sustainability

MDPI

Article

Who Becomes a Fisherman? A Two-Stage Sample Selection Analysis on Small-Scale Fishery Choice and Income in Korea

Jaehee Hwang

Korea Maritime Institute, Busan 49111, Korea; me.jaehee@gmail.com

Abstract: The sustainability of coastal communities is emerging as a primary topic in policy groups. In Korea, the multifunctionality of small-scale fisheries is being emphasized, and the government has attempted various policies, such as the promotion of in-migration and the fishery industry. However, despite the diverse alternatives, the population and fisheries have been continuously downsizing. This trend threatens the sustainability and pluralistic values of coastal communities. This study identifies the crucial determinants needed to expand small-scale fisheries and enhance the economic motivation for sustainable coastal communities. The analysis is conducted with a two-stage Heckman selection model using the Korea Fishery Census and the Agricultural Census. The estimation results show that the socioeconomic incentives and performance of fisheries in coastal areas are limited. In particular, although the policy pays attention to young, highly educated, and in-migrant groups, it seems to have a limited preference for small-scale fisheries due to economic, societal, and institutional constraints. On the other hand, the family-oriented fishing activities and self-governance unique to fishing villages in Korea could improve the multifunctionality of small-scale fisheries in Korea. In addition, when a fishery household engages in production and sales activities as a member of a fraternity or collective wholesale contract, economic outcomes significantly increase. The results suggest that it is necessary to sustain communal socioeconomic activities by opening up communities and adjusting specific operating systems of self-governance.

Keywords: small-scale fishery; fishery household; fishery income; coastal community; sustainability

Citation: Hwang, J. Who Becomes a Fisherman? A Two-Stage Sample Selection Analysis on Small-Scale Fishery Choice and Income in Korea. *Sustainability* **2022**, *14*, 2167. https://doi.org/10.3390/su14042167

Academic Editors: Liontakis Angelos and Tzouramani Irene

Received: 16 December 2021
Accepted: 9 February 2022
Published: 14 February 2022

1. Introduction

Multifunctionality in small-scale fisheries has attracted public attention. Multifunctionality indicates pluralistic values, including sociocultural, economic, environmental, scientific, and security dimensions. The agriculture or ecology sector has traditionally led the discussion of these multifaceted values [1,2]. Valuing nontrade goods, the agricultural sector has protected the domestic market following the opening of the global trade market, and ecology requires a common action for environmental conservation. Recently, small-scale fisheries have been highlighted as a subject of such nontrade values. In response to the decline of small-scale fisheries and local recession [3,4], small-scale and artisan fisheries are perceived to sustain pluralistic functions. As a result, awareness of the positive externalities of small-scale fisheries is increasing [5]. This trend accelerates with the paradigm shifts of industrial development and spatial planning toward postproductivism [6,7]. In particular, countries at the stage of establishing a developed socioeconomic system, such as South Korea (hereafter Korea), emphasize the nonmarket values of coastal communities in the process of exploring a new-normal development direction. (Developing countries pay attention to the contribution of small-scale fisheries in terms of food security, poverty alleviation, and rural and economic development [8].)

The populations of Korean coastal communities are shrinking. Sharp population decline and superaging threaten the sustainability of these communities. In Korea, the number of rural households has reduced by 55.6% over the past sixty years since 1960 [9]. Among the areas where rural households reside, 46% are at risk of a demographic cliff [10].

More seriously, coastal communities in Korea are on the verge of dissolution, with a high risk of local extinction [11]. The fishery population dropped by 80.4% over the last thirty years between 1990 and 2020. In the same period, the number of fishery households declined by 64.5% [9]. Reclamation reduced fishing grounds equivalent to 3.9 times the size of Seoul, the capital of Korea, from 1970 to 2020 [12]. As family-oriented, small-scale fisheries constitute Korean coastal villages [13], out-migration and declining space are dissolving these communities.

Depopulation of small-scale fisheries undermines the multifunctionality of coastal communities. Similar to what has occurred in Japan, Canada, Australia, and northern European countries, self-governance has managed fishing communities in Korea [14], and its disruption discourages local communities. This creates socioeconomic costs for maintaining the spaces in which communities have disappeared. In particular, the poor accessibility and geographically vulnerable location of the Korean coast could contribute to regional decline due to a population decrease. To revitalize such communities and related pluralistic values, Korean society has concentrated on the influx of newcomers and incentives to increase income. However, policy impacts in invigorating coastal communities have not been observed significantly. Meanwhile, the literature on fishing villages in Korea focuses on cultural aspects, organizational characteristics, and the effectiveness of representative projects [15,16]. Recent studies examine the topic of sustainable fishing villages [17,18]. However, since they concentrate on the regional indicators using aggregated data rather than micro-level analysis of individuals and households, there are analytical limitations in discussing the factors of sustainable communities through regenerating family-based small-scale fisheries.

This study focuses on why people work in small-scale fisheries and what increases income in coastal communities. First, this research identifies the determinants of fishery selection out of primary industries in coastal communities. Second, it examines the factors shaping income increase in small-scale fisheries while controlling for selection bias. The analysis is conducted by a two-stage Heckman selection model incorporating the Korea Fishery Census and the Agricultural Census. The results can help find effective ways to revitalize coastal communities and small-scale fisheries in a sustainable manner, since this study addresses the demographic and socioeconomic aspects that shape future coastal communities. The paper is structured as follows. Section 2 provides an overview of coastal communities focusing on small-scale fisheries in Korea. Section 3 describes the method and dataset for used the analysis. Section 4 discusses the empirical results, including the model fit, selection model, and outcome model. Finally, Section 5 provides implications and a discussion.

2. Research Background

2.1. An Overview of Coastal Communities in Korea

Korean fishing villages are located on the edge of the Korean peninsula. In the hierarchy of national land space, rural areas are distributed beyond the boundaries of urban areas in the center of the country, and fishing villages extend from the semiagricultural and semifishing zones [19]. The spatial boundaries of fishing villages are legally defined in Article 2 of the *Fishing Villages and Fishery Harbors Act* and Article 3 of the *Framework Act on Agriculture and Fisheries, Rural Community and Food Industry*. A traditional definition defines a fishing village as a village dependent on fisheries.

Fishing villages are spatially located behind fishing grounds and fishing ports. Fishing grounds are regulated following Article 2 of the *Fishing Ground Management Act*, and fishing port areas are managed by Article 2 of the *Fishing Villages and Fishery Harbors Act*. A fishing field is an area that is allowed to use common sea-level resources for private use, and a fishing port area refers to the water and land areas within a fishing port. A fishing village is composed of a spatial structure in which fishing grounds, fishing port areas, and hinterland villages are interconnected. The economic activity of such a village takes place at the fishing ground, and a fishing port directly connects economic and social space. The villages in

the hinterland build densely populated dwelling groups centered on these fishing port areas [19,20], and for this reason, Korean fishing villages have a spatial structure that is quite different from that of rural and mountain villages (See Figure 1). This spatial structure specifies the fishing activities and culture of small-scale fisheries in a region and forms a unique spatial identity.

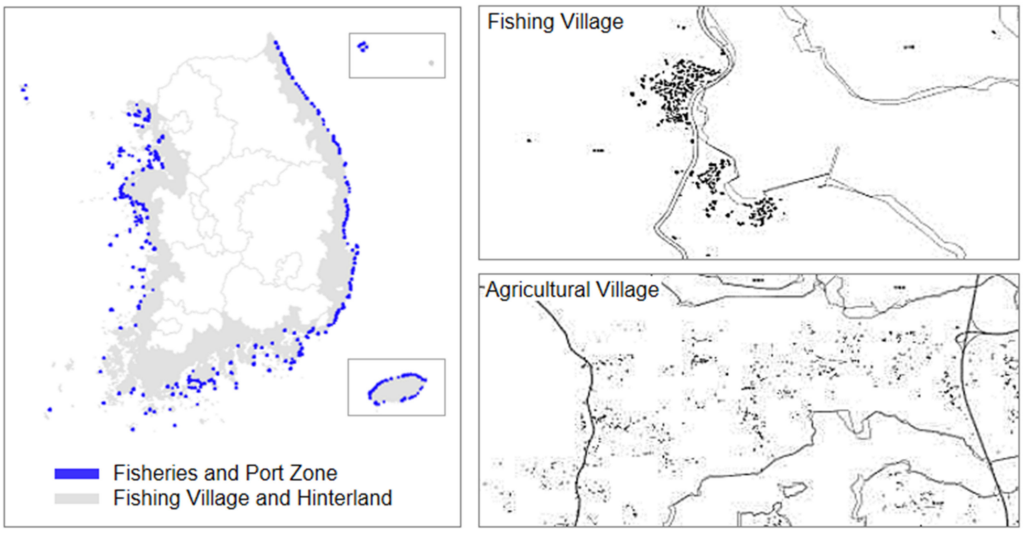

Figure 1. Distribution of fisheries and port zone, characteristics of residential distribution, Korea. Source: [13,21,22].

Korean coastal villages function as economic and living spaces of fishing communities based on this spatial identity [13,23]. Although the spatial structure of each port type is somewhat unique (fishing ports in Korea are composed of national fishing ports, regional fishing ports, fishing villages' fixed fishing ports, etc.), each port includes a community-centered village intensively gathered around a fishing ground and fishing port. In Korea, these communities are called fishing village fraternities or *Eo-chon-gye* in Korean and are also called fishing village cooperatives [14], and community activities are legally guaranteed under Korea's *Fisheries Cooperative Act*. Such a community is operated in the form of a cooperative, and members living in proximity within administrative or economic areas jointly carry out the production and sale of fishery products and environmental management. Therefore, the socioeconomic activities of coastal communities are largely operated by 2029 fishing village fraternities formed along coastal branch lines. These entities, which have the characteristics of a commons, utilize public waters for economic activities through permits, licenses, and reports and are centered on fraternities rather than individuals. According to the community characteristics of production and resource management, the communal nature of social entities, including the culture, customs, and institutions, is also fairly significant. In addition to the fraternities, other private organizations are active in coastal communities, including kinship-based, regional, and self-managed fisheries communities; village development committees; and administrative organizations. The strong communal solidarity of fishing villages is a primary characteristic of these communities that is different from a rural village, mountain village, or city.

