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Land suitability evaluation to increase Hiyung cayenne pepper production at Tapin district South Kalimantan Province

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Abstract

Tapin is one of the districts in South Kalimantan Province, which has a leading sector in agriculture. The agricultural sector contributed 19.6% of the total GRDP value in 2019 but could not significantly increase the regional economy, so this sector needs to be developed. In actual conditions, the yield of Hiyung cayenne pepper was only 145 ha, while the productivity has 11.01 ton ha^{-1}. The large amount of land that has not been utilized in the Tapin Regency opens up great opportunities for agricultural extensification or expansion of planting areas. This research aims to determine the area of land that is suitable and available to increase production. Matching criteria analysis was used to obtain an appropriate and available land area. The results indicated that the land suitability class for Hiyung chili in Tapin Regency was divided into 12 classes. The suitable land area available for Hiyung cayenne pepper in Tapin Regency is 60,380 ha or 28.03% of the total land area. The land suitability class for Hiyung cayenne pepper in Tapin Regency is dominated by class S3 (d, p, ch) with limiting factors in the form of drainage, pH and rainfall in Candi Laras Selatan and Candi Laras Utara subdistricts.

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Introduction

In Tapin Regency, the agricultural sector is the primary sector that is able to absorb the most labor (BPS Kab Tapin, 2019). In a developing country, food security and environmental sustainability are two crucial factors for national growth and development (Omotade *et al.*, 2019). The Tapin Regency BPS noted that in 2018, this sector was able to absorb 40,892 residents or 44% of the total workforce. In 2019, it was recorded that the agricultural sector was able to contribute 19.6% of the total value of GRDP but was still unable to improve the regional economy significantly, so this sector needs to be developed to become a mainstay sector.

Tapin Regency has another development potential besides the food crop sector. Cayenne pepper is one of the horticultural commodities that has a certain uniqueness. The cayenne pepper variety in question comes from Hiyung Village, Tapin Regency, South Kalimantan Province. Hiyung is a local variety of cayenne pepper (*Capsicum frutescens*) that traditionally grown continuously at swampland of Tapin District, South Kalimantan Province.

This cayenne pepper has high productivity and good market prospect and could contribute to increase national cayenne production. This germplasm has been officially registered with the Center for Plant Variety Protection and Agricultural Licensing of the Ministry of Agriculture of the Republic of Indonesia Number 09/PLV/2012 dated April 12, 2012, as a Local Variety under the name Hiyung cayenne pepper. The uniqueness of this chili is the level of spiciness that exceeds the spiciness of other cayenne peppers. The results of laboratory tests in 2012 showed that the level of spiciness was the highest in Indonesia, with capsaicin levels reaching 9,400 ppm (Balai Pengawas dan Sertifikasi Benih Tanaman Pangan dan Hortikultura Provinsi Kalimantan Selatan, 2015). This uniqueness encourages the local government of Tapin Regency to promote it as a superior regional commodity. Promotion is directed as part of agribusiness development efforts to increase production for marketing needs outside the Tapin Regency area while maintaining sustainable food availability for the community. The actual condition of cayenne pepper productivity is still relatively low. The planting area of cayenne pepper is only 145 ha (Dinas Pertanian Tanaman Pangan dan Hortikultura Kabupaten Tapin, 2020). This is because cayenne pepper is grown in a limited place. Planted area, harvest and productivity of cayenne pepper in Tapin Regency in the last 5 years are shown in (Table 1). Efforts to increase production are carried out by means of agricultural extension. Extensification is offered as a management strategy to reduce the perceived negative effects of intensive agricultural management (Horrocks *et al.*, 2014). The large amount of land that has not been utilized in Tapin Regency opens up great opportunities for agricultural extensification or expansion of planting areas. No research is directed at land planning for certain commodities, especially to determine the availability of land for cayenne pepper in Tapin Regency. Based on the background of the problems above, this study aims to compile an evaluation of land suitability for cayenne pepper in the Tapin Regency.

Method

Research location

This research was conducted in Tapin Regency, South Kalimantan Province, which is located at coordinates 2° 11' 40'- 3° 11' 50" South Latitude and 114° 04' 27”-115° 03' 20" East Longitude. This area includes 12 sub-districts, 9 sub-districts and 126 villages.

Types and sources of data

Types of data in this study used primary and secondary data. The data are sourced from related agencies, namely BPS, the Agriculture Service, the Center for Agricultural Land Resources of the Ministry of Agriculture (BBSDLP), and the Public Works and Spatial Planning Service in Tapin Regency (DPUPR). Primary data are production and productivity data sourced from 60 respondents of cayenne pepper farmers. Secondary data is the data in 2019, while preliminary data is obtained from field surveys in 2020, as shown in (Table 2).

