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Smallholding farmers wellbeing in ecosystem services area of high food provider in border area of Indonesia

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ABSTRACT

The utilization of wetland areas poses a threat to the wetland ecosystems's vitality. The Kayan Sembakung Delta in North Kalimantan Province is one of the wetland ecosystems that is widely used by humans for various activities, raising concenrs about its sustainability. This study aims to assess the area's carrying capacity and environmental capacity as well as the level of welfare of small farmers. The research was conducted in March-June 2020 in Tanjung Buka Village, Tanjung Palas Tengah District, Bulungan Regency, which is part of the Kayan Sembakung Delta area. The study employed an analysis of the carrying capacity of the environment as well as an analysis of the poverty and welfare assessment of farmer households using the Nested Sphere of Poverty (NESP) approach. The results showed that Tanjung Buka Village has an area with a high carrying capacity and environmental capacity as a food provider covering an area of 61,352.12 ha. Small farmers experience subjective and objective welfare in the moderate category. Increasing the welfare of small-scale farmers can be done through efforts such as repairing houses below proper standards, meeting food needs, increasing consumption of protein (meat, eggs, fish), providing clean water, diversifying income sources, ease of access to food. sources of employment, promoting conservation of wood and plant species, securing land tenure, complying with local regulations, and improving infrastructure.

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INTRODUCTION

There is a strong correlation between the use and utilization of natural resources, the quantity and quality of life environment, and the carrying capacity of life environment. Knowing the carrying capacity of life environment in a certain area is very strategic issue. Why is that? Understanding the carrying capacity of life environment in a specific area is equivalent to undertanding the capacity of environment to support the life of human and other living creatures, balance between them, and also t understanding the capacity of the environment to absorb energy and/or other substances included within the energy. Therefore, understanding the supporting capacity of the living environment is the initial step toward the better quality and quantity of life environment (Zhang et al., 2022). In this research, the carrying capacity of life environment of an area is estimated using an approach called "Ecosystem Services". According to (Sutrisno et al., 2022), the carrying capacity of life environment can be measured

by ecosystem services. This approach assumes that high performance of ecosystem services leads to high supporting capacity of life environment (Tougeron et al., 2016).

On the other hand, Johansen et al. (2012) explained that the carrying capacity of life environment of an area is determined by human activity in that area. The activity of smallholding farmers can increase the capacity of food provisioning but also have negative impact by degrading environmental carrying capacity. Conversely, environmental condition may affect farmers condition. Therefore, understanding the condition of smallholding farmers well-being in area with ecosystem services as high food provider is significant. The Poverty and wellbeing of smallholding farmers are understood through multidimensional concept. this research uses the model of Nested Spheres of Poverty (NESP) (Wahyuni et al., 2023). Under NESP model, poverty and wellbeing comprise various environments, or in other words, different daily lives. Central environment in this model is subjective wellbeing. Core environment that influences subjective wellbeing is health, material wealth, and knowledge. These three environments are indirectly affected by contextual environment which in the other hand directly influences subjective wellbeing. In this matter, contextual environment consists of natural, economical, social and political aspects (spheres) of the life that directly or indirectly influence core environment. Otherwise, the contextual environment is affected by infrastructure and services (Talukdar & Banthia, 2013). The illustration of NESP model is presented in Figure 1.

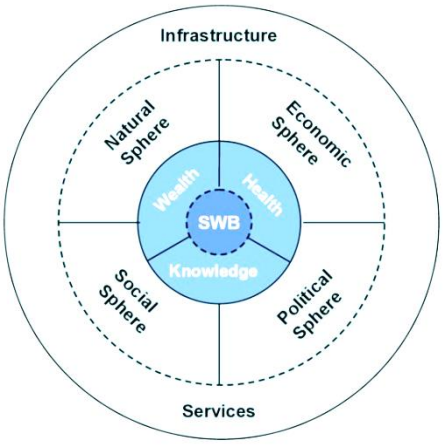

Figure 1. NESP Model (Sutrisno et al., 2022)

By understanding the condition of poverty and wellbeing among smallholding farmers in the area where ecosystem services as high food provider, it becomes possible to identify the challenges faced by these farmers. In line with this perspective, the primary problem addressed in this research is how to improve smallholding farmers in the area where the capacity of ecosystem to provide is high. Meanwhile, the research intends to pinpoint areas with a high supporting capacity as high food provider, comprehend the wellbeing of smallholding farmers in this areasand formulate recommendations on improving the conditions of smallholding farmers in locations with a high capacity for food provision. The research was conducted in Tanjung Buka Village in the administrative of Bulungan Regency, North Kalimantan Province.

RESEARCH METHOD

This research was conducted in Tanjung Buka Village, located within the administrative area of Bulungan Regency, North Kalimantan Province, based on considerations related to the high level of mangrove forest utilization activity in the village. Tanjung Buka Village has an area of 199.45 Km2. According to village data, the population is reported to be 4,056 people residing in 1,047 households. Respondents or people serving as sources of information in this research were selected as household units, following the guidelines outlined by (Groves et al., 2011) when the population exceeds 100 then researchers can choose 10% to 20% of the total population as sample respondents. In this study 104 households were selected as respondents. the selection process involved a lottery, with efforts to ensure an even distribution.

The materials and instruments used in this research consisted of: (i) Ecoregion (landscape) map; (ii) Land use category map; (iii) Slope map; (iv) Computer hardware and software for processing data and information from Geographic Information Systems (GIS). Such software includes ArcGIS, QGIS, MapSource and Global Mapper; (v) Field documentation instruments for verifying maps and field conditions; (vi) Questionnaire assessing the welfare of small farmers; and (vii) Writing and recording equipment.

Data analysis to determine the level of environmental carrying capacity is completed using an

ecosystem services approach, which focuses on the benefits that humans obtain directly or indirectly from ecosystem functions (Villamagna et al., 2013). The outline of this analysis is illustrated in Figure 2.

