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REGULAR RESEARCH ARTICLE

Livelihood Diversity of Rural Communities Without Legal Access to Forest Resources: The Case of Kerinci Seblat National Park in Bengkulu Province

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ABSTRACT

Kerinci Seblat National Park in Bengkulu, Indonesia, was gazetted by the Indonesian government, and its overlaps with forests occupied by most indigenous communities made their farming activities in the area illegal. People were prohibited from accessing and expanding their farming areas in the national park, threatening their livelihoods. The livelihood diversity index (LDI) and livelihood asset index (LAI) were used to explore the livelihood systems of these communities. This study also examines the effect of livelihood assets on livelihood diversity and analyzes livelihood strategy choices using Giddens' structuration theory. A quantitative survey combined with in-depth interviews was conducted in two villages with different land types: wetlands (rice fields) and drylands (farmlands). This study found that the communities diversified their livelihoods into eight types of livelihood strategies. Almost all livelihood indicators were different, and the differences in livelihood asset indicators affected the LDI. As a process of structuration, communities have diversified their livelihoods into farm (e.g., annual and perennial crops), off-farm (e.g., farm wages), and non-farm (e.g., services and government transfer) activities. Rural households have modified their social and physical structures to secure their livelihoods by optimizing agricultural intensification technologies or by seeking non-agricultural income. Households decide whether to specialize or diversify their livelihoods based on factors such as the area of cultivated land, number of crops cultivated, distance of the farming location from the house, total household income, non-farm income, and reciprocal relationships.

KEYWORDS

Livelihood diversity; Access; Exclusion; Structuration theory; Sustainability; Indigenous people.

1. INTRODUCTION

Several dialectical problems regarding the relationship between forest sustainability and livelihood have been found in the Kerinci Seblat National Park (KSNP) area. The KSNP designation in 1982 overlapped with the customary forests belonging to the Rejang indigenous people. This poses serious problems for the sustainability of the livelihoods of thousands of people living in the area. In this protected area, which covers 1,389,510 ha and stretches across the provinces of West Sumatra, Jambi, Bengkulu, and South Sumatra (Karyadi et al., 2018), communities have often been intimidated by repressive actions by police, soldiers, and forestry police (Jaetuloh et al., 2019). They were prohibited from farming and utilizing forest products in the KSNP area, even though they had worked on this *ulayat* land for generations. Moreover, these communities and local political institutions (*Kutai*) have lost their rights to manage and utilize forest resources, further marginalizing the sociocultural function of forests and blurring the forest area's conception of communal rights.

Designating a region as a protected area can support its biodiversity and ecological sustainability. However, this limits access to natural resources, including agricultural land, timber, and non-timber forest products, because the man-to-land ratio increases

(Ryan et al., 2017). Although the forestry policy in Indonesia has been more responsive to improving welfare issues, in practice, it is not devoid of access and exclusion related problems (Sahide et al., 2020). Forest ecosystem functions, processes, and services should be maintained so that, in the long term, they can positively affect ecosystems and human systems (Ali, 2023) and promote sustainable livelihoods (Harbi et al., 2018). Additionally, political initiatives related to vegetation diversity and people's livelihoods have become critical factors for sustaining forests and people (Sulistiyowati et al., 2023).

The pattern of activities in gaining access to and control over land for communities living in the periphery of forests is limited by state territorialization (Abdulkadir-Sunito et al., 2017). This frequently affects local communities that are excluded from forest resources (Marwoto et al., 2017), such that the natural resources utilized are limited and illegally occupied (Ribot & Peluso, 2003; Ribot, 2017). Designation of conservation areas is usually coercive and accompanied by violence (Hall et al., 2011). The ecological sustainability argument has taken precedence over the argument regarding economic needs, because agricultural expansion by farmers poses a complex challenge in forest management, particularly as the government expands new conservation areas (Sardjo et al., 2022). Based on these arguments, forest conservation policies have failed to positively affect livelihoods (Sadeghi et al., 2023).

Previous studies on village communities near KSNP have revealed the significant effects of its establishment in 1982. The centralized political system under the new order (1966–1998) marginalized indigenous communities as it viewed them as a threat to the state's claim over natural resources (Bettinger, 2015a). In the decentralization era (after 2001), local political contestations made customary rights a political commodity. The central government was concerned that the regional autonomy granted to indigenous communities would legitimize them to continue environmentally damaging extraction activities (Bettinger, 2015b). The livelihood insecurity of communities around KSNP is indicated by population pressure and a decrease in land-carrying capacity owing to a high dependence on agricultural intensification (Widiono et al., 2013), sources of income relying only on the agricultural sector (Sukiyono et al., 2013), and vulnerability to climate change (Anggreani et al., 2018). No study has analyzed livelihood systems in this region using a sustainable livelihood framework.

Departing from previous studies, this study aims to reveal the livelihood systems of village communities around KSNP, which are communities without legal access to forest resources. The livelihood system includes livelihood assets, livelihood strategy types, and the impact of livelihood assets on livelihood diversity. This study also analyzes how people develop their livelihood strategies.

2. THEORETICAL FRAMEWORK

2.1 Sustainable livelihood approach

Perspectives on livelihood systems commonly used today rely on sustainable livelihood approaches (Chambers & Conway, 1991; Ellis, 2000; Scoones, 1998, 2015; Solesbury, 2003). This serves a framework that is generally used when analyzing five types of resources: natural, physical, human, financial, and social capital. These resources, called livelihood assets, are accessed and utilized by local communities through a series of interactions mediated by institutions, organizations, and policies to produce sustainable livelihoods.

Livelihood assets vary among communities and are typically defined using key indicators that align with the study objectives. For instance, Ellis (2000) defined natural capital as natural resources (land, water, and trees) that provide product yields for

human survival. Physical capital encompasses assets created through economic production, such as tools, machines, and land improvements. Human capital is related to education and health, whereas financial capital includes cash stock and access to credit for purchasing goods. Social capital involves participation in social networks and associations that provide livelihood support.

The sustainable livelihood framework offers a model for unpacking the complexity of rural problems. This complexity reflects the dynamics of cross-scale changes and focuses on knowledge, power, values, and political changes at the local, supra-local, and global levels (Scoones, 2009). At the supra-local and global levels, the discussion themes commonly relate to development policies, poverty alleviation, climate change, bureaucracy, capital, and knowledge. At the local level, the frequently studied concepts include diversification, coping strategies, and resilience. It should be emphasized that at the local level, the control and utilization of resources is not an empty space without the interests of the parties at a higher level (Bebbington & Batterbury, 2001).

