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Sustainability of Floodplain Wetland Fisheries of Rural Indonesia: Does Culture Enhance Livelihood Resilience?

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Abstract: Preserving small-scale fisheries is the main concern of governments in sustainable growth development because more than 90% of fishers and workers make a living in this business including in floodplain wetlands currently affected by external shocks. Applying the sustainable livelihoods approach (SLA) and framework, this research aimed to analyse the impact of environmental changes on fishing livelihoods in South Kalimantan, Indonesia. Questionnaire administration and in-depth interviews were employed as data collection methods, and structural equation modelling was tested on samples of 550 fishers. We found that environmental changes in natural conditions and human activities had adverse effects on the sustainability of fishing livelihoods. Fishers found massive development disruptive to their fishing activities, putting their livelihoods at risk and making them vulnerable. The findings further acknowledge cultural significance with livelihood resilience. Since The United Nations Educational, Scientific, and Cultural Organization (UNESCO) defines culture as "the entire and distinguishing way of society life", this dimension is integrated into the study's well-recognised framework. The government is recommended to re-evaluate its approach to balancing economic, social, environmental, and cultural factors.

Keywords: environmental changes; fishing; adaptation; institutional support

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1. Introduction

Wetlands are amongst the most varied and productive ecosystems on the planet, moulded by the continuous flood of water and with unique soil quality and various flora and fauna [1]. The international Convention on Wetlands states that wetlands are marsh areas, fens, peatlands, or water bodies, both natural and artificial, permanent and temporary, flooded with static or flowing fresh, brackish, or salt water, including areas of marine water that at low tide do not surpass six metres [2]. 'Wetland' therefore denotes an extensive range of natural inland habitats like marshes, peatlands, floodplains, rivers, lakes, coastal areas, and human-made wetlands like ponds, dams, reservoirs, rice fields, and wastewater treatment ponds and lagoons. Floodplain wetlands are demarcated as low-lying natural zones adjoining big rivers that are seasonally flooded by overspills from the primary river system [3]. Among the heterogeneous natural ecosystems in wetlands, the floodplain wetlands are one of the most essential resources from the freshwater fisheries' perspective [4].

Despite continual efforts in the conservation of wetlands all over the world, the existence of wetlands has continuously been threatened due to various factors [5,6], including floodplain wetland fisheries [7]. This is because fishers relying on simple technology are vulnerable to any devastating effect that a slight disturbance can cause, re-

sulting in business instability. This vulnerability worsens when exposed to poverty, limited access to resources, marginalisation, and inequality [8]. Natural resource dependency confirms the direct relationship between the livelihoods of individuals, communities, and a natural resource and its local economy [9]. Under the current triple-bottom-line business concept which posits that firms should commit to measuring their social (people) and environmental (planet) impact in addition to their financial performance (profit), the strict connection between social and ecological systems has been a primary consideration for managing and adapting to environmental change [10].

In rural South Kalimantan, Indonesia, where most areas are wetlands, fishing is traditionally and typically one of the primary sources of livelihood for communities [11]. These wetlands are a fundamental livelihood resource for the rural population. They are closely related to various economic events and support rural communities with drinking water, irrigation, transport, and food. However, with the rapid growth of human populations, alarming deforestation rates, and ongoing aquatic pollution and habitat degradation, the situation for freshwater and marine habitats throughout Asia has become a rising concern [12,13]. There have been few studies on fish in South East Asia. Still, the one by [14] emphasises that 77 % of wetland fish species will probably be extinct if habitat degradation continues, with Kalimantan being the most heavily impacted. Indonesian fisheries management is complicated with layers of governance, decentralisation, and traditional fishing tenure rights [15]. For decades, the Indonesian government has worked hard to regulate fisheries management in a dynamic and complicated atmosphere to achieve sustainable development goals [16].

Communities along the villages of Danau Bangkau and Danau Panggang in the north and south regions of the South Kalimantan region depend on fishing and fish trading as major livelihood activities. In this area, income from fishing is a household socio-cultural identity. However, the recent environmental changes due to economic and development activities impede fishing and reduce fishermen's and fish traders' income. Human pressure is one of the main hazards to the ecosystem, where mangroves are cut for firewood and charcoal production or cleared for human settlements, and freshwater swamps are converted into settlements and main roads. The existence of various resource users, frequently with conflicting interests, the intricacy of the human–environmental relations, and the connections between diverse ecosystems` functions and services require an integrated management approach to preserve the benefits and resilience of the community depending on the resources [17]. Social–ecological systems' capability to adapt to environmental change has been acknowledged in the fishing business by the concept of 'resilience' [18]. It is examined through the ability to deal with external stresses and conflicts from social, political, or environmental change [19]. Consequently, social–ecological resilience concerns the environment's capacity to resist, endure, recuperate, and adjust to disruption, and the degree to which individuals and institutions can prepare for, deal with, and adapt to such alterations.

A comprehensive view of rural livelihood resilience is captured by the sustainable livelihoods approach and framework [20], delivering a holistic outlook on how households attain or fail to sustain their livelihoods. According to this framework, livelihood resilience depends on the livelihood assets (human, physical, natural, social, and financial) that the household runs. These assets are sequentially enhanced or blocked by rules, bodies, societies, and the broader vulnerability context, including trends and seasonality [21]. A household's blend of livelihood schemes is sustainable if it preserves or increases living standards such as higher wages, a better life, sufficient food, and decreased exposure to external shocks [22]. However, although the framework is widely applied in global poverty alleviation [23], it is still not often implemented in small-scale fisheries [24]. Currently, studies on the sustainable livelihood framework in developing countries predominantly emphasise quantitative analysis of sustainable livelihood capability [25], external interventions' effects on sustainable livelihood capability [26], and livelihood capital impact on capacity [27]. These studies examine less the poverty alleviation

measures' direct and indirect influences on rural people's sustainable livelihood capability.

