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Determination of Superior Agricultural Commodity Areas Based on Historical Data and Land Suitability

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ABSTRACT

Analysis and identification of superior agricultural commodity areas play a crucial role in determining regions with high potential for agricultural development. This study aims to identify priority agricultural commodities and assess their development potential in Lawang, Matur District, Agam Regency, West Sumatra Province. The research was conducted in several stages. First, superior agricultural commodities were identified using the Location Quotient (LQ) and Shift Share Analysis (SSA) methods. Second, the potential development areas for these commodities were determined using the Analytical Hierarchy Process (AHP) and Weighted Linear Combination (WLC) approach, integrated with Geographic Information System (GIS) analysis. The results indicate that the priority agricultural commodities in Nagari Lawang are peanuts for the food crop subsector, shallots for the horticulture subsector, and sugarcane for the plantation subsector. These findings provide valuable information for policymakers and local farmers to optimize land use, enhance agricultural productivity, and support sustainable rural economic development. Furthemore, the methodology used in this study can also be applied to other regions to identify superior agricultural commodities.

1. INTRODUCTION

The agricultural sector is a key driver of economic growth, particularly in developing regions where agriculture plays a dominant role in employment and food security. Agricultural development focuses on increasing production, productivity, and product value-added to enhance farmers' welfare and regional economic resilience. A crucial step in this process is the availability of accurate data and information regarding superior regional commodities, which serve as a foundation for effective agricultural planning and policy formulation (Novita *et al*., 2023).

In Sumatera Barat, agriculture is a main contributor to the regional economy, particularly through the plantation subsector. This sector provides employment for approximately 70% of the population and supports economic stability by ensuring food security and supplying raw materials for industries. Therefore, optimizing agricultural development through accurate commodity identification is essential for sustainable growth and resource efficiency (Lubis *et al*., 2023).

Many regions face challenges in determining and optimizing the development of superior agricultural commodities. Identifying these commodities is essential for ensuring efficient land use, increasing productivity, and promoting sustainable agricultural growth (Yanti *et al*., 2023). Precise analysis is required to assist governments in prioritizing resource allocation, supporting agribusiness investments, and minimizing environmental degradation. Various methods have been applied to identify superior agricultural commodities, combining statistical and spatial approaches to provide comprehensive insights. The findings of this study are expected to provide insights for policymakers, local governments, and farmers in optimizing agricultural development strategies. The results can support decision-making in land use planning, improve regional agricultural productivity, and contribute to sustainable rural economic development. Additionally, the methodology applied in this research can be adapted for other regions facing similar agricultural challenges.

2. MATERIALS AND METHODS

The research focused on Nagari Lawang, Matur District, Agam Regency, West Sumatra Province, Indonesia. This research was conducted from October 2023 to January 2024. The materials used for this research were spatial data of administrative boundaries, soil type, and land cover that can be downloaded from Ina Geoportal; national digital elevation model (DEMNAS) data; and agricultural commodity production data for 2017-2021 in Nagari Lawang, Matur District, obtained from the Agriculture Agency.

This study employs a multi-stage analysis to determine superior agricultural commodities and their development areas. The first stage involves identifying superior commodities using the Location Quotient (LQ) and Shift Share Analysis (SSA) methods. Once identified, the next step is determining the weight of criteria for superior commodity areas using the Analytical Hierarchy Process (AHP). Finally, the Weighted Linear Combination (WLC) approach, integrated with Geographic Information System (GIS), is used to map and analyze the potential development areas for these commodities.

This study used primary and secondary data. Primary data were collected through field surveys and interviews with local farmers and agricultural experts. While secondary data came from the department of Agriculture and other related government agencies. The selection of criteria for the AHP analysis was based on a literature review, expert opinions, and the specific agricultural characteristics of the study area. Key criteria included slope, land cover, and soil type as these factors are critical for determining the potential of superior agricultural commodity areas in Nagari Lawang.

2.1. Determination of Leading Commodities

The analysis was carried out to determine leading commodities in Nagari Lawang aim to be assumed to be potential, which are classified as the essential commodities and commodities that are included in the progressive or advanced group (Suryani *et al*., 2019). This analysis uses the Location Quotient (LQ) and shift-share analysis (SSA) methods with mathematical formulas, such as equations 1, 2, 3, and 4. The measurement criteria for the resulting LQ values are in Table 1.

$$LQ = \frac{l_i/e}{L_i/E} \tag{1}$$

where LQ is Location Quotient Index of agricultural commodities in Nagari Lawang, l_i is the productivity of agricultural commodities i in Nagari Lawang, e is total productivity of agricultural commodities in Nagari Lawang, L_i is the productivity of agricultural commodities i in Matur District, and E is total productivity of agricultural commodities in Matur District.

Next is the shift-share analysis (SSA) method with the mathematical formula:

$$RSG = ri\left(\frac{ri'}{ri} - \frac{nt'}{nt}\right) \tag{2}$$

Table 1. Criteria of LQ value and its

Criteria	Explanation
LQ > 1	The commodity is a basic commodity. The production of the commodity can not only meet the needs of the region but can also be exported outside the region.
LQ < 1	The commodity is a non-basic commodity. The production of the commodity cannot meet the needs of the region so it needs to be imported from abroad.