Rural natural resources underlie the development of agricultural activities as a primary livelihood strategy. However, beyond that, the framework also proposes the inevitability of diversification of income sources and of migration tendencies due to the limitations of the agricultural sector in supporting the population at an adequate level of welfare (Dharmawan, 2001; Ellis, 1993, 1998, 2000; Scoones, 2015). This concept is proposed as a premise that reveals the phenomenon of the survival of rural communities or strategies to accumulate livelihood assets by increasing off-farm and non-farm sector incomes. Sustainable livelihood emphasizes the outcomes of livelihood activities, including the following: increasing income; addressing seasonality, adaptation, and resilience; reducing poverty and vulnerability; and sustainability of natural resources (Ellis, 2000; Scoones, 2015).

2.2 Structuration theory

Rural household livelihood activities are social acts that must be understood both dialectically and across time and space. In addition to livelihood strategies that rely on agriculture, they face other choices for survival (Ellis 2000; Scoones 2015). Every choice has a consequence for household survival. This is complicated because it involves motives and a type of consciousness that may be planned, although most are coercive (Dharmawan, 2001). The dynamics of this social action can be analyzed from the perspective of structuration theory.

Structuration theory posits that action and structure are forms of duality (Giddens, 1984; Sewell, 1992). The concept of structural duality provides the sense that action is tied to structure and that structure is also tied to action. Sibeon (2004) called this *agency-in-structure and structure-in-agency*. Therefore, actors and society are inseparable and interdependent for the sake of their existence.

Structures that were previously understood as outside the actor and coercive by Giddens transformed into something inherent within the actor, reproduced, and simultaneously, as a mediator for the course of action (Sewell, 1992). Structure can only be understood in social practice; that is, the set of actions that are built through consciousness and become the constitution of a particular social system (Giddens, 1984).

Social practices are formed through the recursive and reflexive relationships between agents (actors) and structures. How a structure is formed through action, and vice versa, affects action only when that action takes place. Therefore, structure, in addition to being constraining (material, sanction, and structural barriers), is also enabling (Giddens, 1984). Structure is "enabling" because it provides a mechanism for how actors perform actions. The structure consists of rules and resources involved in

the reproduction of a social system; this can be physical or social (Kinseng, 2017; Mouzelis, 2008).

Actors have a transformative capacity, called agency, to change structures by harnessing allocative and authoritative resources. Allocative resources are material resources that reflect human domination of nature, whereas authoritative resources are non-material resources derived from the ability to dominate actors over others (Giddens, 1984).

3. MATERIAL AND METHOD

3.1 Study area

KSNP is located on Sumatra Island, one of Indonesia's western regions, and extends from the Provinces of West Sumatra, Jambi, Bengkulu to South Sumatra (1°7'13"–3°26'14" South Latitude and 100°31'18"–102°44'1" East Longitude). It has high biodiversity and precious tropical forest ecosystems (Anwar et al., 2023). As one of the world's heritage tropical forests, KSNP is home to various endemic species of flora and fauna, including Sumatran tigers (*Panthera tigris sumatrae*) and the giant corpse flower (*Rafflesia arnoldii*) (Karyadi et al., 2018; Linkie et al., 2006, 2015; Supriatna, 2014; UNESCO, 2023).

This national park was established by the Indonesian government in through a decree of the Minister of Agriculture Number 736/Mentan/X/1982 concerning prospective KSNP areas. The KSNP combined 17 forest groups of protected areas during the Dutch colonial period, namely the *testomix* register during 1921–1926 and nature reserves and wildlife reserves established during 1978–1981 (Supriatna, 2014). In 1982, this area covered 1,424,650 ha and underwent several revisions after the government reassessed it and included production forest areas. It was 1,389,510 ha in 2007 based on the Decree of the Director General of PHKA Number 07/IV-KK/2007 concerning the Determination of National Park Zoning (Karyadi et al., 2018).

This study was conducted in Lebong Regency, which had 98,404.1 ha in the KSNP area. Lebong, a regency in the Province of Bengkulu, where 25.08% of the KSNP area is located, has an area of 192,182 ha. Its administrative area is divided into 12 sub-districts, 11 municipalities, and 93 villages. The 57 villages and municipalities were located at the periphery or within the forest areas. Lebong Regency consists mostly of state forest (118,887 ha [61.86%]), divided into 51.20% national parks (KSNP), 9.14% protected forests (Bukit Daun and Rimbo Pengadang), 1.42% nature parks (Danau Tes), 0.08% nature reserves (Danau Menghijau), and 0.02% production forests (Air Ketahun). Thus, only 38.14% of the total area can be used as a production area for the 107,248 population in 2022 (BPS-Lebong Statistic, 2023).

There are two types of agroecosystems: wetlands and drylands, where most Lebong people work as farmers. The altitude of the region consists of 7.76% < 500 m a. s.l., 58.80% 500–1000 m a. s.l., and 33.44% 1000–1,500 m a. s.l., and the topography consists of mountains, hills, undulations, and plains. The average temperature was 28,70 °C/month and rainfall was 381.20 mm in 2022 (BPS-Lebong Statistic, 2023). A relatively large area of paddy farming was formed on the plain where the river flows. The hills and undulating topography generally facilitated dry farming activities, with coffee as the primary commodity.

Two villages with different agroecosystem characteristics were selected as the study areas. Embong I Village, Uram Jaya Subdistrict, was chosen as a village with dominant wetland agroecosystem characteristics, and Suka Negeri Village, Topos Subdistrict, was chosen as a village representing drylands (Figure 1). The Embong I area covers 111 ha with a population of 408, whereas Suka Negeri spans 73 ha with a

population of 1,703. Both locations are villages directly adjacent to the KSNP and have indigenous Rejang communities that enforce customary norms through *Kutai* customary institutions, representing the patrilineal kinship groups in Rejang. However, the market and modern technology have long influenced these villages. Embong I is surrounded by the circular flow of the Uram River and is located in the foothills of Demong Samin. Suka Negeri is positioned in the upstream along the Ketahun River and is bordered by three hills: Pedinding to the west, Lekenei to the east, and Ba'au to the north. These hills were recognized as traditional forest areas long before the establishment of KSNP.

Regarding location affordability, Embong I Village is closer to Tubei, the capital of the Lebong Regency (± 12.5 km), than Suka Negeri Village (± 60.5 km). However, Embong I is further from Curup, a center of economic activity city, than Suka Negeri. The economic activities of the residents of Embong I were supported by rice farming and aquaculture activities in the rice plots after harvest. The rice fields cover an area of approximately 90 ha. The agrarian economy of the people of Suka Negeri is mainly supported by coffee and several other cash crops (approximately 30 ha). Not all farmers in the two villages farmed in their villages. Many also worked on farms in other villages.

