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REGULAR RESEARCH ARTICLE

Impact and Mitigation Measures of COVID-19 towards Food Security Through Participation in Forest Management by Community in Sook, Keningau District, Sabah

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ABSTRACT

The COVID-19 pandemic has significantly impacted food security for the people due to the imposition of stringent measures to halt the spread of COVID-19 transmission. This study aimed to measure the community's perception of the level of COVID-19 impacts on their food security and to identify the community's participation in forest management around the Forest Management Unit (FMU) in Sook, Keningau District of Sabah, to improve their livelihood. A mixed-method approach was conducted where a total of 122 respondents were sampled using a questionnaire survey, focus group discussion with communities, and expert interviews to gather more valuable data. The result showed that the communities were primarily involved in forest management through employment, empowerment, capacity building, and decision-making, which could indirectly contribute to their food security. Meanwhile, the impacts of the COVID-19 transmission were found to moderately affect the people who live inside or adjacent to the forest. The impacts could be explained based on eight themes as the outcome of Principal Component Analysis (PCA): market access, food storage and safety, resource availability, adequate nutrition, food aid, affordability, continuous food supply, and food adaptation to shock. Communities were mainly involved in agricultural practices and could obtain resources from the forest to supplement their daily need. The communities raise a prominent issue regarding land tenure that needs to be resolved; thus, it is suggested that imperative action be considered to create a balance between conservation, economy, and social responsibilities.

KEYWORDS

COVID-19; Forest management; Food security, Communities participation; Sabah.

1. INTRODUCTION

Food security features four dimensions: availability, accessibility, stability and utilization of food resources. The dimensions generally make up the definition of food security which is internationally accepted as "food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (HLPE, 2017). The food security definition has evolved through the years as researchers conceptualized the term more sufficiently. The word 'food security' alone is too broad for a systematic review. Thus, it can be elaborated into relative cases that are fairly homogeneous in terms of complexity, scale, and indicators used. Peng & Berry (2019) suggested that food security dimensions should be identified in line with different levels: global, national, local, and household levels, to successfully justify the concept. The Food and Agriculture Organization (FAO) used the term 'prevalence of undernourishment' as an indicator to monitor food security in the world. However, it failed to adequately represent how complicated and multifaceted food security is (FAO et al., 2013).

Various studies have listed a few keywords or indicators to measure each dimension of food security identified at national, local, and household levels. For instance, the indicators for food availability include the 'physical presence of food', 'purchase from the market', 'import' (Kuwornu et al., 2013), and 'food aid' (Riely et al., 1999). Food accessibility can be translated as owning assets or services that could increase their ability to obtain adequate sources and satisfy nutritional requirements (Ecker & Breisinger, 2012). These include 'financial support', 'physical access', and 'social factors' (Morse et al., 2018). Meanwhile, food utilization involves the appropriate use of food, including processing, storing, and nutrition knowledge, while adequate sanitation services exist (USAID, 1992). Food utilization includes physical means such as cooking utensils, knowledge, food preference, and family structure. In contrast, biological means involve the consumption of nutrients and food safety concerning sanitation, clean water, and health (Renzaho & Mellor, 2010). Lastly, food stability comprises the three other dimensions of food security, availability, accessibility, and utilization. It can simply mean having access to enough food that is still adequate during uncertainties such as climate events, economic crises, or seasonal food inaccessibility (García-Díez et al., 2021). Food security has emerged as a major global challenge as everyone seeks food to ensure the continuation of their livelihood. Before the Coronavirus 2019 (COVID-19) occurred, more than 821 million people were reported experiencing hunger, and the highest recorded is still in Asia (FAO et al., 2019). Then, it was estimated to increase from 702 million to 828 million people in 2021 (FAO et al., 2022).

The Malaysian government declared the Movement Control Order (MCO) on 18 March 2020 to control COVID-19 transmission. The imposition of the order resulted in the implementation of various mitigation measures intended to curb disease transmission. According to Mohiuddin et al. (2020), the prominent economic earnings for the community in rural areas come from agricultural activities. Though it is suggested that agriculture activities are the least affected during COVID-19 transmission (Ibrahim & Othman, 2020), the MCO's restrictions on people's movement and transportation have impacted supply chains and logistics, notably for farmers seeking to sell their produce. Along with the MCO, the communities' fear of being infected with the virus from outsiders have strictly complied with the standard operating procedure (SOP) that includes social isolation, frequent handwashing and sanitizing, wearing a face mask, avoiding travel to Covid-19 affected areas, self-isolation for 14 days if symptomatic, and recommendation to staying at home (Elengoe, 2020). They have also been putting up roadblocks in their villages that hinder the middlemen's collection of their harvests, such as rubber and oil palm (Rahman, 2020). Ooi & Dambul (2020) also explained that smallholder farmers are experiencing a significant loss on their harvested crops as they have no networking, price determination strategy, and financial resources to transport their products to consumers.