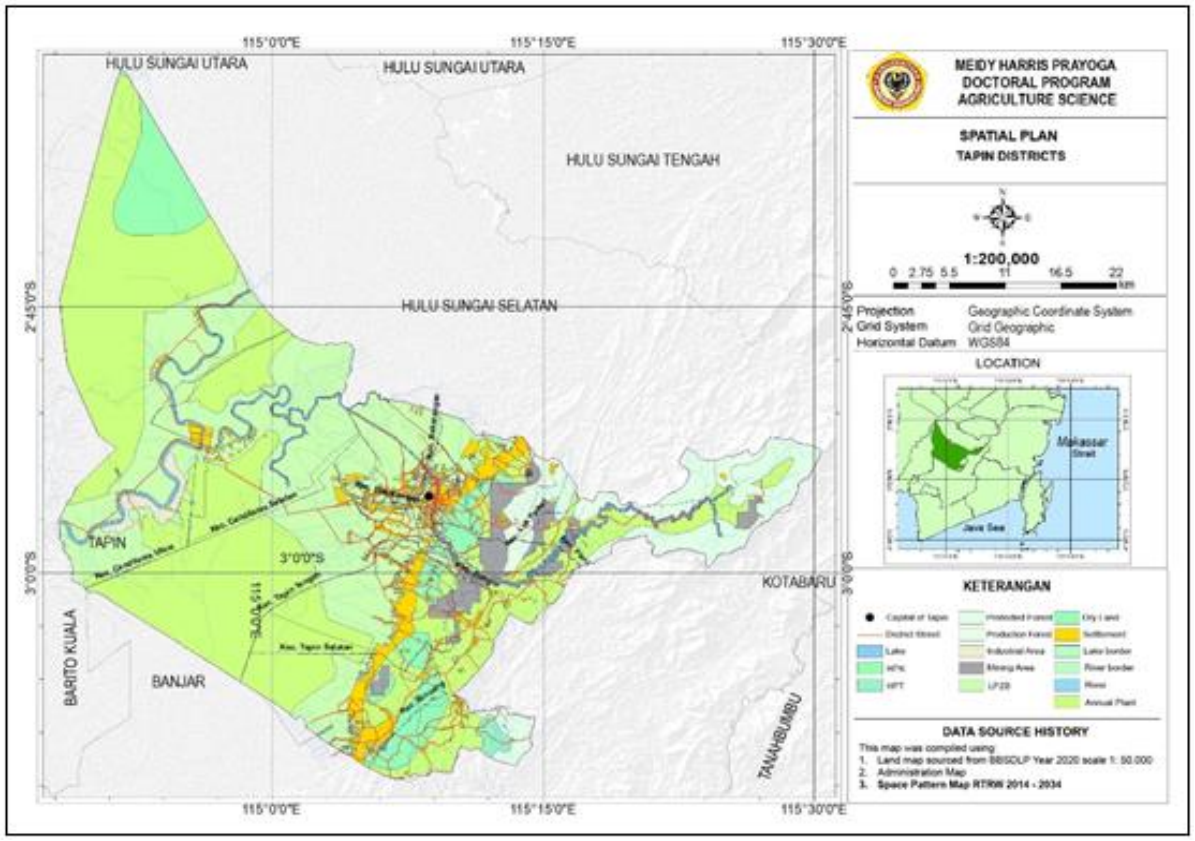

Fig. 1. Tapin Regency Spatial Plan Map.

Data analysis techniques

Land use planning for cayenne pepper commodities uses land suitability evaluation techniques. (Hardjowigeno and Widiatmaka, 2017) suggested that land evaluation is part of the land use planning process. This process is carried out by comparing the requirements demanded by the type of land use, the nature and quality of the land owned by the land to be used so that the land-use class for this type of land use will be known, in this case, cayenne pepper. Analysis of potential land availability for cayenne pepper is an analysis that focuses on understanding the area and distribution of land available for the development of cayenne pepper in the Tapin Regency. Evaluation of land suitability was carried out using the overlay method on a 1:50,000 scale soil map unit with a map of land availability that had been adjusted to the allotment of cayenne pepper commodity. According to (Hardjowigeno and Widiatmaka, 2017) The soil map unit (SPT) is the result of a soil survey as an evaluation unit and as a basis for determining the distribution limit. The soil map unit consists of attribute data, namely soil texture, soil depth, drainage, cation exchange capacity (CEC), base saturation (KB), slope, and rainfall.

Fig. 2. Surjan for cayenne pepper planting soil.

(Ahmed *et al.*, 2016) states that the land evaluation method is the systematic assessment of land potential to find out the most suitable area for cultivating some specific crop. Furthermore, the process was carried

out *Multi Criteria Evaluation* between the characteristics of the land and the criteria for land suitability for cayenne pepper.

In general, cayenne pepper can be cultivated in the lowlands and highlands, in paddy fields, or fields up to an altitude of 1,000 meters above sea level. Good soil for cayenne pepper planting is crumbly or loose, fertile, rich in organic matter, has soil pH between 6-7, sufficient soil water content (Balai Pengawas dan Sertifikasi Benih Tanaman Pangan dan Hortikultura Provinsi Kalimantan Selatan, 2015).