Since President Joko Widodo's pledges to make Indonesia a maritime power, the interest in large-scale marine fisheries has been flowering [14–16,20]. However, the fish industry in Indonesia still consists of small-scale fishers contributing 90–95% of fish production [28]. Nevertheless, we have minor data on small-scale fisheries, and livelihoods are directly challenged by marine resource competition. Furthermore, fishery products of inland waters broadly characterise the livelihood of deprived communities living in remote rural areas. Consequently, a significant fishery contribution to maintaining the food security of the local people is frequently unnoticed.

This study is motivated by the emergent social science of small-scale fisheries management [29]. The study analyses the two-way direction between humans and the environment shaping the way traditional fishing works, allowing a more profound understanding of resource use dynamics and the significance of good management in balancing equity to achieve sustainability. The Danau Bangkau and Danau Panggang village case studies provide an opportunity to examine the distressing problems of conflicting economic and environmental sustainability policies by linking local-level experiences to national governance issues. Since each sustainable livelihood study offers a different critical basis for regional poverty-reduction strategies, this article incorporated cultural assets into the sustainable livelihoods framework to investigate the strategy by which cultural assets have been added as proposed by other scholars [30,31] with the sustainable livelihoods approach (SLA). The inclusion of culture is in line with UNESCO's encouragement in the 2030 plan, positioning culture as a distinctive element of sustainable development to drive and enhance sustainability. Thus, this study aims to use the new sustainable livelihoods approach to evaluate the resilience of fishing in the floodplain of wetlands as a sustainable livelihood resource in South Kalimantan, Indonesia and examine the fishers' capital stocks and livelihood strategies in a resilience context.

2. Theoretical Framework and Hypotheses Development

2.1. Livelihood Resilience

Livelihood frameworks are being progressively studied in various fields to learn the strategies people employ for a specific asset package to survive [32]. This concept pinpoints the competencies, properties, and concerns people confront, and it is helpful for livelihoods in poverty contexts. Some scholars argue that this perspective neglects the social system alterations and gradual social transformation [23,24], which is vital to sustainable development goals. Therefore, integration with the concept of "resilience" is required [33]. Resilience is the capacity of structures to endure, engage, contend with, and adapt to altering social and environmental circumstances while preserving crucial characteristics of the system [34].

Consequently, livelihood resilience is the livelihoods' capability to adjust, uphold, or improve their roles to moderate the shocks in the environment, economy, society, and politics, even including COVID-19 [35]. This resilience emphasises the role of people's support and the personal and mutual ability to react to stressors [33]. However, it is crucial to note that rural livelihoods embrace various capabilities and assets restricted by a particular community's local cultural and historical contexts [30]. The values, customs, and traditional knowledge of society are practically applied to shape and reinforce livelihood assets and to improve convenience. In vulnerable circumstances, those beliefs are vital for strengthening resilience by implementing traditional knowledge practised over generations, which is critical to the sustainability of rural livelihood [36]. Hence, when employed in a livelihood framework, culture may add significantly to the main factors facilitating social agents or actors to counter opposing changes causing shocks on living and welfare.

2.2. Frameworks and Indicators for Measuring Livelihood Resilience

The conceptual and analytical frameworks guiding indicators for measuring livelihood resilience in various contexts have grown in the last ten years. However, The Department for International Development's (DFID) sustainable livelihood approach (SLA) and framework is the most commonly applied worldwide [37,38]. The most prominent part of the SLA is the asset pentagon comprising the principal elements of livelihoods.

In this outline, a people-centred approach is used for the five interdependent pillars of sustainability: human, social, natural, physical, and financial capital. Human capital is an inherent and acquired asset of people comprising skills, abilities, and capabilities [39]. This concept denotes competencies, excellent health, and working power enabling individuals to follow distinctive life strategies to achieve life goals [20].

Social capital includes networks, crowds, organisations, connections, reliance, and interaction [37]. Social capital usually signifies the degree of each person's confidence and solidarity [23]. Natural capital includes access to services and environmental resources crucial for those making livelihoods from natural resource-based activities [35]. Physical capital denotes admittance to services and infrastructure, including fundamental facilities, like electricity, water, telephones, and gas [32]. Financial capital refers to financial sources like money, saving accounts, revenue, credit, current assets, pension allowance, grants, financial remittances, and household property [39].

However, whilst the SLA effectively centralises people and their capabilities to anticipate the shocks, it has not sufficiently examined the implication of a cultural effect in livelihood exploration [40]. Ref. [30] has emphasised the importance of a cultural insight in livelihood investigation. They recognised cultural capital as a novel conception in the livelihood setting, where cultural behaviours are treated as a valuable source of reinforcing rural communities' livelihood sustainability. Therefore, ref. [31] added cultural capital to the SLA. Cultural resilience is vital in attaining rural sustainability, and this study considers to what extent cultural traditions are beneficial in guaranteeing livelihood resilience. Cultural belief empowers people to follow robust livelihood strategies supporting layers of resilience that assist people in dealing with change and translating difficulties into opportunities. Consequently, we support the urgency to explicitly integrate culture in the sustainability dialogue for reaching sustainability objectives relies on culturally laden human behaviour.