The MCO implementation put the jobs and income of the communities at risk. Rural communities in Malaysia are mainly involved in small and medium enterprises. These include agriculture and service sectors, including tourism, manufacturing, and construction, where the limit in operation leads to a permanent shutdown, people start losing their job, and individuals encounter financial pressure (Hassan et al., 2021). In addition, a survey by (Sharudin, 2020) gave evidence that only 53% of low-income earners feel secure with their current jobs, yet 92% of the workers feel stressed by the pressure of the possibility of losing their jobs, while 73% believe that it will be hard finding new jobs after losing one due to the current pandemic situation. As a result, communities that have already lost their source of income and jobs might impede their ability to purchase food.

Forest areas in Sabah are under the state government's jurisdiction, divided into multiple Forest Management Units (FMUs). Forest management in Sabah is adopting the Sustainable Forest Management (SFM) policy, which highlights the forest benefits in terms of social, economic, and environmental (Jugi & Ripan, 2018). To improve forest quality and sustainability, the state government formed a partnership with private sectors to manage the forests through the Sustainable Forest Management License Agreement (SFMLA). The partnership with the private sector will help cushion the resource management budget while the state can focus more on monitoring and policymaking (Mashor et al., 2018). Under the SFMLA, FMU holders should ensure the forest functions as a multiple-use forest based on their Forest Management Plan (FMP), which entails a clear forest management guideline for ten years (Jaini et al., 2015). They should perceive the community issues and implement social forestry to induce community participation in forest management around forest boundaries (Johnlee et al., 2020). Social forestry in Malaysia is defined as "...the involvement of indigenous peoples and local communities on their own initiatives or in collaboration with relevant stakeholders in forest management from the aspects of social, economic, culture and environment for sustainable livelihoods" (MENR, 2022).

The Sabah Forest Policy 2018 aims to strengthen the community's participation in forest management activities. It outlines strategic and various action plans that can be implemented to recognize the community's participation in forest management activities. These include employment, planning, contract service, and decision-making (Sabah Forest Policy, 2018). A few decades before the forest policy was revamped, the state government, through Sabah Forestry Department, had already established a collaboration with communities in forest management through joint forest management. It involves agroforestry projects, biodiversity protection, and community forestry projects which aim to improve their living condition and livelihood (Tongkul et al., 2013). Their involvement in these projects would improve their socio-economic and food security. Though private sectors are bound to achieve the same goals, the information on their progress is still limited and less covered in academic discourse. The local community plays a key role in improving the forest, and their involvement can greatly increase the sustainability of these resources. This claim is based on the fact that locals are accustomed to being close to the forest and depending more on its supplies (Jain et al., 2016). They are often associated with livelihood activities involving collecting forest resources such as food, meat, fodder, and fuel wood. Their long experience with the forest has led to the establishment of traditional knowledge that provides a wide range of natural resource management practices without jeopardizing the goods and services of the forest for future generations (Parrotta & Agnoletti, 2012). Therefore, their knowledge passed down through generations could help the government in forest management. Yet, the FMU should expect that the communities would require assistance in improving their livelihood in return (Shebli et al., 2014). Communities in rural areas are often associated with greater poverty rates, lower income, and lower education levels than urban areas (Hassan et al., 2021). Their vulnerability is then exacerbated by the infrastructure gaps between rural and urban areas that hinder their access to basic services, which are prominent to improve their education, health, food demand, and chance to make a decent livelihood. Infrastructure such as roads ensures access to safe and nutritious food, diversification of livelihoods, and income-generating activities (Memon & El Bilali, 2019).

Sabah is a large land known for its geographical areas surrounded by multiple highlands and protected forests. It is suggested that an isolated place could be a safe shelter from disease transmission as it is easy to maintain social distancing, while nature and heritage could play a crucial role in social cohesion (De Luca et al., 2020).

However, for indigenous people, access restrictions and conflict to their territory were already a serious challenge before the epidemic, and the issues have only worsened since then (Siscawati, 2021). A similar case in Lubuk River Basin, East Kalimantan, revealed that the community living in a resettlement area is facing difficulties in maintaining their food resources due to limited land for cultivation and overlapping problems and conflict with the FMU holder (Wahyuni and Wiati, 2022). In addition, the utilization of forests in that area will depend on laws and regulations as well as forest planning. Meanwhile, in West Kalimantan, communities whose land rights were recognized portrayed the forest as a warehouse that could supplement their food security because resources such as crops and medicines are easily retrievable from the forest without strict regulation (Siscawati, 2021). Unfortunately, the COVID-19 mitigation measures have placed indigenous peoples in an incredibly challenging situation by adding quarantine measures that make it harder for communities to access the forest and a lack of government assistance. It is still questionable whether the community would be benefited from nature for their livelihood and as a mitigation measure from the COVID-19 disease transmission. Therefore, this study attempted to identify the community involvement in forest management, specifically around the FMU area, and to measure their perception of the COVID-19 impact on food security.