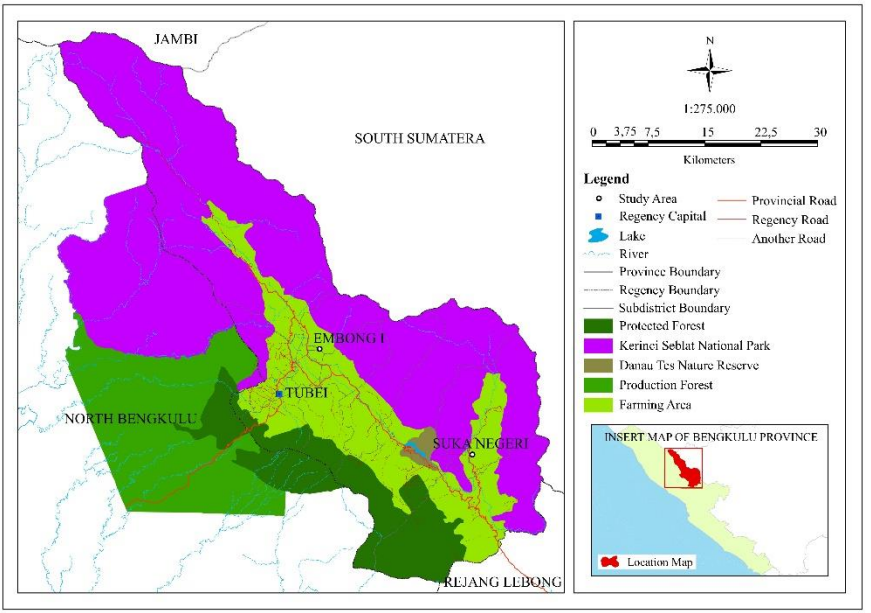


Figure 1. Study area map

3.2 Data collection

Quantitative data were collected through household surveys in each village, by randomly selecting several respondents using cluster sampling techniques. The population of Embong I Village comprises 167 households clustered in Hamlet I (67), Hamlet II (43), and Hamlet III (57). In Suka Negeri Village, the population lives in 499 households, of which 122, 194, and 183 households live in Hamlet I, Hamlet II, and Hamlet III, respectively. By applying the Slovin formula (Ryan, 2013), with a sampling error of 5%, and then choosing proportionally for each hamlet, respondents obtained in Embong I Village as many as 63 households consisting of Hamlet I, II, and III clusters as many as 25, 16, and 22, respectively. Similarly, respondents were obtained from 83

households in Suka Negeri Village: 20, 32, and 31 from hamlets I, II, and III, respectively. Table 1 presents the respondents' profiles.

Data were collected through structured face-to-face interviews with each respondent from November to December, 2022. A questionnaire was used to collect data on the respondents' profiles, household income, and types of livelihood assets (natural, physical, human, financial, and social capital). The study also collected qualitative data regarding conflict, shared norms, and agency through in-depth interviews with ten key informants representing village heads, customary leaders, farmer leaders, and people involved in conflicts with KSNP officers in the past.

Table 1. Socio-demographic profile of respondents

Characteristic	Embong I	Suka Negeri
Number of respondents	63	83
Age (mean ± stdev; years)	50.7 ± 11.6	46.1 ± 10.8
Gender:		
- Male	53 (84.1%)	80 (96.4%)
- Female	10 (15.9%)	3 (3.6%)
Education:		
- No school	1 (1.6%)	3 (3.6%)
- Primary and secondary school	32 (50.8%)	41 (49.4%)
- Senior high school	30 (47.6%)	37 (44.6%)
- University	0 (0%)	2 (2.4%)
Marriage status:		
- Married	50 (79.4%)	76 (91.6%)
- Widow	9 (14.3%)	3 (3.6%)
- Widower	4 (6.3%)	2 (2.4%)
- No marry	0 (0%)	2 (2.4%)
Family size (mean ± stdev)	3.4 ± 1.3	3.2 ± 0.9

Source: Primary data (2022)

3.3 Data analysis

3.3.1 Clustering livelihood strategy

The grouping of livelihood strategy types used a framework based on Ellis (2000), in which the types were determined based on the proportion of household income. Seven sources of household income were identified: annual crops, perennial crops, fisheries, livestock, farming wages, nonfarming activities, and government transfers. To describe the diversity of livelihoods, the criterion for the proportion of annual income from each household source was at least 75%. For example, the proportion of income from annual crops ≥ 75% is called *principally annual crop*, or the proportion of income from perennial crops and non-farms ≥ 75% is called the *perennial and non-farm mix*. Furthermore, the Mann-Whitney U test was used to compare the household incomes of the two villages. To test whether there were differences between the types of livelihood strategies, a one-way analysis of variance (ANOVA) was used. If ANOVA indicated a significant difference, Tukey's test was performed to determine which types were different. All statistical tests were performed at a significance level (α) of 0.05.

3.3.2 Livelihood asset index

By adopting the Life Expectancy Index calculation method (UNDP, 2007), raw data on livelihood assets were standardized, considering the maximum and minimum values of each indicator. The outcomes of this standardization were transformed into an index with values ranging between 0 and 1. This index applies to natural, physical, human, financial, and social capital. The Livelihood Asset Index formula is as follows:

$$LAIx = \sum_{i=1}^{n} \frac{A_i - A_{i_{min}}}{A_{i_{max}} - A_{i_{min}}}, \quad (1)$$

where *LAIx* is an index for livelihood-x assets, A_i indicates the value of the *i-th* indicator, $A_{i_{max}}$ and $A_{i_{min}}$ is the maximum/minimum value of the *i-th* indicator in both villages, and *n* is the number of indicators.

Then, each indicator was compared in both villages using the Mann-Whitney U test, and the obtained index was compared among livelihood types using One-way ANOVA. If the ANOVA indicated a significant difference, Tukey's test was performed to determine which types were different. All statistical tests were performed at a significance level (α) of 0.05.

3.3.3 Livelihood Diversity Index (LDI)

This index represents the diversity of household income by adapting the Shannon diversity index, which is commonly used to calculate the number and evenness of species in an ecosystem (Ortiz-Burgos, 2016). The higher the Shannon diversity index, the more diverse are the species in the ecosystem.

The LDI method measures diversity based on the number and proportion of income sources considered. We adopted a diversity term for multiple income sources, including net income from on-farm, off-farm, and non-farm activities (Minot et al., 2006). Unsold agricultural products were converted into economic value. The formula for the index is as follows:

$$\text{LDI} = -\sum_{i=1}^{n} p_i \ln p_i, \quad (2)$$

where LDI is Livelihood Diversity Index; *pi* is the proportion of household income to *i-th*; and *n* is the number of household income sources. The LDI values ranged from 0 to ln (n). The maximum LDI is achieved if all sources of income have equal proportions, and the minimum is achieved if a single source of income exists.