Thus, our hypotheses would be:

Hypothesis 1 (H1). *H0: The fisherfolks' human asset in floodplain wetlands does not have a significant positive relationship with livelihood resilience when anticipating the shocks of the decline. H1: The fisherfolks' human asset in floodplain wetlands has a significant positive relationship with livelihood resilience when anticipating the shocks of the decline.*

Hypothesis 2 (H2). *H0: The fisherfolks' social asset in floodplain wetlands does not have a significant positive relationship with livelihood resilience when anticipating the shocks of the decline. H1: The fisherfolks' social asset in floodplain wetlands has a significant positive relationship with livelihood resilience when anticipating the shocks of the decline.*

Hypothesis 3 (H3). *H0: The fisherfolks' accessibility to natural assets in floodplain wetlands does not have a significant positive relationship with livelihood resilience when anticipating the shocks of the decline. H1: The fisherfolks' accessibility to the natural asset in floodplain wetlands has a significant positive relationship with livelihood resilience when anticipating the shocks of the decline.*

Hypothesis 4 (H4). *H0: The fisherfolks' physical asset in floodplain wetlands does not have a significant positive relationship with livelihood resilience when anticipating the shocks of the decline. H1: The fisherfolks' physical asset in floodplain wetlands has a significant positive relationship with livelihood resilience when anticipating the shocks of the decline.*

Hypothesis 5 (H5). *H0: The fisherfolks' financial asset in floodplain wetlands does not have a significant positive relationship with livelihood resilience when anticipating the shocks of the decline. H1: The fisherfolks' financial asset in floodplain wetlands has a significant positive relationship with livelihood resilience when anticipating the shocks of the decline.*

Hypothesis 6 (H6). *H0: The fisherfolks' cultural asset in floodplain wetlands does not have a significant positive relationship with livelihood resilience when anticipating the shocks of the decline. H1: The fisherfolks' cultural asset in floodplain wetlands has a significant positive relationship with livelihood resilience when anticipating the shocks of the decline.*

The proposed conceptual model is presented in Figure 1.

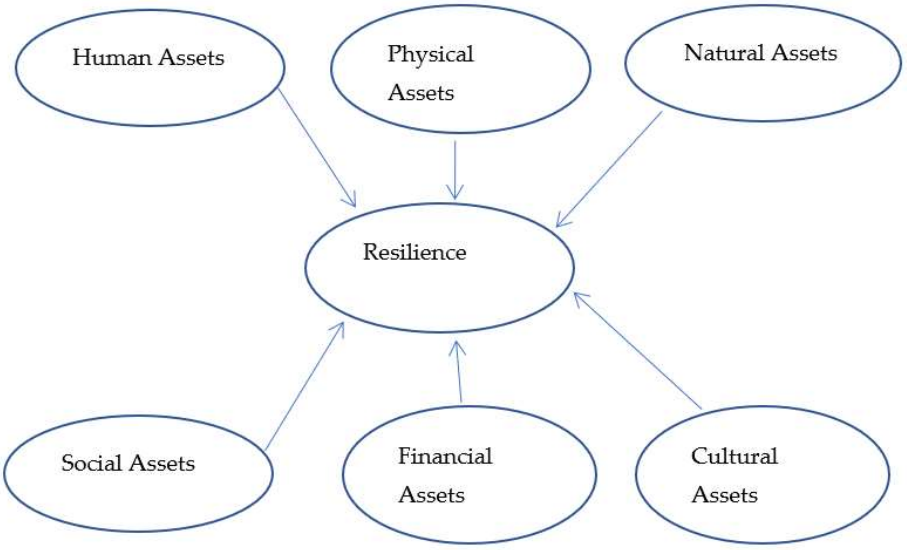

Figure 1. Conceptual model denoting interrelationship among variables.

3. Materials and Methods

The study was carried out in the villages of Danau Bangkau, Kandangan district, Hulu Sungai Selatan (HSS) regency and Danau Panggang, Danau Panggang district, Hulu Sungai Utara (HSU) regency for 8 months from April to November 2021. HSS is located between latitudes 2°29′59″–2°56′10″ S and longitudes 114°51′19″–115°36′19″ E, which is directly adjacent to the district and HSU. HSU is situated between latitudes 2°1′37″–2°35′58″ S and longitudes 114°50′58″–115°50′24″ E. HSS and HSU have a humid tropical climate with frequent rains in the middle of a long dry season. These two areas are the centres of the water fishing business in South Kalimantan.

The research employed a cross-sectional study design in that the effects of environmental pressure on wetland floodplain fishing were examined only once in the communities selected. A mixed method, comprising gathering qualitative and quantitative data from the research site, was implemented. This is because the application of structured surveys alone may not have provided a thorough understanding of the problem [41]. Further, using both quantitative and qualitative data provides a better comprehension of a research problem than applying only one [42].

The research applied non-probability sampling in selecting respondents. The process consisted of a two-stage sampling procedure. Five people near the wetland fishing floodplain were purposively nominated in the first stage. This follows Tobler's first law of geography [30] that everything is related to everything else but near things are more connected than distant things. Communities nearby the fishing floodplain sites were therefore estimated to suffer more from the impact of the environmental pressures. The

discussions were in the local dialect to accommodate the participants' linguistic needs. Some of the issues explored included: *How do the environmental pressures shake your resilience? How has the ecological loss reduced your income*? *What will your future be like with the current environmental loss*? In the second phase, snowballing sampling was used to detect the fishers' resilience for questionnaire administration. The sampling technique was employed since researchers did not have the fishers' records of whose livelihood had been affected. Overall, 550 respondents distributed evenly in the two locations were selected. The quantitative data to assess the proposed model's hypotheses were collected with a questionnaire extracted from previous studies, and structural equation modelling was employed to examine the relationship.

