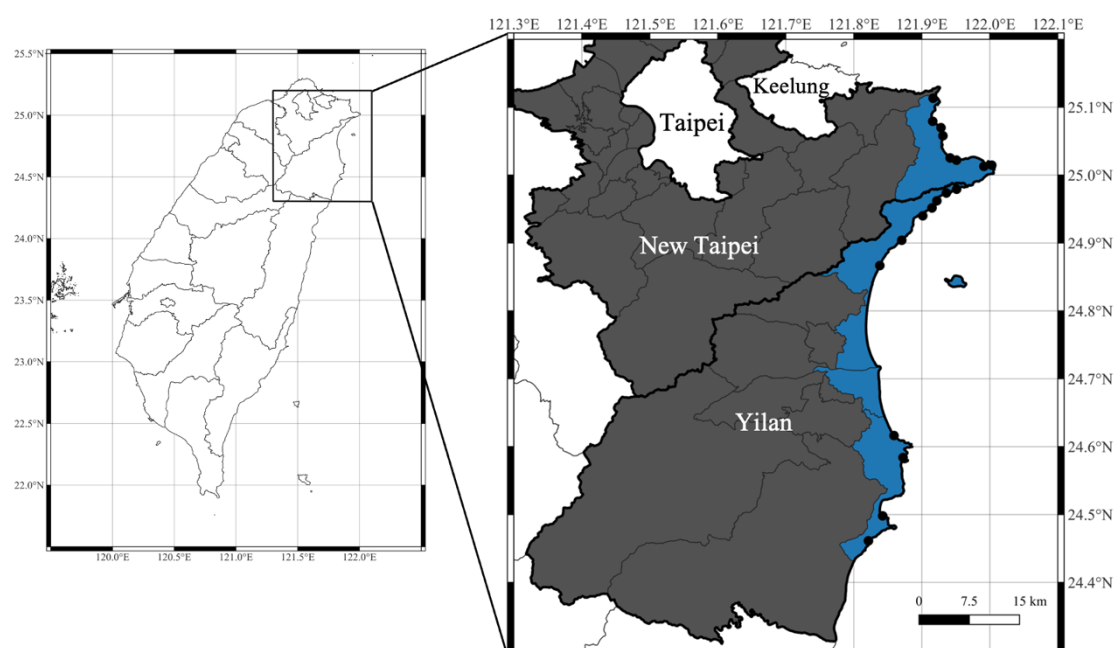


Figure 1. Study sites.



Regarding the research scope, which are the coastal fishing villages in counties in northeastern Taiwan, it is worth noting that Taiwan's early development was primarily reliant on the coastal and offshore fisheries. In terms of the coastal and offshore fisheries production in Taiwan in 2021, Yilan County, Keelung City, and New Taipei City were the primary contributors [21], highlighting the importance of the coastal and offshore fisheries industry in northeastern Taiwan [10]. Nevertheless, in recent years, coastal and offshore fisheries have suffered from the depletion of resources, resulting from factors such as overfishing, fish habitat destruction, environmental pollution, and climate change. During the 1970s, the annual production was over 400,000 tonnes. However, by 1981, the production had dropped to under 400,000 tonnes. As of 2007, the yield had further declined to below 200,000 tonnes. Currently, the production ranges from 160,000 to 180,000 tonnes annually [21].

Coastal villages in Taiwan have been greatly impacted by Taiwan's economic development and industrial restructuring as well. These rural communities face a myriad of challenges, such as limited employment opportunities, population outflow, an aging fishing demographic, inadequate public facilities and infrastructure, and stagnating progress in improving production and living environments [9], all of which impede their ability to achieve sustainable development. As a result, the sustainable development of fishing communities has become a critical research topic that requires academic attention and intervention.

### 3.2. Questionnaire Content

This study adopted a questionnaire survey to investigate the perceptions of fishing community residents regarding the promotion of Satoumi. A three-part questionnaire was designed with reference to the Satoumi Manual of Japan [16] and the Japan Satoyama Satoumi Assessment [22]. The first part, Satoumi Actions dimension, comprised 14 items which were derived from the Satoumi activities undertaken in various parts of Japan as described in the Satoumi Manual of Japan. The second part, SDGs Perceptions dimension, comprised 7 items. The third part was background information, which was designed to collect data on the respondents' gender, place of residence, education level, occupation, income, age, and whether they are local. The first and second parts of the questionnaire were scored using the Likert 5-point scale to indicate the level of perception. The third part provided information for subsequent analysis of residents' characteristics. After the questionnaire was designed, a pretest was conducted on it by experts in July 2020. Any ambiguous wordings were revised to increase the reliability and validity of the questionnaire, and then the official questionnaire was distributed.

### 3.3. Sampling

The questionnaire survey was conducted on local residents and fishers of communities along the coast of the Gongliao District through to Yilan County. Because the livelihoods of fishing community residents mostly depend on fishing-related industries, a majority of their time is typically spent working at sea or on preparatory works, which made random sampling difficult. This study, therefore, selected convenience sampling using the snowball sampling method. Due to the limitation of sampling, the formal survey was conducted by in-person, and some questionnaires were delivered with the assistance of community development associations, fishers' associations, and fishing community residents. The survey took place between August and October in 2020. In total, 202 valid questionnaires were retrieved, after excluding invalid questionnaires with incomplete answers.