Environmental carrying capacity data for ecosystem services is based on spatial data, including the following sources: (i) land scape map, at information scale of 1:250,000, acquired in 2016, provided by the Directorate for Environmental Impact Prevention of Sectoral and Regional Policies and the Directorate General for Forestry Planning and Environmental Governance, both under the Ministry of Environment and Forestry; (ii) A vegetation type map at an information scale of 1:250,000, acquired in 2016, provided by the Directorate for Environmental Impact Prevention of Sectoral and Regional Policies and the Directorate General for Forestry Planning and Environmental Governance, both under the Ministry of Environment and Forestry; (iii) A land cover map, at an information scale of 1:25,000, provided by the Office of Public Works; (iv) A System Grid Map, at size of 5"x5", acquired in 2016, provided by the Directorate for Environmental Impact Prevention of Sectoral and Regional Policies and the Directorate General for Forestry Planning and Environmental Governance, both under the Ministry of Environment and Forestry; (v) An administrative boundary map at information scale of 1:25,000; (vi) A road network map at information scale of 1:25,000. Meanwhile, data regarding smallholding farmers wellbeing encompass various dimensions: (i) Nutrient and health; (ii) Knowledge; (iii) Material; (iv) Economic sphere; (v) Social sphere; (vi) Natural sphere; (vii) Political sphere; (viii) Infrastructure services; and (9) Subjective wellbeing.

People wellbeing index and poverty status are comprehended through variables and indicators utilizing NESP approach. The Variables and indicators of this index are outlined by (Wahyuni et al., 2023) as shown in the Table 1.

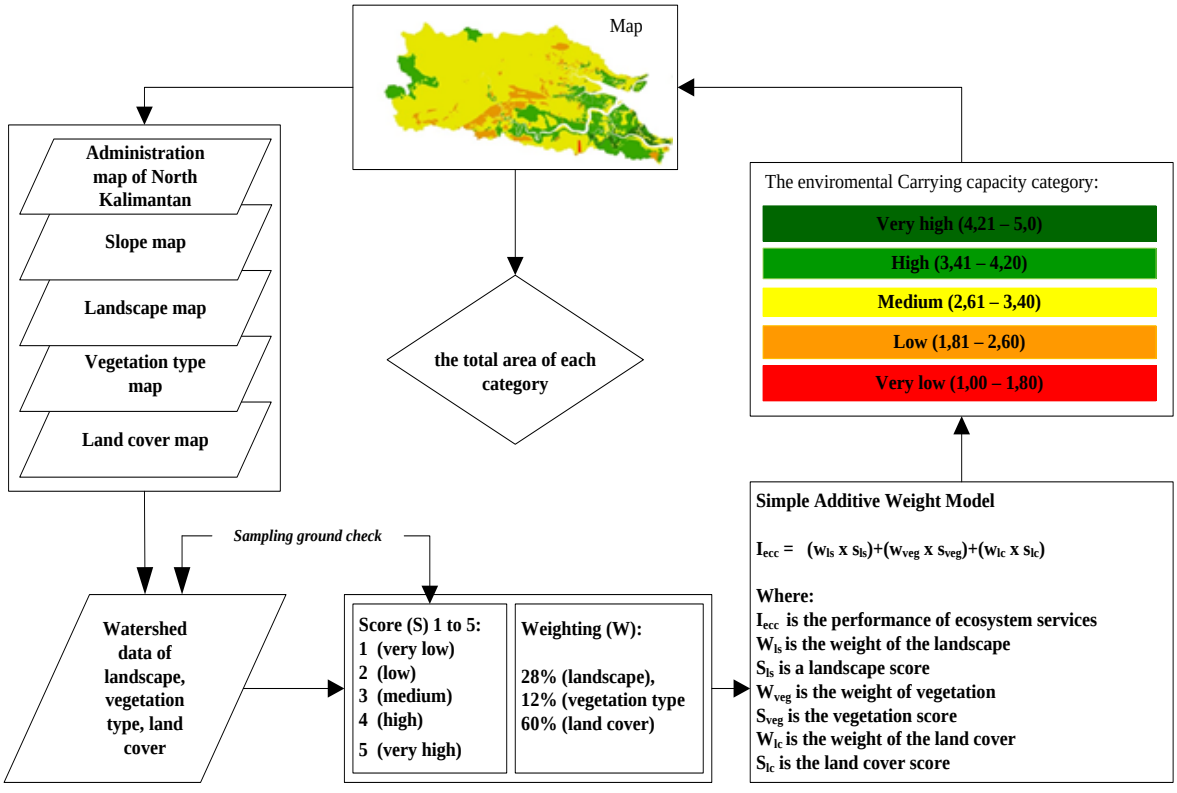

Figure 2. Environmental carrying capacity mapping framework

Table 1. Variables and Indicators of People Wellbeing Index

Variable		Indicator
Nutrient and health	1.	Serious illness
	2.	Medical services
	3.	Medical check up on pregnant mothers
	4.	Help for laboring mothers
	5.	Fulfillment of needs
	6.	Consumption of meats/eggs/fish/chickens
	7.	Sources of drink water
Knowledge	8.	Education level
	9.	Children in 7-18 year of age who attend school
	10.	Illiteracy
	11.	Incapable of Indonesian language
	12.	Skills outside of farming and fishery
	13.	Access to information
Material	14.	Physical condition of the house
	15.	Cloth possession for daily activity and special event
	16.	Household equipment (motorcycle, TV, refrigerator, chainsaw, and internal toilet)
	17.	Electricity
	18.	Cooking fuel
	19.	Wellbeing of household compared to another
	20.	Condition of household in the future
Economic sphere	21.	Difficulty in purchasing refined sugar (the last 12 months)
	22.	Source of income
	23.	a. Number of source of income
		b. Source of fixed income
	24.	Opportunity to seek livelihood
	25.	Capability of making savings (the last 12 months)
	26.	Possession of irrigated land/ non-irrigated land/ garden
Political sphere	27.	Participation/representation in village decision making
	28.	Assurance of land ownership in village
	29.	Implementation of local rules
Social sphere	30.	Land dispute/other conflict
	31.	Trust level among the villagers
	32.	Household participation in village comunal work
	33.	Friendship of children with other children from different tribe
	34.	Friendship of children with other children from different religion
Natural sphere	35.	Current condition of the nature
	36.	Flood/ landslide/forest fire/ pest attack (the last 12 months)
	37.	Water quality of river, lake and water source
	38.	Existence of Bekantan Monkey/ Enggang Bird/ Pygmy Elephant
	39.	Number of wood and vegetation in the forest
	40.	Illegal logging /the logging that damages the forest
Infrastructur services	41.	Access toward the nearby junior high school
	42.	Activity of learning and teaching at school
	43.	Health services frequently used by community
	44.	Condition of road/bridge
	45.	Training, counseling, course and mentoring on business (the last 12 months)
	46.	Implementation of development program initiated by Regency Government (the last 1 year)
	47.	Implementation of village development program (the last 5 years)
Subjective wellbeing	48.	Feeling of wellbeing
	49.	Feeling of poverty
	50.	Feeling of happiness