Covariance-based (CB) SEM was used as this methodology is intended mainly to confirm substantive theory from empirical data. The quantitative data to assess the proposed model's hypotheses were collected with a questionnaire extracted from previous studies. The relationships were verified through appropriate comprehensive measurement, including chi-square ($\chi 2$); the minimum sample discrepancy function ($\chi 2$/pdf); goodness-of-fit index (GFI); adjusted goodness-of-fit index (AGFI); CFI (comparative fit index); and RMSEA (root mean square error of approximation) [43]. Factor loading was estimated to ascertain discriminant validity by retaining a factor loading of 0.50 or higher [44]. Cronbach's alpha coefficient was examined to assess reliability, and those values had to be 0.60 or higher [45].

The variables in Table 1 consist of 29 items measuring human, social, natural, physical, financial, and cultural assets as well as livelihood resilience. Under SEM assumption, the minimum number of samples is five times the items tested; the 550 respondents were therefore feasible [44]. All items were scored on a 5-point Likert scale, with 1 representing "strongly disagree" and 5 designating "strongly agree." Human assets measurement was adopted from the study of [46]. The items were labelled education (HA1), experience (HA2), knowledge (HA3), and assistance from the authorities (HA4). Social and financial assets were also estimated in the same study. The social asset items were labelled as position in society (SA1), involvement in association (SA2), relationship with the authorities (SA3), and involvement in a political party (SA4). Further, the financial asset items were labelled as main income (FA1), moonlighting (FA2), and government donation (FA3).

Natural and physical assets were measured with items developed by [33]. The labels for natural asset items were fishing sites (NA1), pond ownership (NA2), diversity of fish caught (NA3), and the number of captures (NA4). Physical asset items were labelled as road conditions (PA1), the proximity of access (PA2), permits for the fishing site (PA3), and ownership of equipment (PA4). Cultural assets were estimated with items developed by [47]. Those items were place attachment (CA1), indigenous knowledge (CA2), learning (CA3), agency (CA4), institutions (CA5), and collective action (CA6). Finally, livelihood resilience was measured with 4 items: living standard (LR1), employment opportunities (LR2), ecological protection awareness (LR3), and rural attachment (LR4), developed by [23].

Table 1. Measurement items.

Variable	Labels	Statements	Source
Human Assets	HA1	Most family members have been in college.	[46]
	HA2	I have been an angler for a long time.	
	HA3	I have sufficient knowledge of fishing in floodplain wetlands.	
	HA4	I know how to obtain assistance from the government or local agencies to support my livelihood source.	
Social Assets	SA1	My opinion is always taken into consideration in my community.	[46]
	SA2	I have been actively involved in small-scale fishery organisation.	
	SA3	I have a delicate relationship with officials from government agencies responsible for assistance during hard times.	
	SA4	I usually participate in activities conducted by a political party.	

Natural Assets	NA1	The area of floodplain fishing sites is wide.	[33]
	NA2	I have my ponds to fish.	
	NA3	Floodplain wetlands have a variety of fish.	
	NA4	The number of fish caught has decreased recently.	
Physical Assets	PA1	The fishing site is accessible by land and water.	[33]
	PA2	The land and water transportation pool are near my house.	
	PA3	All fisherfolk have full access to floodplain fishing sites.	
	PA4	I have the necessary equipment to fish in floodplain wetlands.	
Financial Assets	FA1	My income from fishing is enough to cover my daily needs.	[46]
	FA2	Besides as an angler, I also make money by doing other jobs.	
	FA3	I received social aid from the government.	
Cultural Assets	CA1	Closeness to this place promotes resilience to environmental change.	[47]
	CA2	We have understandings, skills, and philosophies developed by societies with a long interaction with natural environments.	
	CA3	We can produce, grasp, and manage new information on adverse situations.	
	CA4	The ability of our people enables us to control events affecting socio-economic conditions.	
	CA5	We follow established norms, rules, and organisations derived from social interaction guiding which actions are obligatory, tolerable, or prohibited.	
	CA6	It is common for us to sit together to discuss agreed objectives.	
Livelihood Resilience	LR1	We are concerned with the safety of food and drinking water.	[23]
	LR2	Besides fishing, we farm.	
	LR3	We are aware of environmental protection and ecological values.	
	LR4	We have a high sense of belonging and pride in community and home.	

4. Results

4.1. Characteristics of Research Location

The capital cities of HSU and HSS have two rivers flowing through them: the Amandit River and the Negara River. Along these rivers, many oxbow lakes of various sizes are surrounded by tropical peat swamp forests. During the rainy season, the increase in water level caused the oxbow lakes to enlarge, and the peat swamp area flooded and dried up during the dry season. The rivers, lakes, and this tropical peat swamp forest are interlinked, making a floodplain ecosystem (Figure 2).