### 3.4. Statistical Analysis Method

To provide a profile of the research samples, the first stage of the statistical analysis involved analyzing the sample demographics by using descriptive statistics, including frequency distribution and percentage. The perception of the respondents in Gongliao and Yilan regarding Satoumi actions was subsequently analyzed, using mean, frequency distribution, and ranking to describe how each action was perceived.

The second stage of the statistical analysis was focused on exploring the effects that the characteristics of residents at Satoumi have on the perception of Satoumi actions and SDGs. Regarding statistical operations, exploratory factor analysis (EFA) was employed in combination with principal components analysis (PCA) to streamline the items under both of the questionnaire dimensions into smaller perception variables [23]. A principal component method combined with the varimax rotation technique was used to identify and name the key perception variables. Cluster analysis was employed to classify the respondents into several groups [24]. Hierarchical clustering, based on the residents' perception of Satoumi actions, was performed to select the number of clusters, and then K-means clustering was adopted to distinguish respondents with different perceptions.

After the number of clusters of respondents was determined, analysis of variance (ANOVA) was employed to analyze differences between the perception of each variable under both dimensions. Any significant differences were further analyzed using Scheffe's method (post-hoc test). Finally, the chi-squared test for cross-analysis was used to analyze the differences between the basic attributes of resident clusters who had different perceptions.

## 4. Results

### 4.1. Ranking of Satoumi Action Perceptions

In general, the top three actions perceived as the most important by all of the respondents were as follows: "clear marine litter", "promote environmental education", and "conserve priority species". The three actions perceived as the least important by the respondents were as follows: "marine and land resource surveys", "remove alien species", and "fish stocking practices" (Table 1).

**Table 1.** Ranking the respondents' perception of Satoumi Actions.

Items	Samples ( <i>n</i> = 202)		
	Level of Perception	S.D.	Ranking
Clear marine litter	4.56	0.63	1
Promote environmental education	4.47	0.66	2
Conserve priority species	4.41	0.65	3
Protect and manage fishing ground	4.32	0.68	4
Fishery revitalization and innovation	4.29	0.72	5
Build a database for Satoumi promotion	4.28	0.72	6
Organize Satoumi exchange activities	4.28	0.72	6
Fishing community development	4.27	0.73	8
Protect and create habitats	4.27	0.71	8
Survey and preserve local knowledge	4.24	0.74	10
Launch ocean experience activities	4.22	0.67	11
Survey marine and land resource	4.21	0.69	12
Remove alien species	4.13	0.81	13
Fish stocking practices	4.06	0.89	14

Note: For more information on the survey dataset, please see Supplementary Materials.

### 4.2. Results of Factor Analysis

This study adopted a principal component method in conjunction with the varimax rotation technique to determine key perception variables under the two dimensions: Satoumi Actions and SDGs Perceptions. For items under the Satoumi Actions dimension, the Kaiser–Meyer–Olkin (KMO) value was 0.867 and the Bartlett's test was significant at the 0.01 level ( $\chi^2 = 1703.616$ ,  $p < 0.01$ ). For items under the SDGs Perceptions dimension, the KMO value was 0.801, and the Bartlett's test was significant at the 0.01 level ( $\chi^2 = 652.947$ ,  $p < 0.01$ ). The results indicate that both dimensions were appropriate [25].

The factors under each dimension, with an eigenvalue greater than one, were retained, and items with a factor loading greater than 0.65 were retained. For both dimensions, all of the factors had a Cronbach's alpha of greater than 0.8, indicating that the internal reliability of factors is excellent. Based on the respondents' response, two per-

ception factors were selected from the Satoumi Actions dimension: (1) Empowerment through community-based industry and environmental education (eigenvalue = 3.071, proportion = 38.39, Cronbach's  $\alpha$  = 0.888), and (2) Conservation of crucial biological resources and habitats (eigenvalue = 2.855, proportion = 35.69, Cronbach's  $\alpha$  = 0.868) (Table 2). Two perception factors were also selected from the SDGs Perceptions dimension: (1) Marine socio-economic sustainability (eigenvalue = 2.495, proportion = 41.59, Cronbach's  $\alpha$  = 0.818), and (2) The sustainable use of marine ecological resources (eigenvalue = 1.933, proportion = 32.21, Cronbach's  $\alpha$  = 0.885) (Table 3).

**Table 2.** Result of the PCA for the perception of Satoumi Actions.

Item Description of Satoumi Actions (SA)	FL	CA	EV	Proportion
Empowerment through community-based industry and environmental education (SA-Empowerment)		0.888	3.071	38.39
Organize Satoumi exchange activities (e.g., seminars or workshops)	0.889			
Fishery revitalization and innovation	0.860			
Fishing community development	0.843			
Promote environmental education	0.756			
Conservation of crucial biological resources and habitats (SA-Conservation)		0.868	2.855	35.69
Coastal and seabed habitat protection and creation	0.867			
Conserve priority species	0.864			
Fish farm protection and management	0.804			
Marine and land environmental/resource surveys	0.722			

