

Cultural strategies of the local and transmigrant communities in dealing with land and forest fire disasters in West Kotawaringin District, Central Kalimantan, Indonesia

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Abstract. *Sinta D, Iskandar J, Gunawan B. 2022. Cultural strategies of the local and transmigrant communities in dealing with land and forest fire disasters in West Kotawaringin District, Central Kalimantan, Indonesia. Biodiversitas 23: 4705-4715.* The Indonesian Province of Central Kalimantan has frequently faced catastrophic land and forest fire disasters in the last two decades. In 2015, the province experienced the most extensive land and forest fire disaster in Indonesia, causing severe ecological, economic, and socio-political problems. The villages of Baru and Kumpai Batu Bawah, located in South Arut Subdistrict, are included in the Priority Zone for Forest and Land Fire Disaster Management in West Kotawaringin District, Central Kalimantan Province, Indonesia. The two villages have been recognized as a high potential hazard and vulnerability to forest and land fires since 2015. This study aimed to compare the cultural strategies of the local communities of Baru Village with transmigrant communities of Kumpai Batu Bawah Village with distinctly different cultures in dealing with forest and land fires. The qualitative method was applied in this study. Several field techniques, including observation and semi-structured interviews or in-depth interviews with competent informants of local and transmigrant communities, were employed. The study showed that distinctive strategies were applied by two communities, based on the Traditional Ecological Knowledge (TEK) and embedded with culture for dealing with land and forest fire disasters in the Central Kalimantan ecosystem. Some TEK and cultural factors, including ways of looking at nature, and knowledge related to the environment expressed in the form of behavior such as land management practices for agriculture with disaster mitigation were documented as predominant factors of both communities for dealing with land and forest fire disasters.

Keywords: Central Kalimantan, cultural strategies, land and forest fire, local community, transmigrant

INTRODUCTION

The province of Central Kalimantan has undergone continuous land and forest fire disasters in the last two decades. In 2015, the province even experienced the largest land and forest fire disaster in Indonesia, reaching 200,000 hectares (Lohberger et al. 2017; Noor 2019). Hundreds of catastrophic forest and land fires in Central Kalimantan occurred on peatlands, particularly in degraded areas, due to multiple factors, including climate change, reduced forest cover, and massive human activities (Harrison et al. 2016; Sarmiasih and Pratama 2019; Yulianti et al. 2020a; Yulianti et al. 2020b). Peatland fire disasters have become a global concern because it brings a much higher impact on smoke, and greenhouse gas emissions, which can reach 10 times that of fires on mineral lands (Sabani et al. 2019; Akbar et al. 2021; Daeli et al. 2021). Peatland conversion and drainage have been the main drivers of the socio-ecological crisis in Southeast Asia, particularly in Indonesia and Malaysia (Page and Hooijer 2016; Purnomo et al. 2017; Astuti 2020).

The district of West Kotawaringin is one of the regencies in Central Kalimantan, which has 132,927

hectares of peatland but also 1,122 hectares of fire-prone areas. In 2015, West Kotawaringin District experienced a fire of land and forest disaster of 1,400 hectares, and 582.415 hectares in 2019, while only 223.67 hectares were handled. In 2019, the South Arut Subdistrict was the area that experienced the largest peatland fire disaster in West Kotawaringin, reaching 268.855 hectares, and the fires handled were only 101.87 hectares. The villages of Baru and Kumpai Batu Bawah, inhabited by local people and by transmigrants from Java, respectively, are the two areas in the South Arut Subdistrict that experienced massive canalization to support the food crop agricultural sector and experienced land fires, with the highest area at Subdistrict level and included in the Disaster Management Priority Zone (ZPBB) (Regional Development Planning Agency of West Kotawaringin District 2016; Regional Disaster Management Agency for West Kotawaringin District 2018).

The massive growth rates of the human population, land conversion, climate changes, globalization, and world capitalism have encouraged the exploitative development of peatlands, triggering catastrophic fires, especially during the long dry season (Lovejoy and Hannah 2019; Wibowo et

al. 2021). Massive clearing of peatlands without an understanding of the characteristics of tropical peatlands has led to degradation (Agus et al. 2020), as happened in the former million-hectare peatland clearing area in Central Kalimantan and has become the most severe land fire disaster area (Jayarathne et al. 2018; Goldstein et al. 2020; Yulianti et al. 2020a). This indicates the lack of success of agricultural development on peatlands due to immature management planning so that many land uses are not in accordance with their objectives, lack of application of land conservation principles, and lack of understanding of the characteristics of peatlands (Oktiana 2017).