2. METHODOLOGY

The study was conducted in four villages near the Forest Management Unit 11 (FMU 11) in the Sook sub-district, Keningau, Sabah. The FMU 11 was operated by a private company, Bornion Timber Sdn Bhd (BTSB), licensed for a 100-year term under the Sustainable Forest Management Licensee Agreement (SFMLA). Two forest reserves, the Ulu Sungai Millian and Sapulut make up the concession with a total area of 98,985 hectares (ha). The FMU is further divided into various compartments based on management objectives which fall under Natural Forest Management (NFM), Industrial Timber Plantation (ITP), Community Forest, and Conservation and Protection Zones. Multiple villages had revolved around the concession area, inhabited by native people from different ethnicity and socio-economic background. For this study, four villages were selected, namely Wawasan, located inside the forest reserve; Simbuan, Alab Lanas, and Batu Lunguyan, which were approximately 1 to 3 kilometres from forest boundaries. The total number of households (N) in every village was identified: Wawasan= 20, Alab Lanas= 100, Simbuan= 150, and Batu Lunguyan= 60. The communities' ethnicity in these study sites is mostly Dusun and working as farmers. Their main agricultural activities include cultivating rubber trees, oil palm plantation and cocoa for cash crops, planting vegetables and paddy and collecting non-timber forest products for subsistence use.

In this study, the data are obtained through primary and secondary data. Primary data is collected through household surveys, Focus Group Discussions (FGD), and interviews. The questionnaire survey consisted of open-ended questions; to identify the respondents' opinion on disease transmission and to determine the government assistance provided in reducing the 'pandemic's impact on the community. In addition, close-ended questions are used for respondents to select the answers based on the questions and the Likert Scale to indicate the respondents' level of agreement on certain questions where the scores are given as '0=not applicable', '1= strongly disagree', '2= disagree', 3='moderately agree', '4= agree' and '5= strongly agree'. The questions include the communities' level of agreement on the impact of COVID-19 on their food security and livelihood. For the household survey, the communities were selected through convenience sampling. The minimum target of respondents being sampled was 30%, and the respondents would be the head of every household (ASFCC,

2016). Since the data was collected amidst the COVID-19 transmission, villagers still hesitated to welcome visitors into their houses. Thus, after an initial discussion with the heads of the villages, they willingly contacted every head of the household to gather at the community hall for the survey. The data collection was also conducted twice in January and March 2022 to cover as many respondents as possible for the targeted samples. Meanwhile, the respondents were categorized into groups, men, women, and youth, for the FGD session to collect more in-depth information. Each group consisted of at least ten participants and was facilitated to answer a few questions that followed up a further understanding of their livelihood activities, COVID-19 impacts on their food security, and their preventive measures toward the disease. In addition, a semi-structured interview with representatives from the Sabah Forestry Department and the private company was conducted to investigate the communities' involvement in the management of the FMU. Literature reviews from past studies were obtained as secondary data to support the findings in this study.

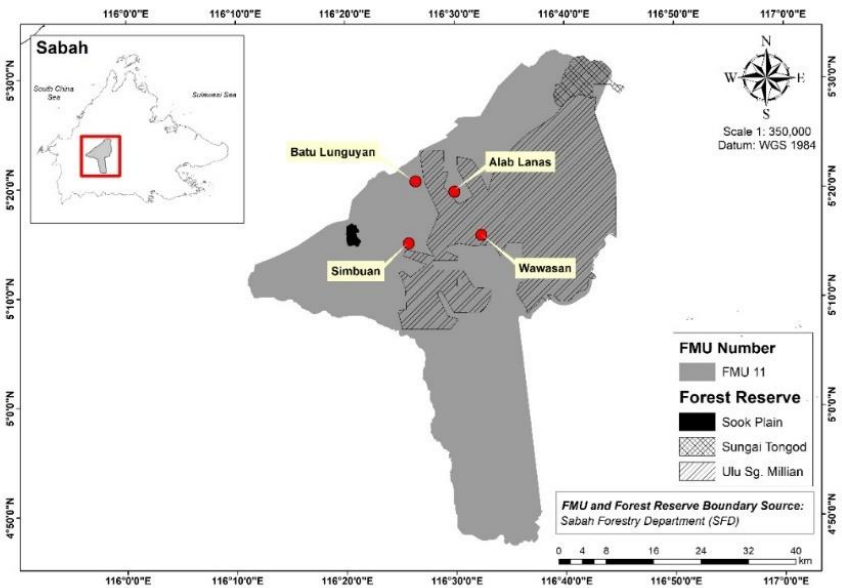

Figure 1. Research site. Source: Sabah Forest Department (SFD)

The data were analyzed using software of Microsoft Excel and Statistical Package for Social Science (SPSS). The data were presented in descriptive analysis involving percentage, frequency and weighted average. Principal Component Analysis (PCA) was conducted to statistically reduce large datasets more interpretably while minimizing important data loss. By examining the scenario from a wider context, PCA was used in this study to determine the actual situation and the magnitude to which the Covid-19 transmission has affected their food security.