However, the demographic and social changes surrounding coastal regions in Korea limit the maintenance of community-centered fishing villages. First, the fishery population has been on a constant decline since 1970, with a compounded annual growth rate of −4.8%. After the fishery household population peaked at 1.16 million in 1970, the numbers radically declined to 496 thousand in 1990 and to 97 thousand in 2020 (See Figure 2). When we extend the spatial scope to administrative districts larger than the community level, a social decrease in population is observed in 70.3% of coastal regions due to out-migration [24]. The size of the aging population (over 65) in coastal communities surpassed 30.5% in 2020,

greatly exceeding the 20% standard defining a superaged society by the United Nations. According to [11], if this trend of population decline continues, 342 coastal communities, which account for 81.2% of the total, will be at severe risk of extinction by 2045.

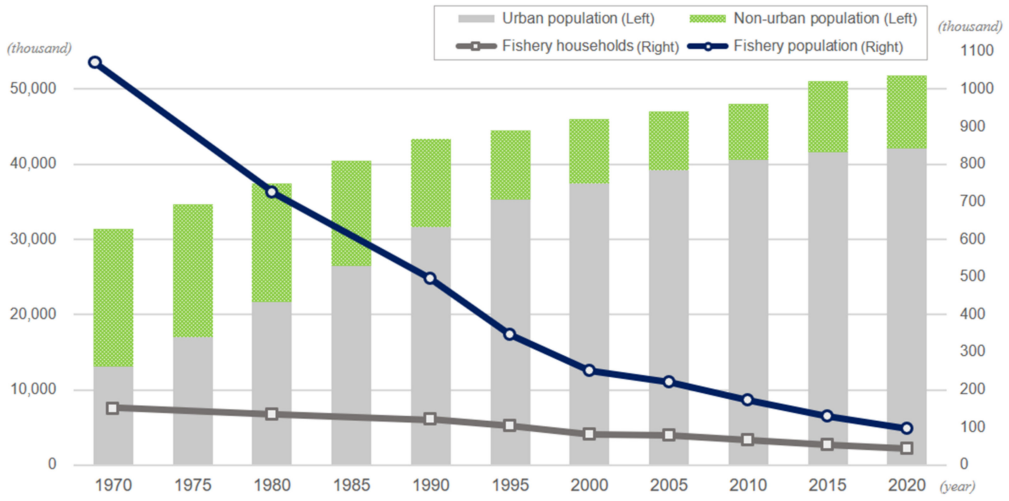

Figure 2. Total population and fishery population changes, Korea. Source: [9].

Quality-of-life measures also show low values in coastal communities. A quality-of-life satisfaction survey of six areas covering welfare, education, transportation, the residential environment, culture and leisure, the environment, and disasters found a satisfaction level of 5.1 points, which is lower than the values for rural areas (6.3 p) and cities (7.0 p) [25]. Moreover, for island populations, the satisfaction level is lower, at 4.2 points. This low quality of life is expected to accelerate out-migration and in-migration, further exacerbating population decline in coastal communities. In addition, the physical environment maintaining coastal communities is changing due to the reduction of fishing grounds through reclamation projects. Reclamation and landfill projects have reduced the area of coastal communities by 2382 km^2 from 1970 to 2020, since cadastral statistics were first compiled [12]. The magnitude accounts for 2.4% of the total land area in Korea. From the dissolution of coastal communities due to the closing and downsizing of fishing grounds, it is possible to reflect on how poor fishing village maintenance has been in Korean society.

Nevertheless, the income from small-scale fisheries is relatively high, and the annual income per household shows a steady increase. According to Korea's Fishery Household Economy Survey [9], the size of fishery household income as a percentage of urban household income has increased from 68% in 2003 to 73.5% in 2020. During the same period, the CAGR (Compound Annual Growth Rate) of fishery household income was 4.8%, while that of farm households rose by 3.1% (See Table 1). The total household income of fishermen in 2020 was recorded as KRW 53.2 million (USD 45,161) since it first crossed KRW 50 million in 2018. These economic benefits of small-scale fisheries can also be utilized as an initial alternative in response to the demand for the regeneration of coastal communities.

Table 1. Annual household income in Korea, 2003–2020.

Group	2003	2010	2015	2020	CAGR
National Average	34,641	43,958	52,230	60,959	3.38%
Urban	35,169	48,092	57,800	72,362	4.34%
Fishery	23,916	35,696	43,895	53,187	4.81%
Agriculture	26,878	32,121	37,215	45,029	3.08%

Note: (1) The annual income indicates total household income including ordinary income, transfer income, debt, and so on. (2) The urban household income is for working households with two or more people. Source: [9]. Raw data is originated from Household Income and Expenditure Survey; Fishery Household Economy Survey; Farm Household Economy Survey. (Measure: KRW, nominal, thousand.)

2.2. A Rationale to Revitalize Coastal Communities

Coastal communities perform pluralistic functions with a fishing port and grounds, operating in the background. The functions are regarded as multifunctional in academia and have been traditionally mentioned in the field of agriculture [26–28]. (Starting with the Uruguay Round (UR) in 1986, which stipulated the opening of the global agricultural market, a multifunctionality concept arose to protect the domestic industry by a direct payment system or subsidies. It has emerged as a full-fledged policy agenda after the Rio Earth Summit in 1992. The World Trade Organization defines it as the "Idea that agriculture has many functions in addition to producing food and fiber, e.g., environmental protection, landscape preservation, rural employment, food security, etc.", while equating it with the non-trade concerns of the agricultural industry (See glossary term at WTO webpage, https://www.wto.org, accessed on 7 February 2021).) In recent years, the multifunctionality of coastal communities has emerged as a major academic and policy goal. Despite little literature in this area compared to that on agriculture or biodiversity, to improve the resilience of coastal communities, positive externalities of small-scale fisheries are emphasized [5]. In addition to tradable market goods, the diverse outputs of nonmarket commodities of small-scale fishing communities include the following: healthy ecosystems and biodiversity, environmental public goods, cultural heritage and coastal viability, tourism and recreation, coastal employment, food security, and strategic benefits of foreign policy [5,29,30]. In particular, developed countries focus on multifunctionalities from the perspective of postproductivism [6]. Moreover, government intervention into nonmarket commodities is required to manage the optimal supply of public and common goods, which the ocean and surrounding communities provide. Considering the country's geopolitical position as a peninsula and sensitivity to environmental changes from neighboring countries, multifunctionality with national security and politics is highly valued in Korea. (The Korean government announced a direct payment system that values the multifunctionality of the small-scale fishery in islands. In recognition of their contribution to maintaining fishing communities, direct payments have been distributed to fishermen in all islands since 2019. The subsidy amount is KRW 750,000 (USD 635) per capita in a year, as of 2021.)

Multifunctional coastal communities are threatened by population decline [3,4,31]. In particular, as described in Section 2.1, the decline in family-oriented, small-scale fisheries impedes the maintenance of the positive public impact of coastal communities. As noted by Hasse [32] and ENRD [33], recent issues such as a population decline, an aging society, and a low birth rate could disintegrate the local community through a vicious cycle of regional decline. ENRD [33] shows that changes in the socioeconomic environments of nonurban areas due to population outflow undermine the overall regional economy, dampen economic performance, reduce economic opportunities such as through job loss, and lead to population decline. As a result, residential conditions are worsening, again resulting in population outflow and creating a vicious cycle that hinders the economic environment and performance in a cyclical pattern.

Coastal communities are also experiencing some of the early stages of this negative cycle. In Korea, along with the population decline of coastal villages, restrictions on basic living services are increasing as economic opportunities decline [13]. Apart from the

increase in the average fishing incomes of some households, limitations on the economic environment and barriers to entry for local communities are identified as factors resulting in population decline. A survey of fishing villagers and city residents shows this trend more clearly. (The survey results are based on [11,13], which conducted surveys of fishing villagers and city dwellers, investigating the factors and prospects for population declines in coastal communities. (1) Survey for fishing village residents, valid sample: 328 people, method: telephone and visit survey, period: 2018.6. (2) Survey for city dwellers (1st round), valid sample: 500 people, method: web-based mobile survey, period: 2018.6; (2nd round) valid sample: 500 people, method: web-based mobile survey, period: 2020.2.) First, fishing village residents cite the ongoing decline of fishery conditions and a lack of jobs as major reasons for leaving fishing villages. This pattern is more significant in villages with a high local extinction index based on the elderly and childbearing female population. Local respondents point out that population outflow resulting from a sluggish local economy lessens access to public services, further worsening overall quality of life. Urban residents also cite vulnerable economic environments as a reason for hesitating to migrate to coastal communities. In particular, after dividing intentions to migrate to fishing villages into three groups, those with the greatest intentions to migrate note that they cannot move to coastal villages due to future income constraints. Young urbanite respondents also point to economic activity problems as a factor resulting in the stagnation of fishing villages.