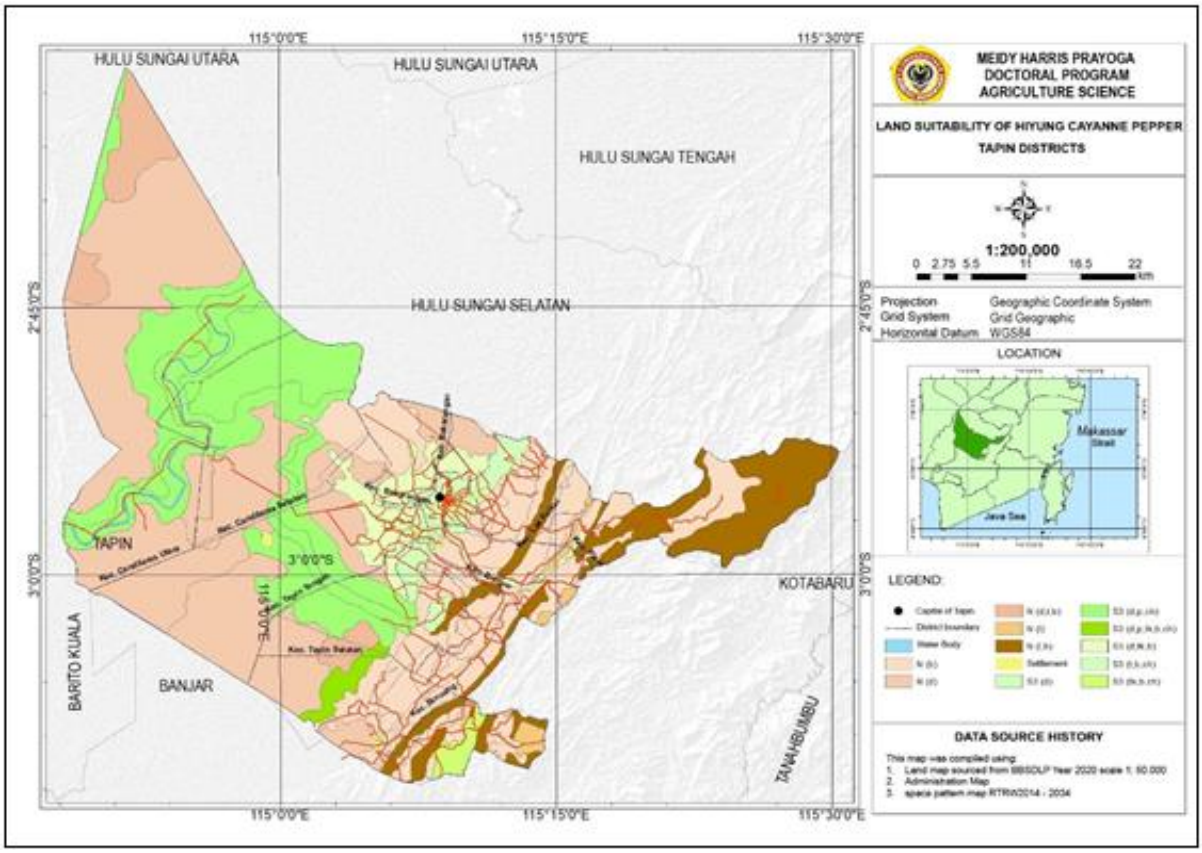

Fig. 3. Map of land suitability for the development of Hiyung cayenne pepper in Tapin Regency.

In this study, growing conditions using the method were *multi-criteria analysis* determined as the basis for making land suitability analysis.

The land suitability class for cayenne pepper is divided into 3 classes, namely very suitable class (S1), moderately suitable class (S2) and marginally suitable class (S3), while the unsuitable order is only used as 1 class, namely N. Criteria for land suitability for food crops commodities refer to chili growing requirements from BPPP 2014. Furthermore, this interview technique with chili plant experts became the basis for determining the land suitability class for cayenne pepper. Interviews were conducted with expert/expertise respondents who really understand the condition of the cayenne pepper plant as many as 4 people consisting of 1). Hiyung cayenne pepper horticultural researcher from the Agricultural Technology Assessment Agency of South Kalimantan Province; 2). Cayenne pepper agricultural extension worker, Tapin Regency Agriculture Service; 3). Secretary of the Department of Agriculture of Tapin Regency, 4). Head of the Tapin District Agriculture Office. Based on the results of the interview, it was concluded that the conditions for growing cayenne pepper with the criteria shown in (Table 3).

Spatial matching procedures within GIS were performed to see the best fit between suitability classes and planned land (Baja *et al.*, 2018). Land availability is then carried out by overlaying the spatial plans of the Tapin Regency 2015-2034 and

land suitability map of Hiyung cayenne pepper. Determination of land availability is carried out based on the consideration of the following criteria: spatial plans, namely an area devoted to agricultural land, in the case of forest area in the spatial pattern being APL (area of other use), dryland agriculture and wetlands. The land cover includes the use of bushland, fields/moor, seasonal crops, dry land and open land.

