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Development of Food Plot at The South China Sea of Indonesia's Outer Island

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Abstract: Establishing food plot in the outer island of Indonesia constitutes a strategic approach to bolstering food security and promoting agricultural sustainability. This study investigates the establishment and consequences of food plot on diverse remote islands in Indonesia. The key objectives encompass assessing soil suitability, determining appropriate crop selection, and implementing agricultural practices tailored to specific local climatic and environmental conditions. The study utilizes a mixed-methods methodology, incorporating soil analysis, crop yield evaluations, and interviews with local farmers and agricultural specialists. There are 14 SMUs in Anambas Islands Regency, that are created by layering various thematic maps such as those showing soil composition, topographic features, land use patterns, and climate data, including precipitation levels. Based on the results of the analysis of field and laboratory data, the actual land suitability class for lowland rice commodities was obtained based on the existing potential in the Anambas Islands Regency Area. From the existing soil map units (SMU), all SMU representative points are declared "marginally suitable" for lowland rice commodities, with suitability class S3. Meanwhile, in the subclasses, the inhibiting factors found were quite diverse, such as limited nutrition (nr) and oxygen availability (oa). Community empowerment in Anambas Islands Regency serves as a fundamental determinant in fostering sustainable development and improving the overall well-being of individuals residing within a community. The objective is to enhance the capacity of community members to exercise autonomy in their lives, facilitate informed decision-making, and collaboratively address challenges.

Keywords: Agricultural Sustainability, Crop Selection, Food Security, Outer Island, Soil Suitability.

1. Preliminary

The Anambas Islands Regency is a development region situated among the outer islands of Indonesia. Establishing a spatially oriented agricultural potential database that is continuously updated and can serve as a critical resource for agricultural development planning and the facilitation of emerging growth centers is imperative.

The development process involves a society's sustainable and long-term economic and social transformation by enacting Law Number 32 of 2004 on Regional Government and Law Number 33 of 2004 on Financial Balance between the Central and Regional Governments. These laws underscore the promotion of autonomy for Regency Governments in Indonesia to execute local development initiatives effectively. The formulation and implementation of regional development strategies wield substantial influence over the trajectory and velocity of economic growth and the advancement of regional development. The legislation outlined in Law Number 26 of 2007 underscores the fundamental importance of land resource data in informing the strategic allocation and utilization of physical space for regional development. The legislation of the Republic of Indonesia, specifically Law Number 41 of 2009, defines Sustainable Food Agricultural Land as a designated area of agricultural land intended for protection and consistent development to ensure the production of staple food for national food independence, resilience, and sovereignty. Sustainable Food Agricultural Land Protection involves the systematic planning, development, and management of food agricultural land in a manner that promotes sustainability. This includes carefully utilizing and preserving these lands to ensure their long-term viability for future generations. Additionally, the process consists of monitoring and controlling activities to maintain the sustainable use of agricultural land and its surrounding areas. The preponderance of agricultural land dedicated to food production consists of wetlands predominantly utilized to cultivate lowland rice.

The Agricultural potential and development study endeavors to evaluate the agricultural capacity of the land in the Anambas Regency and devise strategies for harnessing this potential to enhance the economic prosperity of farmers and residents of the Anambas Islands Regency. Establishing food estate can yield significant advantages in areas experiencing difficulties related to land fragmentation, climate change, and restricted availability of nourishing sustenance. The consolidation of small land parcels into larger plot clusters offers the potential to leverage synergies between adaptation practices and land use to improve food security (Cholo et al., 2018). The ultimate aim is cultivating a competitive agricultural sector benefiting the local farming community. The Anambas Islands Regency holds significant agricultural potential, necessitating a reevaluation of land use and spatial planning using more detailed maps. This is due to the economic perspective that recognizes land as a multifunctional production factor required by various structures and as a limited and contested resource subject to scarcity and competition among sectors. The minor excess value of land relative to agricultural land rent, as opposed to land rent in other sectors such as industry and residential areas, is a primary driver of land conversion.