3. RESULT AND DISCUSSION

3.1 Socio-demographic information

A total of 122 respondents participated in this study, where 20 respondents came from Wawasan, 47 from Simbuan, 33 from Alab Lanas and 22 from Batu Lunguyan. Most were male (67%), and 73% were married. Meanwhile, 90% of the respondents were of Dusun ethnicity, followed by 8% Sungei, 1% Malay and 1% Murut. The respondents also

received formal education from secondary school (66%), primary school (12%), university (10%) and college (7%), yet 5% of them did not receive any formal education. Most of the respondents worked independently as farmers (79%), while others were employed in the private sector (8%), government sectors (7%), businesses (3%), and pensioners (2%). The income of the respondents was expectedly varied, where 30% of them had a monthly income of around RM501 to RM999, followed by 25% RM1000 to RM1499, 19% under RM500, 10% more than RM3000, 9% RM2000 to RM2499, 5% RM2500 to RM2999 and lastly 2% of respondents who managed to generate income around RM1500 to RM1999. Most respondents were listed below Sabah's median income of RM3773 (data as of 2020) (DOSM, 2021).

3.1.1 Communities' dependency on forest

The four villages are located within (Wawasan-Compartment 59) and adjacent to the licensed area, which is approximately 1-3 kilometres from the forest (Simbuan, Alab Lanas and Batu Lunguyan). Their residential areas, located near the forest, projected their frequency of visiting the forest for different purposes. Most of the respondents enter the forest more than three times per week (29%), while others visit the forest 1-2 times per week (12%), 1-3 times/per month (20%), and never visit the forest (18%). Their frequency of forest entry later described their rating on their dependency on various forest resources. From this study, most communities had a very high reliance on forests and trees for food and construction (56%), agriculture production (53%), recreational (25%), collection of medicinal (54%) and other non-timber forest product for provision of food and material for handicrafts (55%). Meanwhile, communities only moderately relied on hunting activities (29%).

3.1.2 Communities' involvement In Forest Management and Food Security

In terms of community forestry and food security, the FMU holder tried to improve the socio-economic and livelihood of the communities by providing job opportunities. The agreement states that any license holder should involve at least 30% of Sabahan natives, known as Bumiputera, to join the company (SFD, 2007). Therefore, communities around the FMU were given the privilege of being hired as staff to join the company or as contract workers. Table 1 highlights the percentage of respondents who received job opportunities from the FMU holder. It showed that 17% of the respondents were individually hired as workers in FMU. In contrast, the respondents interviewed might or might not be employed as workers in the FMU, but 56% also reported that their family members were involved in these job opportunities. Most of them worked as tappers on rubber plantations, and some worked in forest plantations and as officers in the FMU. The communities who worked as rubber tappers within the private company could generate an average income of RM1,200-RM1500 per month and highest paid up to RM9000 per month depending on their persistence (Bornion, 2019). Their recruitment in the company will provide a stable monthly income, which could increase their access to food through purchasing power.

Table 1. Percentage of respondents' involvement in FMU through employment (n=122)

Employment with FMU	Yes (%)	No (%)
Individual	17	83
Family member	56	44

The concession holder has signed a tenure for 100 years, which means they were bound to the overall objectives of Sustainable Forest Management (SFM), where indigenous-related issues also become part of their forest management plan (SFD, 2007). Therefore, the FMU holder established a mechanism to empower communities

that encouraged them to become part of the Millian-Sapulut Community Forestry Committee (MFCSC). This platform aimed to resolve any issues and grievances related to forestry among the forest stakeholders. The FMU holder also involved the community in mapping and establishing demarcation areas between their villages and the forest areas, joint inspection, and maintenance of the water catchment for the communities' daily use.

Local communities and forests are mutually beneficial and depend on each other to continue growing. The existence of other forest stakeholders who develop different interests in the forest functions causes conflicts between them. According to Lunkapis (2018), implementing FMU within the well-defined and demarcated area has limited the community's access to available resources, subsequently threatening their livelihood. On the other hand, the issue concerning customary indigenous land will somehow become critical. Similar cases also happen in these areas where communities are making continuous efforts to defend their right to land tenure to accommodate the increase of their population and for cultivation. Unfortunately, the communities expressed their concern about their land, which could be potentially converted into forest land, as they are now aware of the FMU establishment around their area. This case was found to happen in Batu Lunguyan and Alab Lanas, where the communities had previously cultivated crops on their farmland which are now inside the FMU demarcated areas; thus, it resulted in the communities giving up their land to the FMU. The FMU holder somehow clarified that they have no authority to offer a solution as it is beyond their capability to finalize the decision. Instead, they still show some leniency by allowing the community to harvest crops they have planted in that area for their use but without further expanding the land. In terms of food security, according to the Sabah Forest Enactment, the communities were only entitled to harvest non-timber forest products (NTFP) (Yahya, 2019), such as wild fern, *bunga kantan*, *tuhau* and raw materials for handicrafts at the forest boundary for their consumption, however, with prior notice.

