MAPPING OF THE POTENTIAL ECONOMIC SECTORS OF RENGAT PEATLAND

Pemetaan Potensi Sektor Ekonomi Lahan Gambut Rengat

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ABSTRAK

Pengembangan spesialisasi ekonomi berdasarkan kondisi lahan saat ini sangat penting karena dapat mendukung ekonomi dan melestarikan ekosistem lahan. Spesialisasi dalam suatu bidang ekonomi akan menghasilkan penciptaan merek atau ciri khas suatu produk atau komoditi suatu daerah, yang akan meningkatkan nilai jual dan daya tawar pasar. Salah satu persoalan yang menyebabkan rusaknya fungsi ekosistem lahan gambut adalah pemilihan komoditas atau sektor ekonomi yang kurang tepat dikembangkan. Tujuan penelitian ini adalah untuk mengetahui spesialisasi komoditas lahan gambut di Kabupaten Rengat Provinsi Riau. Metode AHP dan *Borda Count Method* digunakan dalam penelitian ini. Berdasarkan temuan perhitungan AHP dan Borda, setiap desa atau kecamatan sampel yang diteliti memiliki komoditas dan sektor ekonomi tertentu yang berpotensi untuk dikembangkan di lahan gambut. Metode ini juga mengungkapkan bahwa jagung merupakan komoditas yang paling menjanjikan untuk dikembangkan di lahan gambut di Kecamatan Rengat, dengan luas tanam terbanyak di Desa Rawa Bangun. Hasil penelitian ini diharapkan dapat menjadi acuan dan indikator kebijakan pemerintah dalam pengembangan ekonomi lahan gambut di Kecamatan Rengat, Kabupaten Indragiri Hulu, Provinsi Riau.

Kata kunci : AHP, borda, lahan gambut

ABSTRACT

The development of economic specialization based on current regional land conditions is crucial because it can both support the economy and preserve land ecosystems. Specialization in an economic field will result in the creation of a brand or characteristic of a product or commodity of an area, which would increase the market's selling value and bargaining power. One of the issues causing damage to the peat ecosystem's function is the inappropriate selection of commodities or economic sectors being developed. The purpose of this study was to ascertain the specialization of peatland commodities in Rengat District, Riau Province. The AHP and *Borda Count Method* methods were used in this study. According to the findings of AHP and Borda calculations, each sample village or district studied has certain commodities and economic sectors that have the potential to be developed on peatlands. This method also revealed that maize is the most promising commodity to be developed on peatlands in Rengat District, with the most planted area in Rawa Bangun Village. The findings of this study are expected to serve as a reference and indicator for government policies on peatland economic development in Rengat District, Indragiri Hulu Regency, Riau Province.

Keywords: AHP, borda, peatland

INTRODUCTION

Specialization in the economic sector based on current regional land conditions is crucial because it can both support the economy and preserve the land ecosystem. Natural resources have a dual role, namely as capital for economic growth (a resource-based economy) and at the same time as a support system for life (a life support system). Until now, natural resources have played a very important role as the backbone of the national economy and will still be relied upon in the medium term. On the basis of this dual function, natural resources must always be managed in a balanced way to ensure the sustainability of national development. The application of the principles of sustainable development in all sectors and regions is a prerequisite for internalization into policies, laws, and regulations, especially in encouraging medium-term development investments with mutually synergistic principles and complementing the development of good governance based on participation, transparency, and accountability that encourage efforts to improve natural resource management and preserve environmental functions.

The influence of the quality and quantity of environmental and natural resources upon growth

in economic welfare has been widely accepted since the late 1960s (Toman, 2003). Natural resources, particularly mining assets, have been identified as one of the ten most significant variables influencing variation in longterm economic growth (GDP per capita) rates (Sala-i-Martin*, et al,* 2004). However, the more general impact of natural resource endowments on a country's long-term welfare is unclear. The specialization of an economic sector will give birth to a brand or characteristic of a product or commodity of an area, which will increase the market's selling value and bargaining power. Absolute profits will be easier to achieve with specialization in product production (Vanzza Aji et al., 2019). This also applies to areas with peat bogs. Peatland areas can have distinct products that drive the regional economy while maintaining the peat ecosystem's balance. Riau Province has the second largest peatland area in Indonesia, with 3,864,414 Ha of peatland, accounting for 60.1% of the peatland on Sumatra. It covers an area of 1,417,762 Ha (36.7%) with a thickness of less than 300 cm and 2,449,652 Ha (63.3%) with a thickness of more than 300 cm (Wahyunto et al., 2003).

The rapid expansion of commercial agriculture and industrial plantations is putting significant strain on Indonesia's peatlands. Because peatlands can no longer absorb water, they dry out and become more vulnerable to fire (Miettinen et al., 2016). Looking at the characteristics of the land, landscape and land use design, as well as the development of peatland community communities, are all things that must be considered in peatland management (Sulaiman et al., 2019). The nature of irrigation and drainage, plant carrying capacity, thickness and maturity level, and chemical properties that change according to the shape of the land all influence the use of peatlands in the agricultural sector, so that its potential and development will follow this pattern. Based on these characteristics, peatlands are generally more suitable for planting crops with a long growing season (annual) than food and horticultural crops, such as seasonal vegetables and fruits (Syahza et al., 2020). An area of 4.9 million hectares, or about 55 percent of the Riau Province's land area, is peatland consisting of various thicknesses. Various community economic activities are carried out on peatlands, including the fulfillment of food consumption. Fulfillment of food consumption is carried out by planting food crops and horticulture, especially on shallow peatlands (Masganti et al., 2017). Based on the thickness, then the use peatlands can be directed as follows, for peatlands (peat thickness 50 cm) and peat shallow (peat thickness 51–100 cm) is more suitable for cultivation of food crops (rice and pulses); land medium peat (peat thickness 101–200 cm) is suitable for vegetables and horticulture; deep peat (thick peat 201–400 cm) can be used for plantations with limited cultivation; the rest is peatland very deep (peat thickness > 400 cm) directed to become a conservation and restoration area or protected area.