Source: Hamidah (2023)

$$PG = ri\left(\frac{nt'}{nt} - \frac{Nt'}{Nt}\right) \quad (3)$$

$$NG = PP + PPW \quad (4)$$

where *RSG* is Regional Share Growth, *PG* is Proportional Growth, *NG* is Net Growth, *ri* is productivity of commodity *i* in Nagari Lawang in the early years, *ri'* is productivity of commodity *i* in Nagari Lawang at the end of the year, *nt* is productivity of commodity *i* in Matur District in the early years, *nt'* is productivity of commodity *i* in Matur District at the end of the year, *Nt* is total productivity in Matur District in the early years, and *Nt'* is total productivity in Matur District at the end of the year. The SSA method can determine what factors cause the growth of a sector with the criteria in Table 2.

Table 2. Criteria values used in SSA method (Ramadhani & Yulhendri, 2019)

Criteria	Information
$PG > 0$	Commodity *i* in Nagari Lawang is growing rapidly.
$PG < 0$	Commodity *i* in Nagari Lawang is experiencing slow growth.
$RSG > 0$	Nagari Lawang has good competitiveness in commodities *i* compared to other areas.
$RSG < 0$	Commodities in Nagari Lawang cannot compete well with other areas.
$NG \geq 0$	The growth of commodity *i* in Nagari Lawang is included in the progressive (advanced) group.
$NG < 0$	The growth of this commodity in Nagari Lawang is quite slow.

Location Quotient (*LQ*) analysis was conducted on agricultural commodities in Nagari Lawang, namely the food crops, horticulture, and plantation sub-sectors. If the LQ value > 1, then the commodity is classified as central because the production of the commodity not only meets the needs of the region but can also be exported to other regions. Meanwhile, if the *LQ* value <1, then the commodity is classified as non-basic, so it needs to be imported from abroad because the production of the commodity cannot meet the region's requirement Due to a large number of units, the capital sector can be considered a commodity that is very likely to make a profit, but it is necessary to review whether the number increases or decreases each year; in this case, a shift-share analysis (SSA) analysis is needed (Putri *et al*., 2023). SSA analysis is carried out to see the growth of commodities in the area. If the net growth (NG) value in the SSA analysis is > 0, then the commodity is classified as progressive or advanced. NG value is the sum of the regional share growth (*RSG*) and proportional growth (*PG*) values. Meanwhile, if the *NG* value is < 0, the commodity is classified as slow.

Furthermore, to determine the priority of developing superior agricultural commodities, combine the search of location quotient (*LQ*) and shift-share analysis (SSA). The criteria used in the priority of developing essential agricultural commodities are listed in Table 3. The prioritized commodities have $LQ > 1$ and $NG > 0$. The commodity that is the second priority is with $LQ > 1$, and $NG < 0$. The commodity that is the third priority is with $LQ < 1$, $NG > 0$. While the commodity that is the last priority is with $LQ < 1$, $NG < 1$

Table 3. Priority criteria for superior agricultural commodities in Nagari Lawang

Priority	LQ	NG
First (1)	>1	≥0
Second (2)	>1	<0
Third (3)	<1	≥0
Fourth (4)	<1	<0

2.2. Analytical Hierarchy Process (AHP)

They are determining the area for developing superior commodities in Nagari Lawang using the Analytical Hierarchy Process (AHP) analysis technique. This decision-making technique uses many criteria and involves many variables (Nkonu *et al*., 2022). The factors or criteria selected in this study are based on guidelines for assessing land suitability for agricultural commodities, including land slope, soil type, and land cover. A land slope is a natural surface appearance that has a height difference. The magnitude of the slope is obtained when two places with different heights are compared with a horizontal straight distance (Hamdani *et al*., 2016). Land cover includes all types of appearances on the earth's surface. In this case, land cover is the appearance of physical objects on the earth's surface, such as vegetation, water, and other natural objects, without considering human activities (Bashit, 2019).

Next, the predetermined criteria are given a weight value so that AHP calculations can be carried out. Use the Analytical Hierarchy Process (AHP) to calculate the parameter weight value. A paired comparison questionnaire was given to stakeholders. The AHP decision-making system uses perception, preference, experience, and intuition as the components (Zaenurraohman & Permanajati, 2019). The technique compares the level of intensity of interest between two criteria. The first stakeholder is a policymaker who is responsible for the village apparatus in Nagari Lawang and is also a farmer with more than five years of experience. The second stakeholder is a policymaker responsible for the Jorong apparatus in Nagari Lawang and a farmer with more than five years of experience. The third stakeholder is an academic expert in Agricultural Engineering and Biosystems. The fourth stakeholder is the organization Agricultural Extension Center of the Matur District. The fifth stakeholder is an agricultural extension worker in Nagari Lawang. Table 4 shows how the criteria have been set and used to determine the priority.