In the past, local communities living in peatland areas generally had unique Traditional Ecological Knowledge (TEK) in peatland management due to intensive interaction with their ecosystems for thousands of years. TEK can be defined as a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings, including humans, with one another and with the environment (Berkes 2012). TEK is knowledge held by particular people from a specific place that has been developed and applied to specific landscapes for specific purposes by long-time inhabitants (Huffman 2013). Thus, TEK can be in the form of abstract philosophies such as ways of looking at nature, agroecological knowledge, and practices in the form of land management techniques such as peatlands clearing, farming, managing drainage, selecting vegetation types, and applying traditional agroforestry cropping patterns, which indicates the existence of conservation and disaster mitigation as implemented by local communities in Central Kalimantan (Sinta 2021).

On the other hand, the presence of transmigrant communities relocated from Java by the central government on peatland areas for decades and engaged in farming also resulted in their own knowledge of peatland management. Their background as dryland farmers in their home areas and their different patterns from those of local communities may influence their new peatland management practices. The culture mainly interposes between themselves and their environment to ensure their security and survival. The culture has evolved within their local environments and closely analyzed the relationships between specific cultural institutions and their local environments (Milton 1996).

Studies on the role of TEK in relation to risk management and reduction as well as the response to disasters, including climate changes and cross-culture around the world, have been performed by different researchers worldwide (Hop et al. 2017; Rai and Kawas 2019; Zulfadrim et al. 2019; Hosen et al. 2020; Magalhaes et al. 2021; Sekaranom et al. 2021). However, studies on the cultural strategies of the different cultural backgrounds in dealing with disasters have rarely been undertaken. The

present study elucidates the cultural strategies of the local community and transmigrant of West Kotawaringin District, Central Kalimantan, Indonesia in dealing with land and forest fire disasters.

MATERIALS AND METHODS

Study area

This study was conducted in the villages of Baru and Kumpai Batu Bawah in the South Arut Subdistrict, West Kotawaringin District, Central Kalimantan Province (Figure 1). Baru Village is inhabited by local communities consisting of the Melayu (referring to the local Muslim) and Dayak tribes, with an area of 7,920 hectares. The topography of Baru Village is dominated by lowland areas, with an altitude of approximately 30-150 meters above sea level. The paddy fields in Baru Village are typically rainfed rice fields with an area of about 200 hectares and tidal rice fields covering an area of 45 hectares. Commodities grown include rice, corn, tubers, local vegetables, and fruits. As for plantations, it is dominated by large private oil palm plantations with an area of 1,075 hectares, while oil palm plantations owned by the people are 750 hectares, and rubber plantations are 71.5 hectares. Kumpai Batu Bawah Village was opened in 1974 to transmigrants from East Java, Central Java, Yogyakarta, and a few from West Java, with the first placement of 200 families and 865 people who fostered the development of agricultural programs, especially the development of rice crops with an area of 2,350 hectares. The topography is primarily low-lying areas, with an altitude of approximately 0-3 meters above sea level. In contrast to Baru Village, the rice fields in the Kumpai Batu Bawah Village are dominated by technical irrigated rice fields covering an area of 950 hectares, followed by semi-technical irrigated rice fields, rain-fed rice fields, and tidal rice fields covering an area of 215, 158, and 89 hectares, respectively. From the 1980s to the late 1990s, the rice fields of Kumpai Batu Bawah Village had been one of the rice barns in West Kotawaringin District.

The two villages are equally affected by the rainy and dry seasons. They are located around the peat hydrological unit of the Lamandau River-Kumai River but have been heavily degraded, mainly due to canalization which drains the peat so that it is more flammable. The primary canal in Baru Village is around 9,000 meters, and the secondary canal is 13,650 meters, while the primary canal in Kumpai Batu Bawah Village is around 13,050 meters and the secondary canal is around 39,440 meters, with varying depths of peatland between 0.5-5 meters in Baru Village, and 0.5-1 meters in Kumpai Batu Bawah Village, and also as a land fire disaster areas in 2015 to 2017.