This study activity can serve as a regional agricultural development mechanism, necessitating thorough planning to align with biophysical, socio-economic, and institutional circumstances through a regional approach. This methodology aims to facilitate the establishment and expansion of agribusiness centers specializing in various agricultural commodities, including food crops, vegetable crops, fruit crops, plantation crops, and forestry crops. The outcomes of land resource evaluation, bolstered by economic analysis, can be transformed into regional maps of agricultural commodities. These maps furnish details regarding the predominant types of commodities within a region, aligning with the spatial carrying capacity of the land. This alignment enables the area to enhance its competitiveness by producing efficiently at a scale commensurate with its capacity.

The region is economically and agro-ecologically suitable for plant cultivation, and when considering its social and cultural context, it fosters conducive conditions for business development within the local community. Additionally, it is essential to acknowledge the significance of market access and infrastructure in promoting food security (Hakim, 2023a). The facilitation of market access and infrastructure improvement can be crucial in promoting and maintaining local food security by reducing transportation expenses and maintaining stable food prices (Ahmed et al., 2017). Moreover, it has been suggested that the diversification of farming systems and the adoption of market-oriented agricultural practices can contribute to the improvement of nutritional levels and food security among smallholder farming households (Chidiebere-Mark et al., 2022).

2. Research Methods

This study utilizes a diverse range of data sources, including topographic maps, satellite images, land use maps, soil maps, climatic maps, maps of soil damage potential, and maps documenting soil degradation status. At this stage, we have meticulously assembled a comprehensive map comprising 7 districts, covering the entire area of Anambas Regency, leaving no stone unterned in our research.

This research is firmly grounded in a survey-based methodology, which involves direct and first hand field observation and the collection of soil samples from specific agricultural and forestry regions as per delineated work maps. These soil samples were then meticulously analysed in the laboratory.

A. Baseline Map Preparation

The main objective of the preparatory phase is to establish a baseline soil condition map and to identify areas with soils that may be susceptible to potential vulnerabilities. The initial stage in developing the baseline condition map involves the identification of appropriate operational zones by integrating data with the regional spatial planning map. The creation of the baseline condition map consists of several sequential processes, encompassing the identification and categorization of pertinent work areas, the assessment of potential land damage through the use of thematic maps, the overlaying of significant thematic maps, and the evaluation of land suitability. Overlaying baseline maps is critical in assessing land suitability, particularly when employing weighted map overlays. The significance of the button design technique in weighted map overlays will be discussed, emphasizing its relevance in enhancing the accuracy and efficiency of land suitability assessments, as highlighted in the study (Xiang, W. and Salmon, 2001).

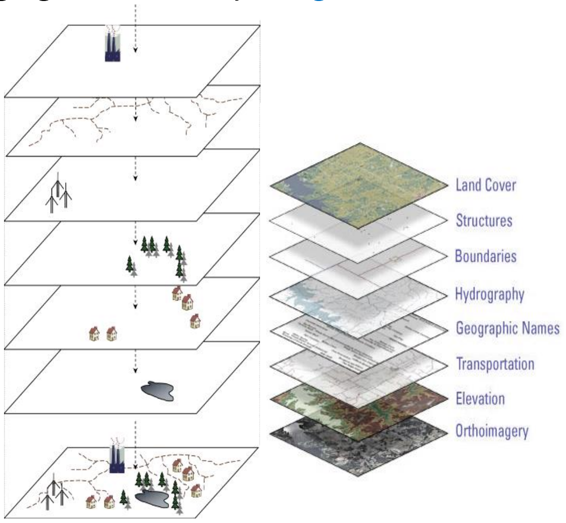

Figure 1. Illustration of map overlaying analysis in land suitability evaluation

B. Land Suitability Analysis

The land suitability analysis aimed to assess the degree to which a given tract is suitable for cultivating specific agricultural commodities. This system employs two distinct orders: Appropriate (S) and Not Appropriate (N). Order S categorizes three classes: Very Suitable (S1), Quite Suitable (S2), and Marginally Suitable (S3). Land suitability classification is contingent upon identifying the most prominent limiting or inhibiting factors. The method of land suitability analysis involves utilizing a geo-statistical approach and Geographic Information System (GIS) to evaluate land suitability for essential crops in a specific region (Aldabaa, A. and Yousif, 2020). Additionally, an essential component of land resource management involves the analysis of land suitability to determine the optimal use of the available land resources. The method involves the utilization of multi-criteria evaluation and Geographic Information System (GIS) techniques to evaluate the appropriateness of particular areas for diverse purposes, including agriculture, urban development, and conservation (Kihoro et al., 2013).