Table 4. Pairwise comparison matrix between criteria

Parameter	P1	P2	P3
P1	1		
P2		1	
P3			1

Description: P1 = Slope, P2 = Soil Type, P3 = Land Cover

Table 5. Inter-criteria assessment scale (Saaty, 2008)

Intensity of Interest	Classification	Description
1	Equally Important	Equal between one interest and another
3	Moderate Interest	Medium category compared to other interests
5	Strong Interest	Strong category compared to other interests
7	Very Strong Interest	Forceful category compared to other interests
9	Very Important	One interest is extremely stronger than the other interest

The basis of the research used is the basic scale from Saaty (2008), namely by dividing it into five scales, with the criteria in Table 5. When the weighting process is complete, an eigenvector calculation will be carried out, which shows the relative weight (w) of each criterion against the other criteria. The first thing to do is determine the normalization value by dividing the value of each criterion by the total value of each column. After the normalization process, the next step is to find the eigenvector, which is often called the priority vector, by finding the number of each row and then dividing it by the number of criteria used so that the relative weight (w) of each criterion is obtained.

The value of the relative weight that has been obtained must perform a consistency test to get more accurate results. The first step is to calculate the principal Eigenvalue (λ_{max}). This principal eigenvalue is captured by adding the multiplication value between the numbers of columns with each relative weight value with the first equation**.**

$$\lambda_{max} = \frac{\Sigma_{i=1}^{n} (A \times W)_t}{n} \tag{5}$$

Next, calculate the consistency index (*CI*) and consistency ratio (*CR*) using the following formulas:

$$CI = \frac{\lambda_{max} - n}{n-1} \tag{6}$$

$$CR = \frac{CI}{RI} < 0.1 \tag{7}$$

where λ_{max} is Principal Eigen Value, *CI* is Consistency Index, *n* is number of criteria, *CR* is Consistency Ratio, and *RI* is Ratio Index. Based on the equation above, the *CI* value obtained is divided by the Random Consistency Index created by Saaty (1994), with the criteria in Table 6.

Table 6. Random Consistency Index, RI (Saragih & Ginting, 2023)

N (Number of Variables)	Random Consistency Index (RI)
1 & 2	0
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

The consistency ratio (*CR*) is declared acceptable if the value is less than or equal to 10% (0.1). If it meets the requirements, the AHP analysis that has been carried out can be declared consistent. A *CR* value > 0.1 indicates that the data is inconsistent (Isneni *et al*., 2020). The analysis produced through AHP will later be subjected to spatial analysis in the mapping process of the superior commodity areas of Nagari Lawang using ArscGIS 10.8 software.

2.3. Weighted Linear Combination (WLC)

The Weight Linear Combination (WLC) method is used to continue the analysis of determining the superior commodity areas of Nagari Lawang. The WLC method is used to integrate the AHP method with GIS, according to Drobne & Lisec (2009). This stage uses soil type maps, land slope maps, and land cover maps. The analysis tool used is GIS through ArcGIS 10.8 software. The relative weight (w) resulting from the calculation of the eigenvector in AHP is used as the weight of each criterion in the analysis, which is generally combined with the WLC analysis method using the raster calculator in ArcGIS 10.8 with the mathematical formula, namely**:**

$$WLC = (\, w1 \;\times\; x1\,) + (\, w2 \times x2\,) + (\, w3 \times x3\,) \tag{8}$$

where *WLC* is Weighted Linear Combination, *w1*, *w2*, and w3 is respectively relative weight of land slope, soil type, and land cover, and *x1*, *x2*, and *x3* is respectively map of land slope, soil type, and land cover. Furthermore, the reclassification of superior commodity areas into 5 suitability classes as in Table 7.

Table 7. Suitability class of superior commodity areas (Arifia *et al*., 2022)

Classification	Information
N2	Very Unsuitable
N1	Unsuitable
S3	Quite Suitable
S2	Suitable
S1	Very Suitable

3. RESULTS AND DISCUSSION

3.1. Superior Commodities of Nagari Lawang

Determination of superior commodities is carried out by combining the analysis of Location Quotient (LQ) and Shift Share Analysis (SSA). Each region has different potential in producing agricultural commodities so that each region can excel in commodities that are very important for their area. Optimizing leading commodities will help regions to increase their economic growth. Agricultural commodities that can be prioritized for regional development must have certain advantages compared to other commodities so that these commodities can show characteristics and provide distinctive features of the region.

3.1.1. Superior Commodities of Food Crop Subsector

The LQ and SSA analysis conducted on agricultural commodities in the food crops subsector included four commodities analyzed, such as rice, corn, peanuts, and sweet potatoes. The four commodities are the food crops subsector in Nagari Lawang. After conducting the LQ and SSA analysis, the main priorities for developing agricultural commodities in the food crops subsector in Nagari Lawang were peanuts and sweet potatoes. Priority data on agricultural commodities in the food crops subsector can be seen in Table 8.