Korean society is dedicated to preserving the multifunctionality of small-scale fisheries and responding to the dissolution of coastal communities in exogenous and endogenous ways. First, exogenously, diverse policies to revitalize coastal societies are being pursued. The Korean government has attempted policy interventions to compensate for social costs anticipated in the near future, since coastal communities are the primary agents that are creating and maintaining public values such as socioeconomic, cultural, resource management, environment, and security values. With the long-term stagnation of fishing villages, the policy direction has shifted from a focus on fishing port infrastructure to a focus on software that promotes the regeneration of fishing villages and population growth [13,34]. In this regard, the latest major policy is *Fishing Village New Deal 300*, which aims to improve settlement in 300 fishing villages. A budget of KRW 3 trillion (USD 2538 million) is dedicated to this policy for 2019 to 2022. Other policies are also being implemented, such as projects to increase returners relocating to fishing villages, income enhancement projects focused on the 6th industry, and comprehensive island development projects. (As Korea has 3382 islands covering 464 inhabited islands, islands are included as a major spatial target for revitalizing coastal communities [35,36].)

In terms of endogenous countermeasures, the fishing village opening project is exemplary. As described in Section 2.1, fishing village fraternities structure the communal nature of Korean fishing villages and lead public contributions with multifunctionality. However, in recent years, the closed nature of fraternities has been identified as a factor hindering the influx of new populations and the vitalization of local communities. To protect the small-scale fishery foundations practiced historically, the fraternities require certain conditions of membership for newcomers, such as a specific period of residence and membership fees under their own articles of incorporation. Since it is difficult to engage in fishery activities without joining the fraternities in Korea, the conditions limit the participation of prospective fishermen and various residents in small-scale fisheries. At a time when the environment surrounding fishing villages and fisheries is different from what it was in the past due to population decline and resource depletion, strategies alleviating these conditions are in high demand. Furthermore, the excessively closed management of the fraternities is recognized as interrupting the maintenance of fishing communities and of increasing socioeconomic value. In this context, coastal communities are opening to lower entry barriers or providing internships to young people to experience small-scale fisheries. Meanwhile, an innovative method is being applied to create economic opportunities for new members by devising a pension system for the retired.

The multilateral alternatives in Korea focus on population growth and local regeneration. Countermeasures aim to increase the number of people participating in small-scale fisheries and provide incentives for new population inflows through income and jobs. From this point of view, this study identifies how coastal households belong to small-scale fisheries and how higher incomes could be achieved as an economic incentive to engage in fishing. Based on the results, this study explores ways to maintain and improve the multifunctionality of coastal communities by revitalizing household-oriented small-scale fisheries.

3. Methodology

3.1. Methods

People choose their major source of income based on personal preference and socioeconomic context [37–39]. In coastal areas, for those who decide to work in primary industries, there are several vocational options. This study splits these options into a dichotomous variable. The occupational choice and economic outcome are statistically interdependent within a sequential decision-making process. The interdependence gives rise to two similar but slightly different issues regarding selection bias. One is self-selectivity from the occupational decision made by the householder. For the other, job choice and related matters influence the income level as a latent variable. Due to choice-based sampling, potential bias is inherent. Heckman correction for sample selection accounts for the sample-induced endogeneity [40–43]. Therefore, this study utilizes a two-stage Heckman selection model to examine the determinants of vocational selection and income for small-scale fishery householders.

The Heckman model postulates that householders make a decision regarding whether or not to participate in fishery activities as an income source, and then earn the income from the sales. In this manner, the vocational decision in coastal communities is estimated at the first stage, and the income regression is carried out consecutively at the second. The first stage identifies the propensity to work in a small-scale fishery sector, employing a probit regression model, as below:

$$\begin{array}{c} s_i^* = \alpha_i w_i + u_i \ , \ u_i \sim N\left(0, \ \sigma_u^2\right) \\ \left\{ \begin{array}{l} s_i = 1 \ if \ s_i^* > 0 \\ s_i = 0 \ if \ s_i^* \le 0 \end{array} \right. \end{array} \tag{1}$$

where s_i^* denotes the latent variable regarding vocational choice, s_i the observed counterpart of s_i^*, α_i the vector of coefficients, w_i the independent variables, and u_i describes the error term. This first phase using the selection equation generates the inverse Mill's ratio (IMR) to correct the selection bias. As a correction factor, IMR is derived from the estimates of ρ and σ. The statistic for IMR, λ_i, is expressed as follows:

$$\lambda_i = \phi(\alpha_i w_i) / \Phi(\alpha_i w_i) \tag{2}$$

where the ratio represents the standard normal density by the standard normal cumulative distribution.

$$y_i = \beta_i x_i + \varepsilon_i \ , \ \varepsilon_i \sim N\left(0, \ \sigma_\varepsilon^2\right) \tag{3}$$

where y_i represents the observed linear income when s_i of the selection model equals 1, β_i the coefficients, x_i the explanatories, and ε_i the error term with normal distribution. Since u_i in Equation (1) and ε_i in Equation (3) are systemically correlated upon the selection bias, the conditional expectation of y_i is given by:

$$\begin{array}{c} E[y_i | x_i, \ s_i = 1] = E\left[y_i | x_i, \ s_i^* > 0\right] = \beta_i x_i + E[\varepsilon_i | u_i > -\alpha_i w_i] \\ = \beta_i x_i + (\rho \sigma_\varepsilon \sigma_u) \left\{ \frac{\phi(\alpha_i w_i)}{\Phi(\alpha_i w_i)} \right\} \end{array} \tag{4}$$

where ρ indicates correlation coefficient, σ_ε the adjusted standard error, and λ_i the estimated coefficient of selection bias. This IMR, λ_i, is incorporated as an exogeneous independent variable in the second phase so that the estimates would be interpreted directly, free of selection bias. Statistical analysis was performed using STATA 13.0 and ArcGIS 10.5.1 software.

3.2. Data

To identify the determinants of vocational choice and income level of fishery households, this research utilizes the dataset combining the Korea Fishery Census and Agricultural Census in 2015. (The 2020 census data has not yet been released (to be released in March 2022), so this study carries out the empirical analysis on the year 2015. The 2015 data used in the analysis is the most recent census data.) In this study, a coastal community indicates a village or a geographical jurisdiction where the fishery is prevailing, prosperous, retained, or sustainable as a socio-economic activity. The microdata for analysis is derived from both fishery and agricultural census respondents who reside in coastal areas where the respondents of the fishery census are located. The analysis excludes the partial set of agricultural census responses in the areas where small- to large-scale commercial fishing or aquaculture have not been carried out. Therefore, the total number of householder observations is 289,961 at the first phase and 54,483 at the second. The spatial unit of the community in coastal areas is based on the smallest level of administrative jurisdiction, which is referred to as the *Eup-Myeon-Dong* level in Korea. (This study sets the *Eup-Myeon-Dong* level as a spatial unit of analysis to identify details at the community level for statistical and analytical purposes. The size of the community-level region, which is the *Eup-Myeon-Dong* here, is smaller than a territorial level 3 (TL3) region defined by the OECD.) The spatial scope contains the administrative districts for marine fisheries under *Framework Act on Fisheries and Fishing Villages Development*. The number of observation areas is 590 coastal villages of the *eup* or *myeon* districts. The distance of the household from a fishing port or coastal line acts as one of the intuitive factors in fishery selection. However, since the census data does not provide the address information of each household or its distance from the harbor or coast, this study utilized the smallest available spatial unit, the *Eup-Myeon-Dong* level. Figure 3 shows the target dataset and the geographic scope of coastal communities examined in this study. Therefore, the distance of the household from the fishing port or coastal line remains an unobserved factor of vocational choice in Figure 4.

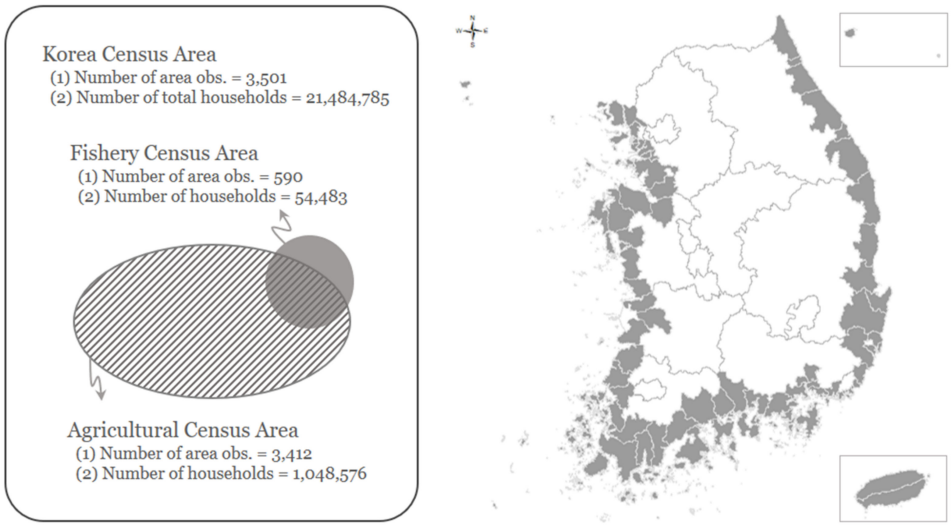

Figure 3. Scope of data.

3.3. Causal Mechanism

Based on the methods and materials explained above, this study applies a linked step approach to examine the factors causing households in coastal communities to belong to fishing groups and the factors increasing income. Since vocational choice and income are interdependent in a sequential process, the linked step as an empirical framework illustrated in Figure 4 is premised on the assumption of selection bias. First, our empirical analysis arises from the following research question. Which factors promote fishery participation and related incomes in coastal communities? The research hypothesis of the present empirical analysis is established as follows. Considering the opportunity cost of economic activities in coastal areas, becoming a fisherman instead of a farmer has an endogenous effect on fishery income. (The classic example of Heckman [41], which identified a specification error between occupation and income, also mainly considers the sample selection bias.) From an economic perspective, householders who choose to work in small-scale fisheries seem to believe that working at a fishery should compensate them for the opportunity cost of working in the agricultural industry. Especially in Korea, it is necessary to closely investigate the determinants of fishery income under bias correction, because the average fishery income is 4.6 times higher than that of agriculture (refer to Section 4.1).