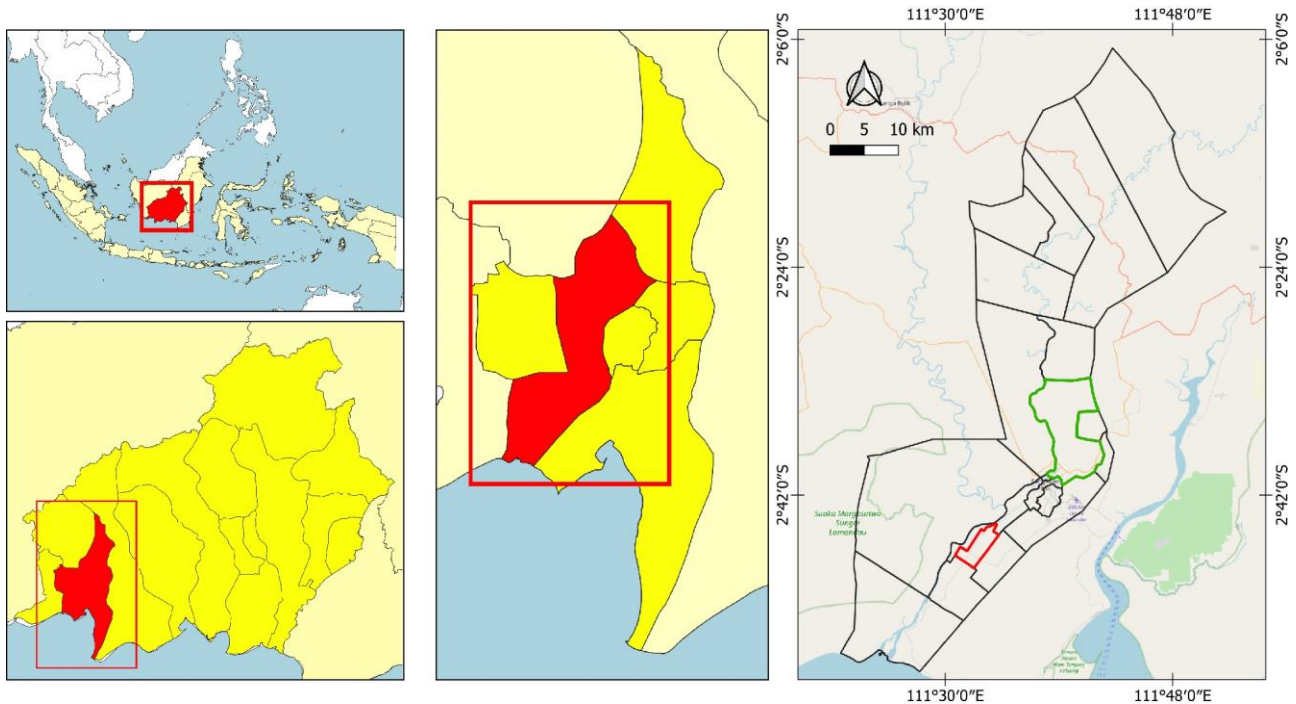


Figure 1. Administration boundary map of Baru Village (green) and Kumpai Batu Bawah Village (red), West Kotawaringin District, Central Kalimantan, Indonesia

Data collection

The qualitative method was used in this study. Several techniques, including observation and semi-structured or in-depth interviews with competent informants, were employed (Albuquerque et al. 2014; Iskandar 2018). The observation was aimed at obtaining data on environmental conditions, local settlements, agricultural types, and forest types. The semi-structured interviews were carried out with competent informants that were purposively selected. The informants were the farmers of local elders and transmigrant, village officials, administrators of Disaster Preparedness Village (KSB), Fire Care Community Group (MPA), Fire Volunteer Front (*Balakar/Retkar*), as well as related stakeholders. The interviews were conducted using an interview guide that has been compiled based on the four pillars, i.e., (1) observation, (2) anticipation, (3) adaptation, and (4) communication by Dekens (2007) to identify local knowledge in disaster preparedness. The secondary data was collected indirectly from various official sources whose information can be accounted for. Some secondary data, including research reports and statistical data, were used in this study.

Data analysis

Data analysis was carried out based on observation and in-depth interviews with informants, while the secondary data were analyzed by cross-checking, summarizing and synthesizing, and making descriptive analysis (Newing et al. 2011; Iskandar 2018). Cross-checking was undertaken by validating obtained data from some informants, observation activities, and secondary data. The validated data were summarized, synthesized, and made into narratives. Special strategies of both communities, i.e.,

local people of Baru Village and transmigrants of Kumpai Batu Bawah Village, in dealing with the land and forest fire disasters were also analyzed.

RESULTS AND DISCUSSION

Humans and communities use their worldviews to interpret environmental information and formulate various activities to treat their environment (Marten 2001; Iskandar 2017). Not all human activities cause environmental damage. There are also human activities that contribute directly or indirectly to maintaining and building biodiversity in various ecosystems. For instance, landscapes that are created or managed by human activities such as forest management, crop cultivation, and the use of fire for farming (Iskandar 2018).

The cultural strategy of the local community in Baru Village

People who interact intensively with an ecosystem generally have traditional agroecological knowledge, especially in subsistence farming practices which helps them to observe and respond to local climate change (Dadi 2019; Hosen et al. 2020), including local communities in Baru Village who have been farming on peatlands for generations. Their culture is based on the interdependence of nature and people, which has resulted in complex and vast knowledge systems, one of which can be seen in natural signs that can be recognized by local communities to be used in managing their agricultural businesses on peatlands (Siahaya et al. 2016). For example, recognizing indicators of changes in dry and rainy seasons, the arrival

of extremely dry and rainy seasons that have the potential to be catastrophic.

In practice, the local farmers in Baru Village have specific knowledge in managing peatlands, i.e., site selection based on the types of plants they grow, land clearing techniques, selection of local plant varieties that are adaptive to peatlands (Figure 2), and cropping patterns in the form of mixed gardens which is one of the traditional agroforestry systems (Iskandar 2017). These attempts serve as local wisdom from the local community to preserve biodiversity (Winarni et al. 2018).