Table 8. Priority Agricultural Commodities in the Food Crops Subsector in Nagari Lawang

No	Commodity	Location Quotient (LQ)	Net Share (NS)	Priority
1	Paddy	0.6795	0	3
2	Corn	0.6269	0	3
3	Peanuts	1.0326	0	1
4	Sweet potato	1.4001	0	1

* NS value is the result of SSA calculation

Table 8 shows that the four commodities (rice, corn, peanuts, and sweet potatoes) have NS values ≥ 0, indicating faster growth, while the two commodities with the highest LQ values peanuts and sweet potatoes are the leading bases of Nagari Lawang, with 1.0326 > 1 and 1.4001 > 1, respectively. Sweet potatoes and peanuts were the top commodities in Nagari Lawang during the 2017–2021 study periods. Nonetheless, the residents of Nagari Lawang are increasingly inclined to use peanut products. This is because the community has a greater interest in peanuts, particularly since Nagari Lawang, located in Matur District, is well-known for its traditional peanut randang cuisine.

3.1.2. Leading Commodities of Horticulture Subsector

The analysis conducted chili, shallot, and avocado as horticulture commodities in Nagari Lawang. After conducting LQ and SSA analysis, it was found that shallot is the leading commodity of the horticulture subsector in Nagari Lawang. Priority data of agricultural commodities in the horticulture subsector can be seen in Table 9.

Table 9. Priority Agricultural Commodities in the Horticulture Subsector in Nagari Lawang

No	Commodity	LQ	NS	Priority
1	Chili	2.2351	-0.3005	2
2	Shallot	1.8014	0.5356	1
3	Avocado	3.4512	-0.0871	2

Chili has an LQ value of 2.2351 and an NS of -0.3005 with a second priority, and shallot has an LQ value of 1.8014 and an NS of 0.5356 with a priority, indicating that shallot has high productivity and is experiencing an increase in productivity. Meanwhile, avocado has the highest LQ value of 3.4512 but a NS of -0.0871, making it a second priority. Shallots have been established as a leading commodity in Nagari Lawang due to their high productivity value. The LQ value of 1.8014 > 1 indicates that shallots are a base commodity. The positive increase in shallot productivity (NS ≥ 0) shows that this commodity is classified as progressive or advanced, making it suitable for further development.

This study's findings align with previous research conducted in other regions, which state that the LQ, SSA, AHP, and WLC methods are effective in determining superior agricultural commodities. Putri *et al*. (2023) in Aceh Province also applied LQ and SSA analysis and identified paddy and chili as leading commodities. However, in Nagari Lawang, peanuts, shallots, and sugarcane were prioritized due to differences in climate, soil characteristics, and market demand. Similarly, Ramadhani & Yulhendri (2019) in Solok Regency found that horticulture crops showed strong competitive growth, which aligns with this study's identification of shallots as a superior commodity. However, unlike Solok, which has a well-developed irrigation infrastructure, Nagari Lawang faces seasonal water limitations, which could impact horticultural productivity. These comparisons highlight that while statistical and spatial methods provide valuable insights, local environmental and market conditions are crucial in shaping superior commodity determination.

3.1.3. Top Plantation Commodities

In Nagari Lawang, sugarcane and cinnamon were plantation commodities that were the subject of an *LQ* and SSA analysis. It was discovered that no commodities are of the utmost importance for the growth of the plantation subsector in Nagari Lawang after the *LQ* and SSA analyses were completed. Sugarcane and cinnamon, on the other hand, are two commodities that are classified as second priority. Table 10 displays information on the priority of plantation commodities.

Table 10. Priority agricultural commodities in the plantation subsector in Nagari Lawang

No	Commodity	LQ	NS	Priority
1	Sugarcane	1.0014	-0.0509	2
2	Cinnamon	1.0692	-0.0669	2

Despite being classified as fundamental commodities (*LQ* > 1), Table 10 reveals that both sugarcane and cinnamon have decreasing productivity (*NS* < 0), making them neither a top priority for development. The community does, however, choose sugar cane over cinnamon. The locals favor sugar cane over cinnamon since it is more profitable, chiefly when producing sugar cane juice to satisfy tourist demands. Nagari Lawang, a favored tourist village overlooking vast stretches of sugar cane fields and Lake Maninjau, has the potential to use this. Focusing on sugarcane development can provide added value through agricultural tourism, attracting tourists to enjoy local products such as sugarcane juice. Thus, despite declining productivity, focusing on sugarcane commodities still provides potential economic opportunities through tourism and regional consumption.

3.2. AHP and WLC of Nagari Lawang's Leading Commodities

3.2.1. AHP and WLC Parameters

3.2.1.1. Land Slope

Based on the classification of land suitability classes, Nagari Lawang is divided into 5 slope classes. Data on the area of slope based on the slope classification can be seen in Table 11. While Nagari Lawang has a range of land slopes, the most prominent one is the rather moderate slope, which ranges from 15 to 25% and covers 350.60 ha, or 25.42% of the total area of Nagari Lawang. 479.38 hectares of the Nagrai Lawang area can be used for agricultural cultivation because the area suitable for such agriculture has a slope of 0–15%. For reasons of safety of use, places or land with high slopes cannot be utilized for agricultural cultivation, according to Setiawan *et al.* (2018), Numerous land management mechanisms must be implemented, requiring a significant amount of central to agriculture while paying attention to conservation.