Assessing soil conditions enables the identification of constraints that impede soil fertility in a given area, thus enabling the development of tailored soil management strategies to address these limitations. The assessment of soil fertility is frequently undertaken through the use of soil analysis or soil testing methodologies. This research utilized five soil fertility parameters, including Cation Exchange Capacity (CEC), Base Saturation (BS), Organic Carbon content, and levels of Phosphorus (P) and Potassium (K) in the soil, under the technical guidelines for soil fertility evaluation (Hakim, 2023b), to evaluate soil fertility status.

A single subclass may contain multiple delimiter symbols; however, the maximum number of permitted symbols is three, with the most predominant delimiter being specified first. Through adherence to the prescribed land evaluation protocols, the resultant assessment findings will manifest in the delineation of actual (A) and potential (P) land suitability classifications. The land suitability analysis method typically involves assessing an area's biophysical and ecological characteristics to determine its agricultural potential (Hassan et al., 2017). The present land suitability assessment encompasses the evaluation of land suitability through empirical field observations and laboratory analysis data. The qualitative land suitability assessment includes socio-economic data to determine land suitability classification. The concept of land potential suitability encompasses the feasibility of optimizing land use by mitigating current inhibiting factors. The enhancements implemented in this instance are of a moderate magnitude and are significant to the agricultural operations of the local community.

C. Community Empowerment

The method involves a systematic process of investigating social phenomena, beginning with the definition of a research problem or question. Researchers conduct a literature review to understand existing knowledge, formulate hypotheses or objectives, and design the study by choosing appropriate methods such as surveys, interviews, or

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observations. Data is then collected and analyzed to identify patterns and insights.

3. Results and Discussion

3.1. Soil Map Unit (SMU)

The overlaying of baseline maps is important for evaluating land suitability and results in a map showing different soil units. There are 14 SMUs in Anambas Regency, The SMU is created by layering various thematic maps such as those showing soil composition, topographic features, land use patterns, and climate data, including precipitation levels. The evaluation of land suitability for particular agricultural commodities, such as rice, necessitates the application of an array of tools and methodologies, including Geographic Information Systems (GIS), remote sensing technologies, and multi-criteria analysis. These methodologies assist in identifying optimal regions for agricultural cultivation by taking into consideration variables such as soil quality, land characteristics, and specific crop requirements (Yangouliba et al., 2020). Furthermore, GIS-based multi-criteria decision-making methodologies have been utilized to assess land suitability and develop suitability maps for rice cultivation in designated regions (Otokiti, K. and Adesina, 2019).

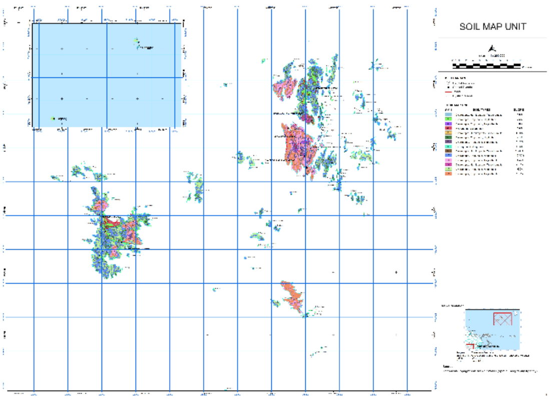

Figure 2. Soil Map Unit of Anambas Islands

3.2. Evaluation of Land Suitability

The Anambas Islands Regency features various soil types with specific uses: Regosols is sandy and limited in area; Gleysols, often waterlogged, is used for rice paddies and dry farming; Cambisols, fertile and less acidic, is suitable for both wet and dry agriculture; Podzolic is older and acidic, used for dryland farming and plantations; and Oxisols, highly weathered with low fertility, is primarily used for agriculture, plantations, and forestry (Hakim, 2019; Hakim, 2023b).