Concerning the cropping pattern, the local farmers use the mixed garden concept, which consists of a combination of perennials and annual crops. In general, farmers have certain areas that can be used as land for planting rice and other seasonal crops, while the highland areas are planted with perennials such as local fruits with tall trunks, such as *durian* (*Durio zibethinus*), *langsar* or *duku* (*Lansium domesticum*), *cempedak* (*Artocarpus champeden*), *asam*

Kalimantan (*Mangifera foetida*), and *rambutan* (*Nephelium lappaceum*). Plant species will be sorted from those with the highest stems in the outer layer, then decreased to annuals on the inside (Figure 3).

The local farmers commonly cultivate land with an area varying between 0.5-2 hectares per family. The selected location is typically about 2-5 km along the river, where the physical appearance of the litter and topsoil is slightly colored dark if designated as an area for seasonal crops such as rice and vegetables. The structure of traditional agroforestry like this generally still resembles forest vegetation with a layered canopy cover. Therefore, its existence has ecological functions such as that given by forests, among others, contributing to preventing or reducing the impact of global warming and also has essential socio-economic and cultural significance for local communities, in particular maintaining food security and poverty alleviation efforts (Abdoellah 2017; Iskandar 2017).

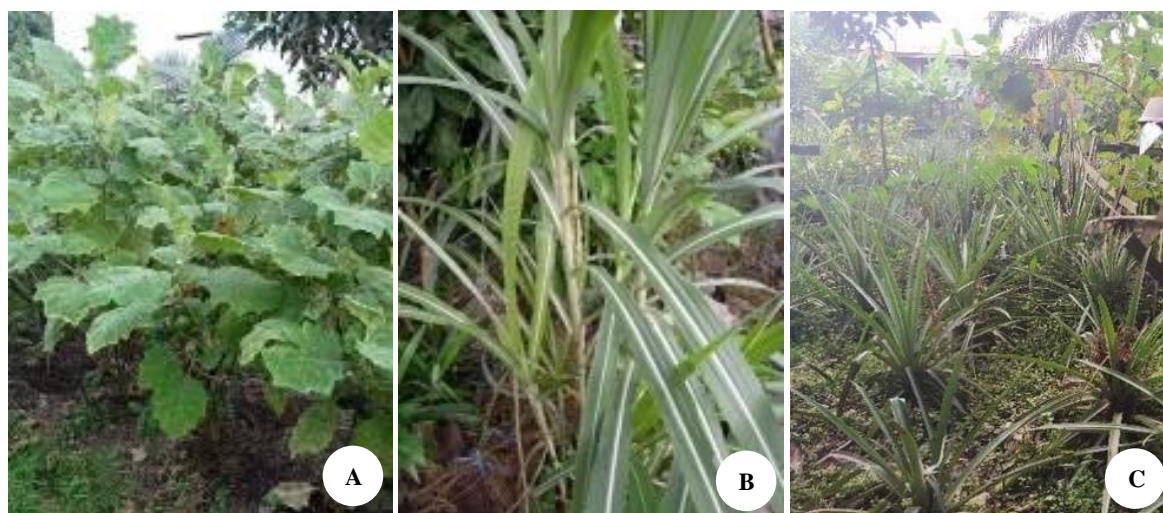


Figure 2. A. Terong Asam (*Solanum ferox*), B. Tebu Telor (*Saccharum edule*), and C. Pineapple (*Ananas comosus*) are cultivated by the local farmers in Baru Village, West Kotawaringin District, Central Kalimantan, Indonesia

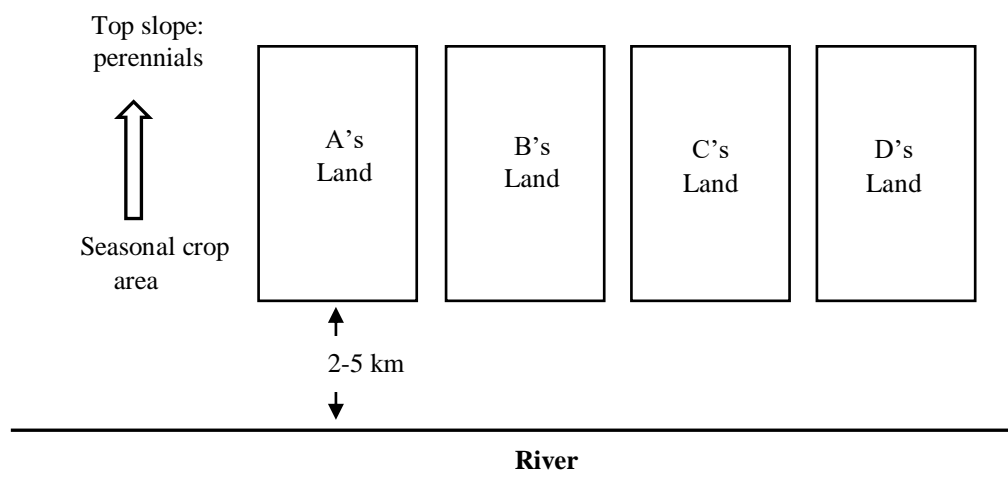


Figure 3. Site selection and cropping patterns of the local farmers in Baru Village, West Kotawaringin District, Central Kalimantan, Indonesia