3.2 The impact of Coronavirus (COVID-19) on food security and approaches to mitigate COVID-19 transmission

3.2.1 The impact of Coronavirus (COVID-19) on food security

PCA analysis has identified 21 variables to form the components that explain the impacts of COVID-19 on the community's food security. The Kaiser Meyer-Olkin (KMO) value obtained is 0.706, which means the variables are suitable for data analysis as the value is above 0.50 (Yong & Pearce, 2013). The factor loading value selected is more than .50 by referring to the rotated component matrix. The eight components were extracted based on the eigenvalue, which is more than 1, with the cumulative total variance explained at 68.90%. The individual variable was coded from V1 to V21 and classified into relevant themes. The themes for the eight components were named 'market access', 'food storage and safety', 'resource available', 'adequate nutrition', 'food aid', 'affordability', 'continuous food supply', and 'food adaptation to shock'. Table 2 below shows the impact of COVID-19 on food security from the communities' perspectives.

Table 2. The outcome of Principal Component Analysis (PCA) and their given theme

Comp	Code	Variable	Rotated component matrix	Theme
1	**V1**	Movement control order hinders the selling and buying of crops	.897	Market access
	V2	Road closure	.867	
	V3	Market closure	.842	

Comp	Code	Variable	Rotated component matrix	Theme
2	**V4**	Lack of knowledge of how to preserve food	.764	Food storage and safety
	V5	Lack of means for food storage (i.e., refrigerator etc.)	.711	
	V6	Malnutrition due to unhealthy eating habits	.698	
3	**V7**	Usage of fodder from the forest to feed the livestock	.699	Resource available
	V8	Increase agriculture production through more land opening	.676	
	V9	Hunting of meat and wild animals	.671	
4	**V10**	Gathering of herbs and medicine from the forest increase	.769	Adequate nutrition
	V11	Good access to water sources for sanitation, hygiene and food preparation	.766	
	V12	The by-product of vegetables, honey and wild meat still easy to find	.682	
5	**V13**	The government help a lot in increasing agricultural yields	.767	Food aid
	V14	Received food assistance from the government	.721	
	V15	Rely entirely on agricultural produce to ensure an adequate daily food supply	.530	
6	**V16**	Job loss	.849	Affordability
	V17	Income loss	.772	
7	**V18**	Stockpile food	.803	Continuous food supply
	V19	Panic buying	.787	
8	**V20**	Shift to highly processed food	.831	Food adaptation to shock
	V21	Shifts to cheaper food	.577	

Based on the result, the first component is named 'market access' and comprises three variables: V1, V2, and V3. Variables categorized in this theme generally reflect the community's access to nearby markets to obtain food and other resources. The MCO implementation to halt the COVID-19 transmission has resulted in road and market closures, impacting the communities' businesses that involved selling and buying crops. The second component is themed 'food storage and safety, consisting of the variables V4, V5, and V6. This component reflects how the communities utilize and store their food supplies. Preserving food became a challenge due to limited knowledge, and less variety of food may likely cause them to experience malnutrition. Next, the third component, which consisted of variables V7, V8, and V9, highlighted the 'resources available'. The mobility restriction had likely caused the community to use fodder from the forest to feed their livestock, increasing their agriculture production and hunting for bushmeats. Variables V10, V11, and V12 made up the fourth component, adequate nutrition.

Meanwhile, the fifth component is formed by the V13, V14, and V15 and is explained as 'food aid'. This component highlighted the availability of other food resources to supplement the community's food during the MCO implementation to curb the disease spread. The sixth component consisted of variables, V16 and V17, named 'affordability'.

This component reflects the impacts felt by the communities who experienced job and income loss due to the implementation of COVID-19 mitigation measures. When their jobs were affected, they lost their income sources, thus led to reducing purchase power and impacting their food quantity. The seventh component is interpreted as a continuous food supply. This component illustrates the ideas that explain food stability at the household level. To ensure enough food supplies, communities kept food stocks and panic buying. Lastly, the eighth component, interpreted as 'food adaptation to shocks', also explains the similar event of communities' food during the unusual event. In this case, during the disease transmission, communities tend to practice adaptation strategies to ensure continuous food supplies in their household by shifting to cheaper and highly processed food

3.3 Communities' rating on the impact of Coronavirus (COVID-19)

Figure 2 highlights the 21 variables and the eight components derived from the PCA analysis. The respondents rated the following COVID-19 impacts based on their experiences throughout the disease transmission and MCO implementation in their respective areas. The rating is based on the Likert Scale, where it is interpreted as 0=not applicable, 1=strongly disagree; 2=disagree; 3=moderately agree; 4=agree; 5=strongly agree. The result shows that the spread of the disease, which resulted in the MCO implementation, has impacted the community's market access and nutrition adequacy at a moderate level. For market access, the strict measures limiting people's movement had moderately impacted the process of selling and buying crops (Code V1; 3.57). For instance, according to the respondents, buyers from the Sabah Rubber Industry Board usually came once every two weeks to collect their products but were temporarily stopped amidst the disease transmission. The restricted movement of people would also mean that the supply side of the food chain is beginning to suffer from the disruption of farm labour and the supplies required to generate food. Therefore, their access to fresh food would be impaired (HLPE, 2020).