Utilization of peatlands based on local wisdom can help preserve peat ecosystems and fulfill people's food needs. The utilization of peatland based on local wisdom can help to preserve the peat ecosystem. Rengat District, Indragiri Hulu Regency, with peat land making up the majority of its land. The thickness of the peatlands here ranges from 0.5 to > 7 meters. According to the table 1., the majority of the areas in Rengat District have peatlands of varying thickness. The use and development of peatland has long been a source of contention. Different perspectives on the use of peatlands sparked this debate, which became divided into two areas of interest: environmental concerns and the development of peatlands for strategic commodity agriculture. A lack of precision in the commodities or economic sectors that are developed is one of the problems that occur in peatlands and cause damage to the peat ecosystem's function. Commodities that do not conform to the characteristics of peatlands, for example, will cause peat water to drain, causing drought and triggering land fires. This condition necessitates that the parties involved

Figure 1. Condition of Peatlands in Rawa Bangun Village and Sekip Hilir Village, Rengat District

Table 1. Peat Thickness by Sub-districts/villages in Rengat District

No	Sub-districts/villages	Peatland	Peat Thickness
1	Sungai Guntung Tengah	Available	0.5 - > 7 meters
2	Sungai Guntung Hilir	Available	0.5 - > 7 meters
3	Kuantan Babu	Available	0.5 - > 7 meters
4	Kampung Dagang	Available	0.5 – 3 meters
5	Kampung Pulau	Available	0.5 - > 7 meters
6	Kampung Besar Kota	Available	0.5 – 1 meters
7	Pasar Kota	None Available	-
8	Sekip Hulu	Available	0.5 – 3 meters
9	Sekip Hilir	Available	0.5 – 3 meters
10	Kampung Besar Seberang	Available	0.5 - > 7 meters
11	Rantai Mapesai	Available	0.5 - > 7 meters
12	Pasir Kemilu	None Available	-
13	Sungai Beringin	Available	0.5 – 1 meters
14	Pulau Gajah	None Available	-
15	Sungai Raya	Available	0.5 – 3 meters
16	Rawa Bangun	Available	2 – 3 meters

Sources: Prims.brg.go.id, data processed

find a solution that strikes a balance between the two interests. One solution is to create a community-based economy based on land suitability (sustainable peatland development) (Zamaya et al., 2021).

Rengat District is made up of 16 villages, the majority of which are located on peat land. The table below shows sub-districts/villages in Rengat District and their peat thickness based on prims.brg.go.id map.

The objective of the study is to mapping economic sectors or commodities that have the potential to be developed in the peatlands of Rengat District.

RESEARCH METHODS

Framework

The goal of this study is to identify the peatlands' economic potential in Rengat District. The issue that the authors of this study raise is that "there is no mapping of the economic potential of peatlands in Rengat District," based on the previously discussed background. By first applying the fishbone method to that issue the researcher was able to pinpoint its source as seen in figure 2.

In figure 2, there are five underlying causes that may be seen in the image above. These issues' underlying causes are:

1. Man

   Public ignorance of goods and products typical of peatlands. Most individuals have so far planted crops that are only highly valuable economically, disregarding the factors that contribute to peatland sustainability. As a result, there was a severe drought that eventually made the ground highly inflammable. As peatlands can never be restored to their original state, they deteriorate and are left as idle, useless land. Publics are vulnerable to catastrophic peat ecosystem degradation, requiring socially and economically inclusive mitigation efforts. The vulnerability of this community can be described by the magnitude of the impact of the fires and the lack of knowledge of changes in peat characteristics after drainage (Gunawan et al., 2020).

   The most frequent problem is the utilization of peat land that doesn't suit the biophysics of the land, either due to the type of plants grown or because peatlands cannot be grown well if the roots are flooded with water that is acidic and low in nutrients. The problem impacts livelihoods and the income received by the community (Surati, et al, 2019).

2. Method

   Peatland products and commodities per sub-district or village have not been specifically included in previous peatland methodologies or research. The level of