After completing data collection based on the mentioned indicators, nine fundamental indices are calculated, including subjective well-being, material wealth, Health, Education, economic environment, natural environment, Political environment.

The index value can be calculated using the following formula:

$$IV = \frac{SO - SMi}{SMa - SMi} x\ 100$$

In which IV is value index, SO is number of scores obtained, SMi is minimum number of scores, and SMa is maximum number of scores. Furthermore, determining the classification of each person/village is determined as follows: (i) critical = 0 – 45, (ii) medium = 46 – 54, (iii) good = 55 – 100.

RESULT AND DISCUSSION

Characteristic of Respondent

This research explores the sociodemographic characteristics of 104 households in Tanjung Buka Village, Tanjung Palas Tengah District, Bulungan Regency, providing essential insights into the dynamics of small farmers in the Kayan Sembakung Delta region. These characteristics provide various aspects, including gender distribution, age demographics, education level, and more.

Achieving gender balance is critical, as previous research underscores the significant impact of women's participation in agriculture on food security and overall household well-being. 55% of respondents are adult men.

Assessing the age structure of respondents is critical for understanding generational dynamics in farming communities. This highlights the involvement of the younger generation and the potential influence of older farmers on agricultural practices. There are 61 farmers aged 30-45 years, and 43 farmers aged over 45-65 years.

Respondents' educational characteristics play an important role in determining people's adaptability to modern agricultural practices and their understanding of sustainable agriculture. Higher levels of education often correlate with increased participation in development initiatives. 104 farmers have a maximum education at junior high school level.

Identifying respondents' main occupation provides an idea of the diversification of livelihoods in society. If the majority of respondents depend on agriculture as their primary livelihood, this information can provide the design of sustainable agricultural development programs that meet the specific needs of these households.

Characteristics such as land ownership, ownership of agricultural equipment, and access to resources provide insight into a community's ability to manage available resources effectively. Most farmers have their own land for agricultural activities.

Exploring respondents' experiences and length of involvement in agriculture adds a historical perspective. Long-term involvement in agriculture can shape people's approaches to agricultural practices and influence their responses to development interventions. All respondents had personal experience or additional skills in the agricultural sector for more than 5 years.

Environmental Carrying Capacity

According to the results of identification, field observations, assessment and weighting, this research found that Tanjung Buka Village has 2 types of landscape, 3 types of natural vegetation and 11 types of land cover. The scores and weights of ecosystem services in food supply are presented in Table 2.

Table 2. Score and Weight of Landscape, Vegetation Type, and Land Cover as Food Provider

Landscape	Score as Food Provider	Weight	Vegetation Type	Score as Food Provider	Weight	Land Cover	Score as Food Provider	Weight
Kalimantan fluvial land	3	0.28	Beach vegetation	3	0.12	Primary mangrove forest	4	0.6
Kalimantan coastal land	3		Mangrove vegetation	2		Secondary mangrove forest	4	
			Herbal vegetation at the bank of brackish river	3		Secondary swamp forest	3	
						Open land	1	
						Plantation/ garden	2	
						Settlement/ built-up land	1	
						Dry land farming with bushes	3	
						Swamp	3	
						Swamp shrubs	3	
						Embankment	5	
						Water body	5	

As indicated by the contents of Table 2, the value of ecosystem services is determined from the score and weight of ecosystem services, referring to landscape, natural vegetation, and land cover in research location. For example, Kalimantan fluvial land that has beach vegetation with land cover of mangrove or secondary mangrove forest (after deforestation) is predicted to have high value of ecosystem service.

The value of ecosystem services is crucial in maintain environmental sustainability and diversity. Ecosystem services can cover a number of benefits, such as providing clean water, flood control, carbon sequestration, and habitat for various species. In this case, the scores and weights of ecosystem services are the key to determining the value of these ecosystem services. For example, in the context of fluvial lands in Kalimantan, coastal vegetation represented by mangrove forests or post-deforestation secondary mangrove forests can make a significant contribution to the value of ecosystem services. Mangrove forests play a vital role in sustaining of coastal ecosystems by acting as a natural fortress that protects the land from erosion caused by sea waves and storms (Winterwerp et al., 2020), (Kathiresan, 2021). Additionally, mangroves serve as a biodiversity buffer by providing a habitat for many unique species, including birds, fish and reptiles. Land cover in the form of mangrove forests on Kalimantan fluvial land also benefits for local communities economically providing resources such as firewood, construction timber, and other non-timber products like agarwood and mangrove crabs. These results can be sold or used on a subsistence basis, contributing to the livelihood of local communities reliant on the mangrove ecosystem. Akram et al. (2023) explained that securing and maintaining land cover in the form of mangrove forests on Kalimantan's fluvial land is important to ensure the survival of ecosystem services that provide sustainable social, economic and environmental benefits.

In determining the value of ecosystem services, scores and weights of ecosystem services play a crucial role (Nellemann & Corcoran, 2010). The ecosystem service score describes the sustainability and quality of ecosystem services at a research location. This score encompasses various factors, including biodiversity, ecosystem productivity and water availability. The higher the ecosystem service score, the more valuable the ecosystem's contribution to human well-being (Villamagna et al., 2013).

