The community livelihoods strategy as a response to peat swamp forest ecosystem change and Covid-19 pandemic in Ogan Komering Ilir Regency, Indonesia

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Abstract. Pressure on peat swamp forests in Ogan Komering Ilir (OKI) Regency for timber extraction, agricultural land, oil palm plantations, and pulp and paper plantation forests cause degradation of peat swamp forest. Communities living around peat swamp forests in OKI Regency are affected by changes of peat swamp forests and Covid-19 pandemic. This study aimed to examine the livelihood strategies of communities around peat swamp forests due to degradation of peat swamp forests and Covid-19 pandemic. The sustainable livelihood analysis was used as an analytical framework in this study. The data obtained were analyzed descriptively qualitatively and quantitatively. The diversification strategy was appropriate to be implemented because it allows the community to achieve improved welfare and be sustainable under peat swamp forest ecosystem change and Covid-19 Pandemic. The diversification strategy also reduced community dependence on natural resource-based livelihoods. Increasing the quality and quantity of human, social, financial, and physical capital were enabling the diversification strategy.

1. Introduction

The area of tropical peatland in South Sumatra province is about 1,26 million hectares or about 19.61 % of the area of tropical peatland in Indonesia. Peatlands in South Sumatra are spread in the east coast region, one of which is in the Ogan Komering Ilir (OKI) Regency [1]. Peatland in OKI Regency is naturally a peat swamp forest formation [2–4].

The natural peat swamp forest in OKI Regency is a production forest that managed for timber extraction in the 1970s. In 1980 a part of the peat swamp forest in the OKI regency was designated as a conservation area, namely the Padang Sugihan Wildlife Reserve which is an elephant protected area. Some forest areas were also converted into transmigration settlements in 1981 [3]. In 1978 in the area of Air Sugihan, OKI Regency, the area of natural forest still reached around 37 %, reduced to 17 % in 1992 to 6 % and completely disappeared in 1998 [5].

Pressure on peat swamp forests for timber extraction, agriculture, oil palm plantations, and pulpwood plantations causes rapid degradation of peatlands [2,6]. Pressure on tropical peatlands caused deforestation and degradation of peat swamp forests. Degradation occurs due to timber extraction as well as various cultivation activities and infrastructure development constructing large-
scale drainage channels to drain the peatlands. Peatland degradation eventually cause recurrent forest and land fires [2,4,7,8].

Peat swamp forest degradation affects the lives of most people in OKI because about 75 percent of the OKI Regency area is wetland. [1,9]. The source of people's livelihood from peat swamp forests is logging, capture fisheries, hunting, raising swamp buffaloes and sonor. The exploitation of peat swamp forests has resulted in the depletion of timber from natural forests, a decrease in fish catches and a decrease in the extraction of peat swamp forests. This condition encourages the community around the peat swamp forest to adjust its livelihood strategy.

This study aims to examine the livelihood strategy of the community in the OKI peat swamp forest area in relation with the degradation of peat swamp forests and Covid-19 pandemic. The results of the study are expected to be used as recommendation in ecosystem rehabilitation activities and the formulation of strategies for the development of peat swamp forests, especially in relation with community livelihoods.

2. Materials and methods

The research was conducted in Riding Village, OKI Regency, South Sumatra Province, Indonesia. The area of Riding village consists of dryland and peatland. The main village settlement is in dryland while the hamlets are located on peatland. The village area is directly adjacent to the Padang Sugihan Wildlife Sanctuary and production forest area (already managed as forest plantation company) (Figure 1). This village was chosen as the research location because part of the village area was degraded peat swamp forest, and village communities had interactions with peat swamp forests as a source of livelihood.

![Figure 1. Research location.](image)

The analysis of sustainable livelihood was used as an analytical framework. This framework was applied because of its ability to explain the livelihood strategies of the community to maintain their lives which were susceptible to vulnerability that caused by pressure and disturbances, in relation to capitals [10,11]. The framework of sustainable livelihood analysis is presented in Figure 2.

Livelihood strategies are capital (natural, human, physical, financial and social capital), activities and access that are mediated by institutions and social relations which together determine the lives of individuals and households [10,11]. The strategy of living in the livelihood sociology leads more to
the understanding of livelihood strategy from the means of living strategy. The livelihood strategy is a tactic and action that is built by individuals and groups in order to maintain their lives while still taking into account the existence of social infrastructure, social structures and prevailing cultural value systems [12]. The framework analyze, how capitals, activities, access are mediated by institutions and social relations that together produce different livelihood strategies (agriculture intensification or extensification, livelihood diversification and migration) [11].

Figure 2. Sustainable livelihood analysis framework (adapted from [11]).