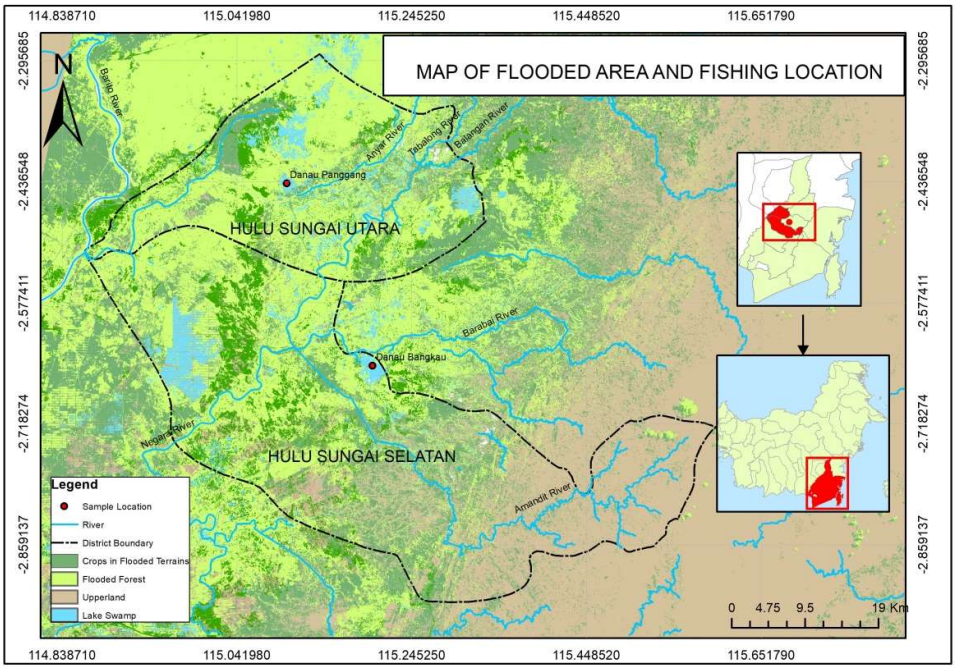

Figure 2. Floodplain map of fishing location in South Kalimantan (source: own collection).

Like most fishing villages in Indonesia [20], fishers in these regencies are categorised as marginalised communities for their isolated site and economic survival foundation. The fishers experienced slow economic progress in the late 1990s and beginning of the 2000s during the massive opening of mining concessions in neighbourhoods. The fishers' livelihood resilience has been changed by histrionic swings in ecological loss over the last decades. There has been forcible socio-economic and environmental shocks and rising consciousness of development contradictions. The leader of one of the fishers' villages uttered:

> *"Before we were poor because of no markets and no access to the financial institution. We caught lots of fish but the price was so low. Now credit and markets are available, but fish is very scarce."* (Interview, 11 August 2021.)

The fishers' up-and-down experiences in their livelihood echo the magnitude of the concurrent and unbalanced rivalry between market-driven progress on one side and sustainability agendas on the other. The situation shows the effect of conflicted governance neglecting the impact on local people's livelihoods when carrying out environmental investment.

Most fishers' houses were made of wood and hay, and children seldom went to school above senior high level. New prospects to shift to other sources of livelihood were available when mining companies massively exploited coal in the area. However, the arrival of newcomers from outside the village was initially resisted by the fishers.

One fisher grumbled:

> *"When I was young, I would like to work in a mining company. But competition between local people and skilled workers from other islands who arrived around the 1980s had been very tough as we never won. We had no choice but to survive instead of coming back to fishers. Before that traditional fisher did well."* (Interview, 26 August 2021.)

The local fishers had criticised the government's failure to impose specialisation protocols. The mining companies were expected to hire local people, and only highly skilled jobs were to be assigned to outsiders. However, as mining operations operated for decades and villagers' young generation noticed new opportunities for income in the fish

market, resistance to the impacts of exploring the environment gradually stopped. The implications of resource weakening have been borne in the village as fishers claimed their incomes were reduced drastically (Interviews, 15 July 2021). The decrease in revenue has been moderated by the fishers' efforts to work in other sectors outside the village. Most of them have become ad hoc labourers in the district or province capital. These substitute jobs are typically low-paid, erratic, and insecure.

4.2. Environmental Pressure on Fishing Business

The environmental pressure experienced by the community in the research area stems from changes in natural conditions and human activities. Based on the results of interviews and observations, the environmental pressure experienced by fishermen arising from changes in natural conditions is the rapid growth of mountain water plants (*Mimosa pigra* Leguminosae) that become weeds and decrease water quality. The environmental pressures from human activities are fish electrocution and population growth.

M. pigra is a kind of sensitive plant that forms shrubs. According to the fishermen, this plant began to grow approximately 10 years ago and is growing very fast (Interviews, 17 July 2021). It is suspected that the spread of these plant seeds was caused by backfill transported from the mountains for road and building infrastructure projects. These mountain plants have covered most of the fishing area (Figure 3).

Figure 3. Sensitive plants covering fishing sites (source: own collection).

The subsequent environmental pressure is the decline in water quality, especially at low tide. This is because the quality of floodplain water is dynamic or fluctuates according to the high- and low-tide seasons. In this season, there is a mass death of fish caused by changes in the water quality to a lethal condition, which is characterised by a pungent stench. Moreover, the activity of electrocuting fish that occurs sporadically is very detrimental to fishers because many small fish die. Population growth, which also means an increase in the fulfilment of the necessities of life, results in competition. The development of new housing and the addition of various facilities mean a reduction in the area of the fishery business, for example, for cultivation and processing activities. The increase in population also increases household waste disposed of by the community. This is also related to people's habits of throwing household waste into the water. In addition to household waste, waste from agricultural activities, either residual fertilisers or herbicides, also causes polluted water conditions.