Ecosystem service weights, on the other hand, place emphasis on the importance of each type of ecosystem service in the context of the study. This weight can be assigned based on preferences and priorities set by stakeholders, such as local communities, policy makers and scientists. For example, if the study area has rich natural vegetation with high biodiversity, the weight of ecosystem services for biodiversity could be increased to reflect its importance.Landscape use is also an important consideration in determining the value of ecosystem services. Natural and intact landscapes tend to provide more diverse and valuable ecosystem services than degraded landscapes (Anderson et al., 2017). Therefore, landscape fragmentation, land cover, and habitat quality are important determinants in evaluating ecosystems services. By considering the scores and weights of ecosystem services, research on the value of ecosystem services can provide valuable insights in managing and protecting the environment (de Jong & van Zanten, 2011). This information can be used to inform environmental policy, guide decisions about sustainable land use, and promote preserving and restoring valuable ecosystems. Through a better understanding of the value of ecosystem services, research contributes to ensuring environmental sustainability and human well-being can be balanced in the future (Butler & Oluoch-Kosura, 2006).

Table 3. The value of I_{ecc} by Category of Ecosystem Service as Food Provider

W_{ls} x S_{ls}	W_{veg} x S_{veg}	W_{lc} x S_{lc}	I_{ecc} as Food Provider	Category of Supporting Capacity
0.28 x 3	0.12 x 4	0.60 x 1	1.92	Low
0.28 x 2	0.12 x 5	0.60 x 2	2.36	
0.28 x 5	0.12 x 3	0.60 x 2	2.96	Moderate
0.28 x 3	0.12 x 4	0.60 x 3	3.12	
0.28 x 2	0.12 x 5	0.60 x 4	3.56	High
0.28 x 3	0.12 x 4	0.60 x 4	3.72	
0.28 x 5	0.12 x 3	0.60 x 4	4.16	
0.28 x 3	0.12 x 4	0.60 x 5	4.32	Very High
0.28 x 5	0.12 x 3	0.60 x 5	4.76	

The value of I_{ecc} as Food Provider is ranging from 1.92 to 4.76 (Table 3). This range of I_{ecc} values indicates that environmental supporting capacity of the area as food provider varies from low (I_{ecc} 1.92 –

2.36) to very high (I_{ecc} 4.32 – 4.76), signifying the inclusion of all categories of environmental supporting capacity.

In addition, the value of I_{ecc} as food provider in high category is varying from 4.32 to 4.76. This range of values indicates that many combinations of landscape, vegetation type, and land cover result in high and low ecosystem services in food provisioning. For instance, the combination of the landscape of Kalimantan fluvial land and vegetation of herbs at the bank of brackish river, with land cover of primary mangrove forest, has produced an ecosystem service with capacity as high food provider.

Furthermore, the I_{ecc} values are inputted into the map of environmental supporting capacity based on ecosystem services. This map is depicted in Figure 3.

In relation to the map above, polygon width of each environmental carrying capacity is calculated and compared to the interval of I_{ecc} values (in ha unit). The result of calculation is displayed in Table 4.

The Table 4 shows that Tanjung Buka Village as food provider is dominated by the area with environmental supporting capacity in very high category (I_{ecc} 4.32– 4.76) and the width of this area is 71,763.74 ha. This area refers to the landscape of Kalimantan fluvial land with vegetation type of herbs at the bank of brackish river and with land cover of primary mangrove forest and edam.

Table 4**.** Environmental Supporting Capacity of High Food Provider in Tanjung Buka Village

Supporting capacity category	Interval Score	I_{ecc} Value
		ha
Very High	4.32-4.76	71,763.74
High	3.56-4.16	61,352.12
Moderate	2.96-3.12	11,435.46
Low	1.92-2.36	15,763.71

Regarding the finding above, environmental support capacity of Tanjung Buka Village in food provisioning is considered high. The reason behind this is that the area of Tanjung Buka Village is generally comprises landscape involving Kalimantan fluvial land and Kalimantan coastal land with vegetation type consisting of herbs at the bank of brackish river, beach vegetation, and mangrove vegetation. Such vegetations has made the area abundant of food sources, providing carbohydrate and protein, such as meats, fish, fruits, vegetables with leaf, beans and cereals. All these food sources are also rich of phytochemicals, micro nutrient substance, and simple sugar.

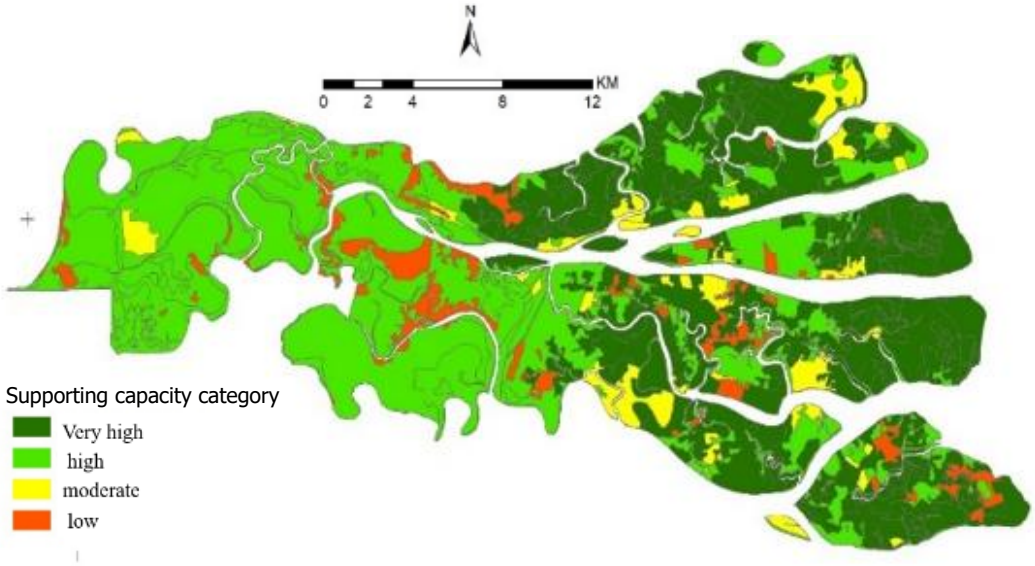

Figure 3. Map of environmental supporting capacity from the ecosystem service of high food provider in Tanjung Buka Village