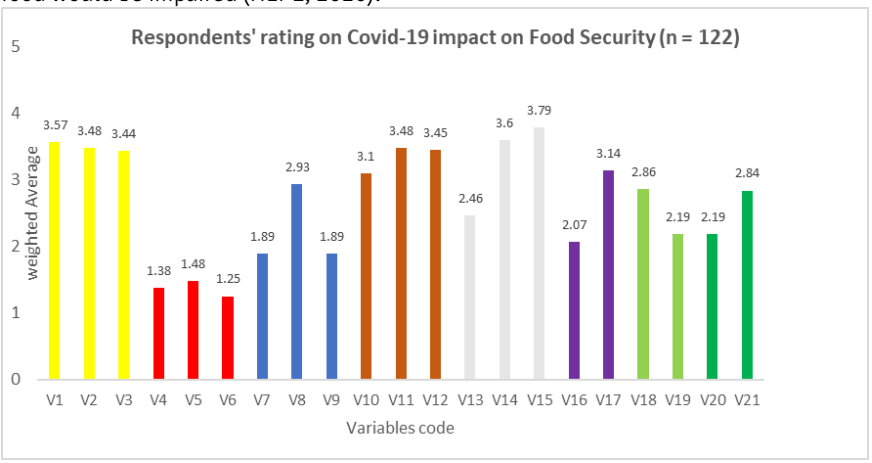

Figure 2. The communities' rating on the Covid-19 impact on their food security
Note: Level of impact based on Weighted Average (0=not applicable, 1=strongly disagree; 2= disagree; 3=moderately agree; 4=agree; 5=strongly agree)

Meanwhile, in the component 'adequate nutrition', the communities had been moderately impacted by the disease as they still can maintain hygiene and process food as they have access to clean water (Code V11; 3.48). The communities can fairly obtain by-products such as vegetables, honey and meat from around the house, garden, their

livestock and from the nearby market (Code V12; 3.45) or by entering the forest to retrieve resources (Code V10; 3.10). In terms of food aid, the communities also moderately agree that Covid-19 caused them to rely entirely on their agricultural produce (Code V15; 3.79) as they also received food and monetary assistance from the government to cushion the impact of COVID-19 toward their food security in household level (Code V14; 3.60). Even before the Covid-19 outbreak, some communities that ventured into agricultural activities and cultivated crops such as rubber, oil palm, cocoa and paddy plantation were commonly receiving assistance on fertilizers, pesticides and seedlings. These were provided by related agencies such as the Sabah Rubber Industry Board, Malaysian Palm Oil Board (MPOB), Lembaga Koko Malaysia (The Malaysian Cocoa Board) and Lembaga Pertubuhan Peladang (Farmers' Organization Authority). The government of Malaysia has announced various assistance to reduce the effect of COVID-19. The PRIHATIN stimulus package was designed to provide people with monetary aid, revive the economic downturn, and assist smallholder enterprises whose operations have been disrupted (Shah et al., 2020). Other notable financial, empowerment and health assistance announced by the government include 1) the People and Economic Strategic Empowerment Programme (PEMERKASA)-to support businesses for economic recovery; 2) the National COVID-19 Immunization Program-vaccination effort to achieve 80% herd immunity against the disease transmission; and 3) short-term economic recovery plan (PENJANA) which was established to support the operation of the business through empowerment, propel business and economy stimulation (Abd Rahman, 2021). COVID-19 has also lowered the purchasing power of some communities that lost their income due to the closure of businesses and limited income-generating activities (V17; 3.14).

On the other hand, the communities disagreed with the variables listed in the components 'resource available', 'continuous food supply' and 'food adaptation to shock'. The community disagreed that the COVID-19 transmission caused them to open more land for agriculture (Code V8; 2.93). They disagreed that they hunt for meat and use fodder from the forest daily (Code V7 and V9: 1.89). It was clarified through the interview that hunting activities for traditional practices are allowed with prior notice, and proper documentation needs to be presented. Despite that, this matter will be reverted to the related authority, such as the wildlife department and Sabah Forestry Department, to decide on the evaluation before giving out permission. In addition, the communities disagreed with the variable listed in the component 'food shortage and safety'. They are against the statements that they lack knowledge in preserving food and experience malnutrition due to unhealthy eating habits.