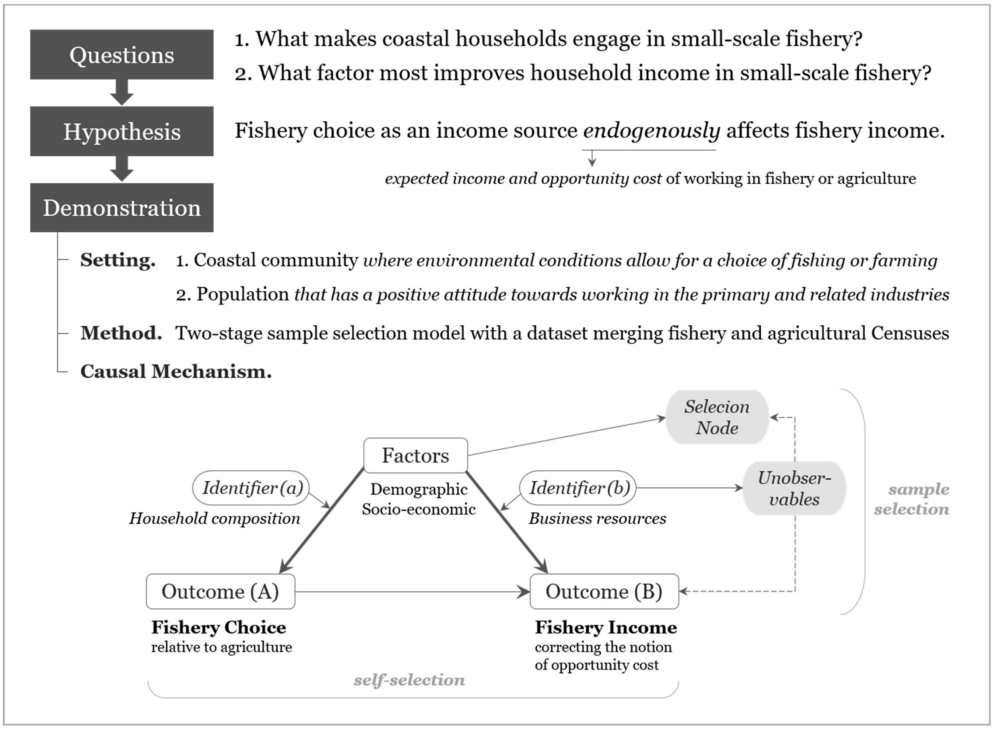

Figure 4. Empirical framework incorporating causal mechanism.

As a background condition of a causal argument, the spatial scope of the analysis is set to the coastal community, and the population includes fishery and agricultural households. This is applied because to choose fishing or another activity as a profession, it is necessary to have environmental conditions that enable marine fishing, such as access to coastal areas. Regarding the population, households with an intention to work in primary industries, such as fishing and agriculture, make different occupational choices from those of households choosing other industries, including manufacturing or services [44,45]. Therefore, this study analyzes households engaged in fishing and agriculture, including forestry, as defined by the Korea Fishery Census and Agricultural Census. Here, the range of fisheries includes small-scale fisheries such as fishing boats or vessels, aquaculture, bare-hand fishing, fishing without oxygen barrels, and others. Agriculture includes agriculture and forestry with ten categories: rice (staple crop in Korea), upland crops, vegetables, cash crops (special

purpose crops) or mushroom, fruits, medicinal crops, flower, other miscellaneous crops, livestock, and others.

To materialize the causal mechanisms illustrated in Figure 4, this study conducts a hierarchical regression with the sample-induced correction term of the sample selection model. Table 2 describes the variables used to estimate the causal relationship. The variables are constructed over two different stages of regression based on the structure of the Heckman selection model. The first step applies the variables used in the selection model, and the second step applies the variables included in the outcome model. In the first step with the binomial probit model, the dependent variable is divided into fishery or agriculture selection, which is outcome (A) in Figure 4. Since this study analyzes the determinants of fishery choice and income after correcting for selection bias, a value of 1 is assigned to the dependent variable when householders living in coastal regions choose to work in a small-scale fishery. The case of selecting agriculture is set as the reference group. With the bias-corrected linear model, the second dependent variable is fishery income as outcome (B) in Figure 4. Income is calculated as the sales amount of all types of small-scale fishing and aquaculture, which are investigated in the Korea Fishery Census. Fishery Sales are coded in categorical form in the raw data, and the dependent variable is linearized by taking the natural logarithm of the median of the sales amount. Additionally, in Figure 4, the selection node shown in gray is a variable that enables observation of the fishery income. The unobservable variables include factors that increase the expected income of fisheries and confound the relationship between fishery selection and income by sample selection.

Table 2. Description of variables.

Variable			Model		Description
			Step 1	Step 2	
Dependent Variable					
	Fishery Choice		○		Fishery=1 when included in Fishery Census, Agriculture=0 in Agricultural Census
	Fishery Income			○	Log transformation of total sales from fishing and aquaculture
Independent Variable					
Demo graphic	AGE	AGE	○	○	Age of householder, mean centering
		AGE_SQ	○	○	AGE*AGE, squared term of AGE
	GENDER	GENDER	○	○	Male = 1, Female = 0
	Migration	MIG	○	○	Migrated within the past 5 yrs = 1, otherwise = 0
	Education	EDU_MID	○	○	Below middle school graduates = 1, otherwise = 0
		EDU_HIGH	Ref.	Ref.	High school graduates = 1, otherwise = 0
		EDU_UNI	○	○	College graduates or higher = 1, otherwise = 0
Socio-Economic	Family Members	HH_NUM	○	○	Number of family members, mean centering
	Household Type	HH_ONE	○		One-generation household = 1, otherwise = 0
		HH_TWO	○		Two-generation household = 1, otherwise = 0
		HH_MULTI	○		Multi-generation household = 1, otherwise = 0
		HH_SINGLE	Ref.		Single-person household = 1, otherwise = 0
Economic Activity and Resource	Fishery Type	FISH_AQUA		○	Aquaculture = 1, otherwise = 0
		FISH_SHIP		Ref.	Fishing boat or vessel = 1, otherwise = 0
		FISH_BARE		○	Bare hand fishing and etc. = 1, otherwise = 0
	Labor	CAREER		○	Experience in fishery, Mean centering
		FULL_TIME		○	Full-time or main income source = 1, otherwise = 0
		EMP		○	More than one employees = 1, otherwise = 0
	Sales	COOP		○	Member of fishing village fraternity = 1, otherwise = 0
		WHOLESALE		○	Wholesale or contract sales = 1, retail or else = 0
	Resource	INFO		○	Utilization of digital devices in sales = 1, otherwise = 0
		TRANSPORT		○	Possession of lorry or van = 1, otherwise = 0

Note: Step 1 for selection model and Step 2 for outcome model. The households included in both Fishery and Agricultural Census are counted as a fishery group.

The explanatory variables are applied differently in the first- and second-stage regression models, reflecting the exclusion restriction of the sequential regression model [46,47]. The analysis includes the household type as an identification variable to avoid multicollinearity between a set of explanatory variables for the first stage and lambda hat. The

household type affects a householder's vocational choice in several ways (e.g., in terms of family business and the manner or purpose of economic activities) [48,49]. However, this is not a crucial factor in determining sales from primary industries, especially when holding the number of family members in the regression model constant [50,51]. The household type as an identification variable, or identifier (a) in Figure 4, is divided into four categories: single-person household, and one-generation, two-generation, and three-generation families. Excluding the household type, a set of explanatory variables of the first phase is controlled for the second phase as well, since these variables affect both the vocation decision and income level. Economic activity and business resources are only included in the outcome model, which estimates the determinants of fishery income. In the presence of sample selection, the set of identifiers (b) given in Figure 4 includes nonobservable variables for the non-fishing group.

4. Empirical Results

4.1. Descriptive Statistics: Fishery and Agricultural Income

The average fishery income of a household is higher than that from agriculture. Table 3 compares the nominal fishery or agricultural incomes of households in 2015. (The microdata for the Korea Fishery Census in 2020 has not been released yet, but the composition by fishery type calculated from the aggregate data of 2020 census is similar to that of 2015 [9]. In 2020, the total number of fishery households was 43,149, and was composed of fishing boats (18,733, 43.41%); aquaculture (9180, 21.28%); bare-hand or other (15,236, 35.31%).) Household fishery income based on fishery sales revenue is KRW 71.4 million (USD 59,987), and the farm income of agricultural households is KRW 16.4 million (USD 13,862) on average. The median value of income is lower than the mean, at KRW 15 million for fisheries and KRW 4 million for agriculture, which seems to be because approximately 70% of the population participates in part-time fishing or agriculture with relatively low incomes. Household heads involved in fishing are 62 years of age on average, and thus are younger than household heads involved in farming. The mean age of the total population is 64.69 years, which is similar to the national pension recipient age (65 years of age is the expected retirement age) in Korea. Considering that the perceived retirement age of workers in Korea is 51.7 [52], householders involved in fishing and agriculture are older overall. The ratio of male householders involved in fishing is 0.74% higher than that of farming households.

Table 3. Descriptive statistics of fishery and agricultural income.