The area with a very high environmental carrying capacity in Tanjung Buka Village supports various species of freshwater and marine fish, which play an important role in providing a source of protein for the local community. The diversity of plants in Kalimantan's fluvial soil and primary mangrove forest in Tanjung Buka Village produces various green leafy vegetables rich in fiber, vitamins and minerals, such as spinach, kale and cassava leaves. According to research by (Wahyuni, 2021), coastal plants that thrive in the Kalimantan area around the Kayan Delta generally produce fruits rich in vitamin C and antioxidants, such as mangoes, rambutans and bananas, which are sources of carbohydrates and important nutrients for locals. The results of research by (Wahyuni et al., 2022) show that the Tanggul area in Tanjung Buka Village has a variety of legumes, such as peanuts and green beans, which are rich in vegetable protein and fiber which are good for digestive health.

Smallholding Farmers Wellbeing

In a family or household, there is someone who acts as the head responsible for the entire family and plays a role in making decisions regarding family life. According to the survey results at the study location, it was noted that as many as 96.4% of households had male heads of families, generally husbands (Table 5). The average number of family members in a household is 4. In general, each household is inhabited by only one family. Furthermore, the average percentage of males aged <17 years was 62.0% of all selected households, indicating a relatively high number of productive-age men in the village. Additionally, the percentage of women living in the household is 46.7%.

Table 5. Sociodemography of Smallholding Farmers

Sociodemography	Unit	Value
Male Head of Family	%	96.4
Average Family Size		4
Average Family amount		1
Population under 17 years old	%	62
Number of women in the household	%	46.7

The largest ethnicity in the research area is the Bugis tribe, consisting 60% of the population. The second largest population is the Javanese ethnic group, accounting for 18%, followed by the Tidung ethnic group at 14%. This demographic distribution is influenced by the dominance of fishing villages and pond farmers in the research location. People of Bugis and Tidung ethnicity manly carry out the professions of fishermen and pond farmers, as traditionally, the life and work of these two ethnic groups are associated with seafaring. The relatively large presence of the Javanese ethnic group is due to the research location (Tanjung Buka) being a transmigration area from Central Java and parts of East Java.

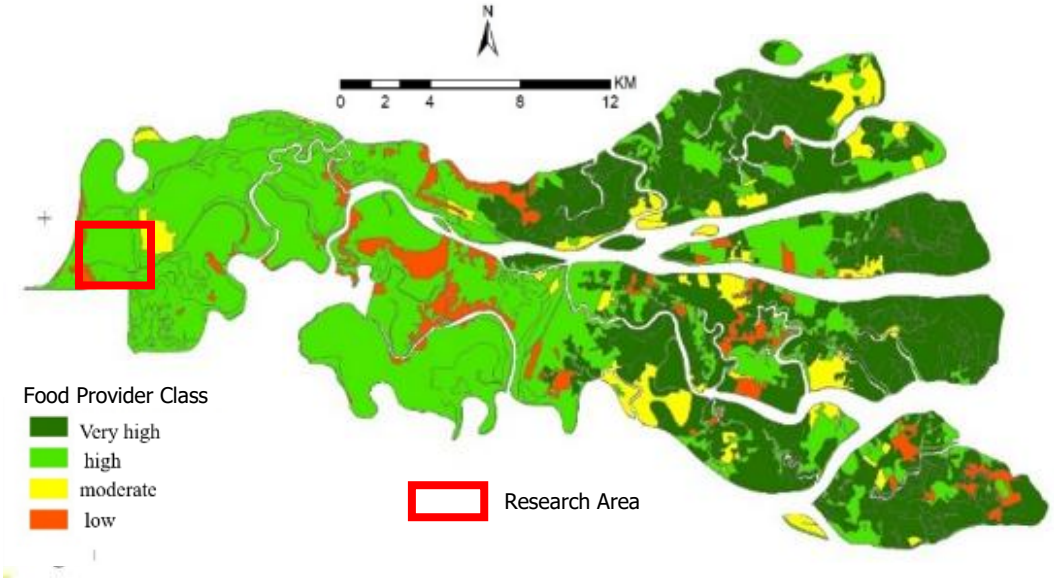

Figure 4. Area with ecosystem services of high food provider as the location of farming work by smallholding farmers