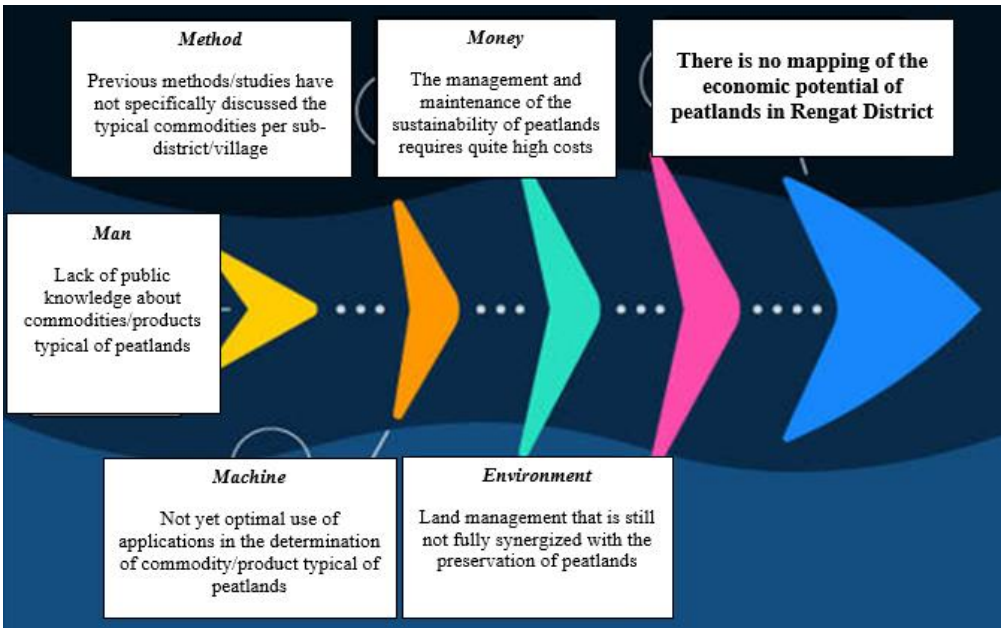


Figure 2. Research Framework

understanding of the nature, character, and ecology of peatlands is felt to be still limited, both among farming communities and among technical implementers in government agencies or institutions, so that the utilization and management of peatlands for agricultural or plantation development pays little attention to the nature of peat as a fragile land resource that is easy to change (Noor, et al. 2014).

3. Machine

   Not yet making the best use of apps for identifying goods or products typical of peatlands. The agricultural system, including fisheries and livestock farming on peatlands, is still labor-intensive and traditional. The use of technological innovation is still very limited; even though it has started to be introduced, only some have adopted it, and only a few components of cultivation have fully adopted it (Noor, et al. 2014).

4. Environment

   A lack of complete synergy between peatland management and sustainability. Knowledge passed down from generation to generation becomes learning for the next generation until it becomes an institutionalized custom called local wisdom. Various local wisdoms from the perspective of utilizing peatlands develop within the local community, although on a limited scale (Noor et al. 2014).

5. Money

   At the moment, maintaining and managing peatlands is highly expensive. Peatlands are acidic; for this reason, preparing land for agriculture requires various tools and equipment so that the acidity level of peatlands can be adjusted and be ready for planting. Communities have limited access, funds, and ability to obtain fertilizers and ameliorants, so to increase soil fertility, farmers burn plant residues and some dry peat layers before planting (Agus & Subiksa, 2008). In previous studies, for vegetable crops, costs for rent and land management amounted to IDR 55,303,500 per hectare (Putra, 2019).

Method of Collecting Data

This research was conducted in Rengat District, Indragiri Hulu Regency, Riau Province. Samples were taken from sub-districts and villages in Rengat District all of which were covered by peat with a thickness of between 0.5 and 3 meters. There are six sub-districts/villages that meet the requirements as samples. To answer the problems of this study, respondents (key informants) were taken from Kampung Dagang Village, Sekip Hulu Village, Sekip Hilir Village, Sungai Beringin Village, Sungai Raya Village, and Rawa Bangun Village.

The stages of data collection begin with determining and separating primary data from secondary data. Data collection techniques included intensive observation, in-depth interviews, documentation techniques, and a literature review. Data collected during field observations included the physical condition of the object of research, such as documentation of

peatlands, the economic condition of the community, commodities on peatlands, the role of the government, and so on. The interview method is the process of obtaining information for research purposes by way of question and answer while face-to-face between the interviewer and the interviewee, with or without using an interview guide. In-depth interviews were carried out by conducting direct interviews with informants, which in this case were village heads and community leaders. The criteria for selecting key informants who are expected to provide the key information needed are:

a. They master or understand something through a process, so that something is not only known but also internalized.
b. Those who are classified as still engaged in or involved in the activity being researched.
c. They have free time to be asked for information.
d. Those who tend to convey the results of their own personal opinion.

The documentation method is a data collection method used to trace historical data. Documentation techniques are part of secondary data collection relating to documents, images, and other data. The documents referred to in this study are books, notes, magazines, newspapers, the internet, and newspapers that are directly related to research. A literature review was conducted to find out whether the research had been carried out or not. In addition to knowing the differences between previous research and the research that will be carried out. The literature review also compares the data with related concepts and theories.

Data Analysis Method

This AHP method can be used in decision-making systems by taking into account the factors of perception, preference, experience, and intuition. Basically, the AHP method breaks down a complex and unstructured situation into its component parts. Then organize these parts or variables in a hierarchical arrangement and give numerical values to subjective judgments about the relative importance of each variable. It then synthesizes these considerations to determine which variable has the highest priority and acts to influence the outcome in that situation.

There are several stages to compiling this research. In the first stage, the author chose the theme of decision-making in selecting commodities that have the potential to be developed on peatlands, then proceeded with identifying problems that occurred in the community in the process of selecting commodities that had the potential to be developed on peatlands, which would later be formulated in a problem formulation. Then the researcher conducts a preliminary study to collect some information related to the problem to be studied and determine the method for solving it, and later the results can be used in preparing a theoretical framework to answer this problem by formulating a hypothesis. The problem being studied will be proven true through conjectures or temporary answers called hypotheses. The next step is to determine the research sample, which ends with the preparation of the research. In the second stage, the authors collect data based on a predetermined sample of respondents. Then determine the research instrument to measure the variable being studied. The instruments used were questionnaires, observations, and interviews. After the data has been collected, the data analysis stage is carried out to answer a problem formulation and a hypothesis using a predetermined method of decision-making, then presented and given a detailed discussion. In the third stage, which is the final stage, after the discussion is explained, the author draws a conclusion from the entire research and then writes a report based on the results of the research itself. For the AHP method in this study using the Expert Choice V 11 application.