**Table 3.** Result of the PCA for SDGs Perceptions.

Item Description of SDGs Perceptions	FL	CA	EV	Proportion
Marine socio-economic sustainability (SDGs-Socio-economic)		0.818	2.495	41.59
Ensure employment opportunities for fishing communities and the sustainable development of the industry	0.848			
Ensure that fishery households have the right to catch and sell fish	0.773			
Protect local marine culture and natural heritage	0.761			
Ensure that Taiwanese citizens learn the required knowledge and skills to promote ocean sustainability	0.651			
The sustainable use of marine ecological resources (SDGs-Ecological)		0.885	1.933	32.21
Conserve and sustainably use ocean and coastal ecological resources	0.938			
Ensure the sustainable management and wise use of fishery resources	0.868			

#### 4.3. The Results of Cluster Analysis and Discriminant Analysis

Clustering of residents was based on the items under the Satoumi Actions dimension, which were selected using factor analysis in the preceding section. Subsequently, a two-stage cluster analysis [26] was performed. First, this study identified three clusters by using hierarchical clustering. Then, K-means clustering was used to distinguish residents who had different perceptions. The results revealed that Clusters I, II, and III had 34, 89, and 79 participants, respectively. In addition, a discriminant analysis was employed to test the results of the cluster analysis, and the results showed that 94.5% of the initial observed values can be accurately grouped into each cluster, implying that the results of cluster analysis were acceptable (Table 4).



**Table 4.** Result of clustering analysis and discriminant analysis.

		Prediction			Total
Cluster		I	II	III	
I	Number	33	1	3	34
	Percentage (%)	97.1	2.9	0	100.0
II	Number	2	87	0	89
	Percentage (%)	2.2	97.8	0	100.0
III	Number	5	4	70	79
	Percentage (%)	6.3	5.1	88.6	100.0

#### 4.4. Types of Residents

For this section, the types of respondents were determined. Based on the ANOVA and Scheffé's test results (Table 5, Figure 2), each cluster was classified according to the perceptions of Satoumi actions and SDGs, and the clusters were subsequently named. Based on the results for the perception of Satoumi actions, Clusters I and II exhibited a non-significant difference in their perception regarding the factor "Empowerment through community-based industry and environmental education (SA-Empowerment)", whereas Clusters I and III exhibited a non-significant difference in their perception regarding the factor "Conservation of crucial biological resources and habitats (SA-Conservation)". Based on the results for the perception of SDGs, Clusters I and II exhibited non-significant difference in their perception regarding the factor "Marine socio-economic sustainability (SDGs-Socio-economic)", whereas Clusters I and III exhibited a non-significant difference in their perception regarding the factor "The sustainable use of marine ecological resources (SDGs-Ecological)". These three clusters were then assigned a name to facilitate the strategic planning for target populations in the future.

**Table 5.** Result of ANOVA and Scheffé's multiple range tests.

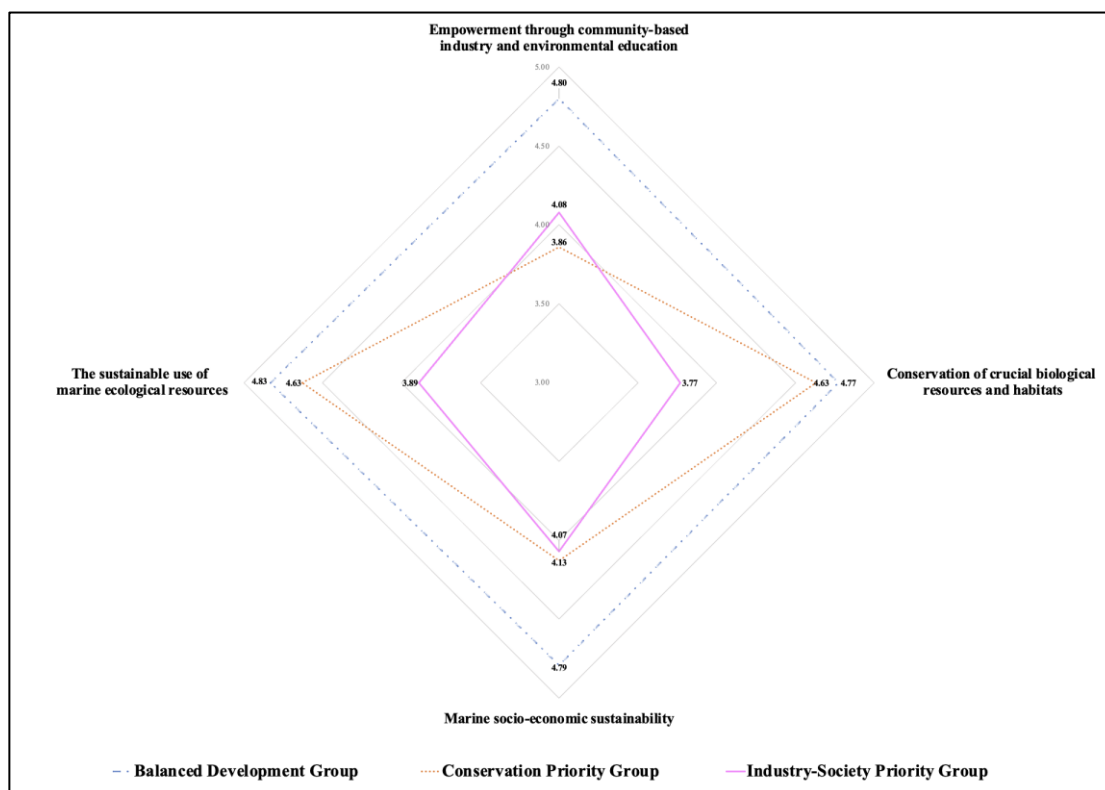
	Cluster I:	Cluster II:	Cluster III:	F-Value	Scheffe Multiple Range Test (p-Value)		
	Conservation Priority Group	Industry–Society Priority Group	Balanced Development Group		I-II	I-III	II-III
	(n = 34)	(n = 89)	(n = 79)				
<b>Satoumi Actions (SA)</b>							
Empowerment through community-based industry and environmental education (SA-Empowerment)	3.86	4.08	4.80	0.00 **	0.07	0.00 **	0.00 **
Conservation of crucial biological resources and habitats (SA-Conservation)	4.63	3.77	4.77	0.00 **	0.00 **	0.11	0.00 **
<b>SDGs Perceptions (SDG)</b>							
Marine socio-economic sustainability (SDG-Social & Economic)	4.13	4.07	4.79	0.00 **	0.73	0.00 **	0.00 **
The sustainable use of marine ecological resources (SDG-Ecological)	4.63	3.89	4.83	0.00 **	0.00 **	0.10	0.00 **