Table 11. Land Slope of Nagari Lawang

Slope Gradient	Criteria	Area	
		Ha	(%)
0-8 (%)	Flat	179.08	12.98
8-15 (%)	Slight	300.30	21.77
15-25 (%)	Moderate	350.60	25.42
25-40 (%)	Steep	227.66	16.51
>40 (%)	Very Steep	321.55	23.31
Total		1379	100

3.2.1.2. Soil Types

Nagari Lawang has two types of soil, namely Andosol and Kambisol. The land area based on the category in Nagari Lawang consisted of Andosol soil, which makes up 900.06 ha or 65.26% of the total area of Nagari Lawang, is the predominant type of soil there. A combination of volcanic ash with relatively deep soil, the andosol soil type is ideal for agricultural use (Pasaribu *et al.*, 2022). In the meantime, 479.13 ha, or 34.74% of the total area of Nagari Lawang, are covered by cambisol soil. Latue & Latue (2023), claim that because Kambisol soil is made up of fertile soil, it is a different emerging type of soil able to support agricultural growth. The texture of cambisols usually varies from rough to fine, depending on the degree of weathering of the parent material. This soil is fertile and has an adequate depth that diversity from shallow to deep; in lowlands, the soil is generally thick, but on steep slopes, the soil is thin (Tufaila & Alam, 2014).

3.2.1.3. Land Cover

Based on the findings, Nagari Lawang has six different types of land cover: ponds, forests, residential areas, rice fields, bushes, and fields or gardens. Table 12 displays the land area in Nagari Lawang based on land cover. Based on Table 12, the land cover of Nagari Lawang is dominated by fields or farmland covering an area of 627.91 ha, which accounts for 45.53% of the total area of Nagari Lawang. The total land available for agricultural cultivation is 1,361.21 ha consisted of forest cover, rice fields, bushes, and fields. Table 13 shows the criteria weighting for the three superior commodities (peanut, shallot, sugarcane), while Table 14 presents the area distribution for the three commodities based on their suitability class. Each commodity is discussed in more detail in the following sections.

Table 12. Land cover of Nagari Lawang

Land cover	Area	
	Ha	(%)
Fields or gardens	627.91	45.53
Bushes	11.24	0.81
Forests	577.80	41.89
Rice field	144.26	10.46
Residential areas	17.47	1.27
Ponds	0.51	0.04
Total	1379	100

Table 13. Criteria weighting for the determination of areas for three superior commodities

Criteria	Weighting		
	Peanut	Shallot	Sugarcane
Land Slope	0.3157	0.3264	0.3813
Soil Type	0.3402	0.2927	0.2095
Land Cover	0.3441	0.3809	0.4093

Table 14. Area distribution of three superior commodities based on suitability class

Class	Suitability	Peanut		Shallot		Sugarcane	
		Ha	(%)	Ha	(%)	Ha	(%)
S1	Very Suitable	209.28	15.18	266.20	19.31	266.41	19.32
S2	Suitable	290.60	21.08	233.35	16.92	233.15	16.91
S3	Quite Suitable	377.93	27.41	378.12	27.42	378.11	27.42
N1	Not Suitable	255.88	18..56	255.06	18.50	255.14	18.50
N2	Very Unsuitable	245.09	17.78	246.05	17.85	245.97	17.84
Total		1379	100	1379	100	1379	100

3.2.2. Superior Commodities 1: Peanut

Peanuts are the best commodity in the food crop subsector in Nagari Lawang, according to a prior analysis that used the LQ and SSA methodologies. To identify the areas for peanut commodities, several criteria were created in the study conducted using the Analytical Hierarchy Process (AHP) technique. The eigenvector, also known as the priority vector, is computed to determine the relative weights (w) of each criterion following the normalization step. The Geographic Information System (GIS) is then used to incorporate the average relative weight for each stakeholder and identify the peanut commodity areas in Nagari Lawang. The weights of each averaged criterion are shown in Table 13.