Land clearing is carried out by controlled slash and burn. The activity starts by building a firebreak with a width of 1-2 meters, cleaning dry leaves on the border of the land, discussing the timing of burning, determining the direction of burning, and the parties involved to keep the fire so that the burning does not hit the other area (Iskandar and Iskandar 2022). The local farmers believe that burning ash will fertilize the soil, overcome the acidity of peatlands, and relatively fewer plant pests and diseases. They came to this finding after comparing the conditions of rice cultivation, especially before and after the regulation prohibiting land clearing by burning was enacted. In the past, even if there was an attack by *Pangau* pests, the local farmers usually simply anticipated it by being farsighted at several points on their land. Some farmers will burn *Asam-asam* bark or camphor to repel *Pangau*, which attacks their rice crops. Likewise, if they have livestock, they will usually be used it around the cages, especially during the transition season, to protect their livestock from disease.

The process of planting rice is generally done by *ditugal*, using more than 20 local rice seeds such as the *Tampui Putih*, *Tampui Kuning*, *Sintang*, *Buntut Kuda*, *Umbang*, *Tali Jambangan*, *Selon*, and other varieties, which are set aside from the previous harvest. Even without using extensive inputs such as agricultural lime and fertilizers, their rice production is sufficient to meet household needs and food reserves during times of famine. Some rice varieties, such as *Umbang*, are known to be more resistant to flooding because of their tall stem structure, which could minimize farmer losses. At harvest time, the local farmers will normally select rice that grows well to be left to mature as seeds for planting the following year. Before being stored in sacks or other containers, the rice grains are usually *dirabun* so that they are not easy to mold when stored for years.

Consciously or not, knowledge related to the local environment and agricultural practices applied by the local farmers has a positive impact on reducing fire disasters in peatlands. Their expertise in reading natural signs, such as the arrival of the long dry season, although it cannot

directly prevent land fires from occurring, can make them more alert and prepare for anticipation. It is challenging for the local farmers to recognize certain signs that can be considered early warnings due to the characteristics of forest and land fires are different when compared to other natural disasters, especially considering that this is not solely caused by natural factors but also by human activities (anthropogenic) (Hu et al. 2017; Sarmiasih and Pratama 2019; Watson et al. 2019; Barmpoutis et al. 2020). However, the local farmers will be aware of the arrival of the dry season, which begins around May to October. If the dry season is predicted to be longer, the local farmers will prepare a land security system to reduce the potential for fires. Firstly, farmers generally dig trenches with varying widths and depths between 0.5-2 meters at the land boundary, which serves as a marker of land ownership boundaries as well as firebreaks when the time for land clearing arrives, and it turns out that these trenches can be used as a last line of defense in preventing the spread of fires on peatlands. According to the experience of firefighters, they will close the water outlets in the trenches that are used as barriers and then fill the trenches with water so that the surrounding area remains wet and land fires do not spread out of areas that have been blocked with water (Figure 4).

Secondly, if the water in the ditch dries up, the surrounding bushes and plants also tend to dry up, so the local farmers clean them up immediately to prevent fuel sources if there is a spark around their land. This is in line with the concept of the fire triangle, which is indeed used in fire prevention measures, including reducing potential fuel and heat sources that may arise either due to natural or human factors. Air is undoubtedly a difficult element to control, but fuel sources (e.g., peat) and heat sources (fire) can be controlled, regulated, and managed (Noor 2019).

Thirdly, some of the local farmers planted banana trees near the ditch, especially in the back area (Figure 5). According to them, the watery nature of banana trunks will help avert a fire from flaring on their land.

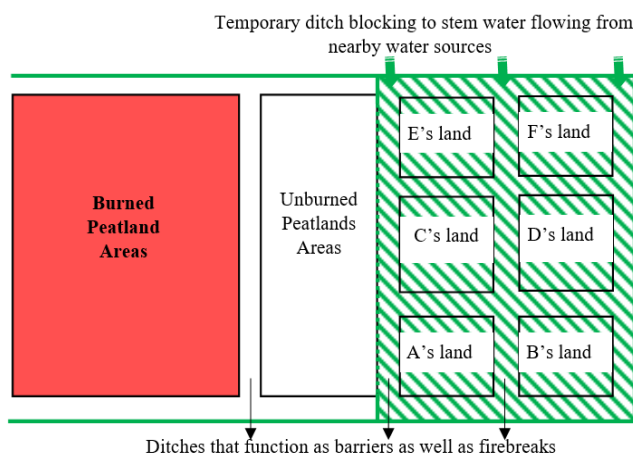


Figure 4. Utilization of ditches or *tatas* on the local farmers' land to contain water and moisten peat areas while preventing the spread of land fires



Figure 5. Banana trees on the border of a local farmer's land in Baru Village, West Kotawaringin District, Central Kalimantan, Indonesia

However, this understanding of the function of the banana tree is not shared by all the local farmers. Only a few proportions of planted bananas are aimed to prevent land fires, while the rest just carry out the hereditary habit of growing bananas in the backyard, especially on land borders, with no other purpose. But they all immediately clean dry leaves around banana trees and ditches regularly, especially if a long dry season is suspected.