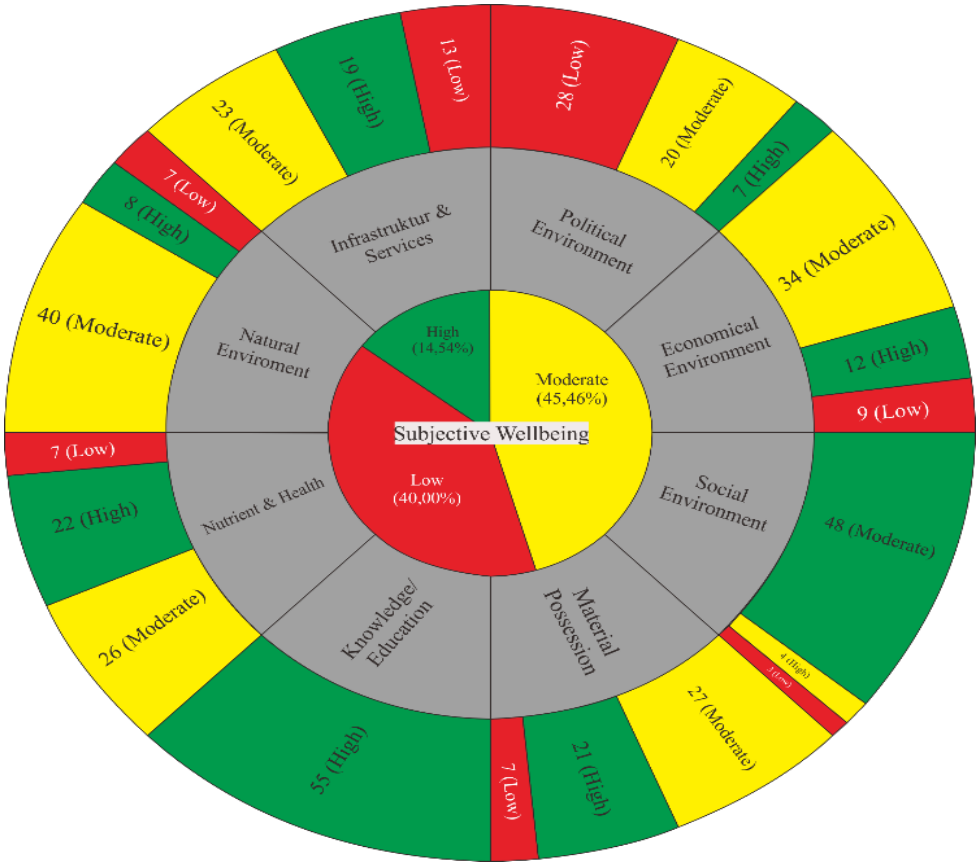

Figure 5. Distribution of smallholding farmers based on their wellbeing level in each living aspect

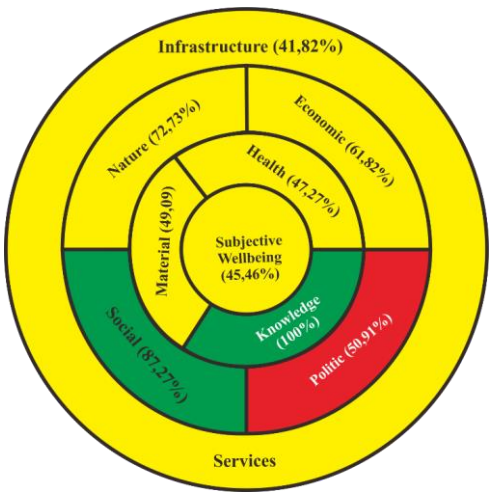

Figure 6. Model of smallholding farmer wellbeing at the area of high food provider based on NESP approach

Smallholding farmer wellbeing at the area of high food provider (Figure 5 and 6) is assessed using the NESP model. This model describes subjective and objective wellbeing influenced by various aspects of daily life such as personal feeling, material possession, health, knowledge, economical environment, natural environment, political environment, social environment, and structure and services.

Based on the Figure 5 and 6, the current research confirms that small farmers in high food supply areas in Tanjung Buka Village, Bulungan Regency tend to have a level of welfare in the medium category. Indeed, smallholders' subjective feelings about their well-being in the moderate category are influenced by the core environment (material possessions, health), contextual environment (natural environment, economic environment), and external environment (structure & services) which are also in the moderate category. The medium category shows that farmers

have not achieved a good level of welfare, especially in the aspects of material ownership, health, protection of natural sustainability as a food source, community livelihood conditions, community structure and services so that efforts are still needed to improve the conditions of high welfare category (good).

Despite these findings, the core and the contextual environment of smallholder farmers in this area are in good condition, particularly in the social and knowledge/educational aspects, there is high awareness in the community regarding the importance of education, as evidenced by sending children to school and ensuring equal treatment in education for both boys and girls. Equality in education is also applied in non-formal education such as the involving women in counseling and outreach activities, especially related to livelihood activities.

The only contextual environment that influences objective well-being in the low category, i.e. critical, is the political environment. The critical category shows that the political environment of respondents related to representation or involvement in village decision-making, certainty of land tenure in the village, and the application of local regulations is still low, requiring intervention to encourage changes in the political environment.

Furthermore, Figure 5 and 6 confirm that small farmers in the high food supply area in Tanjung Buka Village, tend to have a level of welfare in the medium category. This study is supported by previous research highlighting the relationship between the condition of small farmers and their level of welfare. A study by Zhang et al. (2022) shows that smallholder farmers often describe their welfare level as moderate, reflected in their subjective perception of material possessions and health factors. This study also highlights the importance of environmental factors in influencing the welfare of smallholder farmers, with the smallholder environment consisting of three main aspects: the core environment, the contextual environment, and the external environment. The core environment includes material ownership and smallholder health. According to Sutrisno et al. (2022), the core environment of smallholder farmers in the village is categorized as good, meaning that these factors are relatively fulfilled and contribute to a better level of welfare.

The contextual environment includes both the natural environment and the economic environment that affect smallholders. The aspect of the contextual environment that has a significant negative effect on the objective welfare of small farmers is the political environment. Research by Wahyuni et al. (2022) highlighted that the political environment in the northern Kalimantan border area is categorized as low or critical. Political instability and unfavorable policies can pressure smallholders and affect their overall well-being. Overall, this study confirms that smallholder farmers in Tanjung Buka Village, have a level of welfare in the medium category. The core and the contextual environment of smallholder farmers in this area are mostly in good condition, but the political environment is a significant factor influencing their objective well-being. Therefore, special attention is needed to develop a more stable and favorable political environment for small farmers to improve their welfare.

Table 6 indicates that improving the quality of housing is a crucial step in improving the welfare of small farmers. By repairing houses that are not suitable for use, small farmers can acquire a safe and comfortable living place, leading to an overall improvement in family welfare (Meroni, 2007). This aspects holds significant importance in the efforts to improve the welfare of small farmers in Tanjung Buka Village. Inadequate housing, characterized by damage, uninhabitable, or insufficiency, can considerably burden smallholder farmers and their families. Through the housing improvement program, small farmers can access safe and comfortable living place, contributing to an enhanced quality of life (Deelstra & Girardet, 2000). Home improvement may involve renovations, reconstructions, or the addition of essential amenities, such as proper sanitation systems, clean water, sufficient ventilation, and adequate lighting. In addition, sustainability and energy efficiency aspects, such as using environmentally friendly building materials and renewable energy sources (Omer, 2008). This should be considered to minimize adverse environmental impacts and optimize resource use. Decent housing provides safety, comfort, and protection against environmental risks and natural disasters, fostering privacy and adequate space for a healthy family life. Moreover, home improvement can positively impact the economy.