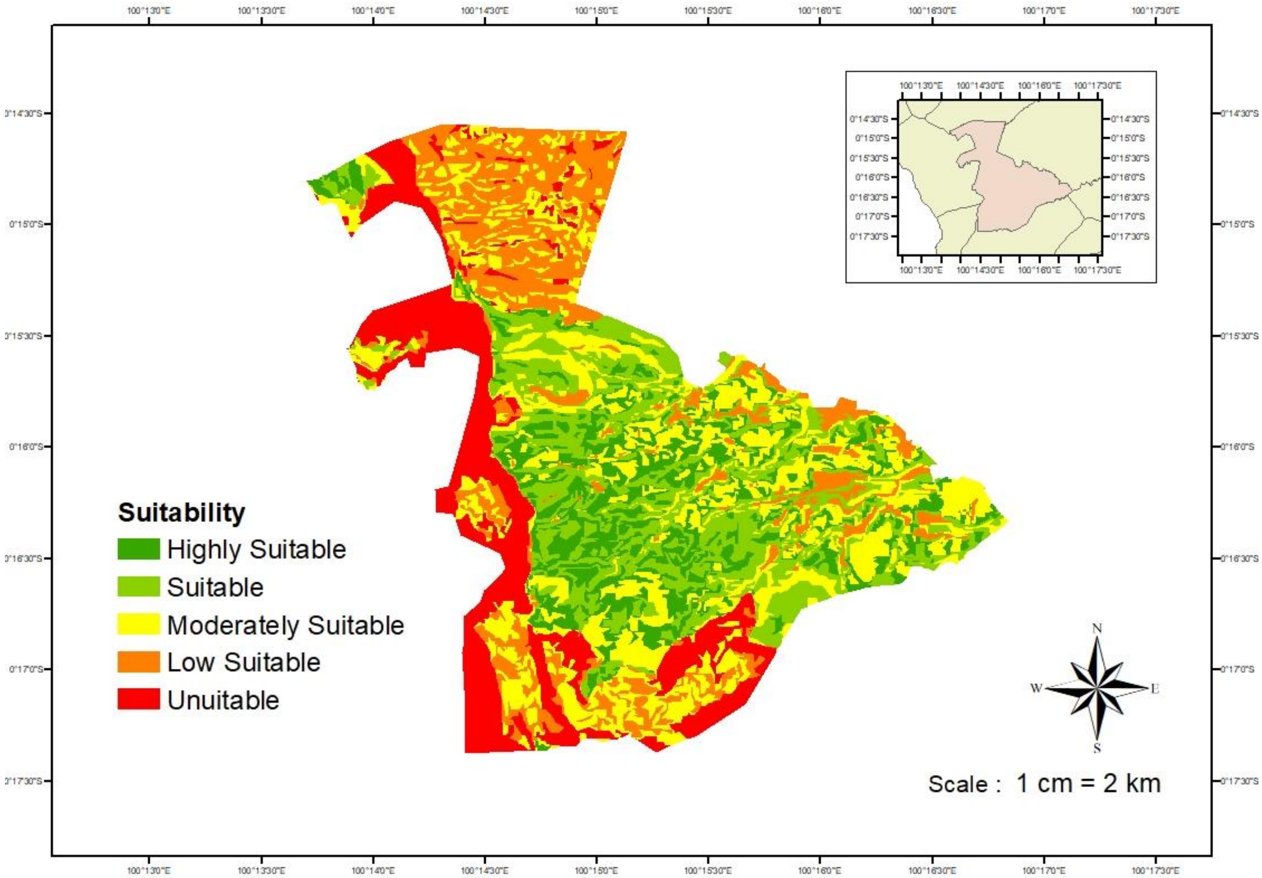

Figure 1. Peanut commodity development area

The weight value of the peanut area determination criteria has almost the same value, indicating that each criterion has the same importance or level of influence in determining the peanut commodity area. This weight can be used or is consistent if the Consistency Ratio (*CR*) value is <0.1. In the calculation, the *CR* value is <0.1, which means that the weight obtained from the weighting between criteria has good consistency or can be used. The weight of each criterion is combined with the WLC analysis method using the raster calculator on ArcGIS 10.8 with a mathematical formula such as Equation (8). The results of determining the peanut commodity area in Nagari Lawang can be seen in Table 14, while the peanut commodity area map can be seen in Figure 2. The Nagari Lawang area is mostly classified as moderately suitable (S3) at 27.41%, covering an area of 377.93 hectares, where the main factor is the high land slope, making improvement impossible. The recommended areas for planting peanuts are in the very suitable class (S1) and the suitable class (S2). The Nagari Lawang area is very appropriate (S1) for peanut commodities at 15.18% with an area of 209.28 hectares, and suitable (S2) at 21.08% with 290.60 hectares. Only 36.26% of the available land area is suitable for peanut (Table 14). Based on the results of calculating the criterion weights (Table 12), the slope influences 31.57% of the determination of the peanut area, and the majority of the agricultural cultivation area has a slope of 8–15% (Table 11). On the other hand, peanuts can thrive on land with slopes less than 8% (Kurniawan *et al.*, 2021).

3.2.3. Superior Commodity 2: Shallot

The weights assigned to the various variables that define the shallot commodity area are listed in Table 13. The consistency of the weights was tested with *CR*, and the results showed a *CR* value <0.1, which means that the resulting weights are consistent and can be used. The shallot commodity area determined for Nagari Lawang are presented in Table 14 and spatially in Figure 3. Based on Table 14, the majority of the Nagari Lawang area is in the quite suitable class (S3) of 27.41% with an area of 378.12 ha, where the main factor is the high slope of the land, so improvements