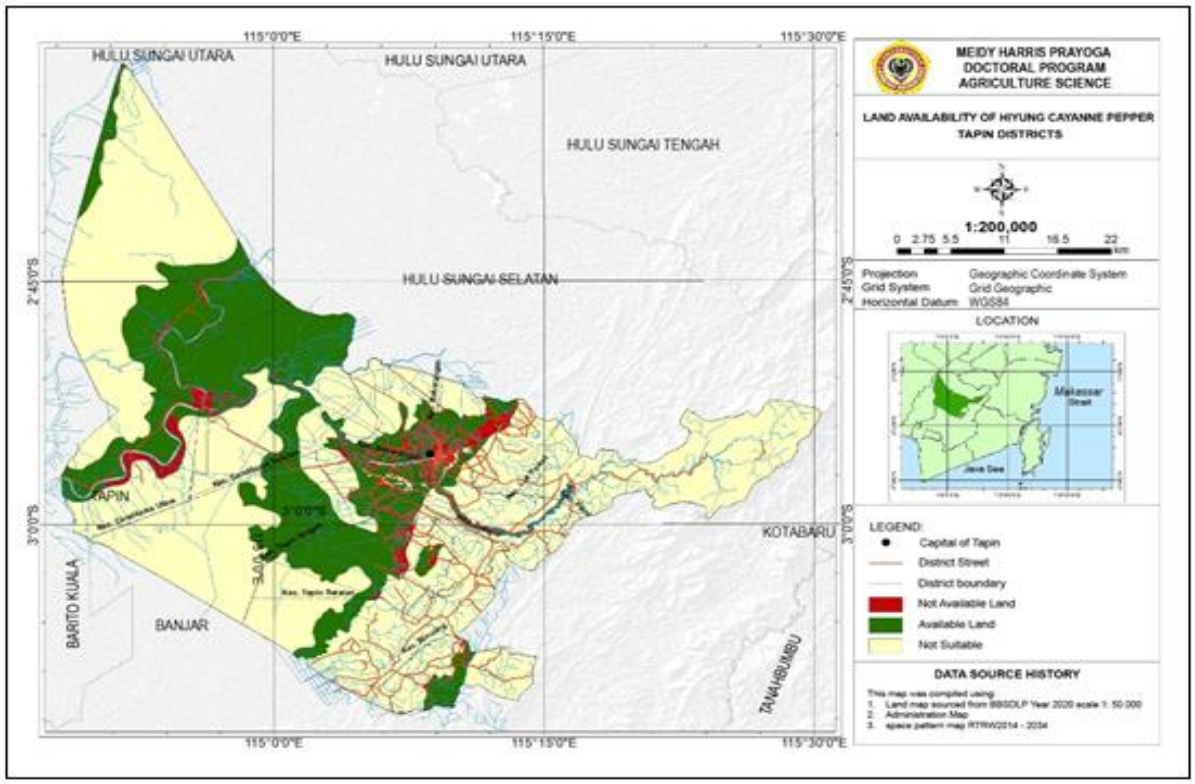

Fig. 4. Map of land availability for Hiyung cayenne pepper commodity development in Tapin District.

Results and discussion

Land is the most important component in farming (Sarina *et al*., 2015). The increasing need for land use for both agricultural and non-agricultural production must be carried out in accordance with conservation measures for future use (Momongan and Sulastriningsih, 2020). Land resources in each area are different depending on the physical and social environment so that the results of information on land are very necessary in land use (Fikrizal, 2018).

Table 1. Planted Area, Harvest, Production and Productivity of Cayenne pepper Hiyung Tapin 2015-2019.

Information	2015	2016	2017	2018	2019
Planted Area (Ha)	56	71	147	148	145
Harvested Area (Ha)	54	71	147	148	145
Production (tons)	178.2	276.9	193.7	1264.8	1596.4
Productivity (tons/Ha)	3.3	3.9	13.2	8.5	11.01

Source: Department of Agriculture, Food Crops and Horticulture, Tapin Regency (2020).

Land use planning was understood and still is as a social process that aims at a sustainable land use and balance of interests in rural areas (Zusammenarbeit, 2011). Information on land can be compiled by conducting land use planning. The land in Tapin Regency is still wide enough for cayenne pepper cultivation, however, according to the results of the study, the production level is still relatively low due to the small area of land planted and cultivation techniques that are still not optimal, so an analysis

aimed at increasing production is needed. The preparation of directives for commodity development needs to consider optimal land use so that it can minimize land damage and errors in land management that exceed the carrying capacity (Nugroho, 2000). Strategies for optimizing the development of agriculture and plantations in Tapin Regency include developing agriculture in accordance with regional potential, increasing horticultural productivity and developing agricultural product processing industry activities. In spatial planning, the aim is to realize the spatial arrangement of the region as an area of agriculture, plantations, trade and services that are environmentally sound in a sustainable manner.

The spatial pattern of Tapin Regency as stated in Regional Regulation Number 10 of 2014 concerning Spatial Planning of Tapin Regency of 2015-2034 divides the allotted agricultural area into an area designated for food crops, an area designated for horticulture and an area designated for livestock.

Table 2. Research data source.

Materials Research	Data source	Agencies
Map of administrative boundaries	Governance Section	Regional Secretariat of Tapin
Results Questionnaire and Interview	Questionnaire Research	Respondents
Soil map and *Land Characteristic* 2019	BBSDLP	BBSDLP
Spatial space map	Dept. of Spatial	DPUPR
climate map/rainfall of 2019	BMKG	BMKG
data farmer group in 2020	Sector Horitikultura	Dispertan
literature relating to the development of commodity cayenne pepper hiyung	-	Library, Internet and related institutions and resources other
Data relevant to the research topic	-	-

The allocation of available land for the development of cayenne pepper commodity is defined as available land and is an area suitable for agricultural use both in terms of status and function of the area. Land damage can be avoided by providing planning for commodity development so that a sustainable land use system can be sought (Sitorus *et al.*, 2012). Based on the spatial plans map in (Fig. 1), the area designation in Tapin Regency is divided into several functions, as shown in (Table 4).