Land suitability analysis describes the level of land suitability for certain commodities. This system uses two orders: suitable (S) and Not Suitable (N). Order S has three classes: very suitable (S1), sufficiently suitable (S2), and marginally suitable (S3). The most severe limiting/inhibiting factors determine the land suitability class. This analysis entails a comprehensive evaluation of multiple factors, including climatic variables, soil characteristics, hydrological attributes, topographical features, and environmental components, in order to assess the suitability of land for agricultural production (Agbeshie, A. and Adjei, 2019). An analysis of existing land use in conjunction with the findings from land capability assessments facilitates the determination of land availability for the development of specific commodities (Tjahja et al., 2019). Such assessments are critical for the identification of soils capable of sustaining optimal crop yields (Aondoakaa, S. and Agbakwuru, 2012).

One sub-class can have more than one limiting factor, but only up to three determining factors are permitted, where the most dominant limiting factor is written first. Following the predetermined land evaluation procedures, assessment results will be obtained in actual (A) and potential (P) land suitability classes. Actual land suitability states land suitability based on physical field observations and data from laboratory analysis. In a qualitative land suitability assessment, socio-economic data is also considered when determining the land suitability class. Meanwhile, potential land suitability is a class that can be achieved through land improvement efforts, indicating the possibility of overcoming existing limiting factors.

Based on the results of the analysis of field and laboratory data, the actual land suitability class for lowland rice commodities was obtained based on the existing potential in the Anambas Islands Regency Area. From the existing soil map units (SMU), all SMU representative points are declared "marginally suitable" for lowland rice commodities, with suitability class S3. Meanwhile, in the subclasses, the inhibiting factors found were quite diverse, such as limited nutrition (nr) and oxygen availability (oa). The results of the suitability assessment for lowland rice commodities at representative points of land map units in the Anambas Islands Regency Area are shown in Table 1.

In order to ascertain the land suitability classification for lowland rice commodities, a number

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of studies offer significant insights. Sudjud, S. and Hadun (2018) conducted a study to identify areas potentially suitable for lowland rice cultivation within Morotai Island Regency, Indonesia. Their research categorized the land into two classifications: those deemed sufficiently suitable (S2) and those classified as marginally suitable (S3). In a comparable study, Amongo et al. (2023) implemented a Geographic Information Systems (GIS)-based land suitability model within the Calabarzon Region of the Philippines. The findings indicated that a significant proportion of the lowland rice cultivation areas exhibited high suitability for tractor utilization, while a subset of these areas was classified as having marginal to moderate suitability. In addition, Fathurrahman et al., (2023) highlighted the significance of assessing land suitability for rice cultivation in the Donggala District as a means to facilitate enhancements in rice production and productivity.

Agbeshie and Adjei (2019) conducted an evaluation of the land suitability for rice cultivation in the Nkrankwanta Lowland region of Ghana. Their assessment identified areas of land that were classified as highly suitable and marginally suitable, utilizing the Soil Quality Index and Nutrient Availability Index as measurement frameworks. In addition, Imanudin et al. (2021) considered arrive reasonableness and agrarian innovation for rice development on tidal marsh recovery in South Sumatra, illustrating noteworthy abdicate potential through the investigation of arrive reasonableness lesson. Ramadhani et al. (2021) centered on horticulture arrive appropriateness within the tidal swampy range of Palingkau Water System Region in Central Kalimantan Area, emphasizing the significance of arrive characteristics and trim prerequisites for arrive appropriateness classification.

Research indicates that conducting a land suitability analysis is essential for optimally enhancing agricultural productivity in a sustainable manner. Research has shown that the implementation of cropland suitability analysis is critical for optimizing the utilization of available land resources to promote sustainable agricultural production (Lamidi and Ijaware, 2022). Furthermore, the cultivation of land-based lowland rice necessitates a comprehensive assessment of land suitability and availability. This assessment is critical for the formulation of strategic policies and programs aimed at improving rice production and productivity (Fathurrahman et al., 2023).