\*\* Significant at 1% confidence level.

(1) Cluster I—Conservation Priority Group: This cluster consisted of 34 respondents (16.83%) and was named Conservation Priority Group because the respondents in this cluster had a higher level of perception on marine conservation factors (SA-Conservation, SDG-Ecological factors) (perception level > 4.5) than on factors related to industrial development (SA-Empowerment, SDG-Social & Economic).

(2) Cluster II—Industry–Society Priority Group: 89 respondents (44.06%) were clustered into this group because they exhibited a higher level of perception ( $>4.0$ ) on factors related to industrial promotion (SA-Empowerment) and socio-economic development (SDG-Social & Economic). This cluster was thus named Industry–Society Priority Group.

(3) Cluster III—Balanced Development Group: 79 respondents (39.11%) were clustered into this group. They exhibited a high level of perception (mean score  $> 4.5$ ) on four factors under the two dimensions of Satoumi Actions and SDGs Perception. This cluster was therefore named Balanced Development Group.



**Figure 2.** Radar chart for comparing perceptions among clusters.

#### 4.5. Cross-Analysis Results

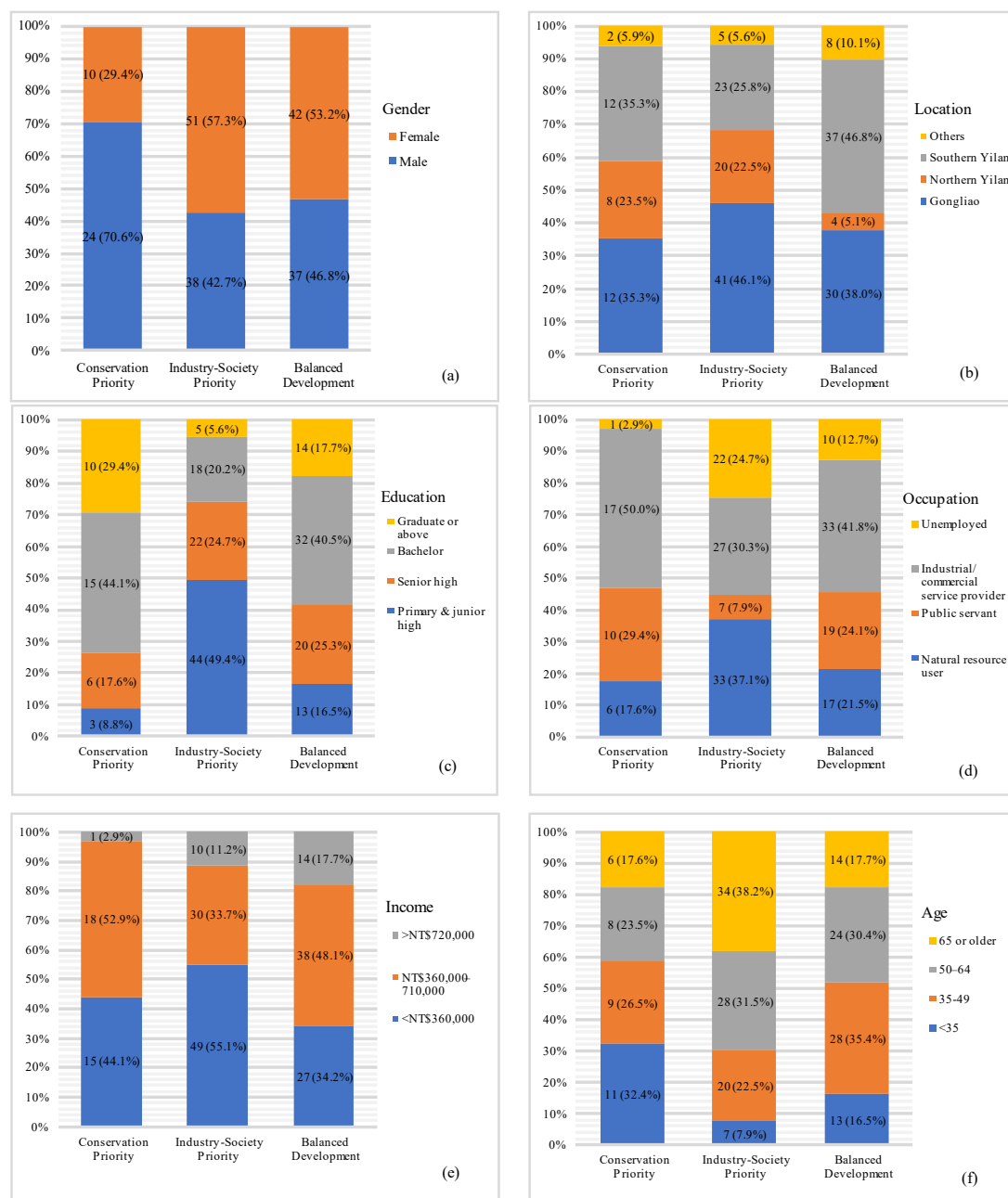
Cross-analysis and chi-squared tests are used to ascertain the demographic differences among each cluster of residents. The cross-analysis results of socio-economic demographics are summarized in Table 6 and Figure 3. In comparing the gender of the residents in each cluster, the analysis results revealed statistically significant differences ( $\chi^2 = 7.904$ ,  $p = 0.019$  \*). Male residents made up the majority of the Conservation Priority Group (70.6%), and the Industry–Society Priority Group and Balanced Development Group comprised mainly female residents (57.3% and 53.2%, respectively). In comparing the place of residence across each cluster, the analysis results revealed statistically significant differences ( $\chi^2 = 16.985$ ,  $p = 0.009$  \*\*). In total, 70.6% of the residents in Conservation Priority Group lived in Gongliao (35.3%) and southern Yilan (35.3%), whereas most of the residents in the Industry–Society Priority Group took up residence in Gongliao (46.1%) and a majority in the Balanced Development Group lived in southern Yilan (46.8%). Regarding the residents' education level, the results indicated statistically significant differences ( $\chi^2 = 39.863$ ,  $p = 0.000$  \*\*). The Conservation Priority Group was made up of residents with a bachelor's degree (44.1%); nearly half of the residents in the Industry–Society Priority Group have completed primary and junior high school (49.4%); and the Balanced Development Group was composed of residents with a bachelor's degree (40.5%). The occupation of each resident across all clusters showed statistically significant differences ( $\chi^2 = 25.551$ ,  $p = 0.000$  \*\*).