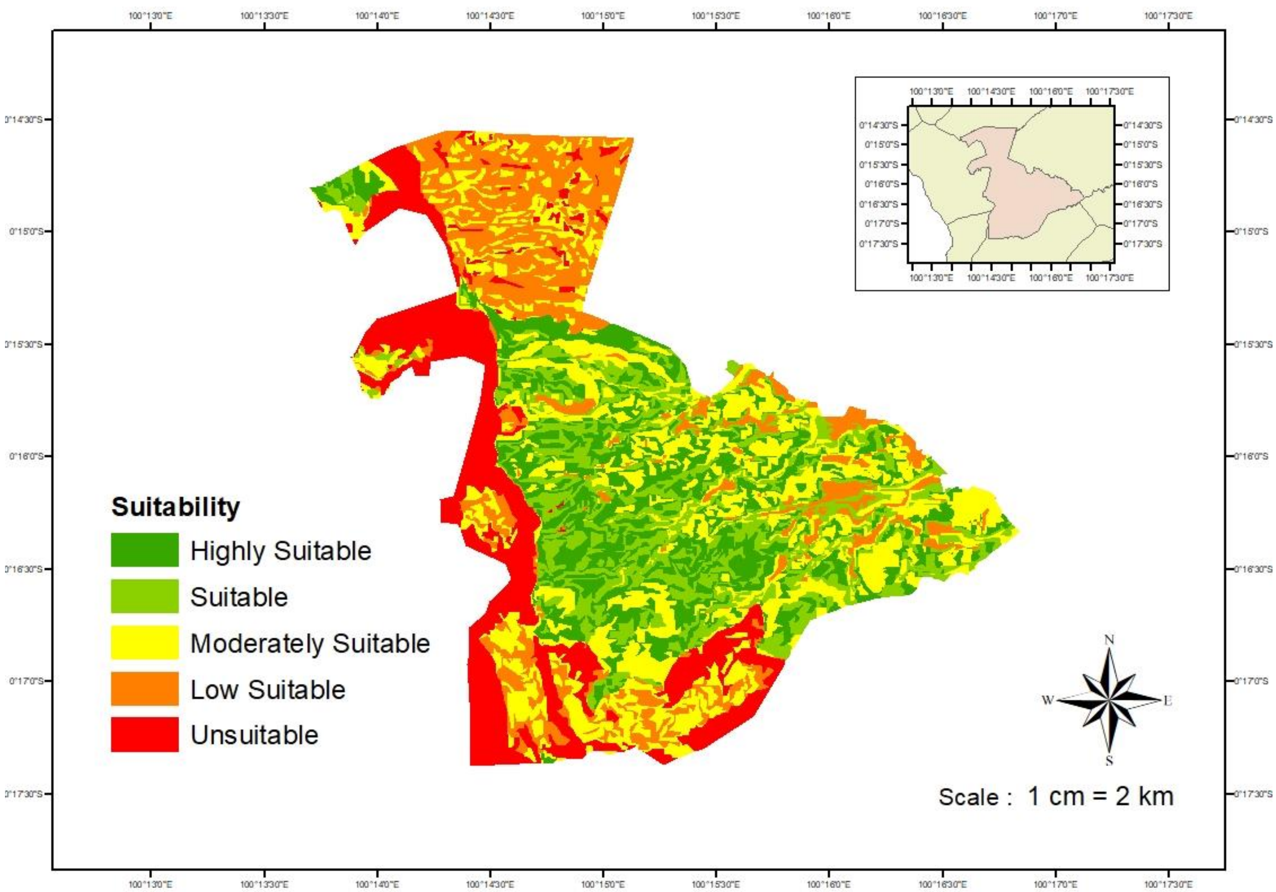

Figure 2. Shallot Commodity Development Area

cannot be made. The recommended area for planting shallot is in the very suitable class (S1) and the suitable class (S2). Nagari Lawang, which is very appropriate (S1) for shallot commodities, is 19.31% with an area of 233.35 ha; suitable (S2) is 16.92% with an area of 233.35 ha. Merely 36.23% of the total land area is suitable for cultivating shallot (Table 14). Based on the results of calculating the criterion weight (Table 13), the slope influences 32.64% of the determination of the shallot commodity area, and the majority of the agricultural land areas have a slope of 8–15% (Table 11). On the other hand, a slope of less than 3% is ideal for shallot (Utami *et al*., 2022).

3.2.4. Superior Commodity 3: Sugarcane

The weights of each criterion averaged in Figure 4 to determine the sugarcane commodity areas in Nagari Lawang are as follows. These weight values show that the sugarcane commodity area is determined by nearly equal influence from each conduct. The Consistency Ratio (*CR*) was used to test the weights' consistency; the results showed that the weights had good consistency, with a *CR* value <0.1. Table 14 and Figure 4 show the spatial findings of the analysis conducted to determine the sugarcane commodity area in Nagari Lawang. Table 14 shows that, with an area of 378.11 ha, the bulk of the Nagari Lawang region falls into the moderately appropriate class (S3) at a rate of 27.42%. The primary contributing element is the land slope, which is unimprovable. The recommended area for planting sugarcane is in the very suitable class (S1) and the suitable class (S2). Nagari Lawang, which is "very suitable" (S1) for sugarcane commodities, is 19.32% with an area of 266.41 ha; and suitable area (S2) is 16.91% or 233.15 ha. Only 36.23% of the available land area is suitable for planting sugarcane (Table 14). Based on the results of calculating the criterion weights (Table 13), the slope influences 38.13% of the determination of the peanut commodity area, and the majority of the agricultural cultivation area has a slope of 8–15% (Table 11). Nonetheless, terrain with a 0–16% slope is appropriate for peanut growth (Savira & Zalmita, 2022).