3.3.4 The effect of livelihood assets on livelihood diversity

The multiple regression analysis was used to examine the effect of livelihood assets on livelihood diversity, using the following equation:

$$Y = \beta_0 + \sum_{i}^{n} \beta_i X_i + \varepsilon, \quad (3)$$

where *Y* is the livelihood diversity index, the dependent variable. *i* is an indicator of household livelihood assets, *n* is the number of indicators, *Xi* refers to the independent variables, which include indicators related to the household's livelihood capital, βi is the regression coefficient for *Xi*, $\beta 0$ is the intercept, and ε is the error of the model.

3.3.5 The Livelihood strategy choices analysis

To analyze how households determine their livelihood strategies, a qualitative descriptive analysis was conducted using the Giddens structuration theory framework (Giddens, 1984). In this analysis, the role of households (actors) in securing their livelihoods is elaborated as well as the role of structures that constitute access to livelihood assets.

4. RESULTS

4.1 Clustering livelihood strategy

Based on the survey, household income in Embong I in 2022 was dominated by annual crop farming activity, especially rice (46.8%), whereas in Suka Negeri, it was dominated by perennial crops, especially coffee (75.0%). Other sizable proportions of income in Embong I included other services (15.4%), government transfers (15.3%), and

perennial crops (12.0%). Other sources of income in Suka Negeri were relatively small (less than 10.0%). This shows that the sources of livelihood in Embong I were more diverse than those in Suka Negeri (Figure 2).

Income from annual crop farming included rice, chili, corn, long beans, tomatoes, kale, spinach, and cayenne pepper farming. Perennial crops included coffee, rubber, bitter beans, stink bean, durian, coconut, orange, papaya, *melinjo*, cinnamon, areca nut, ginger, and cardamom farming. Rice and coffee farming are intensively cultivated, whereas other commodities are side businesses planted as mixed farms on coffee plantations.

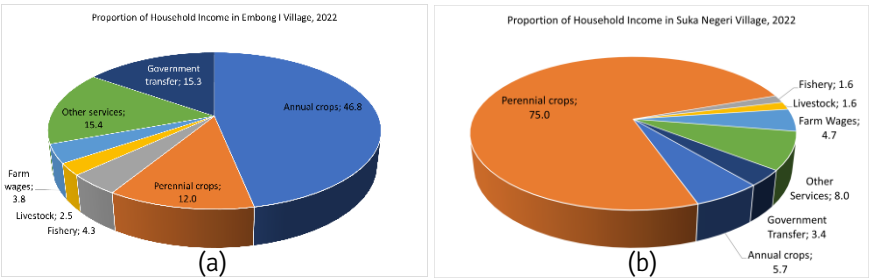


Figure 2. Proportion of household income in Embong I (a) and Suka Negeri (b)

Generally, fisheries and livestock are used as additional income sources. Several households in Embong I cultivate carp in pond plots. Ponds for fishing were established in rice fields, after the farmers harvested their rice, until the next year's planting season. Fishing activities are carried out in the rivers around their villages, namely, the Uram and Ketahun Rivers. Livestock activity is carried out in limited ways, such as in the ruminants of goats, cattle, and poultry such as chickens and ducks. Duck farming in Embong utilizes the rice fields.

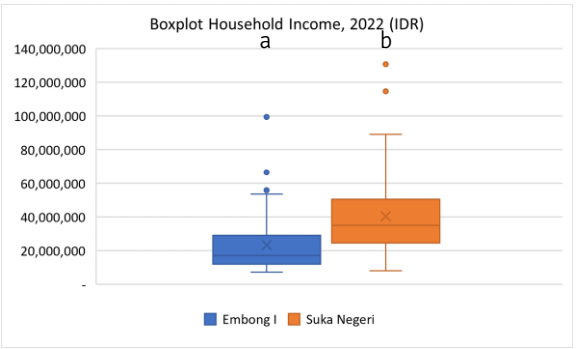


Figure 3. Boxplot presents a comparison of total household income distribution
(Note: The lower-case letters below the whisker in Figure 3 are the results of the Mann-Whitney U test, where different letters show significant differences at $\alpha = 0.05$.)

Non-farm activities include small-scale businesses, construction labor, vehicle repair shop services, and other services. Agricultural wages are received as cash and crop products from other farms. On a limited basis, some households receive remittances from family members working in the city and salaries from village officials. Government transfers are calculated from the social assistance households receive through social protection programs, including the Indonesian Conditional Cash Transfer Program, Non-Cash Food Assistance, Village Fund Cash Transfer Program, and

Smart Indonesia Program.

Figure 3 shows that the average household income in Suka Negeri (IDR 40,454,386) was higher than that in Embong I Village (IDR 23,370,913). This difference was statistically significant based on the Mann-Whitney U test (p = 0.000).

Six livelihood strategies were identified in Embong I Village and five in Suka Negeri Village (Table 2). The agricultural sector dominates the livelihood strategies of both villages. However, Embong I tended to be more diverse in terms of income than Suka Negeri. Only 6.3% of households were categorized as principally annual crops in Embong I, whereas the rest applied a mixed strategy: annual and perennial crops (23.8%), annual crops and government transfers (23.8%), annual crops and non-farms (25.4%), and other mixes (19.0%).

Suka Negeri had limited livelihood diversity. This evidence was shown in the findings of a few households that combined sources of income: the annual and perennial crop mix (15.7%), the perennial crop and non-farm mix (20.5%), the perennial crop and government transfer mix (1.2%), and other mixes (7.2%). Most households (55.4%) cultivated perennial crops.

Based on One-way ANOVA, the average total income of all types in Embong I was significantly different (p = 0.000). However, after a post-hoc Tukey's test ($\alpha = 0.05$), only the types of annual crops and non-farms, other mixes, and annual crops and government transfers differed significantly (Figure 4). In Suka Negeri, the average total income of all types did not differ significantly (p = 0.492).