Providing industrial/commercial services was the occupation of most of the respondents in the Conservation Priority Group (50.0%), followed by public services (29.4%). Users of natural resources formed the majority in the Industry–Society Priority Group (37.1%), followed by industrial/commercial service providers (30.3%). Providing industrial/commercial services (41.8%) followed by public services (24.1%) was the occupation of most of the respondents in the Balanced Development Group. In examining residents' income across clusters, the results showed statistically significant differences ( $\chi^2 = 11.489, p = 0.022$  \*). A majority of residents in the Conservation Priority Group (52.9%) and the Balanced Development Group (48.1%) earned an annual income of NT\$360,000–NT\$710,000; while residents in the Industry–Society Priority Group mostly earned an annual income below NT\$360,000 (55.1%). In analyzing the residents' age across clusters, the results also showed statistically significant differences ( $\chi^2 = 20.627, p = 0.002$  \*\*). The Conservation Priority Group was made up of younger residents, aged 35 years or younger (32.4%) and 35–49 years-old (26.5%); the Industry–Society Priority Group comprised older residents, aged 65 years or older (38.2%) and 50–64 years-old (31.5%); and the Balanced Development Group consisted of mostly middle-aged residents, aged 35–49 years-old (35.4%) and 50–64 years-old (30.4%).

**Table 6.** Personal characteristics of three-type residents.

		Conservation Priority Group		Industry–Society Priority Group		Balanced Development Group		Total	
		<i>n</i> = 34	%	<i>n</i> = 89	%	<i>n</i> = 79	%	<i>n</i>	%
Gender		$\chi^2 = 7.904, p = 0.019$ *							
	Male	24	70.6	38	42.7	37	46.8	99	49.0
	Female	10	29.4	51	57.3	42	53.2	103	51.0
Place of Residence		$\chi^2 = 16.985, p = 0.009$ **							
	Gongliao	12	35.3	41	46.1	30	38.0	83	41.1
	Northern Yilan	8	23.5	20	22.5	4	5.1	32	15.8
	Southern Yilan	12	35.3	23	25.8	37	46.8	72	35.6
	Others	2	2.5	5	5.6	8	10.1	15	7.4
Education Level		$\chi^2 = 39.863, p = 0.000$ **							
	Primary and junior high school	3	8.8	44	49.4	13	16.5	60	29.7
	Senior high school	6	17.6	22	24.7	20	25.3	48	23.8
	Bachelor's degree	15	44.1	18	20.2	32	40.5	65	32.2
	Graduate degree or above	10	29.4	5	5.6	14	17.7	29	14.4
Occupation		$\chi^2 = 25.551, p = 0.000$ **							
	Natural resource user	6	17.6	33	37.1	17	21.5	56	27.7
	Public servant	10	29.4	7	7.9	19	24.1	36	17.8
	Industrial/ commercial service provider	17	50.0	27	30.3	33	41.8	77	38.1
	Unemployed	1	2.9	22	24.7	10	12.7	33	16.3
Income		$\chi^2 = 11.489, p = 0.022$ *							
	<NT\$360,000	15	44.1	49	55.1	27	34.2	91	45.0
	NT\$360,000–710,000	18	52.9	30	33.7	38	48.1	86	42.6
	>NT\$720,000	1	2.9	10	11.2	14	17.7	25	12.4
Age		$\chi^2 = 20.627, p = 0.002$ **							
	<35	11	32.4	7	7.9	13	16.5	31	15.3
	35–49	9	26.5	20	22.5	28	35.4	57	28.2
	50–64	8	23.5	28	31.5	24	30.4	60	29.7
	65 or older	6	17.6	34	38.2	14	17.7	54	26.7
Are you a local?		$\chi^2 = 3.654, p = 0.161$							
	Yes	24	70.6	75	84.3	59	74.7	158	78.2
	No	10	29.4	14	15.7	20	25.3	44	21.8