The activity of electrocuting fish has been going on for a long time and affects the safety of fishers. However, fishers prefer to stay away and catch fish in other locations or pretend not to see the activity. Fishers who electrocute usually come from outside the area. Fishers in this area always try to avoid contact if they meet the perpetrators of electrocution so that physical conflicts between fishers do not occur. With the increasing number of residents, the type of work carried out decreases, causing the number of fishers to increase. Most of the population in the study area had a primary job as a fisherman with decades of experience, so switching to other jobs was not easy. All fishers continued to work as fishers despite facing various environmental pressures.

The economic impact felt by fishers related to environmental pressure is an increase in fishing costs because they have to take or look for other longer routes to get to the fishing area that is usually visited. After all, the expected routes are blocked by the sensitive plant covering the river. As the distance from the fishing base to the fishing ground increases, caught fish handling is also delayed, thereby reducing the quality of the fish and resulting in a lower selling price. The drop in the selling price of fish impacts the income received.

4.3. Structural Model

The model's validity and reliability are crucial in relating the theoretical concept to statistically connected measures. Thus, loading factors and Cronbach's alpha were examined to determine the validity and reliability of the indicators. Table 2 displays that the model had robust convergent validity and internal consistency shown by the values of the loading factors being higher than 0.50 and the Cronbach's alpha values for all variables being higher than 0.60, respectively.

Table 2. Summary of measurement model.

Construct	Items	Loading Factors	Cronbach's alpha
Human Assets	HA1	0.784	0.802
	HA2	0.808	0.712
	HA3	0.712	0.810
	HA4	0.809	0.731
Social Assets	SA1	0.762	0.831
	SA2	0.742	0.759
	SA3	0.736	0.779
	SA4	0.843	0.805
Natural Assets	NA1	0.832	0.861
	NA2	0.801	0.823
	NA3	0.821	0.850
	NA4	0.762	0.872
Physical Assets	PA1	0.705	0.717
	PA2	0.632	0.724
	PA3	0.731	0.801
	PA4	0.691	0.790
Financial Assets	FA1	0.721	0.710
	FA2	0.710	0.704
	FA3	0.719	0.821
Cultural Assets	CA1	0.639	0.721
	CA2	0.605	0.732
	CA3	0.702	0.711
	CA4	0.621	0.760
	CA5	0.632	0.703
	CA6	0.710	0.724

	LR1	0.821	0.814
Livelihood	LR2	0.851	0.864
Resilience	LR3	0.892	0.875
	LR4	0.891	0.892

(Source: own elaboration based on SEM calculation.)

The mean of each variable is presented in Table 3. The mean score of respondents' human assets = 2.03 (out of 5); the respondents for this research are considered in a low level of education, experience, knowledge, and assistance from the authorities. The mean score for social assets = 3.04, which denotes the average societal position, involvement in the association, relationship with the authorities, and participation in a political party. The low mean score for natural assets = 1.98, which indicates that the area of the floodplain fishing sites is limited; respondents mostly do not have their own ponds to fish, floodplain wetlands no longer have a variety of fish, and the number of fish caught has decreased. The mean score for physical assets = 3.08, which shows sufficient access to roads, the proximity of access, fishing site permits, and equipment ownership. The low mean score for financial assets = 2.18, which indicates the high dependency on fishing as a primary income, a scarce opportunity for alternative jobs, and inadequate government donation. The high mean for cultural assets (4.5) explicitly indicates that the community has a high place attachment, indigenous knowledge, learning, agency, institutions, and collective action. Finally, the mean score of livelihood resilience = 3.01, which indicates that the respondents up to this point are still resilient. However, they have a mild concern with food and drinking water safety. Besides fishing, some people farm, some are aware of environmental protection and ecological values, and some have a high sense of belonging and pride in their community and home.

Table 3. Variable mean.

Variables	N	Mean	Std. Error
Human Assets	550	2.03	0.533
Social Assets	550	3.04	0.401
Natural Assets	550	1.98	0.730
Physical Assets	550	3.08	0.413
Financial Assets	550	2.18	0.352
Cultural Assets	550	4.5	0.305
Livelihood Resilience	550	3.01	0.202

(Source: own elaboration based on SEM calculation.)

The complete model indicating the effect of human, social, natural, physical, financial, and cultural assets on livelihood resilience is depicted in Figure 4.