Table 3. Conditions for growing Cayenne pepper Hiyung.

Characteristics of	Land Suitability Class			
	S1	S2	S3	N
Slope (%)	< 8 (flat)	8-16 (sloping)	16-30 (rather	steep)>30 (steep)
Depth of soil	(cm)>75	50-75	30-50	<30
Drainage	well, somewhat hampered	rather quickly, was	hampered	severely hampered, quickly
Texture	bit smoother	fine	medium / somewhat rough	Crude
Soil reaction (pH)	Neutral(6-7,6) - Slightly Acid (5-6)	Acid (4-5)	Very Acid (<4)	Basic (>7,6)
CEC	>16	12-16	8-12	<8
KB	High (>35)	Medium (20-35)	Low (15-20)	Very Low (<15)
Annual rainfall (mm)	500 – 1,000	400-500 or 1000-1200	300 – 400 or 1200-1400	< 300 or >1400
Inundation	never	sometimes	1 month in a year	2-5 months in a year

Source: Analysis results (2020).

The land area in Tapin Regency based on (Fig. 1) is 214,284, 106 hectares consisting of 14 area functions. The development of the Tapin Regency horticultural area is directed at agricultural areas that are used for horticultural crops or can also be used for food crops according to the cropping pattern. Based on the existing spatial plans map, there are 63,874,528 hectares that function as LP2B areas and are planned

for agricultural land use and the planned space allocation for annual crops and plantations is 93,055.475 hectares. Agricultural areas or LP2B and plantations are spread over 10 sub-districts, as shown in (Table 5). Land use planning for cayenne pepper is focused on knowing the actual area and distribution of land available for the development of cayenne pepper commodities in the Tapin Regency. (Hardjowigeno and Widiatmaka, 2017) states that to determine land suitability, it is necessary to evaluate land with a procedure to match land quality or characteristics with land use requirements that have been compiled in the form of land suitability class criteria.

Table 4. Functions and Spatial Planning Area of Tapin.

Function	Area (Hectares)	Space Designation Plan
Lake	9.714	Lake
Forest convertible production	7278.539	HL
Limited Production Forest	923.557	HP
Forest Protection	10571.717	HPK
Forest Production	6,437,893	HPT
Industry Region	1.5403 million	industrial
Mining Region	6,188,009	LH
Dryland	8,280,843	Plantation
LP2B	63,874,528	Settlement
Settlement	10807.822	Agriculture
Lake Border	27.718	River Border
River Border	3568.772	River
River	1719.219	Mines
Annual Plants	93055.475	Plantation
Number	214,284,106	

Source: Department of Public Works and Spatial Planning Tapin Regency.

Actual land suitability class states land suitability based on data from land resource surveys and has not considered the input needed to overcome obstacles or limiting factors in the form of physical environmental properties, including soil properties in relation to the requirements of plant growth being evaluated (Hardjowigeno and Widiatmaka, 2017).

Table 5. Agricultural areas or LP2B and plantations.

District	Agricultural Land Area (ha)	Plantation Land Area (ha)
Bakarangan	6,073.04	-
Binuang	3,830.49	9,108.39
Bungur	832.78	3,883.86
Candi Laras Selatan	15,180.64	8,466.04
Candi Laras Utara	18,123.98	33,966.75
Lokpaikat	2,039.31	1,452.49
Salam Babaris	20.57	4,207.79
South Tapin	5,840.02	4,384.80
Middle Tapin	10,515.20	19,631.20
North Tapin	1,418.47	-
Piani	-	4,851.41
Hatungun	-	3,102.78
Total	63,874, 50	93,055.51

Source: Results of Data Analysis (2021).

Agricultural land in Tapin Regency is still quite extensive and there are still many that have not been cultivated or have been in the form of agricultural land but have not been managed optimally; thus the actual land can potentially still be developed by taking into account the existing inhibiting factors or obstacles. Furthermore, the confirmed availability of land is then carried out by overlaying the spatial plans of the Tapin Regency 2015-2034 and the land suitability map of Hiyung cayenne pepper. Determination of land availability is based on consideration of the following criteria: Spatial plans, an area designated for agricultural land and forest crops or plantations.

Table 6. Results of the Evaluation of Land Suitability for the Development of the Chili Rawit Hiyung Commodity.