Variable		Fishery	Agriculture	Total
General Info.	No. of HHs	54,483	235,478	289,961
	Age, year	62.00	65.32	64.69
	No. of HH members	2.34	2.32	2.32
Average Fishery or Agricultural Income, KRW				
Total		71,400,421 (18.79)	16,449,435 (81.21)	26,774,598 (100.0)
Gender	Male	84,029,351 (80.15)	18,916,100 (79.41)	31,243,200 (79.55)
	Female	20,402,386 (19.85)	6,935,464 (20.59)	9,391,469 (20.45)
Migration	In-migration	65,618,647 (3.55)	9,215,144 (5.63)	16,403,425 (5.24)
	Non-migration	71,613,440 (96.45)	16,880,941 (94.37)	27,347,981 (94.76)
Education	Below middle	35,813,012 (45.19)	10,237,992 (43.50)	15,193,911 (43.82)
	High school	90,227,241 (48.94)	21,329,411 (43.87)	35,463,523 (44.82)
	College, higher	188,400,000 (5.87)	20,896,258 (12.63)	37,168,742 (11.36)
Household Type	One-generation	67,033,512 (50.25)	16,714,186 (46.29)	26,814,871 (47.04)
	Two-generation	96,311,741 (27.00)	20,842,844 (27.61)	34,768,004 (27.49)
	Multi-generation	79,993,116 (5.68)	22,946,883 (5.84)	33,420,479 (5.81)
	1 person HHs, others	42,003,602 (17.07)	7,982,594 (20.26)	13,534,486 (19.66)

Note: (1) HH denotes the number of households. (2) The parentheses in the table indicate the proportion of the population corresponding to each variable.

The number of in-migrant households that have entered fishing or agriculture within the last five years is 5.24% of the total. Migrants account for 3.55% of fishery households and 5.63% of households involved in agriculture. However, the income gap between migrant and

nonmigrant groups involved in fishing is smaller than that for agriculture since the fishery income of migrant households is 91.63% that of nonmigrants. For the education level of household heads, the fishing sector has a lower proportion of highly educated individuals than the agricultural sector, while the income of those with a college degree or higher is nine times higher in the fishing sector than in the agricultural sector. Regarding generational composition, the identification variable of the selection model, single-generation fishery households account for over 50% of the total. The pattern of average fishery income by generation composition also differs from that of farm households. In contrast to agricultural households, for which the farm income of multiple generations is the highest, the average fishery income is highest for households including two generations and multiple generations.

In Korean small-scale fisheries, households that operate fishing boats or vessels as their major fishing activity account for the largest share, at 44.16%. These households are followed by those using bare-hand fishing or other methods, at 33.45%, and aquaculture, at 22.40%. Table 4 presents the household fishery income by fishery type and business characteristics for 2015. The average annual fishery income is highest for aquaculture, at KRW 184.6 million (USD 154,887), and second highest for fishing boats, at KRW 62.7 million (USD 52,633). Bare-hand fishing has the lowest mean income of the three types, with KRW 7 million (USD 5920). Bare-hand fishers are approximately six years older than the other two types on average. (The bare-handed fishing activities in Korea are mainly conducted as tidal flat fishing. Here, bare-hand fishing refers to the fishery activities that capture and collect shellfish, seaweed, and other settled aquatic animals or plants. It includes fishery without oxygen feeder, catching with bare hands, net fishing, etc.)

The number and proportion of new entrants are the highest in aquaculture (1044 households, 4.34%). The share of the income gap between in-migrants and nonmigrants is the smallest. The fishery income of migrants is lower than that of nonmigrants on average, where the migrants' income is 90.82% that of nonmigrants in aquaculture, 89.66% that of nonmigrants for bare-hand fishing, and 74.80% that of nonmigrants for fishing boat fishing. Thus, new entrants of small-scale fisheries in Korea prefer the aquaculture industry, given its associated high incomes. In addition, the proportion of fisheries operated as a subsidiary business is the highest for fishing boats, at 87.81%, which is likely because the productivity of fishing boats or vessels is affected by seasonality and weather. The sector with the highest proportion of full-time workers is aquaculture (38.12%). Furthermore, the average fishery income is 7.48 times higher when involving one or more workers running a scaled business. Fishing boats or vessels mainly support family-based or single-person fishery activities with no employees (98.38%).

In Korea, 70.70% of fishery households are members of fishing village fraternities, representing a major constituent of local small-scale fisheries. Bare-hand (76.57%), fishing boat (74.23%), and aquaculture (65.04%) households jointly engage in economic activities within the local fishing community. Although the average fishery income of fraternity members is higher than that of nonmembers in bare-hand fishing, the income of nonmembers is higher in fishing boat and aquaculture fishing, which require investment in equipment or facilities. Specifically, nonmembers' fishery income is 1.85 times that of members in aquaculture, where households tend to make wholesale or contract sales rather than selling through the federation of fisheries cooperatives. Regarding informatization and digitalization, the use of digital devices for production or sales accounts is found for just over half of the total (54.88%). Vans or trucks are owned by a large proportion of aquaculture and bare-hand fishery households, where the wholesale percentage is high.

Table 4. Descriptive statistics of fishery income by fishery type.

Variable			Boats	Aquaculture	Bare Hand	Total
General Info.	Age, year		59.78	59.67	66.49	62.00
	Career, year		27.23	27.25	34.70	29.73
Average Fishery Income						
Total		INC	62,730,513	184,600,000	7,055,774	71,400,421
		HH	24,059 (44.16)	12,202 (22.40)	18,222 (33.45)	54,483 (100)
Migration	In-mig	INC	47,441,954	168,200,000	6,342,411	65,618,647
		HH	448 (2.46)	1,044 (4.34)	444 (3.64)	1,936 (3.55)
	Non-mig	INC	63,424,028	185,200,000	7,073,754	71,613,440
		HH	17,774 (97.54)	23,015 (95.66)	11,758 (96.36)	52,547 (96.45)
Working Hours	Full-time	INC	79,738,476	263,100,000	9,839,514	121,500,000
		HH	2,222 (12.19)	9,172 (38.12)	4,463 (36.58)	15,857 (29.10)
	Part-time	INC	52,251,770	139,300,000	6,669,182	50,817,054
		HH	16,000 (87.81)	14,887 (61.88)	7,739 (63.42)	38,626 (70.90)
Employ-ment	One, more	INC	149,600,000	306,300,000	64,210,170	214,700,000
		HH	295 (1.62)	6,860 (28.51)	5,358 (43.91)	12,513 (22.97)
	None	INC	28,075,859	89,332,394	6,115,262	28,684,677
		HH	17,927 (98.38)	17,199 (71.49)	6,844 (56.09)	41,970 (77.03)
Fishing village fraternity	Member	INC	52,789,091	153,900,000	7,322,252	61,348,614
		HH	13,527 (74.23)	15,648 (65.04)	9,343 (76.57)	38,518 (70.70)
	None	INC	81,225,740	284,800,000	6,288,009	95,651,939
		HH	4,695 (25.77)	8,411 (34.96)	2,859 (23.43)	15,965 (29.30)
Sales type	Wholesale	INC	74,199,759	203,200,000	8,745,465	87,002,039
		HH	9,537 (52.34)	17,824 (74.08)	8,385 (68.72)	35,746 (65.61)
	Retail	INC	29,943,368	143,600,000	5,200,323	41,636,026
		HH	8,685 (47.66)	6,235 (25.92)	3,817 (31.28)	18,737 (34.39)
Digitaliza-tion	Digital	INC	62,922,024	181,500,000	7,018,733	73,354,251
		HH	9,988 (54.81)	12,577 (52.28)	7,337 (60.13)	29,902 (54.88)
	None	INC	62,520,737	189,200,000	7,100,705	69,023,649
		HH	8,234 (45.19)	11,482 (47.72)	4,865 (39.87)	24,581 (45.12)
Vehicle	Lorry, van	INC	76,174,516	219,900,000	9,153,170	106,300,000
		HH	5,268 (28.91)	10,442 (43.40)	7,266 (59.55)	22,976 (42.17)
	Else, none	INC	52,421,172	132,500,000	6,202,826	45,970,089
		HH	12,954 (71.09)	13,617 (56.60)	4,936 (40.45)	31,507 (57.83)

Note: (1) INC denotes a fishery income in KRW and HH means the number of households. (2) The type of bare-hand in the table includes bare-hand fishing, fishing without oxygen barrels, (tidal) flat fishing, and other. (3) The parentheses in the table indicate the proportion of the population corresponding to each variable. (4) Gray-shaded rows are described in detail above Table 4.

4.2. Model Fit: Relationship between Fishery Choice and Income

Table 5 reports the estimation results for vocational choice and fishery sales in coastal communities. The columns of the selection model show engagement in fishing and agriculture. The outcome model delivers the regression result of the second stage on income determinants. In terms of model fit, the Wald test ($p < 0.01$) rejects the null hypothesis that vocational choice between fishery and agriculture and the likelihood of income increase are independent (i.e., rho is statistically significantly different from zero). These results suggest that the probability of income gains from fishery choices is lower than that of choosing agriculture in coastal communities. This result proves the validity of the causal mechanism employing the Heckman selection model.

Table 5. Estimation results of two step Heckman selection model.