However, some communities did not own refrigerators to store and preserve food. This situation was recognized in Wawasan, located inside the forest reserve. They were not entitled to basic facilities such as electricity and depended on limited power generation from solar energy. Communities in rural areas usually possess indigenous knowledge passed down through generations. Ibnouf (2012) asserts that native foods that have undergone drying and fermentation processing can produce more affordable and nutrient-dense food for the general populace, serving as the foundation for the rural community's existence. Zhou et al. (2019) state that women benefit from food security more than men because women are entirely in charge of preparing, processing, and storing household food. By contrast, this study revealed that there is no gender difference in doing jobs to ensure food security at the household level. Men and women share the same responsibilities, except those men tend to do mostly the hard jobs compared to women.

3.4 Communities' approaches to mitigate COVID-19 transmission

The respondents highlighted a few keywords (see Figure 3) on the preventive measures they applied to avoid disease transmission within their areas during the FGD session and survey. Based on the open-ended question in the questionnaire survey, most communities mentioned their obligation to the Standard Operating Procedure (SOP) formulated by the government. At the same time, some of them specifically elaborated on the content of the SOP, such as practicing social distancing, self-quarantine, abiding by every government regulation and wearing a protective mask. Meanwhile, the communities also mentioned a few measures for self-protection, such as taking the vaccination, monitoring health, strict care in personal hygiene and always praying.

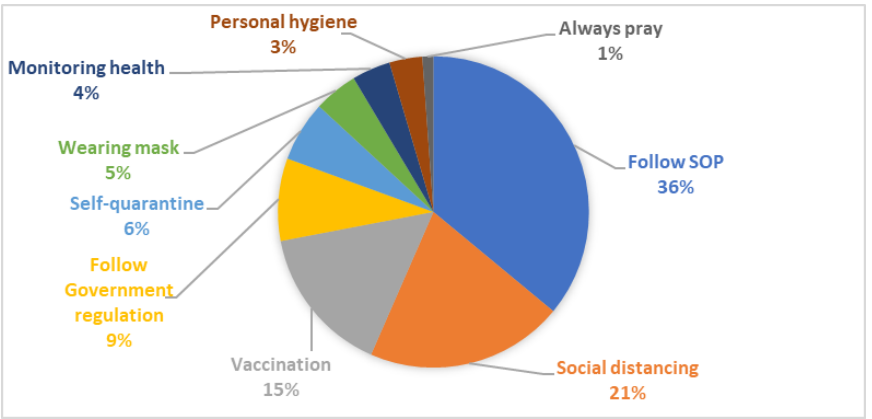

Figure 3. Community's approaches to preventing Covid-19 transmission, n=122.

The study revealed that the communities were only moderately affected by the disease transmission. It could be influenced by various factors such as their locality, which is isolated at the forest fringe and can easily maintain social distancing (De Luca et al., 2020). In addition, the communities also showed strong adherence to the standard operating procedures implemented by the government throughout the COVID-19 transmission and were fully aware of the need to wear protective masks, self-quarantine, regular health monitoring, vaccination and avoid mass gatherings. However, the aftermath of the early COVID-19 spread was unpleasant, where their access in and out of the village became difficult, which impaired their food security. Their income was reduced, and some claimed that they lost their jobs. Therefore, the communities went to the nearby forest area to retrieve wild food to supplement their food stocks at home. There would be a tendency for the community to rely more on forest resources during this event when they have less access to the market (Belcher et al., 2014) and start practicing coping strategies to adapt to the situation (Maxwell, 1996). Another factor that influences the moderate impact of COVID-19 on community food security could be that most of them were farmers, meaning their focus would be more on food production and income generation. Table 4 shows the list of communities' livelihood activities from the four villages, which help them generate income and ensure food security in their household.

Table 4. Communities' activities to support their food security at the household level

Livelihood activities	Wawasan	Batu Lunguyan	Simbuan	Alab Lanas
Rubber plantation	√	√	√	√

Livelihood activities	Wawasan	Batu Lunguyan	Simbuan	Alab Lanas
Oil palm plantation		√	√	√
Beehive-keeping	√			
Rearing livestock		√	√	
Collecting NTFP	√	√	√	√
Paddy plantation		√	√	√
Fruits orchard	√	√	√	√
Cocoa plantation		√	√	√
Cultivating vegetable crops	√		√	√

Based on the findings, communities from the four villages were involved in the rubber, fruit orchard and collection of NTFP. It was found that Batu Lunguyan, Simbuan and Alab Lanas communities have more diverse agricultural activities than Wawasan. The communities who live at the fringe of the forest could venture into rubber, oil palm and small-scale cocoa plantation for monetary gain. At the same time, Wawasan can only depend on rubber and fruits for income generation as this village is a community forest compartment located inside the forest reserve managed by the BTSB. To clarify, communities involved in rubber plantations could be on their land or working with the FMU. It was reported that the communities who cultivated rubber could generate a monthly income of around RM1000 or less and oil palm around RM700-RM800 per tan.