\* Significant at 5% confidence level; \*\* Significant at 1% confidence level.



**Figure 3.** Personal characteristics of different gender (a), location (b), education (c), occupation (d), income (e), and age (f) of three-type stakeholders.

## 5. Discussion and Policy Implications

The value of Satoumi lies in the realization of a society in harmony with ecosystems through an awareness of local needs and acquiescence to diverse opinions and contributions. Therefore, whether relevant policies introduced by the government are enforced under the opinions and awareness of the majority is imperative [27]. The discussion of this study is presented in two aspects.

### 5.1. The Trend Observed Based on Coastal Residents' Perceptions

#### 5.1.1. Ranking of the Perception of Satoumi Actions

The ranking of the perception of Satoumi actions revealed that all of the respondents recognized Satoumi actions, attaching particular importance to the actions, “clearing marine litter ( $m = 4.56$ )”, “promoting environmental education ( $m = 4.47$ )”, and “conserving

priority species ( $m = 4.41$ )". This result may be attributed to the global impact of marine litter on the coastal environment or fisheries in recent years, which is an emerging marine conservation issue that has also made the general public and local residents who rely on the ocean for their livelihoods realize the urgency of marine environmental education.

For actions that ranked in the middle-range priority, respondents attached the importance of intervention measures for contexts in the Northeast Coast of Taiwan, particularly for crucial livelihood resources (e.g., "protect and manage fishing ground,  $m = 4.32$ ") and related environments (e.g., "protect and create habitats,  $m = 4.27$ "). On the other hand, due to the predominance of traditional industries in the study area, negative perceptions of the traditional industries and the outflow of human resources caused by urbanization have resulted in the declining trend of coastal industries. Respondents' emphasis on "fishery revitalization and innovation ( $m = 4.29$ )" may be due to their desire for new development through a new means to bring about socio-economic benefits [28]. However, to find available resources or draw up a development direction, the involvement of local stakeholders is required, and "fishing community development ( $m = 4.27$ )" is one of the key drivers of these actions. Similar experiences, cases, and discourses have also been found in other Satoumi cases [3,28]. Although actions related to "build a database for Satoumi promotion ( $m = 4.28$ )" or "organize Satoumi exchange activities ( $m = 4.28$ )" were not highly prioritized by respondents, these actions still hold the potential for strengthening the relationship between the sea and people, and enhancing ocean literacy [29], which is crucial for cultivating potential supporters for ocean conservation and sustainable development in the future.

The finding reveals an important insight into lower-ranked priority actions, indicating not to overlook fundamental works such as resource investigation (e.g., "survey and preserve local knowledge,  $m = 4.24$ "; "survey marine and land resource,  $m = 4.21$ "), especially under the deteriorating trend of the erosion of traditional knowledge and practices, which emphasize the maintenance, use, and transmission of traditional knowledge as an active cultural resource in society [30]. Using "launch ocean experience activities ( $m = 4.22$ )" as an example, it is highly suitable to integrate the knowledge of local fishermen, residents, and experts regarding the local environment and biology of fishing villages into the design of the experiential activities, in order to enhance civic interaction and interest in the ocean [16]. As the promotion of Satoumi is based on the local ecology and local actors, a comprehensive inventory is necessary to understand and identify the complex relationships and potential issues or opportunities that may arise from the interactions between social and ecological actors [31].

Compared to other actions, "remove alien species ( $m = 4.13$ )" ranks second to last. This may be due to the issue not currently causing significant livelihood difficulties for respondents and is therefore not considered an urgent matter. However, this does not mean that the issue is unimportant. There have been anecdotal reports of religious release activities in Taiwan involving species such as Tiger grouper, *Epinephelus fuscoguttatus*  $\times$  *Epinephelus lanceolatus*, but their ecological impact remains to be investigated. Additionally, escapes of aquaculture species (e.g., red drum, *Sciaenops ocellatus*) may also have potential impacts on marine ecosystems [32]. In the case of Okinawa in Japan, fishermen took proactive measures to remove the crown-of-thorns starfish, which was found to have an impact on the coral reef ecosystem [33]. Our study's findings differ from other cases in the current context. Previous research indicates that marine invasive alien species receive less attention, and their impacts are not adequately recorded. Therefore, there is a need for the systematic monitoring and management of invasive alien species, particularly in marine and tropical regions [34].