Traditional communities have knowledge of management practices in preparing their agricultural lands, cropping, and soil and water management practices that are environmentally friendly, often reflecting adaptation to local climate (Lebel 2013; Maren et al. 2014). In addition to utilizing natural signs for use in land management, they also apply agricultural practices in the form of mixed gardens or traditional agroforestry, namely perennials (rubber and fruit plants) combined with annual crops, and do not cultivate peatlands by plowing the soil because of their tendency to release pyrite when the top layer is turned over. Using local superior seeds/seedlings that are adaptive to extreme environmental conditions and planting banana trees on land borders to prevent the spread of sparks also play a role in Disaster Risk Reduction.

The use of natural resources and the environment of local communities in the past were able to maintain the sustainability of the ecological system (Megawati et al. 2020). Despite implementing shifting cultivation systems and slash-and-burn systems to meet the food security of their communities (Leo et al. 2021), large fires rarely occur, so in the past, the Dayak community, on average, only had experience putting out small fires and rarely have experience fighting large fires on a large scale (Sinta 2021). Empirically, the belief of indigenous peoples, which is manifested as local wisdom, is capable and effective in controlling human behavior that tends to dominate and exploit natural resources arbitrarily because the rules contain what the community must do with the management of their resources which is also accompanied by sanctions (Chisholm 2016; Roslinda 2016; Njau et al. 2019).

Nowadays, the knowledge of agroecology and its practice has begun to fade. In the past, the community trusted some people more than others due to their special skills and abilities in reading landscapes, skies, and other environmental elements, so their advice tended to be followed, but the condition has shifted. Economic changes, remittances for work outside the village, and transformations in the education system where the young do not respect the old have resulted in the weakening of traditional agroecological knowledge and skills that can actually play a significant role in Disaster Risk Reduction (Dekens 2007).

The fading of local knowledge related to the environment in general and peatland management in particular to local communities in Baru Village is nothing new. This shift is generally in line with changes in the social stratification of society. Dove (1988) and Lahajir (2001), in their studies on Dayak communities in West Kalimantan and East Kalimantan, stated that the collapse of longhouses in local communities, which are local social systems, has led to changes in traditional farming systems.

In Baru Village, this shift has caused the extinction of the TEK related to the environment, especially in reading natural signs, the extinction of more than 20 local rice varieties that Baru Village farmers plant annually, and the abandonment of traditional agroforestry. These consequences later resulted in a decline in disaster mitigation efforts based on local community knowledge.

It is worse as currently, not many local people in Baru Village have the knowledge to read natural signs thoroughly. This environmental knowledge also tends only to be owned by elders' of the local farmers and is not evenly distributed. In addition, from 2004 to 2022, many local farmers in Baru Village have got difficulty predicting the change of seasons as before due to the many natural phenomena that disrupt the seasons. For example, a big flood almost comes every five years. From 2004 to 2019, there has never been a flood, but in 2020 and 2021, a giant flood came and, in fact, submerged the Baru Village area with a much higher water level. The period of the last flood disaster also lasted longer. This was detrimental to farmers because almost all of their crops, including pinang (*Areca catechu*), coconut (*Cocos nucifera*), and durian (*Durio zibethinus*), which are more than 7 meters tall, were destroyed by the flood.

The 5th Intergovernmental Panel on Climate Change (IPCC) report in 2014 revealed that global air temperatures have risen by nearly 0.8°C, and there will be an average temperature increase of 3°-5° C by the end of this century. Also, there will be an unfavorable climate, climate uncertainties, rainfall deviations, and the increased risk of plant pests are really perceived by farmers in the field. This can adversely affect farmers, such as difficulties in determining the agricultural calendar and declining crop production and productivity, leading to food insecurity (Panjaitan et al. 2018; Santika et al. 2020).

The strategy of the transmigrant community in the Kumpai Batu Bawah Village

Unlike the local farmers who can select locations to grow rice, vegetables, and perennial crops, transmigrant farmers in Kumpai Batu Bawah Village do not have this option. The location of the land given during the transmigration placement has been determined by the government, whereas they must manage the two hectares of land that has been given. At first, transmigrant farmers experienced great difficulties, especially when they found out that the land conditions in the village were far different from the land conditions in their home areas. But over time, their experiences and interactions with local communities have provided certain knowledge and adaptation, for example, distinguishing between the rainy season and the dry season and predicting extreme floods and droughts by observing natural signs.