Table 6. Improvement of Objective Wellbeing of Smallholding Farmers in Tanjung Buka Village

Objective Wellbeing		Efforts To Improve Wellbeing
Core Environment	Material Possession	Repairing inexpedient houses
		Making available of cooking fuels
	Health/ Nutrient	Fulfilling the food needs
		Serving protein consumption (meat, egg, fish)
		Supplying clean water
Contextual Environment	Economic	Increasing income source diversity
		Facilitating the seek for livelihood (job)
		Increasing ability to save money
		Ensuring the adequacy of garden/plant field
	Nature	Conserving endemic animals
		Conserving wood and plant species
	Political Environment	Getting involved in the politics
		Assuring land possession
		Implementing local regulations
Infrastructure Environment	Structure and Services	Repairing roads and bridges
		Organizing counseling/training/courses/mentoring for entrepreneurship
		Implementing development program/activity

Access to safe and affordable fuel is an important factor the welfare of small farmers (Talukdar & Banthia, 2013). The use of efficient and environmentally friendly fuels should also be considered. In Tanjung Buka Village, ensuring access to safe, affordable, efficient and environmentally friendly fuel is crucial for improving the welfare of small farmers in Tanjung Buka Village. Fuel is essential for cooking, heating and meeting daily energy needs. Limited access to adequate fuel can impede the productivity of smallholder farmers, emphasizing the importance of considering sustainability and energy efficiency when selecting fuels. Efficient fuel use helps smallholder farmers save on energy costs and reduce the negative impact on the environment. Exploring alternatives such as energy-efficient stoves or renewable energy-based cooking technologies (for example, biogas or biomass), can be valuable.

Efforts to ensure adequate and quality food availability for small farmers deserves attention. A sustainable agricultural approach, including diversification of food crops, can contribute to increase food availability at the household level (Tambunan, 2015). Ensuring adequate protein consumption, such as meat, eggs and fish, is important for meeting the nutritional needs of small farmers. Diversification of food crops is one approach that can be used to increase food availability (Wahyuni et al., 2022). Diversifying food crops allow small farmers to access a more varied and nutritious range of foods while reducing vulnerability to weather disturbances, pests and plant diseases that can impact crop yields (Legesse & Drake, 2005). Alongside sufficient food availability, attention to adequate protein consumption including meat, eggs, and fish, is crucial. Protein is an important nutrient in meeting nutritional needs and promoting growth. Sustainable agricultural approaches, such as using organic fertilizers, efficient water management, and soil conservation, contribute to sustainable food production and environmental protection (Ferris et al., 2014).

Developing a smallholder economy (socioeconomic), diversifying income sources is critical to reducing risks and improve welfare Increased access to non-agricultural employment opportunities can enhance the welfare of small farmers. Inclusive financial programs, encompassing financial literacy and access to financial institutions, support long-term programs to improve farmer welfare (Raza et al., 2023). When smallholders have better access to off-farm employment opportunities, they have opportunities to diversify their incomes. Farmers can look for additional work or start side businesses in other sectors that can provide additional income. In addition, inclusive financial programs also have an important role in improving the welfare of small farmers, with adequate financial literacy, farmers can understand how to manage their finances more effectively (Tambunan, 2015). They can learn about saving management, investing, and financial risk management, all of which can help them increase their financial stability. Access to financial institutions such as banks, cooperatives or microfinance

institutions is also important for smallholders. Through this access, they can obtain capital loans to expand their farming business, purchase better equipment or seeds, and develop more efficient farming practices. Smallholder participation in local political processes can influence policies that support improving their welfare.

By being actively involved in local political forums, such as village government meetings or farmer advocacy groups, small farmers can voice their problems and needs (James & Sulemana, 2014). Smallholders can influence policy-making relevant to the agricultural sector and their well-being through political participation. Farmers can propose concrete solutions, provide input to policy makers, and collaborate with related parties to achieve common goals. In addition, smallholder political participation can help raise awareness among policy makers about the challenges smallholders face (Legesse & Drake, 2005).

Good infrastructure, such as roads and bridges, is vital in smallholder accessibility and connectivity with markets and other services. Good infrastructure, such as roads and bridges, is essential for smallholder accessibility and connectivity with markets and other services (Ferris et al., 2014). Smallholders can overcome geographical barriers and reduce high logistics costs through adequate infrastructure. Good roads allow small farmers to deliver their crops more efficiently and in less time. Farmers can access a broader market, send their produce to distribution centers, and sell their crops at better prices. Good road infrastructure also facilitates access to agricultural extension centers, financial institutions and health care facilities, so that smallholder farmers can get the information, support and services they need.

Research Implication

The study provides valuable insights into the complex interplay between human activities, environmental sustainability, and the welfare of small farmers in the Kayan Sembakung Delta. The implications drawn from this research are multifaceted, encompassing environmental conservation, agricultural practices, and socio-economic development. This section discusses the key research implications, emphasizing potential areas for further investigation and practical applications.

Environmental conservation and sustainable agriculture. The findings highlight the need for a concerted effort towards the conservation of wetland ecosystems, particularly peat lands and mangrove forests. Policies and strategies should be developed to ensure the sustainable use of these areas, taking into account the carrying capacity and environmental capacity. Further research could delve into specific conservation measures, including the restoration of degraded areas and the promotion of sustainable agricultural and fishery practices.

Welfare enhancement for small farmers. The study identifies various factors influencing the subjective and objective welfare of small farmers. Policymakers and stakeholders should focus on targeted interventions to improve the living conditions of farmers in Tanjung Buka Village. Initiatives such as housing improvements, access to cooking fuel, food security, and income diversification should be prioritized. Future research could explore the effectiveness of specific interventions and their long-term impact on farmer welfare.