"Fish stocking practices ( $m = 4.06$ )" were perceived as the least important among respondents living in Yilan and Gongliao, so the next important step is thinking of ways to raise residents' awareness of the benefits of fish stocking practices. Previously, a Japanese study presented various evidence showing that fish stocking is unnecessary (because of low recapture rate and the low economic efficiency of stocking). However, stock enhancement programs cannot be easily terminated because they play an important role in having



fishers recognize the importance of fishery management. Nevertheless, Japan overcame this problem by contributing released fish to total landings, which enables fishers to be personally involved in conservation efforts while effectively utilizing fishery resources and understanding the importance of fishery management [35]. This approach can serve as a reference for Taiwanese authorities.

#### 5.1.2. Personal Characteristics of Three-Type Residents

Past studies showed that socio-economic factors influenced the environmental awareness, attitudes, and behaviors of residents. For example, a study observed that uneducated populations were unsupportive of conservation efforts compared with the educated populations [36]. Masud and Kari [37] reported that younger people were more aware of environmental problems than their counterparts because young people have easier access to information, such as the mass media and social networks. Income is also a key factor influencing environmental awareness [37,38]. According to the result of cluster analysis, the clusters were characteristically the same as the results of the aforementioned studies. For example, the Industry–Society Priority Group which has the highest number of people ( $n = 89$ ) differed characteristically from the respondents in the Conservation Priority Group and Balanced Development Group. Specifically, the Conservation Priority Group and Balanced Development Group consisted mainly of respondents with a higher education level (44.1% and 44.5% have a bachelor's degree, respectively), providers of industrial/commercial services (50.0% and 41.8%, respectively), and moderate income earners (52.9% and 48.1%, respectively). In comparison, the Industry–Society Priority Group mainly consisted of respondents with primary and junior high school education (49.4%), low income earners (55.1%), users of natural resources (37.1%), and older respondents (38.2%). Based on this empirical study and the researcher's current observation of coastal fishing communities in Taiwan, residents of fishing communities are generally older and capable of tapping into the wisdom they have gained throughout their life to utilize coastal resources. The respondents in the Industry–Society Priority Group highly valued the factor "empowerment through community-based industry and environmental education" probably because of their attempt to search for diverse resources to strengthen their industrial competency in order to tackle the challenges arising from marine pollution and the depletion of marine resources. The respondents in this group also recognized the importance of "marine socio-economic sustainability", which further highlights how much they valued employment opportunities for fishing communities, sales and marketing channels, cultural preservation, and acquisition of knowledge and skills. The Conservation Priority Group highly valued the "conservation of crucial biological resources and habitats" and "sustainable use of marine ecological resources." After the lifting of martial law in 1987, coastal areas in Taiwan were frequently used to engage in various activities, particularly water recreational activities related to the service sector [39]. However, the service sector is not only a user of marine resources, but also a provider of tourism travel services. Therefore, stakeholders in this sector tend to use the environment and natural resources more wisely because of their industry characteristics. Finally, the Balanced Development Group held a high level of perception toward socio-economic development and environmental protection. According to the findings of this study and the results of relevant empirical research, individual beliefs or governmental policies have demonstrated a shift from the emphasis on absolute development or restrictions among other binary approaches to a commitment to marine conservation and the stability of social and economic development [8,40,41].

#### 5.2. Consideration of Diverse Opinions Facilitates the Balanced Development of Coastal Areas

The observation of this study, with respect to the larger sample size of the Balanced Development Group, revealed that to a certain extent, most of the residents along the northeastern coast of Taiwan have hoped to consider the balanced development between the economy, environment, and society when thinking about coastal actions and sustainability issues. There is actually a development context in which such a result occurs. In

line with the global trend of mainstreaming biodiversity, Taiwan also drafted a Biodiversity Promotion Program in 2001 and adopted the Aichi Biodiversity Targets to revise its Biodiversity Sustainable Development Action Plan in 2012. Drawing on the foundation of the Taiwan Ecological Network, the Council of Agriculture of Executive Yuan built a network of partnerships and collaborative governance for Satoumi landscapes and the ecological blue way. Based on the foundation of its affiliated agencies, the Fisheries Agency and Fisheries Research Institute, the Council of Agriculture embraced the support of the coastal and ocean sustainable partners (e.g., local residents, NGOs, and local governments), joining forces across regions to govern watersheds, mountains, and other areas in Taiwan [40,41]. Therefore, the concept of Satoumi, defined as “coastal sea-used sustainably in order to support life of local people” [3,6], has been internalized into the sustainable development strategy for coastal regions of Taiwan.

For residents in the Conservation Priority Group, the government is becoming more inclusive of the voices of local residents, as evidenced by the launch of community-based marine conservation programs by the Ocean Conservation Administration. These programs offer small-sum subsidies as a means of encouraging local communities and organizations to invest resources in various marine conservation efforts, such as ecosystem restoration, ocean citizen science, friendly fishing activities, marine conservation promotion, and ocean clean-up activities. Following the promulgation of the Coastal Zone Management Act in 2015, the Minister of the Interior initiated a locally integrated coastal management program aimed at interlinking coastal management and development organizations in counties and cities to build a local coastal management mechanism in 2019. In 2017, the Environmental Protection Administration of Executive Yuan established the Taiwan Marine Debris Management Platform in collaboration with civic environmental organizations. Each party recognizes the complex nature of marine debris and the limited capability of a single agency or organization, and feels the urgency of taking environmental actions at all levels. Therefore, the Environmental Protection Administration united both the private and public sectors, inviting relevant agencies to engage in discussions and continuously encourage stakeholders to raise public awareness and support environmental actions to reduce the generation and impact of marine debris.