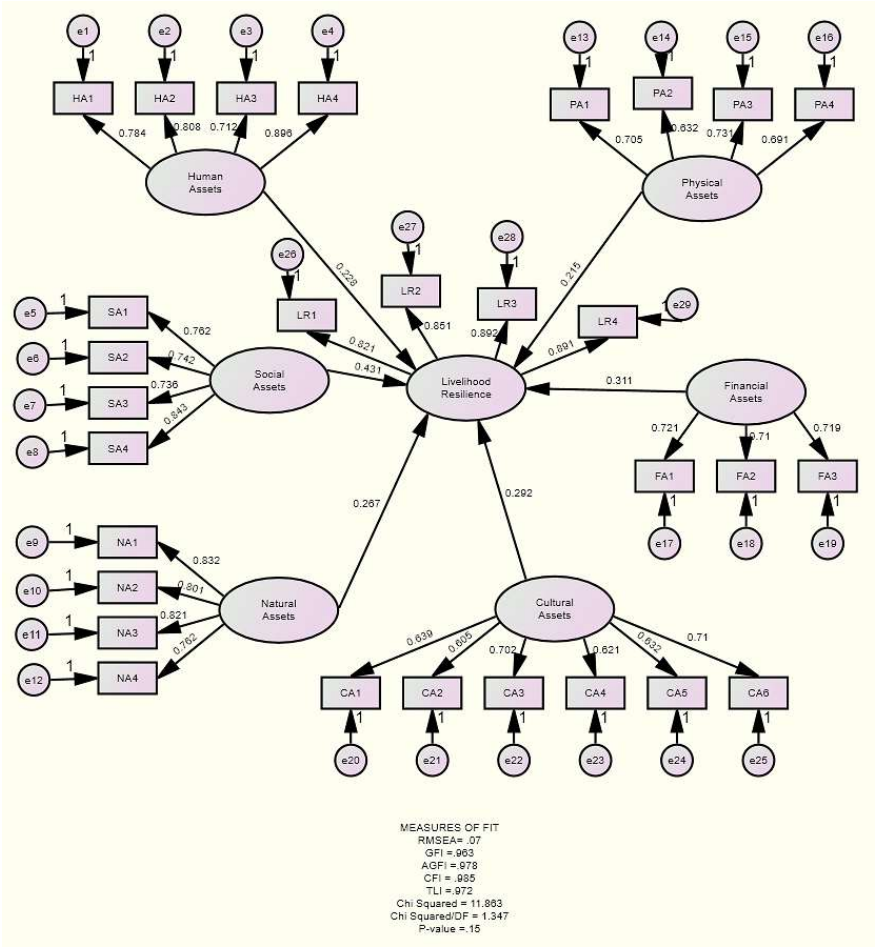

Figure 4. The effect of human, social, natural, physical, financial, and cultural assets on livelihood resilience (source: SEM calculation).

SEM requires a small chi-square statistic ($\chi 2$) value and probability (P) less than 0.05. However, these values are often disregarded because researchers use other measurements to assess the model fit [48].

The threshold of 0.95 for the Tucker–Lewis index (TLI), 0.90 for the norm fit index (NFI), 0.90 for the incremental fit index (IFI), and 0.06 for the root mean square error of approximation (RMSEA) satisfactorily verify the acceptance of a model fit [49]. Other scholars have recommended other goodness-of-fit statistics: a CMIN/DF (the minimum sample discrepancy function) expected value of ≤2.0 [50], GFI (goodness-of-fit index) approaching 0.90, and AGFI (adjusted goodness-of-fit index) close to 0.90 or higher [44]. Thus, examined with these measurements, the model displays accepted robustness: CMIN/DF = 1.347 (<2), AGFI = 0.978 (>0.90), TLI = 0.972 (>0.95), RMSEA = 0.07 (higher than 0.06). The synopsis of structural equation modelling is displayed in Table 4. The table indicates that the entire paths are significantly positive, implying all six hypotheses are accepted.

Table 4. The model summary.

Construct	Estimate	CR	P	Conclusion
Human Assets to Livelihood Resilience	0.228	2.121	0.005	Significant
Social Assets to Livelihood Resilience	0.431	3.620	0.001	Significant
Natural Assets to Livelihood Resilience	0.267	2.176	0.005	Significant
Physical Assets to Livelihood Resilience	0.215	2.103	0.005	Significant

Financial Assets to Livelihood Resilience	0.311	2.981	0.003	Significant
Cultural Assets to Livelihood Resilience	0.292	2.224	0.004	Significant

(Source: own elaboration based on SEM calculation.)

5. Discussion

In the environment context, the study result supports the claim in recent work of particular scholars investigating small-scale fisheries in developing countries [9,10,28,29] that when the environment is contaminated due to reckless human actions, it will fatally affect the livelihood of the community in the surrounding area. Consequently, fishers synergise the various assets/capital (natural, physical, financial, social, human, and cultural) available to them to manage their livelihoods. Natural capital—the living and non-living constituents of ecosystems—is crucial to providing goods and services for people, including water, air, and aquatic sources [20]. The two lakes are natural capital, delivering fish and fish business for livelihoods. The rapid growth of sensitive plants has become a threat, obstructing the fishing business and reducing the viability of fishing. However, it can enhance fishing by creating a concealing place for fish and can become a livelihood source if people can transform them into marketable products.

Physical assets include infrastructures such as vehicles, utensils, and machinery. The disposal of these assets increases productivity and improves people's living standards. Boats, canoes, and working apparatuses called trap, wire stage trap, stage line, and portable lift net are physical capital used by fishers to make fishing sustainable. However, obstruction by sensitive plants hampers their usage, presenting a threat to the fishing business's resilience and sustainability. Moreover, the application of an electric device to paralyse fish implemented by an outsider endangered the business's sustainability. Those intruder fishers make simple electro-appliances operating on car batteries with electric wires dipped into the water. Electric fields produced by these simple tools are uncontrollable and impact fish of all sizes and ages, even those species with no commercial value. Despite laws prohibiting this practice [51], local fishers repeatedly testify that outsider fishers are using this method, confirming that it is commonly practised. A critical constituent of the fishing livelihood is the fishers' expertise, familiarity, and healthiness, which create the human capital/asset [52]. Sensitive plants influence this asset as they function as propagating sites for mosquitoes (malaria) and snails (schistosomiasis). Furthermore, electrical fishing is risky for fishers around the sites as the electrical device used is very rudimentary and hazardous. When fishers are infected with malaria or are electrocuted, their output is affected, for they cannot go fishing during their sickness and healing.

Floodplain wetland fishers in this area depend upon financial assets/capital, including cash, savings, and credit, to obtain physical assets to run their activities. The environmental pressure decreases the number of fish being caught. This disturbs both fishermen and fish sellers depending on the fishermen for selling commodities. The yield drop shrinks the financial assets/capital of the fishers. This reduction impacts their capability to secure the physical assets needed for their livelihoods. Strategies embraced to handle financial problems to reduce the reliance on natural assets include treating the fish to create alternative products with better commercial value, such as dried/salted fish and fish fillets traded as ingredients in crackers. However, due to the tiny scale of the economy, this strategy was trivial and could not satisfy the fishermen's basic needs. Previous studies on different types of fishing in Indonesia, e.g., marine fishers [53], river fishers [54], and lake fishers [55], portrayed similar results.