Tabel 2. Household livelihood strategy and average income per household in Embong I and Suka Negeri Village

Livelihood Strategy	Criteria	Embong I		Suka Negeri	
		Households	Income (IDR)	Households	Income (IDR)
Principally annual crop (Type 1)	Income proportion of annual crop ≥ 75%	4 (6.3)	16,217,500	–	–
Principally perennial crop (Type 2)	Income proportion of perennial crop ≥ 75%	–	–	46 (55.4)	43,599,630
Annual and perennial crop (Type 3)	Income proportion of annual crop & perennial crop ≥ 75% but each ≤ 75%	15 (23.8)	24,020,900	13 (15.7)	39.427,000
Annual crop and government transfer mix (Type 4)	Income proportion of annual crop & government transfer ≥ 75% but each ≤ 75%	15 (23.8)	11,472,600	1 (1.2)	8,050,000
Annual crop and non-farm mix (Type 5)	Income proportion of annual crop & non-farms ≥ 75% but each ≤ 75%	16 (25.4)	37,196,625	–	–
Perennial	Income	–	–	17	38,968,765

Livelihood Strategy	Criteria	Embong I		Suka Negeri	
		Households	Income (IDR)	Households	Income (IDR)
crop and non-farm mix (Type 6)	proportion from perennial crop & non-farms ≥ 75% but each ≤ 75%			(20.5)	
Principally non-farm (Type 7)	Income proportion of non-farm ≥ 75%	1 (1.6)	44,185,000	-	-
Another mix (Type 8)	Income proportion of more than 2 income sources ≥ 75%, i.e annual crops, fishery, livestock, and non-farm	12 (19.0)	19,647,000	6 (7.2)	28,176,833
All		63 (100)	23,370,913[a]	83 (100)	40,454,386[b]

Notes: Numbers in brackets indicate percentages. Superscript letters a and b indicate significant differences at $\alpha = 0.05$.

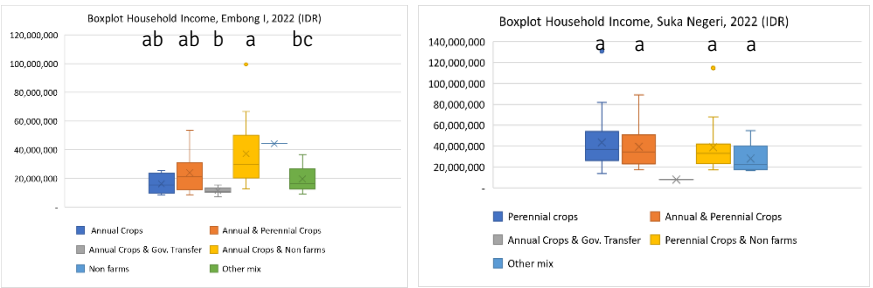


Figure 4. Boxplot of total household income by type of livelihood strategy
(Note: The lower-case letter above the whisker is the result of the Tukey test, where different letters show a significant difference at $\alpha = 0.05$. The principally non-farm type in Embong I and the annual crop & government transfer mix type in Suka Negeri were not statistically tested because there was only one respondent)

4.2 Livelihood asset and diversity

Embong I's natural capital indicators were relatively lower than those of Suka Negeri for cultivated land and number of cultivated plant types (Table 3). Embong I's physical capital indicators—the number of manual equipment types and conditions of farming roads—were higher than those of Suka Negeri; however, the number of machinery equipment, house floors, and distance to the cultivated area were lower.

Table 3. Household indicators of livelihood assets in Embong I and Suka Negeri

Livelihood Assets	Indicators	Embong I	Suka Negeri
Natural Capital	Cultivated land (ha)	0.94[a]	2.16[b]
	Number of plants cultivated (n)	2.63[a]	3.57[b]
Physical Capital	Number of manual equipment (n)	5.49[a]	3.40[b]
	Number of machinery equipment (n)	0.06[a]	0.59[b]
	House floor (m^2)	89.62[a]	111.38[a]

Livelihood Assets	Indicators	Embong I	Suka Negeri
	Distance to the cultivated area (km)[1)]	1.28[a]	7.50[b]
	Condition of farming road (score)	3.25[a]	1.22[b]
Human Capital	Education level of family head (score)	3.25[a]	3.21[b]
	Percentage of family members with senior high school or above (%)	39.32[a]	48.86[a]
	Number of productive age population (15-64 years)	2.57[a]	2.63[a]
Financial Capital	Total income (IDR)	23,370,913[a]	41,078,238[b]
	Income per capita (IDR)	8,277,634[a]	13,406,506[b]
	Non-farm income (IDR)	6,757,143[a]	4,583,968[b]
Social Capital	Average Give: Receive Ratio[2)]	0.89[a]	1.07[b]
	Reciprocal relationships frequency[3)]	33.41[a]	23.57[b]
	Number of interaction agents (n)[4)]	2.92[a]	3.35[a]

Notes: [1)] This is referring to the distance from their house. [2)] A comparison between the number of aid types given and the number of aid types received by households in the past month. The types of aid are grouped into four: food supplies, caregiving, medical treatment, and specific jobs. [3)] Reciprocal relationships include attendance for the last year at wedding festivities, celebratory events, and funeral services. [4)] Agents consist of customary leaders, village officials, mosque administrators, local merchants, sub-district officials, district officials, journalists, political parties, NGOs, and banks. We asked the respondents, "have he/she interacted with the following agents for the last six months?" The superscript letters in each row are the results of the Mann-Whitney U test, where different letters indicate a significant difference at $\alpha = 0.05$.

The human capital indicator, the family head's education level, was almost identical in both villages. Conversely, the indicator for family members with senior high school education or above is higher in Suka Negeri than in Embong I. All Embong I financial capital indicators—total income, income per capita, and non-farm income—are lower than those of Suka Negeri. The social capital indicators (give:receive ratio and number of interaction agents) in Embong I are lower, whereas reciprocal relationships are higher, than in Suka Negeri.

Standardizing the livelihood asset indicators into an index simplified the analysis. Based on the calculation, the following comparison is obtained: (1) the natural (0.389), financial (0.189) and social (0.275) capital indices in Suka Negeri are higher than in Embong I (0.211; 0.119; 0.238, respectively); (2) the physical capital index in Embong I (0.428) is higher than in Suka Negeri (0.223); and (3) the human capital index of the two villages (0.439; 0.462) is relatively the same (Figure 5).

The index of each livelihood asset is also interesting to analyze. Each type has a different index (Figure 6). Figure 6 shows the typical patterns of livelihood assets for all livelihood strategies. Based on the one-way ANOVA test, the significant differences in indices between the types of livelihood strategies in Embong I were natural, financial, and social capital (Table 4), whereas in Suka Negeri, they were natural and social capital (Table 5). The details of the Tukey's test results for the livelihood asset index are presented in Tables 4 and 5.

In Embong I, the highest natural capital index was owned by households with the annual and perennial mix (0.333), physical and human capital in the annual crops and non-farm mix (0.462; 0.523), financial capital in the principally non-farms (0.341), and social capital in the annual crops and non-farm mix (0.327). In Suka Negeri, the natural capital index was the highest in the annual and perennial crop mix, followed by physical capital in the other mix (0.263), human capital in the perennial crops and non-farm mix (0.530), financial capital in the perennial crops and non-farm mix (0.232), and social capital in the annual and perennial crops mix (0.383).