Variable	Selection Model D.V. | Fishery Choice		Outcome Model D.V. | Fishery Income	
	Coefficient	S.E.	Coefficient	S.E.
CONSTANT	−0.8730 ***	0.0114	17.3658 ***	0.3593
AGE	−0.0059 ***	0.0003	−0.0327 ***	0.0018
AGE_SQ	−0.0002 ***	0.0000	−0.0007 ***	0.0001
GENDER	−0.0521 ***	0.0086	0.3022 ***	0.0311
MIG	−0.1961 ***	0.0137	−0.3071 ***	0.0706
EDU_MID	0.0335 ***	0.0069	−0.0642 **	0.0270
EDU_UNI	−0.4772 ***	0.0108	0.8032 ***	0.1090
HH_NUM	0.0313 ***	0.0051	0.0461 ***	0.0112
HH_ONE	0.1436 ***	0.0101		
HH_TWO	0.0709 ***	0.0141		
HH_MULTI	−0.0090	0.0234		
FISH_AQUA			0.3344 ***	0.0257
FISH_BARE			−0.7718 ***	0.0271
CAREER			0.0146 ***	0.0009
FULL_TIME			0.5952 ***	0.0224
EMP			1.7020 ***	0.0254
COOP			0.1990 ***	0.0215
WHOLESALE			1.2223 ***	0.0209
INFO			0.1960 ***	0.0198
TRANSPORT			0.3061 ***	0.0213
IMR(λ)			−1.9273 ***	0.2556
Rho(ρ)			−0.6880	
N	289,961		54,483	

Note: (1) ** $p < 0.05$, *** $p < 0.01$. (2) For the multicollinearity check, mean VIF (variance inflation factor) is 2.75 in the selection model and 1.43 in the outcome model. The VIF values of all variables are less than 10 in each model.

The estimates of IMR (λ), the correction variable for selection bias, reject the null hypothesis that the errors are uncorrelated, which means the data are consistent with selection (-1.9273, $p < 0.01$). The negative direction of the estimates reveals that the income increase from fishery selection is lower than that of choosing agriculture. This shows a different perspective on fishery income from that of the descriptive statistics, where the average fishery income is 4.6 times higher than the average agricultural income (see Section 4.1). Although a higher fishery income is observed for small-scale fishery households than the average farm income for farm households, the income decline resulting from choosing fishing instead of agriculture is at a statistically significant level when the explanatory factors affecting occupational selection and income are controlled. This means that the likelihood of an income increase at the fishery is low if the causes of higher fishery income are controlled as a reference value. In other words, it can be inferred that fishers' incomes increase on average when they decide to engage in agriculture while controlling the explanatory variables included in the model. Additionally, according to the CONSTANT variable in the outcome model, fishery income is estimated at KRW 34.8 million (USD 29,278) in the reference group of the fishing sample (characteristics of the explanatory variable in fishers' reference group: average age, female, non-migrant, high school graduate, average number of household members, fishing boats or vessels, average year of working experience, part-time, no employee, non-member of fishing village fraternity, retail sales, no digital device, no large vehicle). This is less than half (48.88%) of the average fishery income at KRW 71.4 million (USD 59,987) according to the Fishery Census. To compensate for the decline in the competitiveness of small-scale fisheries, the comparative advantage of fisheries as an income source should be improved. Evidence-based policies on the factors of fishery income increase could also contribute to revitalizing coastal communities based on fishing industries.

4.3. Selection Model: Vocational Choices

From the test results elaborated in Section 4.2, this study interprets the coefficient in Table 5 as the estimate with explanatory power. Since the coefficient values of CONSTANT show a conditional mean based on the results of each model, the controlled requisite in

the selection model is found to be negatively influenced by fishery choice. Except for the number of household members and the household type, most of the explanatory variables controlled by the model have a negative effect on fisheries versus agriculture. In other words, the variables showing a negative direction appear to have a positive effect on the selection of agriculture rather than on the selection of fishing.

The probability of belonging to the fishery group rather than agriculture increases as the number of family members (HH_NUM) increases. Similarly, among household type variables (HH_ONE, HH_TWO, and HH_THREE), the probability of choosing fishing rather than agriculture is higher for single- and two-generation compositions than for single-person households. Concerning household type, single-generation households (HH_ONE) are more likely to be in the fishery group than two-generation families (HH_TWO). It appears that single-generation households show twice the probit probability as two-generation households in terms of choosing fishing over agriculture compared to single-person households. In contrast, multigenerational households (HH_MULTI) show a higher probability of choosing agriculture over fishing than single-person households, but the estimated coefficient is not statistically significant.

Demographic variables such as age, gender, and migration are found to promote the probability of being a farmer rather than a fisherman. The older the household head is, the lower the probability of fishing engagement is (AGE). This seems reasonable, as fisheries, even small-scale fisheries, are generally considered to involve more physically demanding work than agriculture [53,54]. This is also documented by the descriptive statistics in Table 3, with the lower average age of those working fisheries than that of workers in agriculture. In addition, since the age variable is centered on the mean, the younger the household head is, the higher the probability of entering a small-scale fishery is. These results have implications for revitalizing coastal areas to achieve sustainable fishing villages through the influx of young fishermen.

Gender and migration also have an interesting effect on the determinants of fishery selection for coastal householders. According to Table 5, fewer men than women (GENDER) and fewer newcomers than native residents (MIG) engage in fishing rather than agriculture. According to the descriptive statistics, the male ratio of farm household heads is 79.4%, whereas the male ratio is 80.15% for fishery households. Although the proportion of women participating in economic activities as household heads is small in both fishing and agriculture, the negative direction of the male variable indicates the relatively higher active participation of women involved in fishing than in agriculture, *ceteris paribus*. In this context, if small-scale fishing is promoted by reflecting the preferences of the young and female groups, it is expected to expand the fishing population and enhance the sustainability of coastal communities. On the other hand, the migrant population is more likely to include farmers than fishers, which is attributable to social and policy factors affecting fishing villages and the fishery industry in Korea, which make it difficult for newcomers or returners to enter [13].

For the education variables with high school graduates as the reference group, the likelihood of choosing fishing over agriculture is higher in the low-education group (EDU_MID and EDU_UNI). As education leads to an increase in income [50], the avoidance of fisheries among highly educated people is expected to have a negative effect on overall fishery income and the economic performance of coastal villages. Since these results are found even when generational characteristics that affect the level of education, such as age, are controlled, it is necessary to consider why fishing is not attractive as an occupation to highly educated people. Various studies have pointed out that the highly educated population generally has a low preference for primary industries and leaves rural or coastal areas [24,32]. To revitalize small-scale fisheries, an in-depth analysis should be conducted on why highly educated groups prefer agriculture over fishing, even in coastal areas. An increase in the highly educated population is needed to diversify fishery activities and improve the sustainability of coastal communities, as only skilled workers in the primary industry remain in coastal areas, where population decline is severe.

4.4. Outcome Model: Fishery Income

The outcome model shown in Table 5 displays the determinants of fishery income after correcting the selection bias caused by vocation choice. The explanatory variables controlled by the model have a positive effect on the increase in fishery income of households on average (CONSTANT). The coefficient is found to be statistically significant for all variables, including IMR (λ). Unlike in the selection model, the household type variables are not included because they are used as the identification variables for two-stage analysis.

The results show that in general, *ceteris paribus*, the incomes of fishermen who are young, highly educated, part of a fishing village fraternity, and actively using informatization methods tends to be higher. First, a causal effect is observed between a younger age and higher fishery income. According to the estimated marginal effect (AGE), fishery income has a tendency to decrease by 3.27 percent as the householder's age increases by one year. This is found when controlling for various factors, such as experience included in the age variable as the average, diverging from the assumption that the older the household head is, the higher his or her income [27]. This result has interesting implications for the age coefficient of the selection model. Table 4 shows that younger age has a positive effect on both fishery engagement and higher incomes relative to those of agriculture. From the preference for fisheries and high-income potential of younger individuals, improving conditions for entry into fishery activities for the young and middle-aged can enhance the sustainability of small-scale fisheries in coastal communities.

The gender and education variables in the outcome model show the opposite results to those of the selection model. Fishery households with female householders are more likely to choose fishing in the selection model, whereas male householders have a more positive effect on fishery income than female householders (GENDER). Because the male group's high labor income is inevitable in the primary industry [25,48], income enhancement should be supported for the female group by expanding the economic activities of coastal communities to the processing and service sectors. In terms of education level (EDU_MID and EDU_UNI), unlike in the fishery selection model, there is evidence that a higher education level generates a higher fishery income. In particular, if high school graduates (EDU_HIGH), the reference group, have the characteristics of college graduates in the model (EDU_UNI), it is estimated that fishery income will increase by 80.32 percent. Since the first-stage model shows the less educated group's fishery preference in Table 5, a strategy is needed to encourage highly educated householders to join fishing villages and participate in the fishery and related industries. Based on the two-step Heckman selection model, migration is a statistically significant determinant that reduces the probability of fishery work and income simultaneously (MIG). This indicates that householders who have migrated to coastal areas within the past five years prefer agriculture over fishing and have difficulties generating revenue when choosing fishing as an income source.

The coefficients of economic activity and resources show that capital investment and economies of scale are also statistically significant factors that increase fishery income. With regard to fishery types, the income effect of operating aquaculture (FISH_AQUA) is higher and that of bare-hand fishing (FISH_BARE) is lower than that of fishing boat fishing (or vessels, FISH_SHIP). Business assets such as experience, full-time work, and employment have a positive effect on the level of fishery income. For instance, when holding average age constant, one more year of experience is associated with a 1.46 percent increase in income (CAREER). Running a full-time business raises fishery earnings by 59.52 percent compared to part-time employment (FULL_TIME), and income grows by 170.20 percent with one or more employees (EMP). The advantages of economies of scale, such as participation in cooperative units, are also found in production and sales. In particular, the coastal communities of Korea are managed mainly by fishing villages, and participation in a fishing village fraternity is essential for income generation, raising fishery income by 19.90 percent (COOP). However, it is customarily difficult for young people and migrant households to belong to a fraternity [34]. Sustainable coastal communities must promote cooperative groups by easing membership requirements and attracting young

and in-migrant individuals. Additionally, sales through digital devices improve fishery income by 19.60 percent (INFO).