Meanwhile, some communities that planted cocoa can generate an income of around RM9 per kilogram for dried cocoa. Communities also cultivated vegetable crops such as sayur manis, onion, tomatoes, cassava, long beans, chilli, and cabbages. Next, fruits planted include durian, langsat, mango, rambutan, mangosteen, banana and pineapple. These food resources, including paddy, are mostly for the communities' consumption. Communities in Simbuan also generate income for their consumption from livestock such as pigs and buffaloes, while Batu Lunguyan sells Tilapia fish. Since the communities live nearby to the forest, they can retrieve NTFP, which include rattan, bamboo, tuhau (*Etlingera coccinea*), bunga kantan (*Etlingera eliator*) and tomborua (*Plectocomiopsis geminiflora* (Griff) Becc.). The demand for NTFP, such as bamboo and rattan, is significant among women in Batu Lunguyan to make handicrafts. Therefore, communities can be considered self-sufficient during the pandemic as they can obtain food from their agricultural production.

Although the communities cannot fully receive the benefit of the forest even though they are close to the resources, they could still obtain other benefits through its ecosystem services which could enhance the productivity of their crops. Forests cater to myriad non-provisioning ecosystem services, which are significant for agricultural intensification. These include water and local climate regulation, pollination and nutrition cycling, pest control, soil fertility improvement, and erosion control (Gitz et al., 2021). Meanwhile, the communities rely on non-timber forest products and crops to provide additional daily sustenance. Foods derived from forests could offer a variety of healthful foods that are high in vitamins and fibre and low in salt (Arnold et al., 2011). It also can support household nutrition in times of famine, low agricultural output, climate-induced vulnerability, and food shortages caused by other unexpected events (Vinceti et al., 2013). It is perceived that land for subsistence farming was more significant in this area. They need both land and income to ensure food security and better livelihood. Lunkapis (2018) revealed that the issue of land ownership has been going on for quite some time in this area, thus suggesting alternatives through capacity building and the establishment of commercial crops to help the communities improve

livelihood along with the economic and conservation activities around FMU. It is also prominent for the FMU to always ensure sustainable forest management as the forest has an important contribution to agricultural intensification through its ecosystem services, climate change mitigation and extreme weather condition (Atin et al., 2022).

3.5 FMU Roles in mitigating COVID-19 transmission

The FMU holder was very dedicated to aiding the communities with agroforestry projects, several sponsorships, training, and capacity building. Communities recruited to join their company will be first enrolled on a training programme to enhance skills and their performance at work. Various agroforestry projects, such as rubber plantation and durian budding training, were conducted to involve communities in their management. Meanwhile, they are also committed to empowering, especially women who have traditional knowledge of making handicrafts. For example, in Batu Lunguyan, there is a manufacturing and collection centre for handicrafts where women pioneer this project. Therefore, the FMU holder hosted a training session in collaboration with the Batu Lunguyan community to encourage nearby communities keen to venture into bamboo weaving, produce their products and sell them to supplement their monetary gain. In addition, they also performed their social responsibilities by providing the communities with facilities such as community halls, churches, relevant sponsorships, and incentives for students who excel in their studies.

The establishment of the community forestry division in their organization is the appropriate platform for the community to communicate with the company. The FMU holder played a significant role in mitigating COVID-19 transmission by allowing the community to collect non-timber forest products around their forest boundary. It is suggested that the FMU could also contribute to food security by integrating the multiple-use concept of the agroforestry system for food production and selecting a specific site for this purpose within the FMU area (Lintangah et al., 2022).

4. CONCLUSION

In conclusion, the communities were impacted by COVID-19 transmission at a moderate level. The impact can be explained based on 'market access', 'food storage and safety', 'available resources', 'food affordability', 'continuous food supply' and 'adaptation in time of shocks'. Communities are accustomed to living in isolated areas, making it easier for them to become adaptive throughout the MCO implementation. Meanwhile, their alternatives to food security are retrievable from the nearby forest boundaries, specifically, the non-timber forest products for their consumption and are mainly ventured into agricultural practices. It can be concluded that the communities were living a sufficient livelihood, but the issues on tenure and the right to the utilization of resources remain unresolved. The community strongly adhered to the government SOP; thus, they practice their mitigation measures against COVID-19 to avoid being infected by the disease. The communities' participation in forest management could contribute to sustainable forest management as they live closer to the forest area. However, the current forest policy has not fully recognized their roles in the forest. The dispute between the communities and FMU may affect the community's participation in resource management and lead to a misconception about the FMU establishment's core objectives in their area. Therefore, it is suggested that the pertinent action is to identify the communities' issues within the area, and alternative socio-economic for livelihood improvement shall be conducted to create a balance between conservation, economic and social responsibilities.

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