Households that rely on annual and perennial farming activities tend to have better natural capital. Households that combined non-farming practices tended to have better other capital. Thus, households with varying incomes tended to have better access to livelihood assets. However, households in Embong I that relied on annual crops or combined them with government transfers had a low index. Similarly, in Suka Negeri, households with combined government transfers had the lowest index. This indicates that government transfers are generally considered as a livelihood strategy for households with poor livelihood assets.

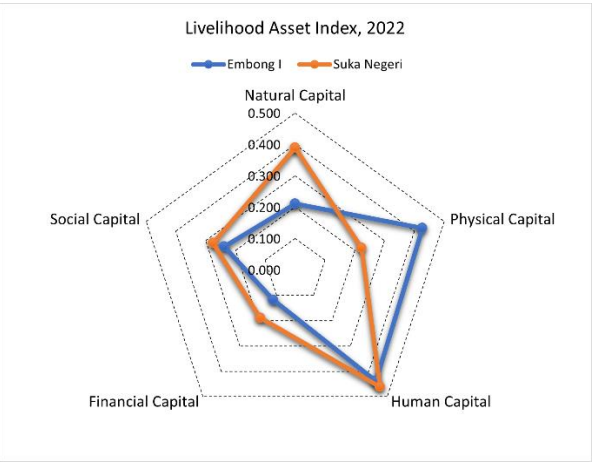
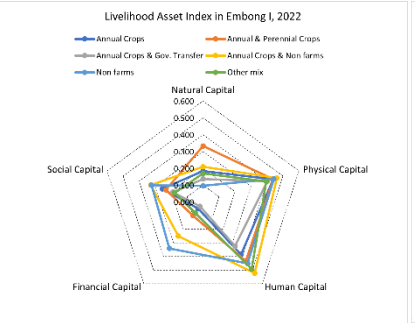


Figure 5. Pentagon of livelihood asset index



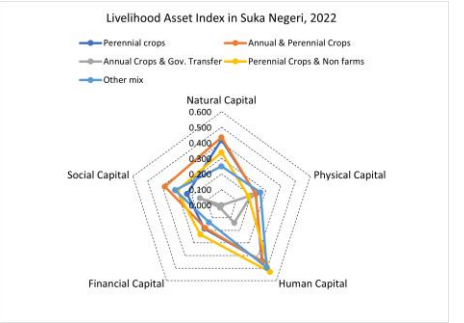


Figure 6. Pentagon livelihood asset index on every type of livelihood strategy

The LDI for Embong I was higher than that of Suka Negeri (LDI Embong I = 1.027; LDI Suka Negeri = 0.612; Table 6). This indicates that the sources of household income in Embong I are more diverse. The highest diversity of livelihoods in Embong I was in the other mix type (LDI = 1,460), followed by the annual and government transfer type (LDI = 1,084), annual crops and non-farm mix (LDI = 1,071), annual and perennial crops mix (LDI = 1,067), and principally non-farm (LDI = 0.765), and the lowest is the principally annual crop type (LDI = 0.729). In Suka Negeri, the highest was the other mix type (LDI = 1.291), followed by the annual and perennial crops mix type (LDI = 0.985), annual crops and government transfer mix (LDI = 0.982), and perennial crops and non-farm mix (LDI = 0.918), and the lowest was the principally perennial crops type (LDI = 0.480). This calculation shows that the mixed type has a higher LDI owing to its larger components and proportions.

Table 4. Livelihood asset index of Embong I households

Livelihood Asset	Principally annual crop	Annual & perennial crop mix	Annual crop & gov. transfer mix	Annual crops & non-farm mix	Principally non-farm	Another mix	Sig.
Natural Capital	0.184^{abcd}	0.333^{a}	0.137^{be}	0.209^{ce}	0.096	0.170^{de}	0.001^{**}
Physical Capital	0.439^{a}	0.440^{a}	0.402^{a}	0.462^{a}	0.443	0.396^{a}	0.323
Human Capital	0.386^{a}	0.434^{a}	0.324^{a}	0.523^{a}	0.451	0.493^{a}	0.093
Financial Capital	0.049^{ab}	0.101^{a}	0.031^{a}	0.250^{b}	0.341	0.080^{a}	0.000^{***}
Social Capital	0.254^{ab}	0.232^{ab}	0.189^{a}	0.327^{b}	0.322	0.177^{a}	0.015^{*}

Notes: ***, **, and * respectively denote the results of the One-Way ANOVA test between groups that are significant at the 0.001, 0.01, and 0.05 levels. The superscript letters in each row are the results of the Tukey's test, where different letters indicate a significant difference at $\alpha = 0.05$. The principally non-farm type was not tested because it was only one respondent.

Tabel 5. Livelihood asset index of Suka Negeri households

Livelihood Asset	Principally perennial crop	Annual & perennial crop mix	Annual crops & gov. transfer mix	Perennial crops & non-farm mix	Another mix	Sig.
Natural Capital	0.421^{a}	0.436^{a}	0.000	0.339^{a}	0.250^{a}	0.038^{*}
Physical Capital	0.231^{a}	0.230^{a}	0.200	0.183^{a}	0.263^{a}	0.250
Human Capital	0.443^{a}	0.450^{a}	0.140	0.530^{a}	0.495^{a}	0.382
Financial Capital	0.187^{a}	0.180^{a}	0.018	0.232^{a}	0.136^{a}	0.409
Social Capital	0.233^{a}	0.383^{b}	0.146	0.301^{ab}	0.314^{ab}	0.005^{**}

Notes: **and *, respectively, indicate that the results of the One-Way ANOVA test between groups are significant at the 0.01 and 0.05 levels. The superscript letters in each row are the results of the Tukey's test, where different letters indicate a significant difference at $\alpha = 0.05$. The annual crop & gov. transfer mix type was not tested because it was only one respondent.

Table 6. Livelihood diversity indices among livelihood strategy types

Livelihood Strategy Type	LDI Embong I	LDI Suka Negeri
Principally annual crop	0.729	-
Principally perennial crop	-	0.480
Annual and perennial crop mix	1.067	0.985
Annual crop and government transfer mix	1.084	0.982
Annual crop and non-farm mix	1.071	-
Perennial crop and non-farm mix	-	0.918
Principally non-farm	0.765	-
Another mix	1.460	1.291
All	1.027	0.612

Note: We calculated LDI from seven sources of income: annual crop, perennial crop, fishery, livestock, farm labor, non-farm, and government transfer. The maximum value is ln (7) = 1.946, thus LDI ranges from 0 to 1.946.