In this study, the Industry–Society Priority Group had the largest sample size, which likely implies that the opinions of this group of people will be mainstream among coastal residents of Taiwan. Previously, Taiwanese authorities had responded to the Blue Economy trend during 2015–2018. For example, the Fisheries Agency (affiliated to the Council of Agriculture of Taiwan) launched the Coastal Blue Economy Growth Program [42], adopting community-based sea farming projects to promote ocean productivity and the economic development of coastal areas [8]. With the rise in environmental conservation awareness, in reality, fishers as a key stakeholder are also asked to join ocean conservation action networks, compelling them to face trade-offs between catering to the needs of the ocean and continuing production for their livelihoods, which is associated with increased fisheries costs due to regulatory restrictions or limited access to resources (e.g., marine protected areas). This conflicts with the productionist orientation of some industrialized forms of agriculture [43]. We should therefore align the attitude of the Industry–Society Priority Group with that held by the Balanced Development Group or enforce policies and relevant regulations so that environmental protection and livelihoods are integrated. To this end, relevant authorities must develop an innovative model that balances the value of environmental protection and the associated costs, and enables all participants in the entire system (e.g., fisheries, aquatic products) to understand and provide their support. Thus, to develop coastal areas, the principle of the wise use of resources [44,45] must still be adhered to when formulating a strategy that secures existing livelihoods and meets expectations on environmental protection.

Finally, this study examined the mainstream policies implemented by the Taiwanese government for coastal zone development, and found that Satoumi contents have been internalized in governmental policies for fisheries, ocean conservation, marine studies,

coastal management, and rural development. Locals of coastal communities should be appropriately empowered to learn the Satoumi concept and develop the ability to participate in decision-making and understand what governmental resources are available. In doing so, when the socio-ecological sustainability of a place is threatened, then industries, the government, academia, community residents, and NGOs will have the opportunity to take collective actions and collaborate to solve predicaments, thereby creating a mechanism that promotes a bottom-up approach and collaborative governance [8,28,41,46]. This process will help strengthen the SEPLS and community resilience of coastal areas.

## 6. Conclusions

This study conducted a questionnaire survey of coastal residents in the context of northeastern Taiwan for investigating the standpoint and perception of residents regarding Satoumi actions and SDGs to provide suggestions for the formulation of specific coastal development strategies. By analyzing the perceptions of Satoumi actions, it was found that all respondents had a high level of agreement towards Satoumi actions. Furthermore, ranking Satoumi action perceptions demonstrated the residents' perceived priorities for these actions in the context of northeastern Taiwan. Through factor analysis, Satoumi actions were associated with two factors: "Empowerment through community-based industry and environmental education", and "Conservation of crucial biological resources and habitats". In addition, the SDGs Perceptions dimension consisted of two factors, "Marine socio-economic sustainability" and "The sustainable use of marine ecological resources". The results of cluster analysis showed that three-type stakeholders were identified according to their perception toward economic development and ocean conservation. The three groups were named Industry–Society Priority Group, Conservation Priority Group, and Balanced Development Group.

Based on Taiwan's current experience, policies on biodiversity mainstreaming and sustainability concepts have been implemented in the development of coastal areas. These policy tools allow stakeholders with various perspectives to have voices and the right to take action. However, coastal residents in this study still have considerable opinions that are focused on industries and the society. This finding echoes the current global trend of finding a balance between economic development needs and environmental protection in coastal zone development [47]. Therefore, it is suggested that any policy related to coastal environmental or economic development should make good use of tools and methods that encourage stakeholder interaction, dialogue, and consensus-building. Furthermore, future research should focus on further analyzing various coastal management policy tools to establish a comprehensive toolkit for sustainable coastal governance.

Finally, given that the 2010–2020 Strategic Plan for Biodiversity failed to halt the trend of ecological degradation, the United Nations' COP 15 in 2022 proposed a new global biodiversity framework that emphasizes the participation of diverse stakeholders in addition to the conservation and sustainable use of biodiversity [48]. Through the perspective of local residents, this study revealed that respondents held a high level of agreement towards various Satoumi actions. The results of the ranking also indicated the urgency of certain Satoumi actions and identified measures that have been implemented in the current context in Taiwan but still require improvement. The Satoumi approach, which emphasizes conservation and sustainable use of coastal resources without excluding human activities, requires a holistic concept when applied as an approach to the sustainable governance of Taiwan's coastal areas. More efforts need to be invested in to explore the needs of various stakeholders, and to promote collaboration and coordination among them. Therefore, it is recommended that the Satoumi concept relies on public–private collaboration to initiate and sustain its application for sustainable development of coastal SEPLS. It is expected to provide greater protection for biodiversity and bring about transformative change in society, toward more sustainable and equitable social, environmental, and economic development.

**Supplementary Materials:** The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/su15107919/s1>, Table S1: Respondents' perception on Satoumi Actions. Table S2. Respondents' perception on SDGs. Table S3. Correlation Matrix of Pearson Correlation Coefficients of Satoumi Actions (SA) Variables. Table S4. Correlation Matrix of Pearson Correlation Coefficients of SDGs Variables.

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