District	Land Suitability Class,	Limiting Factors of	Land Suitability Land	Area (ha)	% Area land
Bakarangan	N (b)	Saturation bases	Unsuitable	3418.73	1,595
	N(d)	Drainage	Not Available	1309.30	0.611
	Settlements	-	Unsuitable	3.56	0.002
	S3(d)	Drainage	In accordance Conditional	171.04	0.080
	S3(d, tk, b)	Drainage, cation exchange capacity, base saturation	accordance Conditional	2106.84	0.983
			Total	7009.46	3.271
Binuang	N		(b)In accordance	6614.01	3,087
	N (d)	Drainage	Not Available	7001.37	3,267
	N (d, t, b)	drainage, soil texture, saturation bases	Unsuitable	1121.14	0,523
	N (l, b)	Topography, Saturation bases	Unsuitable	1037.96	0.484
	Settlements	-	Settlements	160.56	0.075
	S3(d, p, ch)	Drainage, soil acidity, Rainfall	Conditional	20.39	0.010
	S3 (d,p,tk,b,ch)	Draina se, base saturation, cation exchange capacity	accordance Conditional	0.902 17.887,45 8.348	
					1.932,02
Bungur	Water Body	-	Water Agency	0	0,000
	N (b)	Saturation bases	Unsuitable	5687.46	2,654
	N (l)	Topography	Not Appropriate	598.87	0.279
	N (l, b)	Saturation bases	Unsuitable	1253.69	0.585
	Settlements	-	Settlements	116.19	0,054
	S3 (d)	Drainage	In accordance Conditional	333.24	0.156
	S3(d, tk, b)	Drainage, base saturation, cation exchange capacity	accordance Conditional	883 06	0.412
				8872.51	4.141
South Candi Laras	Water Agency	-	Water Agency	89.32	0.042
	N (b)	Saturation bases	Unsuitable	1788.12	0.834
	N(d)	Drainage	Mismatch	8070.17	3.766

	S3(d, p, ch)	Drainage, Soil Acidity	Conditionally	15,679.02	7,317
	S3 (d,tk,b)	Drainage, Base saturation, cation exchange capacity	Conditionally	69.87	0.033
			Total	25,696.5	11,992
North Laras Temple	Water	-	Bodies Water Bodies	623.7	0.291
	N (d)	Drainage	Not Available	34662.24	16.176
	N (d, t, b)	drainage, soil texture, saturation bases	Unsuitable	6639.69	3.099
	S3(d, p, ch)	Drainage, soil acidity,	S Conditional esuai	21099.04	9.846
			Total	63024.67	29.412
Hatungun	Water Body	-	Water Agency	0	0,000
	N (b)	Saturation bases	Unsuitable	2251.11	1,051
	N (l)	Topography	Not Appropriate	838.88	0.391
	N (l, b)	Topography	photo According to	1,818,81	0,849
	S3 (tk,b,ch)	Cation exchange capacity, Base saturation, Rainfall.	Conditional accordance	1736.70	0.810
			Total	6645.51	3.101
Lokpaikat	N (b)	Saturation bases	Unsuitable	4570.99	2,133
	N(d)	Drainage	Not in accordance	1404.00	0.655
	N (l, b)	Topography, Saturation bases.	Not Suitable	591.98	0.276
	Settlements	-	Settlements	102.52	0.048
	S3 (d)	Drainage	Conditional	1.717.13	0.801
	S3 (d,tk,b)	Drainage, cation exchange capacity,	Conditionally	Base549.06	saturation0.256
			Total	8,935.68	4,170
Piani	N (b)	Saturation bases	Unsuitable	7402.31	3,454
	N (l)	Topography	Not Appropriate	228.51	0.107
	N (l, b)	Topography, Saturation bases	Unsuitable	12694.06	5.924
	S3(d, tk, b)	Drainage , cation exchange capacity, base saturation	accordance Conditional	143.65	0.067
			Total	20468.53	9.552
Salam Babaris	N (b)	Saturation bases	Unsuitable	5409.49	2.524
	N (l, b)	Topography, Saturation bases	Unsuitable	795.92	0.371
	Settlements	-	settlement	167.98	0.078
			Total	6373.40	2.974
South Tapin	N (b)	Saturation bases	Unsuitable	4413.43	2.060
	N(d)	Drainage	Not Available	516.23	0.241
	N (d, t, b)	drainage, soil texture, saturation of bases	Not suitable	670.43	0.313
	N (l,b)	Topography,saturation	Not suitable	Base672.34	0.314
	Settlement	-	Settlement	80.51	0.038
	S3 (d)	Drainage	Conditional	1,278.50	0.597

	S3 (d,p,ch)	Drainage, Soil acidity, Rainfall.	Conditional accordance	5577.95	2.603
	S3(d, p, tk, b, ch)	Drainage, base saturation, cation exchange capacity, soil acidity, rainfall.	Conditional Accordance	117.35	0.055
	S3 (d,tk,b)	Drainage, cation exchange capacity,saturation	Conditionally compliant	Base843.31	0.394
	S3 (t,b,ch)	Soil texture, Base saturation, Rainfall.	Conditional accordance	588.69	0.275
			Total	14758.73	6.887
	Body Water	-	Water Agency	0.02	0.000
Central Tapin	N (b)	Saturation bases	Unsuitable	653.96	0,305
	N(d)	Drainage	Not in accordance	19698.54	9.193
	Settlements	-	Settlements	571, 54	0.267
	S3 (d)	Drainage	Conditional	408.14	0.190
	S3 (d,p,ch)	Drainage, Soil Acidity, Rainfall.	Conditionally compliant	6,492.88	3,030
	S3 (d,tk,b)	Drainage, cation exchange capacity,saturation	Conditionally compliant	Base3,473.16	1,621
			Total	31,298.24	
North Tapin	N (b)	saturation	Not suitable	Base305.51	0.143
	N (d)	drainage	Mismatch	38.35	0,018
	Settlements	-	Settlements	438.04	0.204
	S3(d)	drainage	In accordance Conditional	1696.76	0.792
	S3(d, tk, b)	drainage, cation exchange capacity, base saturation	accordance Conditional	834.92	0.390
			Total	3.313, 59	1,546
Total				214.284.27	100.00

Source: Research Analysis Results 2021.