In solving problems using the AHP method, there are several basic principles that need to be understood, namely:

1. Decomposition (hierarchical arrangement), namely the process of analyzing real problems into a hierarchical structure of its supporting elements. The implementation of the hierarchical structure arrangement can be seen in the following figure:

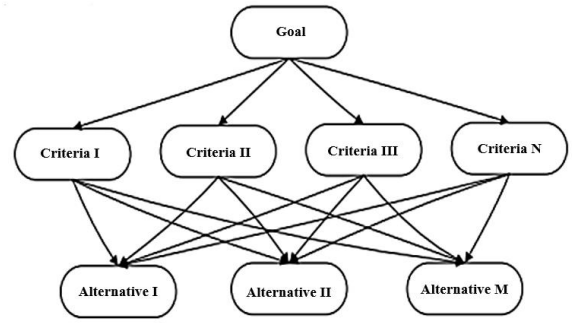


Figure 3. AHP Hierarchical Structure

In this study, using the AHP analysis method, which has a form of decomposition structure, the first level is the decision objective. The purpose of this research is to determine what

sectors or commodities have the potential to be developed on peatlands in Rengat District with the aim of fulfilling food needs while maintaining the sustainability of these peatlands. On the second level are the criteria. The criteria for achieving this goal are sectors or commodities that are friendly to peatlands, have high economic value, and are affordable and easy to manage. The third level is alternatives. Various alternatives were formulated in the research based on the results of the pre-research conducted by the researcher. The alternatives are maize, rice, bananas, vegetables, and pond fish. The choice of this alternative was based on interviews conducted with the community in various villages and kelurahans in Rengat District. This commodity, besides being able to meet food needs, also has a competitive selling value. Alternatives for determining suitable planting areas are also determined in the calculations using the AHP method.

2. Comparative judgment is carried out by evaluating the relative importance of the two elements. The results of this assessment are presented in the form of a pairwise comparison matrix which contains the level of preference between each criterion. The preference scale used is the Interest level scale (Ilham & Mulyana, 2017). In the pairwise comparison matrix determines priorities using the Saaty scale (Zhang, Liu, & Yang, 2009), for various problems, a scale of 1 to 9 is the best scale for expressing opinions. Each pairwise comparison is evaluated on a Saaty scale of 1-9 as follows:

   1. Both criteria are equally important and have the same peatland economic sector

   3. Criterion (A) is slightly more important (moderate importance) than (B)

   5. Criterion (A) is more important (strong importance) than (B)

   7. Criterion (A) very strong importance compared to (B)

   9. Criterion (A) is more important (extreme importance) than (B)

   2, 4, 6, 8 = Middle value

3. Determining the priority point of the criteria used is the Additive Normalization (AN) method.

   The Borda method is a voting method that can complete group decision making, where in its application, each decision maker gives a rating based on the available alternative choices. In the election process using the Borda method, each voter is given an alternative choice.

This study was carried out in the sample area, which has a peat thickness of between 0.5 and 3 meters, because this peat thickness falls into the category of shallow, medium, and medium peat, which the community is permitted to use for economic sustainability. This study's sample area included three villages: Sungai Beringin, Sungai

Sector/Commodity (Maize, Rice, Banana, Vegetables and Pond Fish)

Criteria (A)	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Criteria (B)
Kampung Dagang																		Sekip Hulu
Kampung Dagang																		Sekip Hilir
Kampung Dagang																		Sungai Beringin
Kampung Dagang																		Sungai Raya
Kampung Dagang																		Rawa Bangun
Sekip Hulu																		Sekip Hilir
Sekip Hulu																		Sungai Beringin
Sekip Hulu																		Sungai Raya
Sekip Hulu																		Rawa Bangun
Sekip Hilir																		Sungai Beringin
Sekip Hilir																		Sungai Raya
Sekip Hilir																		Rawa Bangun
Sungai Beringin																		Sungai Raya
Sungai Beringin																		Rawa Bangun
Sungai Raya																		Rawa Bangun

The left side is more important ◄——► The right side is more important

Raya, and Rawa Bangun, as well as three villages: Kampung Dagang, Sekip Hulu, and Sekip Hilir. Previous research was conducted using secondary data as well as direct observations in the field by researchers. The agricultural, fishery, and trade sectors have been identified as economic sectors and commodities with development potential. Maize, bananas, rice, and vegetables are among the agricultural commodities. Pond fish are traded in the fishery sector, as are traditional and modern retail businesses.

Table 2. Implementation of the Borda Method

Voter/Decision Maker	Candidates / Alternative Choices				Ranking	Poin
	A	B	C	D		
1	2	3	0	1	1	3
2	3	3	0	2	2	2
3	1	2	1	0	3	1
Borda Method Calculations	6	8	1	3		

RESULTS AND DISCUSSION

The results of pre-research interviews conducted by researchers found that peatlands in Rengat District have the potential to develop food crops and horticulture. Based on these pre-research results, the researchers decided to choose five main commodities that have the potential to be developed in Rengat District based on being friendly to peatlands, having high economic value, the cost of managing these commodities is affordable and easy to manage. These commodities are maize, rice, bananas, vegetables and fish ponds. The following is a figure of the AHP peatland commodity hierarchical structure in Rengat District (figure 4).

The overall calculation of AHP using the Expert Choice 11 application for the selection of peatland areas with the potential to be developed in Rengat District results in Rawa Bangun Village receiving a score of 22.6 percent, Kampung Dagang Village receiving a score of 17.0 percent, Sekip Hilir Village receiving a score of 16.1 percent, Sekip Hulu Village receiving a score of 15.4 percent, Sungai Raya Village receiving a score of 15.0 percent, Sungai Beringin Village received a score of 13.8 percent. Maize receives a score of 28.4 percent, bananas receive a score of 20.9 percent, traditional and modern retailers receive a score of 19.1 percent, vegetables receive a score of 13.7 percent, fish ponds receive a score of 10 percent, and rice receives a score of 7.5 percent (figure 5).