4.3 The effect of livelihood asset on livelihood diversity index

The regression analysis (Table 7) shows that the indicators of livelihood assets significantly affect the LDI in both villages (F-value Embong I = 2.044; F-value Suka Negeri = 4.306). The variables of cultivated land, number of plants cultivated, non-farm income, and frequency of reciprocal relationships were significantly affected by LDI Embong I. In Suka Negeri, the LDI is affected by the distance to cultivated land, total income, and non-farm income.

This regression analysis proves that two natural capital indicators, one financial capital indicator, and one social capital indicator significantly affect the LDI in Embong I. Cultivated land and non-farm income indicators have a negative effect, meaning that the greater the cultivated land and non-farm income, the smaller the LDI. However, the

number of plants cultivated had a positive effect, meaning that the more plants cultivated, the more diverse the livelihood. One physical capital indicator and two financial capital indicators have significant effects on LDI Suka Negeri. Distance to cultivated areas and total income indicators were negatively affected, whereas nonfarm income was positively affected.

Table 7. Regression analysis output of the influence livelihood asset indicators on livelihood diversity index.

Variables	Embong I			Suka Negeri		
	Coefficient	t-value	Sig.	Coefficient	t-value	Sig.
Constant	0.686*	3	0	0	0	1
Cultivated land	-0.183**	(3)	0	(0)	(1)	0
Number of plants cultivated	0.105**	3	0	(0)	(0)	1
Number of manual equipment	(0)	(1)	1	0	3	0
Number of machinery equipment	(0)	(1)	0	(0)	(0)	1
House floor	(0)	(1)	1	0	1	0
Distance to cultivated area	(0)	(0)	1	-0.020***	(4)	-
Condition of farming road	(0)	(0)	1	0	0	1
The education level of the family head	0	1	0	0	2	0
Percentage of family members with senior high school or above (%)	(0)	(1)	0	(0)	(1)	0
Number of productive age population	0	2	0	0	1	0
Total income	0	1	0	-6.338E-009*	(2)	0
Income per capita	0	0	1	0	1	0
Non-farms income	-1.263E-008*	(2)	0	9.895E-009*	2	0
Average Receive: Give Ratio	(0)	(1)	1	(0)	(0)	1
Reciprocal relationships frequency	0.005*	2	0	0	1	1
Number of interaction agents	(0)	(2)	0	0	1	1
F-value	2.044*		0	4.306***		-
R Square	0			1		

Notes: ***, **, and * respectively denote the regression analysis results that are significant at the 0.001, 0.01, and 0.05 levels.

5. DISCUSSION

5.1 Livelihood system based on land type

Rural households tend not to rely on just one income source but look for different ways to secure their livelihoods. Limited access to land resources in villages around KSNP was the main determining factor for this diversity. However, this is not necessarily because it is still determined by the condition of the livelihood resources accessible to households, where the choice to diversify is determined by how much access they have to natural, physical, human, financial, and social capital (Figures 5 and 6). This study

found eight types of livelihood strategies: annual crop, principally perennial crop, annual and perennial crop mix, annual crop and government transfer mix, annual crop and nonfarm mix, perennial crop and nonfarm mix, principally nonfarm mix, and other mixes (Table 2).

There was a relationship between income level and livelihood diversity in both locations: Embong I (wetland type) and Suka Negeri (dryland type). Although income in Embong I is lower than in Suka Negeri (Table 2), livelihood diversity is higher (Table 6). Conversely, in Suka Negeri, income is higher, but diversity is lower than in Embong I (LDI Embong I = 1.027, LDI Suka Negeri = 0.612). The in-depth interviews also revealed the significant role of rural merchants, called *toke* in securing the finances and everyday needs of farmers. Toke is not only a trader, but also a moneylender for farmers. This finding indicates that livelihood diversity does not necessarily affect income level. This phenomenon is more accurately interpreted as a symptom of survival strategies due to limited access to natural capital. Diversifying household income is aimed to reduce vulnerability and risk (Jalal et al., 2021; Maru et al., 2021).

Suka Negeri households relied heavily on perennial farming, especially for coffee. Embong I began to diversify by conducting non-agricultural activities (Figure 2). Prominent non-agricultural activities included small-scale trading of household goods, construction labor, vehicle repair, and electrical installation services. The limited level of digital communication tools such as smartphones played a role in marketing the results of vegetable farming, fisheries, and small-scale food businesses. Uniquely, the choice to diversify livelihoods in Suka Negeri did not generate a significant difference in the total income. However, the choices of annual crop and non-farm mix, other mixes, and annual crop and government transfer mix types in Embong I were significantly different (Figure 4).

The regression analysis (Table 6) confirms that non-farm income, number of plants cultivated, and reciprocal relationship frequency positively affected LDI, whereas cultivated land negatively affected LDI, in Embong I. In Suka Negeri, distance to the cultivated area and total income negatively affected LDI, whereas non-farm income positively affected LDI. The indicators of non-farm income and total income that affect LDI are the same as those used in research on agro-pastoral villages in China (Liu et al., 2020). The increase in nonfarm income in Embong will decrease the LDI, whereas in Suka Negeri, it will increase the LDI. This indicates that Embong I households are becoming non-farm households, or there is an increasing erosion of agriculture-based activities. Conversely, in Suka Negeri, because coffee farming activities are dominant, there are patterns of increasing diversity in non-farming activities. However, this degree of influence was minimal, with a coefficient close to zero.

The land area in Suka Negeri had no significant effect on the LDI, whereas in Embong I, it had a negative effect. This indicates that the limited land in Embong I has the opportunity to increase the role of non-agricultural sources of livelihood, while there is no significant land limitation problem in Suka Negeri. The average land area in Embong I was smaller (0.96 ha) than that in Suka Negeri (2.16 ha) (Table 2). Smaller land ownership in Embong I is possible because rice field farming can be intensively conducted in areas below 1 ha. Farmers use superior seeds with productivity above 5 tons/ha, which is profitable. However, the intensification of paddy fields remained low because the planting index had only reached 100, indicating that farmers planted only once a year. In addition to non-farming activities, livelihood diversity can be achieved by increasing the types of agricultural activities such as farming other than rice (the positive influence of the number of cultivated plants in the regression analysis).

The distance to cultivated land is large in Suka Negeri, causing this factor to

negatively affect livelihood diversity. This implies that households whose land is far from their homes are less likely to diversify their income sources. The remote location near KSNP, with an average of 7.50 km (Table 3), causes farmers to stay overnight in their farming areas, varying from seven days to one month, especially when caring for and harvesting coffee. A negative effect was also observed for total income. With a minimal level of influence, the total income of households that tend to specialize in coffee farming is higher.

The significance of social capital can be seen in the reciprocal relationship frequency indicator in Embong I, which has a positive effect on LDI. Social networks expand the information, knowledge, and relationships of rural households regarding farming activities and opportunities to work in the non-farm sector (Baird & Gray, 2014).