Specific knowledge of transmigrant farmers in managing peatlands is obtained through several stages. At the beginning of arrival, the land clearing was carried out using a controlled slash-and-burn system adopted by the local community. Likewise, the planting process at the beginning of land clearing has been carried out not only in a *ditugal* way but also using superior rice seeds distributed

by the government through the Indonesian Ministry of Agriculture or local superior rice seeds obtained independently through local residents. Even without using large inputs such as lime and fertilizers, rice production has continued to increase compared to the planting in the first year. But still, on average, their rice production is lower than that of lowland rice, as they could acquire on the island of Java.

In addition, the rise of the green revolution has affected the way of farming of the transmigrant community in Kumpai Batu Bawah Village. In the 1980s, some farmers began to apply rice cultivation techniques of Javanese (Figure 6). For example, peatlands are plowed, given agricultural lime to reduce acidity levels, fertilized, and protected from pests and diseases using inorganic pesticides. Such practices in peatlands effectively increase rice productivity, especially when using the recommended nationally superior seeds.

The triumph of some transmigrant farmers then encouraged other transmigrant farmers to imitate the adaptation. Several years later, more intensive support for canal infrastructure helped transmigrant farmers plant rice from only once a year in the beginning to twice a year. Therefore, the village of Kumpai Batu Bawah was one of the centers for rice granaries in West Kotawaringin District until 1993s (Figure 6).

However, over time, the condition of the peatlands in the village of Kumpai Batu Bawah began to change, mainly due to the massive canalization that was built as a means of supporting the national food security program. In addition, the inaccuracy of planting system innovations on peatlands by adopting lowland rice cultivation techniques in Java has a negative impact. After a few years, pyrite begins to appear in the tillage layer (0-30 cm), which causes increased soil acidity and saturation of aluminum, thus damaging the growth of rice plants (Saputra and Sari 2021; Yeny et al. 2022).

Although the planted area for lowland rice and upland rice has decreased drastically, the planted area for secondary crops, vegetables, and plantation commodities has continued to increase (Figure 7). Changes in the

condition of peatlands in the village of Kumpai Batu Bawah were then exacerbated by climate change and the emergence of disasters such as floods and extreme droughts, inevitably making the community return to adapting, primarily related to planted commodities.

The connections between communities and their lands are an essential source of adaptation. Farmer adaptation strategies for forest and peatland fires include adjusting the crop pattern (Hosen et al. 2020; Rozaki et al. 2022). When farmers think that the rainy season will be longer and cause major floods, they will anticipate changing crop commodities. Farmers on peatlands tend to select crops with shorter lifespans, such as mustard greens (*Brassica juncea*), water spinach (*Ipomoea aquatica*), and spinach (*Amaranthus* sp.) over maize (*Zea mays*) and eggplant (*Solanum melongena*), so they can harvest before the water submerges the land, while other adaptations are in the form of shifting rice commodities into plantation commodities such as rubber and oil palm. In addition, they also started using polybags to grow vegetables such as green onions (*Allium porrum*), chilies (*Capsicum annum*), and tomatoes (*Solanum lycopersicum*) as an adaptation to floods that inundated their land for a long time (Figure 8). Thus, farmers can still earn income from their agricultural land.

Knowledge related to the local environment and agricultural practices applied by transmigrant farmers has a positive impact on reducing the incidence of fire disasters on peatlands. Although the knowledge of transmigrant farmers in recognizing natural signs is not as complex as the knowledge of the local farmers due to less time to observe nature and experience in managing peatlands in the area compared to local communities who have managed peatlands for generations, it is quite effective to make them alert and anticipate the situation. Although such knowledge cannot directly prevent land fires, it can at least minimize economic losses due to disasters, especially if considering the different characteristics of forest and peatland fires that are not caused solely by natural factors but also by human activities or anthropogenic factors (Hu et al. 2017; Sarmiasih and Pratama 2019; Watson et al. 2019; Barmputis et al. 2020).



Figure 6. Rice fields in Kumpai Batu Bawah Village, West Kotawaringin District, Central Kalimantan, Indonesia in 2014. Source: Documentation of Agricultural Extension in West Kotawaringin District (2014)



Figure 7. Agricultural land in Kumpai Batu Bawah, West Kotawaringin District, Central Kalimantan, Indonesia which almost flooded in 2014. Source: Documentation of Agricultural Extension in West Kotawaringin District (2014)



Figure 8. One of the adaptation strategies of transmigrant farmers in dealing with land conditions in the village Kumpai Batu Bawah, West Kotawaringin District, Central Kalimantan, Indonesia

The land security system built by transmigrant farmers in the village of Kumpai Batu Bawah to prevent fire disasters is slightly different from that of the local farmers in Baru Village. Only a few transmigrant farmers deliberately make ditches or *tatas* on the borders of their lands. According to transmigrant farmers, the clear distribution of land from the government makes wooden stakes sufficient to mark the boundaries of land ownership. In addition, the majority of transmigrant farmers, although they also practice the slash-and-burn system when clearing land, rarely build *tatas* or firebreaks. Transmigrant farmers planted banana trees, not with the intention of marking land boundaries or preventing the spread of sparks to their land, but for economic purposes. In addition, the planting position is usually not exactly on the border of the land, as is done by the local farmers. According to them, planting banana trees on land borders is actually dangerous because the dried leaves and bark of banana trees can be one of the triggers for fire to spread to their land.