Data related to the general condition of the village were obtained through village monographs. Field data related to biophysical aspects were obtained through field observations. Data from village communities was obtained through semi-structured interviews and focus group discussions (FGD). Structured interviews were conducted to explore socio-economic data. FGDs were conducted to gather data on village history, peat swamp forest management and confirmation to strengthen field data and interview results [13–15].

Table 1. Variable and measured data.

| Variable          | Measured data                                                      |
|-------------------|--------------------------------------------------------------------|
| Natural Capital   | peatlands, natural forests, settlements, clean water, river depths, capture fisheries, hunting, livestock and agriculture |
| Human Capital     | education and health                                               |
| Social Capital    | community organizations, social networks                           |
| Financial Capital | source of funding, financial institutions                           |
| Physical Capital  | roads, bridges, markets, electricity networks and places of worship |

The data obtained were analyzed qualitatively and quantitatively. The descriptive quantitative data analysis technique was carried out by giving a score of 0 to 3 with the assumption that the more supportive an element is, the greater the score [16]. To equalize the weight of the calculation and facilitate interpretation, the scoring results are converted into values on a scale of 0 (zero) to 10 (ten) [17].

3. Results and discussion

3.1. Community livelihoods in Riding Village related to livelihood capital

The daily life of the community in Riding Village was carried out by interacting with wetlands and drylands. Interaction with wetlands in the form of extractive activities in peat swamp forests. Plantations and cultivation were carried out on dry land or mineral soils.

Extractive activities in wetlands related to livelihoods that can be carried out by the people of Riding Village were logging, hunting and fishing. In addition, the people of Riding Village were also familiar with sonor activities. Sonor is rice cultivation which is carried out on burnt peat swamps.
Sonor activities were carried out by sowing rice seeds on burnt peat swamps, then leaving them without maintenance. The community returned to the location about four months later to harvest rice. Initially sonor was carried out by the community on a small scale after a fire broke out in the peat swamp forest. Sonor in Riding Village started to become a large-scale and recurring activity since the peat swamp forest fires that occurred during the long dry season in 1961 which recurred in 1963, 1967, 1969, 1973, and so on every three years.

Cultivation activities carried out by the people of Riding Village on mineral lands were planting paddy fields, secondary crops, and rubber. The cultivation pattern used was the same as that commonly practiced by farmer in South Sumatra, planting field rice and secondary crops between newly planted rubber plants. Rice and secondary crops were planted until the rubber plants are 3-4 years old, when the canopy was closed.

Livestock activities in the form of swamp buffalo grazing were carried out by the community of Riding Village since 1990s. The swamp buffalo that he cultivates was a local swamp buffalo of OKI, namely the Pampangan swamp buffalo. Buffaloes were grazed from morning to evening, then housed at night. Grazing was carried out in wetlands not far from the village area and the Padang Sugihan Wildlife Reserve.

The extraction of natural resources without restoration or improvement had resulted in changes in the condition of the peat swamp forest around Riding Village from time to time. The dynamics of the natural capital in Riding Village starting in the 1970s is presented in Table 2.

### Table 2. The dynamics of natural capital in Riding Village.

| Number | Key factors          | Year | <1970 | 1980 | 1990 | 2000 | 2010 | 2016 |
|--------|----------------------|------|-------|------|------|------|------|------|
| 1      | Peatlands            |      | xxx   | xx   | xx   | x    | x    | x    |
| 2      | Natural forest       |      | xxx   | xx   | xx   | x    | x    |      |
| 3      | Settlements          |      | x     | x    | xx   | xx   | xxx  | xxx  |
| 4      | Clean water          |      | xx    | xx   | xxx  | xxx  | xxx  | xxx  |
| 5      | River depths         |      | xxx   | xx   | xx   | x    |      |      |
| 6      | Capture fisheries    |      | xxx   | xx   | xx   | x    |      |      |
| 7      | Hunting              |      | xxx   | xx   | xx   | x    |      |      |
| 8      | Livestock            |      | 0     | 0    | 0    | xx   | xxx  | xxx  |
| 9      | Agriculture          |      | x     | x    | xx   | xxx  | xxx  | xxx  |

Remark: xxx = many; xx = medium; x = little; 0 = no/exhausted

The trend of decreasing natural capital related to peat swamp forest in Riding Village occurred slowly in the 1980s and began to accelerate in the 1990s. Meanwhile, the condition of natural resources related to cultivation activities and physical development showed an improvement.

The condition of the peat swamp forest around Riding Village changed drastically starting in the late 1970s along with the presence of companies holding Forest Concession Rights (Hak Pengusahaan Hutan/HPH) permits. Timber harvesting using the HPH system turned out to be unsustainable, causing degradation of forests and peat ecosystems. Degradation of the peat swamp forest ecosystem due to deforestation had worsened with recurred forest fires with the peak of large-scale forest fires that occurred in 1997/1998 [3].