This study reinforces previous findings that livelihood diversity is a universal phenomenon in achieving sustainable livelihoods (Ellis, 2000; Liu et al., 2020; Mao et al., 2020; Minot et al., 2006; Scoones, 2015). Given the limiting factor of access to forest resources, diversifying livelihoods is one way to achieve sustainable livelihoods. Rural households avoid poverty and achieve prosperity depending on their livelihood base (Deng et al., 2020). This choice is primarily determined by household access to the five types of livelihood assets (Peng et al., 2022). In addition, for communities that rely on marginal farming, the survival capacity depends on diversifying sources of income and their ability to utilize social capital during the crisis (Meert et al., 2005).

5.2 Livelihood diversity as a strategy choice through structuration process

The choice to diversify or specialize in a single source of income is a dynamic relationship between various factors that, in Giddens' structuration theory, is described as structural and agent dynamics (Giddens, 1984; Jones & Karsten, 2008). In this study, structure includes access to resources such as natural, physical, human, financial, and social capital. Agents are rural households that must make strategic decisions to secure their livelihoods.

The structuration process is as follows: First, farmers operate in the context of a social structure that includes norms, values, beliefs, and rules passed down by previous generations. For example, the belief that planting rice only once a year and growing crops in rice fields or farmland by clearing forests are manifestations of gratitude to God. Most farmers in both study areas believe that if they plant paddies outside the month of the Rabiul Awwal (the 3rd month of the Hijri calendar), they will experience crop failure due to rodent predation. They also conducted ceremonies when clearing farmland, planting, and harvesting, led by religious leaders, and attended by their neighbors to prayer. In addition to the spiritual values inherent in farming activities, there are social values such as togetherness and mutual sharing, which manifest in labor exchanges. Therefore, the choice to live in harmony with nature and communality is sufficient to support people's lives. They were part of the social structure that guided farmer actions and were formed long ago, although today their embeddedness features have changed.

Second, state restrictions regarding the determination of forest areas (KSNP) over traditional forests made it impossible to legally use forests as a livelihood base. After officers from KSNP installed forest area boundary pegs in 1991, farmers were prohibited from engaging in farming activities despite continuing to farm in their traditional forest or *ulayat* land, such as in Demong Samin Hill for the Embong I community, and Pematang Ampelas and Pedinding and Ba'au hills for the Suka Negeri community. Many forest resources initially used by farmers, such as wood to build houses, flora and fauna directly consumed by the community for food, and the clearing of forests for agricultural land, were legally inaccessible.

Some farmers secretly cleared forests for agricultural land in the KSNP area. However, several cases of arrests and convictions among those who engage in such activities within forest areas led them to have negative experiences of trying to violate state regulations. In this context, access to forests, which indicates land availability as a limiting factor (Rasmus et al., 2021; van Vliet et al., 2013), and the presence or absence of rights that legitimize farmers to manage land resources (Hall et al., 2011; Marwoto et al., 2017) were structures that restrained individuals.

Third, what is happening with the phenomenon of livelihood diversity is the reaction of farmers to the restrictive structure. The decision to diversify sources of income or rely on only one source depends on the evaluation of factors such as land access, physical conditions, and other contextual factors. Farmers with the capacity to transform had the ability and power to make decisions to act, determined by factors such as the area of land controlled, number of crops cultivated, distance of the house to the farming location, total household income, non-farm income, and social relations that they have established.

These factors were the social and physical structures (Kinseng, 2017; Mouzelis, 2008) that emerged as empowering opportunities and new sources of restraint that led to the performance of the livelihood systems of farming communities in the villages. This new structure was formed in line with the influx of technological influences and market economies, which opened opportunities to develop new types of work (Thu et al., 2023). If land access is limited, farmers use their agencies to find alternative solutions, such as optimizing agricultural intensification technologies or seeking income outside the agricultural sector (Moreda, 2023). Individual agencies allow farmers to learn from their own experiences and from others in their communities (Ruangsarakul et al., 2019), such as by increasing the crop index twice a year and cultivating coffee using modern technology. Plots of rice fields that were left alone after harvesting were used for freshwater fish farming. Additionally, adopting cash crops in farmers' agricultural systems also makes money the dominant medium of exchange, facilitating the flow of goods and services and raising household income (Klasen et al., 2013; Li et al., 2018; Meng et al., 2020).

Livelihood diversity indicates that farmers can transform material and structural barriers such as limited access to land, into opportunities to maintain their livelihoods. We also observed that farming actors have allocative and authoritative resources that can be utilized to overcome structural barriers (Giddens, 1984; Sewell, 1992). However, this study proved that farmers' agency still created a new structure of social adaptation, as shown by the survival strategy patterns in most rural communities. This change indicates that the structure of the vulnerable has grown (Cramb et al., 2009) as they were obstructed from their forests and had to depend on their cash crop products (Bernstein, 2010); However, market-oriented farming without social security makes communities more susceptible to risks (Ellis, 2000).

6. CONCLUSION

Exclusion, defined as the elimination of communities from access to forest resources, did not automatically change their livelihood system. This study found that exclusion, which limits natural capital, especially land, is the primary driver of livelihood diversity. In wetland villages, limited access to natural capital forces households to seek alternative sources of livelihood other than agriculture. Simultaneously, the actors' ability to increase cropping intensity is still weak. Conversely, in dryland villages, limited access to natural capital can be overcome by relying on cash crop commodities, particularly coffee.

Livelihood diversity is built on rural households by combining emerging opportunities and leveraging individual agencies' capacities to respond to the constraints of social and physical structures. The tendency of livelihood diversity that has led to the increasing role of the non-agricultural sector is more evident in villages characterized by wetlands because of the highest restrictions on access to forests and low access to agricultural land.

The choice to diversify as a livelihood strategy was a response to the urgency of securing a livelihood. Depending on whether annual or perennial crops were no longer adequate as the primary source of income, they tended to diversify. The diversification strategy chosen in this case was influenced by mastery of livelihood assets.

Regarding limited access to agricultural land, there is an opportunity to manage customary forests that currently overlap the KSNP area. Indigenous communities, NGOs, and the Lebong Regency government have been struggling with this, as it has become mandatory, based on Constitutional Court Decree Number 35/PUU-X/2012. In the Decree, it is stated that customary forests must be excluded from state forest areas. This study aligned with the Lebong Regency Government's proposal regarding the Rejang indigenous people (Regional Regulation Number 4/2017 Concerning the Recognition and Protection of Rejang Indigenous Peoples), which was submitted to the Ministry of Environment and Forestry. This finding underscores the significance of supporting such endeavors for forest access by considering aspects of the sustainability of forest functions in maintaining the balance of ecological functions and livelihoods.

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