5. Discussion

The coastal community in Korea is shrinking. The associated population and number of households have been decreasing. The physical area has also reduced since 1970. Recently, a crisis of socioeconomic stagnation in the coastal community has deepened, along with a nationwide population cliff in Korea [11,13,34]. To revitalize coastal communities and multifunctionality, this study identifies how small-scale fisheries and their fishery incomes are promoted. A two-stage Heckman selection model is applied to the analysis, merging the Korea Fishery Census and Agricultural Census at the household level. The findings highlight that coastal households do not tend to choose fishing activities, and difficulty in generating income is a crucial factor in not selecting fishing as a major income source. Furthermore, community-led economic activities increase fishery income, while the migrant group is less likely to enter fishing and earn an above-average income. Our discussion of the primary findings is as follows.

First, fishing engagement and income are negatively interdependent. In coastal communities, the probability of a higher income being achieved when choosing fishing is lower relative to that for agriculture. Although descriptive statistics show a higher average income of fisheries compared to agriculture, it is estimated that the potential income of fisheries is not competitive when controlling for factors affecting occupation choice and income. In general, fisheries are perceived to provide high incomes since the average annual income of fishery households is 86% that of urban worker households, which is higher than that of farming (72.8%) or forestry households (60.6%) for 2020. However, small-scale fisheries in Korea do not guarantee a high return on average when considering socioeconomic investments and costs of fishing village fraternity membership, fishing grounds, fishing boats, and aquafarms. A probabilistic preference for agriculture, which is relatively easy to enter and guarantees a stable income throughout the year, is observed even in coastal regions geographically appropriate for fishing. Since householders choose their means of living based on financial outcomes and sustainability, it is necessary to seek ways to enhance the economic motivations of fishery entry. In addition to direct income increases, indirect incentives should be devised through subsidies and policies. Basic incomes for living in a fishing village or a direct payment system for the public interest in coastal communities could be considered as alternatives [55].

Second, the household type significantly influences fishing participation. In the selection model with fishery choice as the dependent variable, single- and two-generation households are more likely to choose fishing over agriculture than single-person households. The number of household members shows a similar pattern. The probability of fishery selection by householders increases as the number of household members increases. This suggests that there is a need to support family-oriented small-scale fisheries and that Korean coastal regions are characterized by local family-oriented communities of fishing groups, fishing village fraternities, and associations, with the household serving as the basic unit [13]. Mantziaris et al. [56] also emphasizes the societal value of these family-run fisheries. On the other hand, when the number of household members is controlled as an average value, single-generation households show twice as much probit probability as two-generation households. This seems to be because a compact household composition is somewhat free of the risks of choosing fishing, which is more unstable than agriculture as a source of income.

Third, fishing presents challenges as a stable income source. The probability of choosing fishing over agriculture is low in the older and more educated group, which shows a preference for a socioeconomically stable choice. The current fishery environment is different from that in 1970, when the population of marine fisheries accounted for 3.7% of the total population. Recently, the stability of participating in fishing activities and generating income has been lower than in the past due to restrictions on entry into fishing

village fraternities, reductions of marine resources, regulations on the use of fishing grounds, policies to reduce fishing vessels, climate change, and a low preference for labor-intensive industries [3,31,57,58]. In general, small-scale fishing as a profession seems to be recognized as a field of limited economic attractiveness given the associated constraints [59]. The outcome model, which uses fishery income as a dependent variable, also shows remarkable results. The marginal effect of fishery income is strong in the young, male, or highly educated groups. Regarding the age variable, it is estimated that younger individuals pursuing *high risk and high returns* have higher fishery incomes (the high-education and male groups are excluded from this interpretation because their expected income is predicted to be higher than that of the reference group when rationally choosing a job [25]).

Fourth, newcomers and returners are less likely to enter the fishing industry. In addition, they are less likely to have high incomes even when they select small-scale fishing. From the results of the first- and second-phase estimations, in-migrant households have, over the past five years, shown less of a preference for fisheries and fewer economic outputs. The migration variable exhibits the second-lowest probability of fishery selection in the selection model. The fishery incomes of in-migrant householders are 30.7% lower than those of nonmigrant householders under the same conditions. As population inflow is emphasized to increase the sustainability of coastal communities and small-scale fisheries in Korea [10,32], socioeconomic incentives should be devised to improve the probability of fishery entry and increased income for in-migrants. Additionally, it is necessary to compensate for the constraints from moving residence to increase the incomes of migrants, since migration lowers fishery income even when controlling for years of career experience as an average.

Fifth, the communal attribute of economic activity contributes to an increase in fishery income. Coastal communities in Korea are operated by heavily communal fishing village fraternities [13]. Although there are some differences by region and fish species, economic activities are based on the principle of coproduction and codistribution between members. Fishing organizations self-govern at the village level in the form of cooperatives [14]. The analysis results show that the probability of an income increase is 19.9% higher when a fisherman engages in production and sales activities as a member of a fishing village fraternity. Based on this result, although fraternities have recently limited coastal in-migration, their positive impact on economic performance requires community-led economic structures in fishing villages by opening current organizations and adjusting the operating system. In addition, seafood wholesale, which is mainly pursued in the form of a collective wholesale contract through fisheries cooperatives at the national and local levels, increases income by 122.2% compared to individual sales and retail.

Finally, the more capital input there is, the greater the economic outcomes of small-scale fisheries are. The fishing industry requires a relatively large amount of capital input even at the household level [60,61]. According to our estimation results, fisheries with a large amount of capital input, including aquaculture and fishing boat fishing, show a higher probability of income increase than bare-hand fishing or fishing without oxygen barrels (women divers; *Haenyeo* in Korean). Aquaculture, which involves continuous facility management, displays a 33.4% higher income effect than fishing boats. Fishing by fishing boats increases income by 77.2% compared to bare-hand fishing and other forms of fishing. In addition to their high initial investments, aquaculture and fishing boats have institutional constraints related to government policies. However, in line with the fishery choice model, their income effect clearly extends beyond entry restrictions. To revitalize various types of small-scale fisheries and improve incomes, it is necessary to overcome the initial constraints and promote socioeconomic incentives for fishery activities.

Although this study has implications for coping with the decline of small-scale fisheries and coastal communities, it has analytical limitations in encouraging sustainability and resilience in many countries, including Korea. In particular, there are limitations in interpreting the factors that enhance competitiveness in fishing among various occupations found in coastal communities because the present analysis only targets occupations in

primary industries such as agriculture and fishing. In addition, since the 2020 census, the latest data have not been released, and a time-series analysis has not been conducted amid rapidly changing socioeconomic environments. Supplemental work can strengthen the causal mechanisms of the presented empirical framework as well as having academic and policy implications. Further research should be focused on adjusting the community-led fishing system, increasing the influx of young and in-migrant groups to local communities, and exploring differences in socioeconomic characteristics by fishing type and sea area or region. Related future studies could help revitalize coastal communities in Korea and other countries with similar environmental and societal conditions.

Funding: The research was funded by Korea Maritime Institute.

Informed Consent Statement: Not applicable.

Data Availability Statement: The primary dataset of this study is based on Korea Fishery Census and Korean Agricultural Census, which are originally derived from Microdata Integrated Service (MDIS) at https://mdis.kostat.go.kr/eng/index.do.

Conflicts of Interest: The author declares no conflict of interest.

References

1. Hector, A.; Bagchi, R. Biodiversity and ecosystem multifunctionality. *Nature* **2007**, *448*, 188–190. [CrossRef] [PubMed]
2. Knickel, K.; Renting, H. Methodological and conceptual issues in the study of multifunctionality and rural development. *Sociol. Rural.* **2000**, *40*, 512–528. [CrossRef]
3. Iversen, A.; Asche, F.; Buck, M.; Henriksen, E.; Stein, J.; Svalestuen, S. The growth and decline of fisheries communities: Explaining relative population growth at municipality level. *Mar. Policy* **2020**, *112*, 103776. [CrossRef]
4. Kokorsch, M.; Benediktsson, K. Where have all the people gone? The limits of resilience in coastal communities. *Nor. Geogr. Tidsskr. Nor. J. Geogr.* **2018**, *72*, 97–114. [CrossRef]
5. Mulazzani, L.; Camanzi, L.; Malorgio, G. Multifunctionality in fisheries and the provision of public goods. *Ocean. Coast. Manag.* **2019**, *168*, 51–62. [CrossRef]
6. Salmi, P. Constraints and opportunities for small-scale fishing livelihoods in a post-productivist coastal setting. *Sociol. Rural.* **2015**, *55*, 258–274. [CrossRef]
7. Salmi, P. Post-productivist transformation as a challenge for small-scale fisheries: Changing preconditions and adaptation strategies in the Finnish Archipelago Sea Region. *Reg. Stud. Mar. Sci.* **2018**, *21*, 67–73. [CrossRef]
8. Béné, C. *Small-scale fisheries: Assessing their contribution to rural livelihoods in developing countries*; Food and Agriculture Organization of the United Nations: Rome, Italy, 2006; Volume 1008, pp. 1–57.
9. KOSIS (Statistics Korea). Available online: https://kosis.kr (accessed on 28 November 2021).
10. Lee, S. *Regional Employment Brief*; Korea Employment Information Service: Eum-seong, Korea, 2020. (In Korean)
11. Park, S.; Ryu, J.; Hwang, J.; Lee, S. *A Study on Social Strategy in Fishing Community against age of demographic extinction*; Korea Maritime Institute: Busan, Korea, 2018. (In Korean)
12. Ministry of Land, Infrastructure and Transport. *Press Release on Cadastral Statistical Yearbook*; Ministry of Land, Infrastructure and Transport: Sejong, Korea, 2020. (In Korean)
13. Hwang, J.; Park, S.; Yun, Y. *A Way to Make Coastal Communities as a Modern Utopia*; National Research Council of Korea: Sejong, Korea, 2020. (In Korean)
14. Lee, S.; Midani, A.R. Fishery self-governance in fishing communities of South Korea. *Mar. Policy* **2015**, *53*, 27–32. [CrossRef]
15. Ahn. B.; Lee, J. Research on categorizing the fishing village fraternity and comparing the characteristics by type. *J. Fish. Bus. Adm. Korea* **2021**, *52*, 83–99. (In Korean) [CrossRef]
16. Lee, H.; Seo, J. Searching for ways to express and publicity evaluation of fishing villages through examples of fishing village New Deal 300 project. *J. Korean Hous. Assoc.* **2021**, *32*, 2234–3571. (In Korean)
17. Lee, S.; Kim, J. The analysis about factors affecting of extinction risk in fishing village. *J. Fish. Bus. Adm. Korea* **2020**, *51*, 67–79. (In Korean) [CrossRef]
18. Lee, C.; Park, J.; Kang, H. Analysis of important factors for sustainable fishing village development. *J. Korean Soc. Rural. Plan.* **2020**, *26*, 23–38. (In Korean) [CrossRef]
19. Park, S.; Lee, S.; Lee, H. *A study on Definition and Spatial Analysis of Fishing Community for Integrated Development*; Ministry of Oceans and Fisheries: Sejong, Korea, 2014. (In Korean)
20. Park, S.; Ryu, J.; Lee, S.; Lee, H.; Lee, S. *Strategy for the Vitalization of regional economies in Inland Fishing Communities Network*; Korea Maritime Institute: Busan, Korea, 2017. (In Korean)
21. National Spatial Data Infrastructure Portal. Available online: https://www.nsdi.go.kr (accessed on 7 December 2021).
22. Public Data Portal. Available online: https://www.data.go.kr (accessed on 7 December 2021).