Table 1. Land Suitability Analysis for Paddy Commodity

Code	pH (H_2O)	Org-C (%)	Tot-N (%)	P_2O_5 (ppm)	KTK (me/100g)	Tot-K_2O (mg/100g)	Texture	Drainage	Erotion	Slope (%)	Precipitaion (mm)	Land Suitability (Actual)	Land Suitability (Potential)
T 1	5.1(S2)	1.38(S1)	0.15(S2)	18.47(S2)	13,67(S2)	8.03(S3)	SiL(S1)	W(S3)	VL(S1)	0-8(S1)	2000-2500(S2)	S3nroa	S2nroa
T 2	5.0(S2)	1.68(S1)	0.12(S2)	16.19(S2)	14,69(S2)	6.34(S3)	SiCL(S2)	W(S3)	VL(S1)	0-8(S1)	2000-2500(S2)	S3nroa	S2nroa
T 3	5.0(S2)	1.84(S1)	0.17(S2)	23.32(S2)	13,93(S2)	2.22(S3)	SiCL(S2)	W(S3)	VL(S1)	0-8(S1)	2000-2500(S2)	S3nroa	S2nroarc
T 4	5.2(S2)	1.91(S1)	0.16(S2)	19.25(S2)	14,94(S2)	1.37(S3)	SiC(S2)	W(S3)	VL(S1)	0-8(S1)	2000-2500(S2)	S3nroa	S2nro
T 5	5.2(S2)	2.32(S1)	0.14(S2)	25.03(S2)	15,70(S2)	9.56(S3)	SiC(S2)	W(S3)	VL(S1)	0 – 8(S1)	2000-2500(S2)	S3nroa	S2nroarc
T 6	5.5(S1)	2.16(S1)	0.15(S2)	23.32(S2)	15,19(S2)	8.71(S3)	SiCL(S2)	W(S3)	VL(S1)	0-8(S1)	2000-2500(S2)	S3nroa	S2nroarc
T 7	5.5(S1)	1.53(S1)	0.17(S2)	19.25(S2)	14,69(S2)	1.37(S3)	SL(S2)	W(S3)	VL(S1)	0-8(S1)	2000-2500(S2)	S3nroa	S2nroa
T 8	5.6(S1)	1.61(S1)	0.14(S2)	16.19(S2)	15,45(S2)	16.57(S2)	SiL(S1)	M(S3)	VL(S1)	0 – 8(S1)	2000-2500(S2)	S3oa	S2oa
T 9	5.5(S1)	1.46(S1)	0.15(S2)	22.48(S2)	14,94(S2)	2.73(S3)	SL(S2)	W(S3)	VL(S1)	0-8(S1)	2000-2500(S2)	S3snroa	S2nroarc
T 10	5.6(S1)	2.08(S1)	0.14(S2)	21.66(S2)	14,43(S2)	15.88(S2)	SiCL(S2)	M(S3)	VL(S1)	0-8(S1)	2000-2500(S2)	S3oa	S2rcoa
T 11	5.1(S2)	1.58(S1)	0.11(S2)	16.10(S2)	14,53(S2)	6.24(S3)	SCL(S2)	W(S3)	VL(S1)	0-8(S1)	2000-2500(S2)	S3nroa	S2nroa
T 12	5.7(S1)	1.66(S1)	0.18(S2)	15.88(S2)	15,20(S2)	16,04(S2)	SiL(S1)	M(S3)	VL(S1)	0 – 8(S1)	2000-2500(S2)	S3oa	S2oa
T 13	5.2(S2)	1.58(S1)	0.12(S2)	17.42(S2)	11.96(S2)	7.76(S3)	SiL(S1)	W(S3)	VL(S1)	0-8(S1)	2000-2500(S2)	S3nroa	S2nroa
T 14	5.6(S1)	1.77(S1)	0.17(S2)	20.12(S2)	17.10(S2)	9.01(S3)	SiCL(S2)	W(S3)	VL(S1)	0-8(S1)	2000-2500(S2)	S3nroa	S2nroarc

Source: Result of Analysis, 2024.

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Land Suitability Class:	Limit factors:
S1: very suitable	nr: nutrients retention
S2: sufficiently Suitable	rc: root condition
S3: marginally Suitable	oa: oxygen availability
W: Well-Drainage	wa: water availability
M: Moderately-Drainage	
VL: Very Low	

3.3. Community Empowerment Program

A fundamental principle in the development of community empowerment programs is the authentic involvement of all stakeholders throughout the entire process, beginning with the identification of community assets and challenges and continuing through to the formulation of the program itself. To effectively implement the community empowerment program in the Anambas Islands Regency, which is founded on local resources, it is essential that the process of formulating this program commences at the grassroots level within the community. Following the initial formulation of the program at the community level, this foundational framework serves as a crucial point of reference for subsequent discussions at the regional level. The development of the program at the community level results in the establishment of a framework or guidelines for community empowerment initiatives.