From the results of the analysis obtained land area that is available and appropriate. In commodity development planning, agricultural areas require information regarding the suitability and capability and availability of land so that the land can be productive in a sustainable manner and minimize the occurrence of land conflicts due to overlapping land due to unclear land status (Sitorus *et al.*,2012). Suitable land is land that can be planned for the development of cayenne pepper commodity, while unsuitable land is land that cannot be planned for the development of cayenne pepper commodity. Based on the analysis results, the actual land suitability for the cayenne pepper commodity is obtained, as presented in (Table 6).

(Table 6) shows that the actual land suitability class in Tapin Regency consists of S3 and N classes with various limiting factors. An S3 class is land that has a heavy limiting factor where this limiting factor will greatly affect productivity and require more additional inputs when compared to land classified as S2. Pakpahan (2018) states that high capital and intervention from the government and the private

sector are needed in overcoming the limiting factors for S3. In class N, the land has a very severe and difficult limiting factor (Subardja *et al.*, 2018). The results of the land suitability evaluation show that the limiting factors possessed by land in the S3 land suitability class for Hiyung cayenne pepper commodity in Tapin Regency are very obstructed drainage (d), root media or soil texture (t), base saturation (b), capacity cation exchange (tk), soil pH (p), and water availability or rainfall (ch). These various land limiting factors can be improved by providing capital/high inputs in overcoming the limitations or limiting factors of the existing land conditions. (Table 7) shows the actual land area that is conditionally suitable for the development of cayenne pepper is 67,752.72 hectares, or 31.62% of the district area.

The area of land that is conditionally suitable for the commodity of cayenne pepper is dominated in Candi Laras Utara sub-district or with an area of 21,099.04 hectares. In contrast, Salam Babaris sub-district is a sub-district that does not have suitable land for planting cayenne pepper. (Table 8) shows the area of land that is conditionally suitable for developing cayenne pepper commodities in each sub-district.

Table 7. Land Area in accordance with conditions for the development of Hiyung Cayenne pepper Pepper Commodity.

sub-district	Land Area (ha)		Total land	% area for land conditionally compliant
	conditionally compliant	not suitable		
Bakarangan	2.277.88	4,731.58	7,009.46	3.27
Binuang	1,952.42	15,935.04	17,887.46	8.35
Bungur	1,216.30	7,656.21	8,872.51	4.14
South Candi Laras	15,748.89	9,947.61	25,696.50	11.99
North Candi Laras	21,099.04	41,925.63	63,024.67	29.41
Hatungun	1736.70	4908.8	6645.50	3.10
Lokpaikat	2266.19	6669.49	8935.68	4.17
Piani	143.65	20324.88	20468.53	9.55
Salam Babaris	-	6373.4	6373.40	2.97
South Tapin	8,405.79	6,352.94	14,758.73	6.89
Middle Tapin	10,374.18	20,924.06	31,298.24	14.61
North Tapin	2,531.68	781.9	3,313.58	1.55
Total	67,752.72	146,531.54	214,284 ,26	100.00

Source: Research Analysis Results 2020.

Commodities needs for intensification through the provision of inputs and some treatment specific for the land (Addharu *et al.*, 2021). In the evaluation of land suitability, several assumptions can be made about the types of improvement efforts that can be carried out at certain management levels (Hardjowigeno and Widiatmaka, 2017). Improvement efforts can be made in overcoming the limiting factors so as to change the actual land suitability into potential land suitability. Drainage (d) in general can affect agricultural soil conditions, namely soil aeration, soil moisture, transport and effectiveness of nutrients and pesticides, soil temperature or temperature, toxic substances and pests, soil erosion and flooding, crop fertility and crop yields (Effendy, 2011). The drainage concept based on (Effendy, 2011) research in agriculture in swamps that can be done to improve drainage is leaching and making shallow drainage to help remove toxic materials and diseases. From the results of research observations, the way local farmers deal with blocked drainage is to make beds or surjans with an average planting distance of

50 cm with a surjan width of 80 cm with an average height of 70 cm (Fig. 2). Texture (t) is closely related to the root media. Organic fertilizers have a very significant effect on porosity (Lawenga *et al.*, 2015). According to (Pakpahan, 2018), efforts to improve texture can be done by adding organic matter to the soil, such as giving manure and compost so that the soil texture can be smooth.

Table 8. Land Area Available for the Development of Hiyung Cayenne pepper Commodity.

Land Availability	Area	% Land Area
Not available land	7.419,06	3,46
available land	60.282,97	28,13
Not suitable	146.582,20	68,41
Total	214.284,23	100,00

Source: Research Analysis Results 2020.