Captured fisheries in peat swamp forests began to decline when large-scale logging of natural forests began in the 1980s. The degradation of the peat swamp forest which was a fish habitat causes a decrease in capture fisheries products. Waters condition in Riding Village also changed as the ecosystem of peat swamp forest deteriorated. Rivers and creeks had narrowed their flow and significantly reduced their discharge since the 1980s.

3.1.1. Natural capital
The condition of natural capital determines the development of the social and economic system of a community that depends on natural resources for its livelihood. Currently, the natural resources in Riding Village had a low score, while the settlement and cultivation activities had a high score. This showed that natural capital must receive special attention in development activities because it involves livelihood of community.

3.1.2. Human capital
Education and health are two main aspects which are considered to determine the condition of human capital. Based on physical and social considerations, education in Riding Village during the research was conducted was classified as good. Educational facilities in the form of elementary school and junior high school are available in Riding Village. Facilities for the high school level are not yet available, so people must go to the sub regency city to take high school education. Public awareness of education is classified as high because people generally take up to senior high school education which must be taken in sub regency city. Community participation in education is also reflected in the independent construction of junior high school. Awareness and participation in education are classified as lacking for residents of Riding Village who live in hamlets located about more than five km from the main village.

Health aspects as human capital are examined from health facilities and infrastructure, health services, availability of health insurance and community awareness and participation. The health facilities and infrastructure only enough to serve the main village but had not yet reached the entire area of the village which was very wide and consists of scattered hamlets. The community interacts with health facilities provided by the government when experiencing severe illness, which cannot be cured with over-the-counter drugs. Economic factors also limited access to health infrastructure. Nevertheless, the people of Riding Village, especially those who live in the main village, had a high level of awareness to improve their health status through integrated health services post activities and environmental health.

3.1.3. Social capital
Social capital often functions as a safety valve for a community to survive when natural capital and human capital were in poor condition [11]. Social capital in Riding Village was built and maintained by the community through limited social relations in small groups, such as neighborhood association (Rukun Tetangga/RT), death charity associations (Perkumpulan Amal Kematian/PAK), women recitation and agricultural land preparation groups. Relationships that occur were based more on the same needs, both voluntarily and/or mandatory. Forced social relations occurred because of the existence of social order maintained by the community and believed to be beneficial. This type of social relationship was more dominant in Riding Village which was indicated by the existence of neighborhood association and death charity associations. The relationship that occurs was based more on the same needs, both voluntarily and/or forced. Compulsory social relations occur because of the social order that the community maintained and is believed to be beneficial. This type of social relationship was more dominant in Riding Village, and voluntary relationships were low. This means that social capital was less conducive to community productivity and had the potential to become a conflict. Poor social capital conditions had the potential to threaten the sustainability of community livelihoods.

3.1.4. Financial capital
The availability of funds for the economic development of the community in Riding Village was quite good. Funds can be sourced from formal institutions (banks and pawnshop), and non-formal institutions (individual capital owner/toke). Funding also come from development projects, both from government and non-government such as non-governmental organizations (NGOs) as well as collaborative projects with foreign countries.

Communities tend to prefer to got funds from the toke, arguing that they did not require complicated administrative requirements. The rate of return of the community varies from low to high,
but in general, it could be stated to be quite high. This rate of return was closely related to the fluctuations in the prices of the main commodities produced by the community. When the price of primary commodities was high, the rate of public return also high. Conversely, when the main commodity prices fall, the rate of return also decreased.

3.1.5. Physical capital
Facilities such as road, bridges, markets, electricity networks and places of worship in the main village were generally in moderate to good condition. These facilities were classified as poor for hamlets whose locations were scattered far away from the main village. Wastewater Treatment Plant (WWTP) is not available in Riding Village. Wastewater from household flowed into rivers or creeks directly.

3.2. Community livelihoods in Riding Village
The reality of community livelihoods in Riding Village to adapt to sustainable livelihoods was analyzed using the capital pentagon combined with the household livelihood strategy. There were three strategies for household subsistence farmers: 1) intensification/extensification of agriculture; 2) diversification; and 3) migration [11]. The results of the assessment of community livelihood capital in Riding Village were presented in Table 3 and Figure 3.

| No. | Livelihood Capital   | Score |
|-----|----------------------|-------|
| 1.  | Natural capital      | 6.3   |
| 2.  | Human capital        | 6.4   |
| 3.  | Social capital       | 3.3   |
| 4.  | Financial capital    | 8.7   |
| 5.  | Physical capital     | 6.0   |

Table 3. The score of the livelihood capital of the community in Riding Village.