However, the similarity is that transmigrant farmers also routinely clean dry leaves on the land borders in anticipation of fire sparks, especially if the long dry season comes. In addition, transmigrant farmers usually provide water pumping machines on their land. They take water from wells or irrigation canals using pipes. Under normal circumstances, this aspirated water will be used to meet the water needs of crops and vegetables. If the dry season comes, the water will be mapped by village officials to be reported to the officers of the National Disaster Relief Agency (BPBD) of West Kotawaringin District as a water supply, thus facilitating the process of extinguishing fires at any time there is a land fire around their lands.

As in Baru Village, the villager of Kumpai Batu Bawah is also encountering economic changes or remittances for work outside the village, and changes in the education system, resulting in a weakening of traditional skills or environmental knowledge regarding the recognition of natural signs that play a significant role in lowering disaster risk in the area (Dekens 2007).

Factors influencing the different strategies of local and transmigrant communities

The ethnicity of the two communities determines the cultural pattern, both in abstract forms such as ways of looking at nature, as well as knowledge related to the environment. The cultural pattern is subsequently to be expressed in the form of behavior such as peatland management practices for agriculture, which may contain disaster mitigation and play a role in disaster risk reduction. The local community in Baru Village, for example, is excellent at apprehending natural signs related to the environment and utilizing this mastery to manage their agricultural land and minimize environmental damage. This is reflected in their land management practices, such as not turning peatlands or not plowed, selecting local commodities that are more adaptive to marginal lands, using natural materials to overcome acid soil (Sazawa et al. 2018; Bourdon et al. 2021), controlling pests and diseases, and practicing traditional agroforestry planting patterns, in which such practices have been the result of thousand years of trial and error by their ancestors.

For transmigrant farmers in the village of Kumpai Batu Bawah, despite having interacted with peatlands for decades, they have repeatedly tried peatland management for agriculture and exchanged information with local residents, and their agricultural management practices tend to be more varied. The technological innovations provided are generally faster due to the motivation to successfully manage the land they currently have. However, agricultural practices with high chemical inputs and the use of machines to cultivate peatlands could reduce soil quality and result in a decrease in agricultural productivity. Therefore, it can be seen that although agricultural productivity in local communities is not that high, it is naturally sustainable when compared to transmigrant communities which are able to produce high productivity over a certain period but are ultimately less sustainable. This, in the end, will also have an effect on reducing the risk of peatland fire disasters. One of them can be seen from the fire coverage in the two villages. In local communities, the fire coverage tends to be smaller due to their better land security systems. The ditches or *tatas*, which double as land markers and firebreaks, can generally be used as a last line of defense to prevent fires from spreading on peatlands.

In 2019, the village of Kumpai Batu Bawah with a total area of 2,350 hectares, experienced a land fire disaster of 55 hectares, and only 16 hectares could be extinguished. Meanwhile, Baru Village which has a total area of 7,920 hectares, has experienced a land fire disaster of 53.25 hectares and can be extinguished for an area of 18.25 hectares. It can be seen that Baru Village, which has an area of almost three times that of Kumpai Batu Bawah Village, has actually experienced a smaller burned area and a larger extinguishing range. In addition, canalization also affects the severity of degradation, which in turn exacerbates the risk of land fires (Amal et al. 2019; Sutikno et al. 2020). In Baru Village, the primary canal is 9,000 meters long, and the secondary canal is 13,650 meters, while in the village of Kumpai Batu Bawah, primary and

secondary canals have been built at 13,050 meters and 39,440 meters, respectively. Although the area of Kumpai Batu Bawah is only a third of the Baru Urban Village, the primary and secondary canals are much larger, so they considerably affect the decrease in water level, especially during the long dry season. Hayasaka et al. (2014), in their study in the former peat land clearing area, suggested limiting the construction of irrigation canals that contribute to further development and subsequent drying of the soil.

Based on our study, it can be concluded that land and forest fire have been determined by natural and anthropogenic factors, including agricultural practices. In the past, the practices of traditional shifting cultivation of Dayak communities were strongly based on TEK and embedded with culture, as a result, some land and forest fires rarely occurred. Nowadays, the casualties of land and forest fires disasters have tended to increase due to both natural environmental changes, including climate changes, and anthropogenic factors. Some TEK and cultural factors have been considered essential factors in affecting the strategies of both communities in the villages of Baru and Kumpai Batu Bawah, for dealing with land and forest fire disasters in South Arut Subdistrict, West Kotawaringin District, Central Kalimantan Province.

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