Using the Analytical Hierarchy Process (AHP) method, it was discovered that maize in Rawa Bangun Village, rice in Sungai Beringin Village, vegetables in Sekip Hilir Village, bananas in Sekip Hulu Village, pond fish in Sungai Raya Village, and traditional and modern retail in Kampung Dagang Village have the potential to be developed in the sample area. The result of the AHP analysis can be seen in table 3.

The results of the analysis show the point of the criteria: maize, 28.4%; banana, 20.9%; vegetables, 13.7%; pond fish, 10.5%; and rice, 7.5%, with a 6% inconsistency. The alternative order is Rawa Bangun Village, Sekip Hilir Sub-District, Sekip Hulu Sub-District, Sungai Raya Village, and Sungai Beringin Village, with sequential points of 22.6%, 16.1%, 15.4%, 15.0%, and 13.8%. From the results of the AHP, it was found that maize planting has the potential

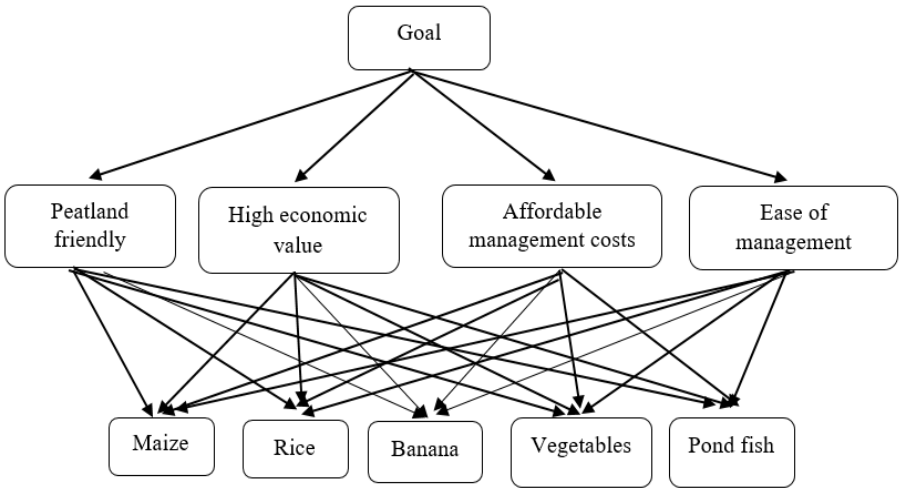
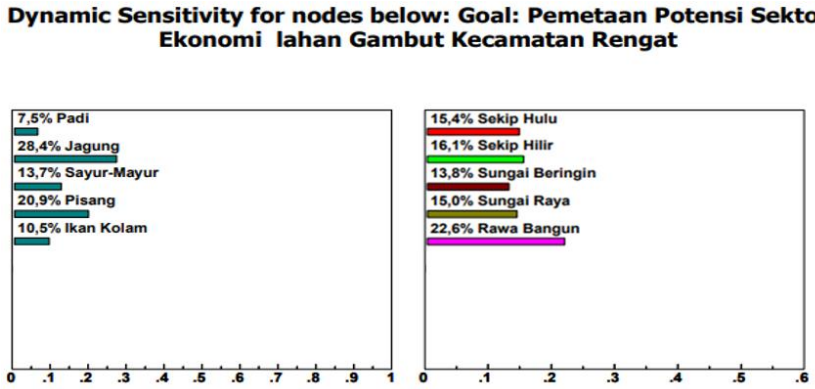


Figure 4. AHP Peatland Commodity Hierarchical Structure in Rengat District



Figures 5. Dynamic Sensitivity for Nodes Below Mapping Potential Economic Sectors in Peatland Rengat District

Table 3. The Result of The AHP Analysis

Criteria	Alternative				
	Rawa Bangun	Sekip Hilir	Sekip Hulu	Sungai Raya	Sungai Beringin
Maize (28,4%)	54,3%	11,5%	12,3%	7,6%	9,5%
Banana (20,9%)	15,8%	14,4%	20,8%	16,0%	15,3%
Vegetable (13,7%)	25,8%	37,2%	15,8%	9,3%	7,3%
Fish Pond (10,5%)	12,5%	15,7%	15,0%	29,8%	10,8%
Rice (7,5%)	10,9%	6,5%	5,3%	18,2%	53,3%

Source : Processed Data By The Research Team, 2022

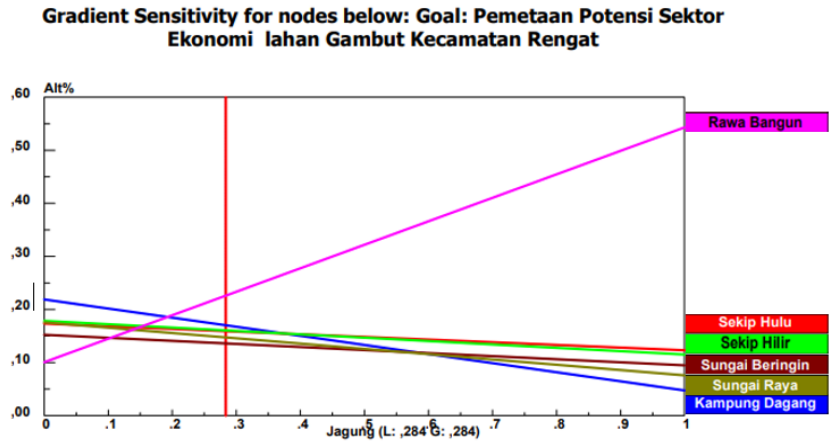
to be developed in Rawa Bangun Village with a point of 54.3%, banana plants have the potential to be developed in Sekip Hulu Village with a point of 20.8%, vegetables in Sekip Hilir Village with a point of 37.2%, pond fish in Sungai Raya Village with a point of 29.8%, and rice has the potential to be developed in Sungai Beringin Village with a point of 53.3%. The results of this study showed that the most potential to be developed on peat land in Rengat District is maize, with the location of the development area in Rawa Bangun Village.