Figure 3. Results of sustainable livelihood analysis of Riding Village

Table 3 and Figure 3 showed that financial capital had the highest score, followed by human, natural, physical, and social capital. Financial capital was a major factor in the declining condition of natural capital and reduced public access to natural extraction due to the peat swamp forest area that had been subject to management permits by company (Industrial Plantation Forest). With this condition, community livelihoods based on natural capital eventually shifted, extraction activities decreased, while cultivation activities increased. Cultivation activities require the availability of more financial capital. Financial capital was not an obstacle to reach and the community's rate of return was
also good. Financial capital is needed to intensify agriculture with limited land that could be used for cultivation activities and it was impossible to call it agricultural extension in wetlands with land conditions that were already burdened with management permits.

Apart from limited access to wetlands, the area of plantation ownership in Riding Village was also getting narrower. Prior to 1980, the average plantation area was five ha. In the period 1980 to 2000, the average plantation area was three ha. After 2000, plantation ownership averaged one to two ha. [18] stated that access to agricultural land and its ownership is essential for sustaining livelihoods and is an economic capital because access to land provides employment and income.

Limited land management encouraged community to carry out an adaptation strategy. Human capital, especially education, supports the development of cultivation through agricultural intensification. The intensification strategy undertaken was to increase production input by using superior seeds, better harvest technology and increasing labor. Improved education also allows wider financial access to agricultural capital. Education also encourages the development of diversification of livelihoods in line with the gradation of peat swamp forests as natural capital.

In addition to the source of income from the agricultural sector (farm income), the community of Riding Village who had high school education began to undertake a strategy of diversifying their sources of income outside the agricultural sector (non-farm income). Some of the educated groups who were also the younger generation still had activities related to agricultural cultivation such as owning rubber gardens, sharing, or working on their parents' gardens. Fishing activities were also still being carried out to get additional income. The shift and increasing interest of the younger generation in off-farm and non-farm income sources according to [18] has also occurred in some developing countries. The age of the head of the household is a demographic variable estimated to have an important influence in determining livelihood and livelihood strategies. [19] state that younger individuals are more likely to change jobs and they prefer non-agricultural jobs more than older people. The diversification of income sources outside the agricultural sector (non-farm income) chosen by the younger generation in Riding Village was to work as permanent or contract workers in HTI companies, pulp and paper mills, oil palm plantations as well as HTI company and oil palm plantations partners around the village. This livelihood diversification strategy ultimately encouraged the adoption of a migration strategy by the people of Riding Village.

The migration strategy undertaken was to carry out mobility outside the village, either permanently or circularly to generate income. Some of the younger generation who had a primary preference for working in cities as employees or having their own business (non-farm income) were carrying out permanent migration. Circular migration was carried out by groups who work as permanent or contract employees in other villages or sub-districts near to Riding Village. This strategy was supported by physical capital in the form of road access and transportation equipment that supports their mobility.

Social capital was the capital with the lowest score in the livelihoods of the community of Riding Village. The low social capital score had the potential to become an obstacle to the livelihood sustainability of the community in Riding Village. Weak social relations can become an obstacle in forming social networks that are conducive to cohesiveness in the management of natural capital and the achievement of sustainable livelihood strategies. This requires attention to individual networks, complex arrangements, systems of rights and obligations designed to improve livelihood security in the future. [20] state that social capital is needed by households to secure potential future profits.

3.3. The reality of community livelihoods in Riding Village in the Covid-19 pandemic

The livelihoods of the community in Riding Village were not too much affected by the Covid-19 pandemic. The community can still market the main agricultural product in the form of rubber latex because road access and transportation remain open for the transportation of goods. The community could still work on HTI, pulp and paper mills, oil palm plantations as well as HTI company partners and oil palm plantations around the village.

Change occurs in social capital during the Covid-19 pandemic. In the era of the Covid-19 pandemic, community mobilization to cities by public transportation has decreased. The food trade
sector between regions which usually occurs through weekly traditional markets became more limited. To meet the need for processed food which was usually obtained from the market, some households try to produce by themselves and trade personally with other households in the village area. The limited access to the processed food market due to the Covid-19 pandemic created new networks that can potentially become an important force in the economy and other aspects of social existence.

4. Conclusions
The diversification strategy was the strategy most likely to be applied in community interactions with degraded peat swamp forests and the Covid-19 pandemic. Diversification strategy was suitable to be applied because it allows maximizing income from more than one income sector. The diversification strategy also allowed the community to achieve increased welfare and sustainable livelihood. Diversification strategies also reduced people's dependence on natural resource-based livelihoods. Increasing the quality and quantity of human, social, financial, and physical capital would enable a diversification strategy.

5. Authors’ Contributions
All author contributed equally to this work. All authors collect and analyze data, discussed the results and implications, and commented on the manuscript at all stages.

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