23. Kim, D.; Lee, H. Development direction for the fishing village fraternity through survey for its members. *J. Korean Isl.* **2017**, *77*, 1–18. (In Korean)
24. Jang, I. An empirical analysis of social population change and policy implications: Focusing on coastal area in Korea. *Stat. Res.* **2021**, *26*, 33–65. (In Korean)
25. Park, S.; Yun, Y.; Hwang, J.; Lee, H. *A Comprehensive Report on Quality of Life in Islands and Fishery Areas*; Ministry of Oceans and Fisheries: Sejong, Korea, 2020. (In Korean)
26. Huylenbroeck, G.; Vandermeulen, V.; Mettepenningen, E.; Verspecht, A. Multifunctionality of agriculture: A review of definitions, evidence and instruments. *Living Rev. Landsc. Res.* **2007**, *1*, 1–43.
27. Hwang, J.; Lee, S. The effect of the rural tourism policy on non-farm income in South Korea. *Tour. Manag.* **2015**, *46*, 501–513. [CrossRef]
28. Wiggering, H.; Müller, K.; Werner, A.; Helming, K. The concept of multifunctionality in sustainable land development. In *Sustainable Development of Multifunctional Landscapes*; Springer: Berlin, Germany, 2003; pp. 3–18.
29. Ropars-Collet, C.; Leplat, M.; Goffe, P.L. Commercial fisheries as an asset for recreational demand on the coast: Evidence from a choice experiment. *Mar. Resour. Econ.* **2017**, *32*, 391–409. [CrossRef]
30. Chen, C. Diversifying fisheries into tourism in Taiwan: Experiences and prospects. *Ocean. Coast. Manag.* **2010**, *53*, 487–492. [CrossRef]
31. Thompson, C.; Johnson, T.; Hanes, S. Vulnerability of fishing communities undergoing gentrification. *J. Rural. Stud.* **2016**, *45*, 165–174. [CrossRef]
32. Haase, T. Demography of rural decline and expansion. In *A Living Countryside? The Politics of Sustainable Development in Rural Ireland*; Routledge: New York, NY, USA, 2016; pp. 257–274.
33. ENRD. *Smart Villages: Revitalizing Rural Services*; European Network for Rural Development: Brussel, Belgium, 2018.
34. Park, S.; Hwang, J.; Yun, Y.; Lee, H.; Ryu, J. *A Study on the Construction of Smart Fishing Community in the Era of the 4IR*; Korea Maritime Institute: Busan, Korea, 2019. (In Korean)
35. Ministry of Oceans and Fisheries. *The Second Official Plan on Comprehensive Management of Uninhabited Islands*; Ministry of Oceans and Fisheries: Sejong-si, Korea, 2020.
36. Ministry of the Interior and Safety. *A White Paper on Inhabited Islands*; Ministry of the Interior and Safety: Sejong-si, Korea, 2021.
37. Dawkins, C.; Jamali, D.; Karam, C.; Lin, L.; Zhao, J. Corporate social responsibility and job choice intentions: A cross-cultural analysis. *Bus. Soc.* **2016**, *55*, 854–888. [CrossRef]
38. Higgins, M. Changing careers: The effects of social context. *J. Organ. Behav. Int. J. Ind. Occup. Organ. Psychol. Behav.* **2001**, *22*, 595–618. [CrossRef]
39. Judge, T.; Bretz, R. Effects of work values on job choice decisions. *J. Appl. Psychol.* **1992**, *77*, 261. [CrossRef]
40. Certo, S.; Busenbark, J.; Woo, H.; Semadeni, M. Sample selection bias and Heckman models in strategic management research. *Strateg. Manag. J.* **2016**, *37*, 2639–2657. [CrossRef]
41. Heckman, J. Sample selection bias as a specification Error. *Econom. J. Econom. Soc.* **1979**, *47*, 153–161. [CrossRef]
42. Hwang, J.; Lee, S. Classification of 6th industrialization of agriculture and effect on farm household income. *J. Rural. Dev.* **2016**, *39*, 1–28.
43. Kennedy, P. *A Guide to Econometrics*, 5th ed.; Cambridge: London, UK, 2003.
44. Roberts, K. The determinants of job choice by rural labor migrants in Shanghai. *China Econ. Rev.* **2001**, *12*, 15–39. [CrossRef]
45. Obayelu, O.; Ifeoluwa, O. Choosing a career path in Agriculture: A tough calling for youths in Ibadan metropolis, Nigeria. *Agric. Trop. SubTropica* **2019**, *52*, 27–37. [CrossRef]
46. Huber, M.; Mellace, G. Testing exclusion restrictions and additive separability in sample selection models. *Empir. Econ.* **2014**, *47*, 75–92. [CrossRef]
47. Morrissey, K.; Kinderman, P.; Pontin, E.; Tai, S.; Schwannauer, M. Web based health surveys: Using a two-step Heckman model to examine their potential for population health analysis. *Soc. Sci. Med.* **2016**, *163*, 45–53. [CrossRef]
48. Alves, C.; Gama, A. Family business performance: A perspective of family influence. *Rev. Bras. Gestão Negócios* **2020**, *22*, 163–182. [CrossRef]
49. Olson, P.; Zuiker, V.; Danes, S.; Stafford, K.; Heck, R.; Duncan, K. The impact of the family and the business on family business sustainability. *J. Bus. Benturing* **2003**, *18*, 639–666. [CrossRef]
50. Choi, E.; Park, J.; Lee, S. the effect of the comprehensive rural village development program on farm income in South Korea. *Sustainability* **2020**, *12*, 6877. [CrossRef]
51. Kim, B. An analysis on the determinants of fishery receipts of fishery household in Korea. *Ocean. Policy Res.* **2009**, *24*, 27–55. (In Korean)
52. Job Korea; Albamon. A Survey on Retirement Age Perceived by Employees. 2021. Available online: https://www.jobkorea.co.kr/goodjob/tip/view?News_No=19205 (accessed on 14 December 2021). (In Korean)
53. Østergaard, H.; Jepsen, J.; Berg-Beckhoff, G. The workload of fishermen: A cross sectional survey among Danish commercial fishermen. *Int. Marit. Health* **2016**, *67*, 97–103. [CrossRef] [PubMed]
54. Woodhead, A.; Abernethy, K.; Szaboova, L.; Turner, R. Health in fishing communities: A global perspective. *Fish Fish.* **2018**, *19*, 839–852. [CrossRef]

55. Ryu, J.; Eom, S.; Park, S.; Goh, D.; Shim, S.; Oh, S. *A Study on Public Functionalities of Fisheries and Fishing Communities: The Case of South Korea*; Korea Maritime Institute: Busan, Korea, 2019. (In Korean)
56. Mantziaris, S.; Liontakis, A.; Valakas, G.; Tzouramani, I. Family-run or business-oriented fisheries? Integrating socioeconomic and environmental aspects to assess the societal impact. *Mar. Policy* **2021**, *131*, 104591. [CrossRef]
57. Power, N.; Norman, M.; Dupré, K. The fishery went away: The impacts of long-term fishery closures on young people's experience and perception of fisheries employment in Newfoundland coastal communities. *Ecol. Soc.* **2014**, *19*, 6. [CrossRef]
58. Nicolosi, A.; Di Gregorio, D.; Arena, G.; Laganà, V.; Privitera, D. Small-scale coastal fisheries in the midst of adaptation and diversification: Insights from southern Italy. *Sustainability* **2021**, *13*, 7393. [CrossRef]
59. Patchell, J.; Cheng, C. Resilience of an inshore fishing population in Hong Kong: Paradox and potential for sustainable fishery policy. *Mar. Policy* **2019**, *99*, 157–169. [CrossRef]
60. Wang, B.; Han, L.; Zhang, H. The impact of regional industrial structure upgrading on the economic growth of marine fisheries in China: The perspective of industrial structure advancement and rationalization. *Front. Mar. Sci.* **2021**, 860. [CrossRef]
61. Carvalho, N.; Casey, J.; Guillen, J.; Rodgers, P. Characterising investments in EU fisheries and defining their desirability. *Fish. Res.* **2020**, *221*, 105396. [CrossRef] [PubMed]