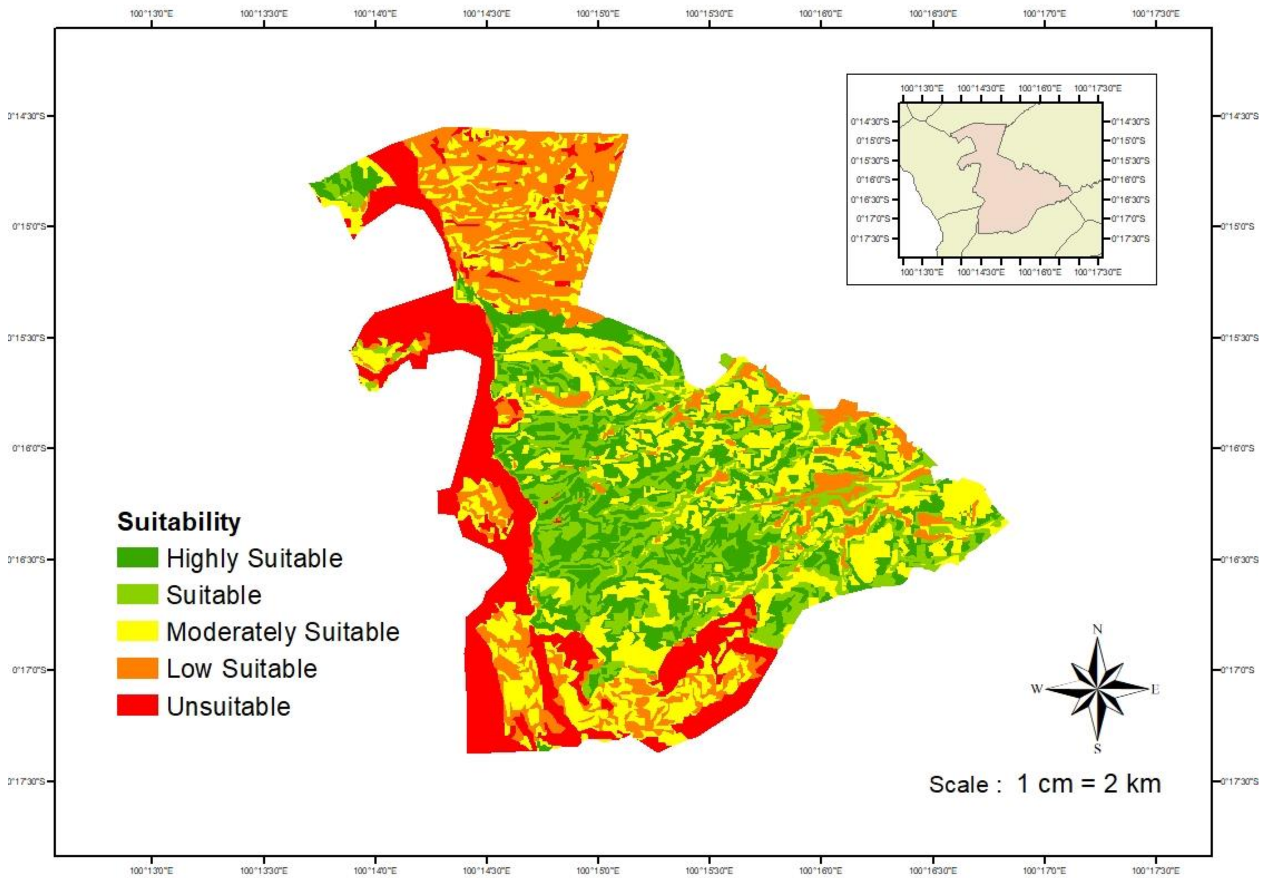

Figure 4. Sugarcane Commodity Development Area

This study focused on land suitability factors such as slope, soil type, and land cover and did not integrate with economic variables such as production costs, farmer income, and market access for decision-making. Therefore, future research can expand this study by incorporating economic and social factors, such as market price trends, farmer preferences, and government support policies for further analysis. In addition, integrating remote sensing technologies, such as Sentinel-2 imagery or UAV-based monitoring, can provide real-time tracking of agricultural productivity. Finally, applying LQ, SSA, AHP, and WLC methodologies to other regions with different agroecological conditions will help evaluate the flexibility and adaptability of this approach for broader agricultural planning.

4. CONCLUSION

In Nagari Lawang, Matur District, Agam Regency, West Sumatra Province, the main agricultural products are sugar cane (plantation subsector), peanuts (food crops subsector), and shallot (horticulture subsector). With a total area of 209.28 ha (15.18%), shallot of 266.20 ha (19.3%), and sugar cane of 266.41 ha (19.32%), the development area in Nagari Lawang for the criterion is ideal (S1). These results provide essential information for farmers and local governments in optimizing land use and increasing agricultural productivity. Integrating GIS and AHP-based analysis can serve as a model for other regions to identify and prioritize agricultural commodities more efficiently. Additionally, the findings support sustainable land use planning, enabling policymakers to allocate land resources more effectively while minimizing environmental degradation. The methodology used in this research can be adaptable to other regions facing similar agricultural challenges. By modifying the weights of AHP criteria and GIS-based spatial parameters, regions with different soil types, climate conditions, or economic contexts can implement a similar framework to enhance agricultural decision-making. Future studies should explore the integration of economic feasibility assessments and real-time monitoring technologies to further refine the identification and development of superior agricultural commodities.

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