Maize

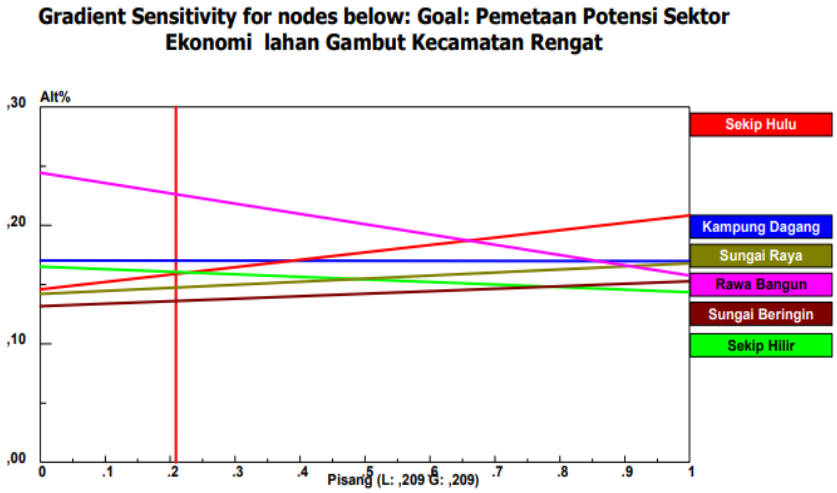
From the results of the AHP (figure 6), it was found that the maize commodity has the potential to be developed in Rawa Bangun Village with a point of 54.3%. Maize has become a popular crop grown on peatlands in Rengat District. Maize is the main national food commodity besides rice and soybeans, so it has strategic economic value. Maize is used as the second staple food after rice and can also be further processed as animal feed or industrial raw materials, so it has very good marketing prospects (Harniati, 2000). Many of the farmers in Rawa Bangun Village grow maize because of the abundant maize production. According to the results of the AHP and the results of interviews with key informants, Rawa Bangun Village is a very promising area for the development of maize plants with special treatment to neutralize the acidity of peatlands (both chemical and natural ingredients added) so that maize has high productivity, a sweet taste, early maturity, and a longer shelf life (Syukur and Rifanto, 2014). Rawa Bangun Village is a supplier of maize for the needs of residents in Rengat District. Market opportunities for maize crops at the regional level are also very promising. It is evident from the results of pre-research interviews with farmers that the demand for maize is quite high, and the price is IDR 12,000 per kilogram.

Banana

From the results of the AHP (figure 7), it was found that the banana commodity has the potential to be developed in Sekip Hulu Village with a point of 20.8%. The banana plant is a plant that is widely cultivated by the people of Indragiri Hulu Regency and is a superior commodity, where production reached 162,150 quintals in 2015 and was the highest in Riau Province (Central Statistics Agency, 2022). Bananas have wide utility because, apart from being a raw material for the food and non-food industries, they are also used for household consumption (Makarawung et al. 2017). Bananas are also a source of input for small and medium businesses in Rengat, namely banana chips. Banana chips are regional



Figures 6. Gradient Sensitivity for Nodes Below Maize

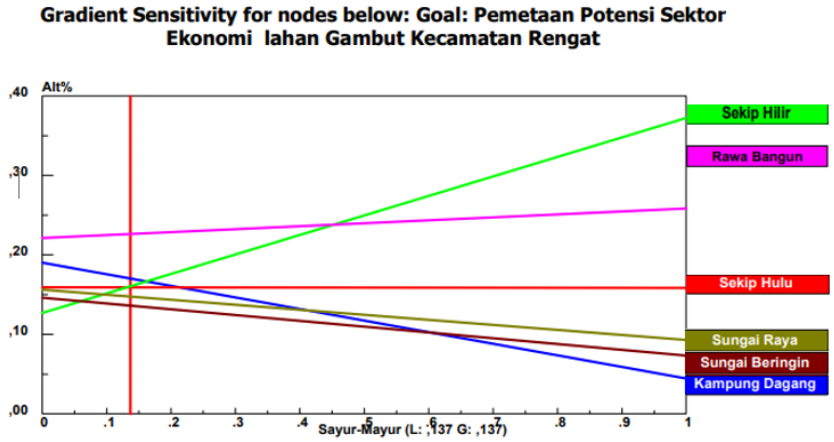


Figures 7. Gradient Sensitivity for Nodes Below Banana

specialties that are used as snacks and souvenirs typical of Rengat. Banana, the main raw material for making banana chips, is a plant that can grow well on peatlands with a depth of 50–100 cm. Bananas are suitable for planting in West Rengat and Batang Gansal Districts. Of course, this can be a synergy between sub-districts in Indragiri Hulu Regency to develop banana-based industries. If banana plants of various varieties according to industrial needs can be well developed, they will become regionally superior commodities. Bananas can meet the needs of the banana chip industry and other industries such as banana flour and other processed bananas that require further study and research (Zamaya, 2021). Commodity selection on peatlands is closely related to the typology of overflow, seasonality, economic value of commodities, and availability of technology. Horticultural commodities (vegetables and fruits) have a higher economic value than food crops but require more intensive cultivation techniques (Masganti 2014).