Community vulnerability is mostly high during changes in the water conditions of rivers/lakes. For fishers, seasonal changes mean changes in productivity, implying income reductions. When the water conditions are favourable, fish with high demand in the market will be plentiful and vice versa. Furthermore, switching occupations is not an alternative due to lacking knowledge and information outside the fishery realm.

Since social asset/capital refers to the capacity of fishers to capture advantages within social structures, community involvement theoretically presents numerous benefits to local communities. This proposition has been a sine quo non for most international donor organisations to support natural resource management projects [20]. Since rural farming communities in Indonesia have positive characteristics, including kinship, cooperation, solidarity, and mutual trust among neighbours, social capital can be used in empowering programs and improving community welfare with the support of transformative leadership and mentoring [55]. Two approaches are available in community involvement: Community-based management (CBM) and co-management [56]. CBM is community-directed resource management where the local societies are responsible for deciding the best governance model for them—implementing CBM shifts river resource management in Indonesia from the current government authority to a more considerable community-based source. This paradigm needs a significant adjustment to the organisation structure, laws, and policies to implement the new administration models [57], mainly in power elites and structures embedded in the political system.

As such, CBM is likely less appropriate for the current decentralised river management in Indonesia. Co-management emphasises community-focused resource management with more designs on mutual provisions between the government, the resource users, stakeholders, and the native community as the primary arrangement. Co-management can be a suitable empowerment method for communities just coming into the democratisation process and adjusting to a new social and political atmosphere after three decades of centralised and authoritarian governmental control. Moreover, co-management has been proven effective in managing small-scale fisheries in some developing countries [58]. In another region of Indonesia, co-management has improved technical efficiency and limited stress on small-scale shrimp polyculture farmers [59].

Most fishers are kinfolks that have been fishing across generations and retain far-reaching local ecological familiarity. One fisherwoman said she would not need any direction for she has been fishing since she was a child and knows every traditional fishing facet. Traditional knowledge must then be considered in socialising agendas. If not, such plans might be perceived to underestimate fishers' cultural familiarity and respond negatively. Moreover, solid links to the homeland retained by many indigenous fishers generate distinctive insights for understanding and reacting to environmental change. Rural people of South Kalimantan are recognised by a unique river culture different from an agrarian or inland culture with a strong responsiveness to land ownership. The river is not just a water source but also a life orientation and identity as many daily activities are carried out in the river, ranging from bathing, washing, fishing, trading, and providing transportation routes to children's playgrounds [60]. Although urban people seem to have left the river culture, the three river culture products—the floating market, river transportation, and floating houses—are still maintained today by the local government as tourist attractions. Therefore, anglers were confident that their familiarity, abilities, beliefs, norms, and life-long experiences as the product of river culture were beneficial in countering the shocks due to livelihood vulnerabilities. This supports the previous finding on the country that it is diverse geographically and socioeconomically, and that the sustainability efforts to meet basic needs are strongly influenced by social and cultural values [55].

To sum up, various capital practices interrelate to produce goods and services. For fishers in this rural area of Indonesia, the amount of fish captured rests on several assets/capital, including the obtainability of fish stocks (natural capital) that, in turn, is contingent upon habitat quality (natural capital). Moreover, fish capture is also affected by mechanised and monetary sources such as vessels, the dexterities and familiarity of fishers (human capital), and fisheries management (social capital). The analysis in the respective areas indicates that environmental pressures have threatened the use of all of these assets. The environmental damage has reduced the throughput of the fisheries'

business in this rural area. Consequently, it affects fishers' income and threatens the sustainability of people's livelihoods.

Furthermore, the impact of this damage will create the opportunity for more significant agricultural land clearing since the farming sector is an alternative livelihood for the society when the fish catch is declining. Ironically, not much can be done by the government to protect the fishers due to the unfit approach to the fishers' community. For the small-scale fishers in the villages of Danau Bangkau and Danau Panggang, due to their multifaceted immersion not only in the commercial but also in traditional fishing, their involvement in policy making and administration could provide the possibility of an enriched data collection and more extensive consideration, cooperation, and co-management to achieve sustainable goal development in the small-scale fishery.

6. Conclusions

The analysis of floodplain community interventions using the SLA framework in a rural area of a distinctive Indonesian region provides evidence that the livelihoods of the poor are becoming more threatened and that environmental shocks have impacted these communities severely. The household survival strategy of the respondents prominently depends on the availability of natural assets, capital, and expertise, the present economic cycle, and the magnitude of the shocks. However, cultural values have enhanced livelihood resilience. The trigger for alterations may come from outside, but adaptation comes from within through dynamic interaction among the people.

This study is too region-specific, and the developed model may not be a point of reference for wetland fisheries in other parts of the world. However, researchers have noted [61,62] that people must familiarise themselves with regions and communities as social–ecological systems. Here, people rely on interdependency resources and services available in dynamic ecosystems. Consequently, sustainable solutions in this region should require active engagement with the groups of people affected by policy decisions and other stakeholders who must live with and participate in implementing potential solutions. Future studies should be expanded to larger territories of floodplain wetland fisheries in rural Indonesia to ensure the generalizability of the findings.

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