Table 2. Community Empowerment Program Plan and Activity Indications

No	Program Plan		Program Indicator
I	Capacity Building	1.	Enhancing community empowerment and capital within the domain of plantation crop cultivation, specifically focusing on rubber and clove production.
		2.	Enhancing community empowermenty and capital in the domain of cultivating alternative plant species beyond dominant agricultural commodities.
		3.	Enhancing community empowerment and capital within the domain of fisheries cultivation.
		4.	Enhancing community empowerment and capital within the domain of livestock cultivation.
		5.	Enhancing community empowerment and capital within the domain of home industries centered on value-added agricultural commodities (agroindustry).
		6.	The advancement of small and medium enterprises (SMEs) entails the provision of support in the formulation of suitable business models, particularly those that leverage distinct and high-quality commodities.
II	Group/institutional strengthening	7.	Strengthening of Groups and Institutions: Enhancing agricultural and plantation extension services, as well as agro-industrial extension initiatives, with a focus on superior commodities.
		8.	Placement of Support Personnel and Facilitators
		9.	Enhancing the capacity and effectiveness of community institutions, particularly through the development and support of agricultural cooperatives. Enhancing the Efficiency and Fortification of Capital Components
		10.	Enhancing the capacity and cohesion of agricultural cooperatives and various social and economic organizations.
III	Improvement of health services	11.	The Allocation of Healthcare Professionals
		12.	Enhancing the health outcomes of residents and fostering environmental well-being.
		13.	Enhancing healthcare facilities and infrastructure.
IV	Improving education services	14.	Enhancing Educational Facilities and Infrastructure
		15.	The advancement of informal education frameworks centered around agribusiness and agroindustry.
V	Cultural mentality development	16.	Placement of religious teaching staff
		17	Legal counseling
		18	National insight counselling

Source: Result of Analysis, 2024.

Community empowerment serves as a fundamental determinant in fostering sustainable development and improving the overall well-being of individuals residing within a community. The objective is to enhance the capacity of community members to exercise autonomy in their lives, facilitate informed decision-making, and collaboratively address challenges. Numerous studies have underscored the importance of community empowerment, particularly within the frameworks of agriculture and rural development. Sau et al., 2021) emphasized the importance of alternative business training models for environmental-based community empowerment among farmer labor. The study highlighted the need for mapping community assistance or empowerment in various areas such as coastal regions, forestry, rice fields, and mountains, showcasing the diverse needs and opportunities for empowerment across different agricultural settings.

Furthermore, Mulyaningsih et al. (2021), a study was conducted examining the empowerment of environmentally conscious rice farmers as a strategy for promoting sustainable food security in Banten Province. The findings of the study indicate that the empowerment of lowland rice farmers to adopt

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environmentally sustainable innovations is contingent upon individual characteristics and the support systems present within the agricultural community. This underscores the necessity for tailored empowerment strategies that take into account both personal attributes and external support mechanisms.

Community empowerment initiatives, as elucidated by Zainal et al. (2021), serve to enhance the agency and capacity of local populations to influence decisions that affect their lives. The efforts were made to improve community welfare by engaging in activities that promote community initiatives, stimulate economic enterprises, and enhance production capacity. Through the facilitation of community self-help initiatives and the promotion of economic development, these programs play a significant role in fostering resilient and self-sustaining communities.

4. Conclusion

Based on the results of the analysis of field and laboratory data, the actual land suitability class for lowland rice commodities was obtained based on the existing potential in the Anambas Islands Regency Area. From the existing soil map units (SMU), all SMU representative points are declared "marginally suitable" for lowland rice commodities, with suitability class S3. Meanwhile, in the subclasses, the inhibiting factors found were quite diverse, such as limited nutrition (nr) and oxygen availability (oa). Community empowerment in Anambas Islands Regency serves as a fundamental determinant in fostering sustainable development and improving the overall well-being of individuals residing within a community. The objective is to enhance the capacity of community members to exercise autonomy in their lives, facilitate informed decision-making, and collaboratively address challenges.

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