Vegetables

From the results of the AHP (figure 8), it was found that vegetable commodities had the potential to be developed in Sekip Hilir Village with a point of 37.2%. Sekip Hilir Village has the potential to grow vegetables. This was obtained from the results of the AHP and observations made by the research team. Spinach, squash, long beans, cucumbers, and other vegetables are being developed. The community grows vegetables between the oil palm harvests, where the farmers' vegetable gardens are located adjacent to the oil palm plantations. Every day, the people of Rengat District need vegetables as nutritious food. The continual demand is, of course, a tremendous opportunity to grow better vegetables in Sekip Hilir District. According to the findings of interviews with sub-district officials, vegetable farmers are currently threatened by pests and flooding if there is heavy rainfall. Agricultural technology to repel pests and anticipate that the land will not be



Figures 8. Gradient Sensitivity for Nodes Below Vegetables

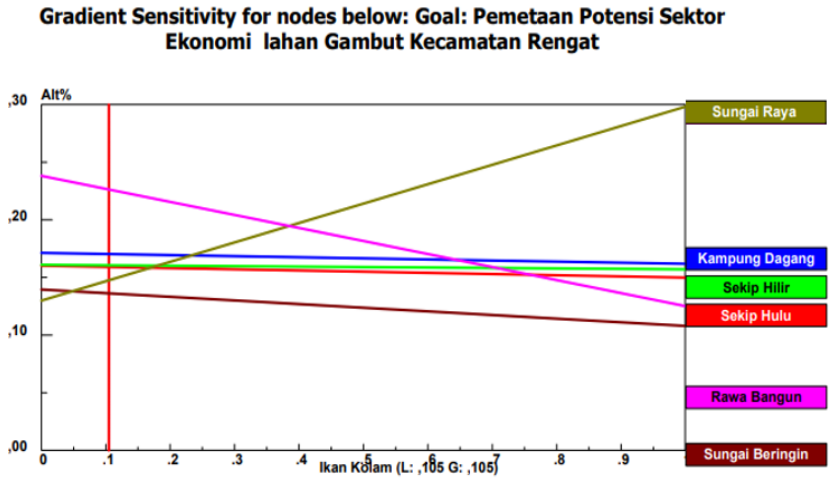
inundated for too long during high rainfall is, of course, very much needed in this sub-district. In this case, what also needs to be considered is the pattern of planting vegetables on peatlands. The cropping pattern is a farmer's strategy for optimizing agricultural land (Putra, 2019).

Pond Fish

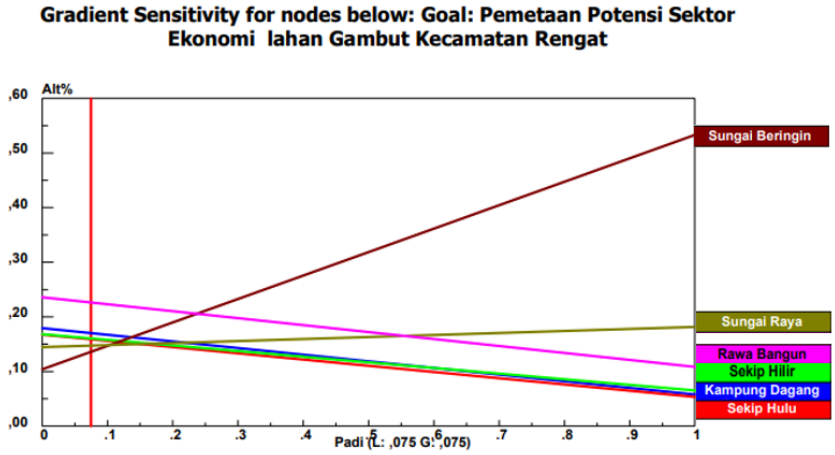
From the results of the AHP (figure 9), it was found that pond fish commodities have the potential to be developed in Sungai Raya Village, with a point of 29.8%. Pond fish is one of the agricultural sectors in the fisheries sector that can be developed on peatlands. Several types of fish developed in the peat waters of Rengat District, including catfish, African catfish, and tilapia. Pond fish farming generates community income. To maximize the potential of peatlands through fisheries, strategies for dealing with low pH problems must be optimized. The best use of local fish that have adapted to the peatland environment in Sungai Raya Village is one of the strategic options that can be implemented. To support the development of sustainable aquaculture, it is necessary to have an understanding of proper environmental management in peat waters. To optimize the existing potential, it is necessary to transfer technology in the development of fish that have the potential to be cultivated in peat waters so that regional welfare and development, especially fisheries-based development, can be achieved (Huwoyon, 2013).

Rice

From the results of the AHP (figure 10), it was found that the rice commodity has the potential to be developed in Sungai Beringin Village with a point of 53.3%. Based on the research team's observations, secondary literature review, and interviews with a number of village and sub-district heads, rice has the potential to be developed in this village. Sungai Beringin Village previously developed paddy and was successful, but the community is increasingly interested in



Figures 9. Gradient Sensitivity for Nodes Below Pond Fish



Figures 10. Gradient Sensitivity for Nodes Below Rice

and shifting to planting oil palm because the price is more promising and their rice fields are often inundated due to the village's proximity to the Indragiri river. Village officials are currently trying to encourage and invite villagers back to plant rice. The level of sustainability of rice farming on peatlands is in the good and highly sustainable category (Wardie and Sinta, 2016).

Together with AHP, this research employs the Borda method, the outcome of which is a ranking of commodities with the potential to be developed based on the decision maker's results. According to the Borda method results (table 4), maize received the highest score of 22, followed by bananas with a score of 20, traditional and modern retail received a score of 18, vegetables received a score of 17, pond fish received a score of 15, and rice received a score of 14. Maize is the most promising commodity to be developed on peatlands in Rengat District using both AHP and Borda methods. Rawa Bangun Village is where it is grown. The conservation properties of corn are inferior when compared to perennials, but in this study, the focus is on plants that are suitable for peatlands and that support the food security of the people of Rengat District. In this study, the selected commodities did not contain perennial or annual plants because, in addition to focusing on choosing peatland-friendly plants, they can also meet people's consumption needs.