NESP Approach. The utilization of the NESP approach in assessing poverty and welfare provides a comprehensive framework. This method could be applied in similar contexts to assess and address poverty from a multidimensional perspective. Researchers and policymakers in other regions can adopt and adapt the NESP approach to gain a nuanced understanding of poverty and guide targeted interventions.

Community engagement and empowerment. Sustainable development in the Kayan Sembakung Delta requires active involvement and empowerment of the local community. Initiatives should be designed collaboratively with the community to ensure cultural sensitivity and local relevance. Future research may explore participatory approaches in decision-making, community-based conservation efforts, and the role of indigenous knowledge in promoting sustainability.

Policy development and implementation. The study underscores the importance of effective policy implementation for achieving environmental conservation and improving farmer welfare. Policymakers should consider the integration of local regulations, infrastructure development, and support for community-driven initiatives. Future research could assess the impact of existing policies and recommend modifications for better alignment with the needs of the community and the environment.

Education and capacity building. Enhancing the capacity of small farmers through education and skill-building initiatives is crucial for long-term sustainability. Research can explore the effectiveness of training programs, awareness campaigns, and educational interventions in improving agricultural practices, resource management, and overall community resilience.

Cross-border collaboration. Given the border area context, there is potential for cross-border collaboration in addressing shared environmental challenges and promoting sustainable development. Future research could explore opportunities for regional cooperation, knowledge exchange, and joint conservation efforts among neighboring countries. The research on smallholding farmers in the Kayan Sembakung Delta provides a foundation for actionable insights and future exploration. The implications outlined above emphasize the interconnectedness of environmental conservation, agricultural practices, and community well-being, urging a holistic and collaborative approach to address the complex challenges faced by small farmers in border areas of Indonesia.

Technological innovations for agricultural sustainability. The integration of technology in agriculture can play a pivotal role in enhancing both productivity and sustainability. Future research could explore the adoption of precision agriculture, remote sensing, and other advanced technologies to optimize resource use, monitor environmental changes, and improve overall agricultural efficiency. Additionally, the study could investigate the barriers and facilitators to technology adoption among small farmers in the Kayan Sembakung Delta.

Climate change resilience and adaptation. Considering the vulnerability of wetland ecosystems to climate change, it is imperative to assess the resilience of smallholding farmers. Research can delve into climate change adaptation strategies, such as resilient crop varieties, water management techniques, and early warning systems. Understanding the local impacts of climate change and developing adaptive measures can contribute to long-term sustainability and the well-being of the farming community.

Market access and value chain development. Improving market access and strengthening value chains are critical components of rural development. Research could explore ways to enhance the marketing capabilities of small farmers in Tanjung Buka Village, facilitating their integration into broader markets. Attention to post-harvest infrastructure, market information systems, and cooperative structures could contribute to increased income and overall economic well-being.

Gender dynamics in agriculture. An in-depth examination of gender dynamics within agricultural practices and household welfare is essential. Research could investigate the roles of men and women in smallholding farming, addressing potential gender disparities in access to resources, decision-making power, and the benefits derived from agricultural activities. Understanding these dynamics can inform gender-sensitive interventions aimed at promoting equitable development.

Ecosystem services valuation. Assigning economic value to ecosystem services can strengthen the case for conservation and sustainable resource management. Future research could employ ecosystem services valuation methods to quantify the benefits provided by wetland ecosystems. This includes assessing the economic value of water purification, flood regulation, and biodiversity conservation, providing policymakers with tangible incentives for investing in the preservation of these ecosystems.

Community-based ecotourism opportunities. Exploring the potential for community-based ecotourism initiatives can contribute to both conservation and economic development. The Kayan Sembakung Delta's unique ecological features may attract ecotourists, providing an alternative income source for local communities. Research could investigate the feasibility, challenges, and benefits of implementing such initiatives, ensuring they align with sustainable and culturally sensitive practices.

Longitudinal studies for sustainable impact assessment. To measure the lasting impact of interventions and changes in the Kayan Sembakung Delta, longitudinal studies are crucial. Future research could establish a continuous monitoring system to assess the sustained effects of welfare-improvement programs, conservation efforts, and policy implementations. This longitudinal perspective will provide valuable insights into the resilience and adaptability of the community and ecosystems over time.

Partnerships with non-governmental organizations (NGOs) and international organizations. Collaboration with NGOs and international bodies can amplify the

impact of interventions in the Kayan Sembakung Delta. Research may explore opportunities for partnerships that bring additional resources, expertise, and global best practices to address environmental and social challenges. Such collaborations could facilitate knowledge exchange, capacity-building, and the implementation of effective, evidence-based interventions.

The research implications outlined above extend the scope of the study on smallholding farmers in the Kayan Sembakung Delta, providing a comprehensive roadmap for future research and practical applications. By addressing technological, climatic, market-related, gender, and ecological dimensions, researchers and policymakers can work towards holistic and sustainable solutions that foster the well-being of small farmers and safeguard the unique wetland ecosystems in border areas of Indonesia.

CONCLUSION AND SUGGESTION

Tanjung Buka Village has a food supply area with an I_{ecc} value of 4.32-4.76 which includes a very high carrying capacity of 71,763.74 ha. The area in question is an area with a Kalimantan fluvial land landscape with herbaceous vegetation on brackish river banks and land cover in the form of primary mangrove forests and dams. Smallholder farmers in food supply areas show high subjective and objective prosperity in the medium category. The medium category shows that farmers do not feel welfare, especially regarding material ownership, health, protection of nature as a food source, community living conditions, community structure and services. Recommendations for efforts that can be made to improve farmers' welfare are repairing uninhabitable houses, providing fuel for cooking, seeking aid for food, especially protein (meat, eggs, fish), providing clean water, increasing the diversity of sources of income, facilitating the search for a livelihood (employment), increasing awareness and ability to save, ensuring sufficient garden/crop land, conserving endemic animals, conserving wood and plant species, getting involved in politics, guaranteeing land ownership, implementing regional regulations, repairing roads and bridges, and organizing counseling/training/courses/ entrepreneurial assistance.

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