In this study, the focus was on food and horticultural crops that could grow well and adapt to peatlands. The selection of commodities that are able to adapt well to peatlands is very important to obtain high crop productivity. Commodity selection is adjusted to plant adaptability, economic value, capital capability, skills, and business scale. Vegetables (lettuce, chives, kale, spinach, chilies, tomatoes, eggplants, and pariah) and fruit plants (papaya, pineapple, watermelon, and melon) are plants that have high economic value and are very well adapted to peatlands (Subiksa, 2011). The conservation properties of maize are inferior when compared to perennials, but in this study, the focus is on plants that are suitable for peatlands and that support the food security of the people of Rengat District. In this study, the selected commodities did not contain perennial or annual plants because, in

Table 4. Commodity Borda Results that have the Potential to be Developed in Rengat District

Komodities	Decision Maker						Total Score
	LKD	LSH	LSHr	KDSB	KDSR	KDRB	
Banana	4	1	2	3	3	3	20
Rice	5	5	5	1	3	3	14
Maize	5	2	2	2	2	1	22
Vegetables	5	3	3	3	3	2	17
Pond Fish	2	5	5	3	3	3	15

Information : LKD : Village Head Kampung Dagang
LSH : Village Head Sekip Hulu
LSHr : Village Head Sekip Hilir
KDSB : Village Head Sungai Beringin
KDSR : Village Head Sungai Raya
KDRB : Village Head Rawa Bangun

addition to focusing on choosing peatland-friendly plants, they can also meet people's consumption needs.

The world is concerned about the growing phenomenon of peatland damage, especially since it has been discovered that peat plays an important role in global climate regulation, which will have a huge impact on a wide range of life on Earth. Perennials and annual crops are indeed recommended for long-term peatland conservation, but in this study, the focus was on food crops and horticulture in order to support the food security of peatland communities in Rengat District, Indragiri Hulu Regency. Perennials will be studied in further research.

Peat is classified as a wetland habitat that can absorb (sequester) and store (sink) carbon in large quantities, preventing greenhouse gases (primarily CO2) from escaping into the Earth's atmosphere and contributing to climate change (Najiyati, 2005). Not all peat swamp land in Riau Province is suitable for economic activities such as agriculture, fisheries, or other economic sectors. This is due to a number of constraints, including peat thickness, low fertility, high acidity, a pyrite layer, and sub-soil substratum (under peat) that can be quartz sand.

Because of their organic matter, peatlands burn easily, and has irreversible dryness, high porosity, and high tensile strength with low vertical hydraulic conductivity. Peat soil fires are extremely dangerous. It is difficult to extinguish because it can penetrate beneath the ground surface. The embers that were thought to have been extinguished are actually still stored in the ground and have spread unknowingly to the surrounding areas. Coals in deep peatland are usually only extinguished by heavy rains. As a result, peat fires must be avoided by not burning land, throwing away even the smallest embers such as cigarette butts carelessly, especially during the dry season, and maintaining soil moisture peat by not overdraining. Forest and peatland fires have a negative ecological impact by destroying most sources of biodiversity, killing hundreds of wild animals, and causing air pollution that affects health, economic activity, and transportation. The resulting air pollution increases the number of patients suffering from respiratory tract infections.

The selection of plants in optimal peatland management remains a conundrum, namely between meeting community needs and preserving peatlands (Zamaya, 2021). The ever-increasing population forces humans to meet their basic needs for food, clothing, and shelter in the area in which they live. According to the various studies that have been conducted, there is a conflict between the fulfillment of the community's primary needs and the sustainability of the peatland ecosystem. Peatlands are more suited for horticulture (vegetable and fruit) and annual crops, but very few shallow peat soils are good for food crops, especially lowland rice. Due to how readily they can be damaged, peatlands must be exploited with extreme caution, and their suitability must constantly be taken into account (Ritung & Sukarman, 2018). In order to manage water resources, preserve biodiversity, store carbon, and provide oxygen, harm to peat ecosystems must be avoided.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The development of peatlands is heavily influenced by the understanding or perception of the community regarding the nature and characteristics of peatlands as well as management methods, which were not given enough attention in the early stages of development. As a result of insufficient information regarding the techniques of cultivating and managing peatlands, the use of peatlands seems arbitrary (plan by doing), which in turn, unknowingly, turns peatlands into degraded lands.

Specialization in an economic field will result in the creation of a brand or characteristic of a product or commodity of an area, which will increase the market's selling value and bargaining power. The Analytical Hierarchy Process (AHP) method was used to find that maize has the potential to be developed in Rawa Bangun Village, rice in Sungai Beringin Village, vegetables in Sekip Hilir Village, bananas in Sekip Hulu Village, pond fish in Sungai Beringin Village, and traditional and modern retail in Kampung Dagang Village. The Borda method was used to bolster and support the AHP findings. According to the Borda method results, maize received the highest score, followed by bananas, traditional and modern retail, vegetables, pond fish, and rice. The results of AHP and Borda calculations show that each sample village or sub-district studied has certain commodities and economic sectors that have the potential to be developed on peatlands.

The conservation properties of maize are inferior when compared to perennials, but in this study, the focus is on plants that are suitable for peatlands and that support the food security of the people of Rengat District. In this study, the selected commodities did not contain perennial or annual plants because, in addition to focusing on

choosing peatland-friendly plants, they can also meet people's consumption needs.

Recommendations

The results of this study are expected to be a reference and indicator in determining government policies in peatland economic development in Rengat District, Indragiri Hulu Regency, Riau Province.

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