In the research of (Hayati and Hardarani, 2019), the characteristics of the land for the cultivation of cayenne pepper in the Lebak swampland are described by the organic C content, which has high to very high criteria; there is only 1 farmer and 1 land that has low criteria. CEC or cation exchange capacity (tk) indicates that the land used has high to very high CEC criteria. The use of manure can increase the organic C content so that the CEC will also increase. Base Saturation became a general indicator of soil trophic status,presumed to be better than other single characteristics, including the pH value (Bieganowski *et al.*, 2013).

From the mapping results, base saturation (KB) in the study area is dominated by base saturation with low to very low criteria. The recommended management to improve the status of soil fertility is by the addition of organic fertilizer and Phonska Fertilizer in accordance with the needs of the plant. On the other hand need to be done as well as the manufacture of tillage terrace to the efficiency of fertilizer (Sardiana *et al.*, 2017). According to Hayati and Hardarani (Hayati & Hardarani, 2019) to overcome the level of base saturation, phonska fertilizer can be used as a source of P_2O_5 content and K_2O content with adjusted dosages, in line with research by Pinasti *et al.*, (2020) where the application of NPK phonska fertilizer has a significant effect on flowering age of cayenne pepper plants, harvest age, fruit yield weight, and number of cayenne pepper plants. The limiting factor of soil pH (p) is the acidity of the soil that must be known by farmers before cultivating cayenne pepper. The pH soil is a very important feature, because it depends on a number of functions that have relation to crops, such as nutrient assimilation by crops, microflora development and generating of ions can be toxic to plants, such as aluminium (Murgas *et al.*, 2015). Reaction or soil pH is an important factor that can affect the process of nutrient absorption by plant roots. Reaction or soil pH is the level of acidity or alkalinity of an object as measured by a pH scale between 0 to 14. An object is said to be acidic if the pH scale number is less than 7 and is called alkaline if the scale is acidic. pH is more than 7. Soil is neutral if the pH scale is 7, neither acidic nor alkaline. The ideal soil for plant growth and development is neutral soil. However, some plants are still tolerant of soil with a slightly acidic pH, namely soil with a maximum pH of 5 (Burhani, 2019). At pH 5.6-7, cayenne pepper plants can grow and develop optimally because they are in accordance with plant physiology.

In the cultivation of cayenne pepper, the soil pH is too acidic (pH <5). From the results of the study, it is known that the pH level of the soil at the research site is classified as very acidic (pH <4), so that it is necessary to give a dose of agricultural lime (dolomite). (Yunarzi, 2019) states that to increase the pH level of the soil by one pH level, 2 tons of dolomite (agricultural lime) is needed per hectare. Dolomite is given during land cultivation so that the soil pH can be stable and ready to be planted when the seeds or cayenne pepper seeds are planted.

Table 9. Area of Land Available for Development of Hiyung cayenne pepper Commodity in Tapin Regency.

Sub-District	Land Area (Ha)			Area	% Available Land
	Available Land	Not available land	Not suitable		
Bakarangan	1.672,89	586,04	4.750,54	7009,47	0,78
Binuang	1.926,08	19,91	15.941,50	17.887,49	0,90
Bungur	933,52	277,79	7.661,2	8.872,51	0,44
Candi Laras Selatan	14.795,70	1.022,51	9.878,33	25.696,54	6,90
Candi Laras Utara	19.114,40	1.906,06	42.004,20	63.024,66	8,92
Hatungun	1.672,17	78,08	4.895,28	6.645,53	0,78
Lokpaikat	1.310,88	942,6	6.682,20	8.935,68	0,61
Piani	103,14	40,61	20.324,70	20.468,45	0,05
Salam Babaris	0	0,00	6.373,40	6.373,40	0,00
Tapin Selatan	7.337,26	1.044,26	6.377,20	14.758,72	3,42
Tapin Tengah	9.684,88	705,61	20.907,70	31.298,19	4,52
Tapin Utara	1.732,05	795,59	785,95	3.313,59	0,81
Total	60.282,97	7.419,06	146.582,20	214.284,23	28,13

Source: Research Analysis Results 2020.

Rainfall is an important factor for the availability of water for plants. From the results of the study, it is known that the level of annual rainfall at the study site is low between 300-400 or 1,200-1,400 mm/year. The low rainfall can be overcome by drilling wells in locations around the Surjan so that it can overcome water shortages as well as overcome land fires that often occur in the dry season. Spatially, the suitability of land for cayenne pepper for the development of cayenne pepper commodity is shown in (Fig. 3). The results of the evaluation of land availability after being overlaid with a spatial pattern show that there are 60,282.97 hectares' available land or 28.13% of the total area for the development of cayenne pepper commodity in Tapin Regency. Spatially, the availability of cayenne pepper for Hiyung cayenne pepper commodity development is shown in (Fig. 4). (Table 9) shows the land area available for the development of cayenne pepper in Tapin Regency. The sub-districts that have available land suitable for planting cayenne pepper are dominated by 3 sub-districts. Candi Laras Utara sub-district is a sub-district that has the most dominant available land area of 19,114.40 ha or 8.92% of the district's area. Candi Laras Selatan District covers an area of 14,795.70 ha or 6.90% of the district's area. Tapin Tengah District has an available land area of 9,684.88 ha or 4.52% of the district's area.

Conclusion

Land suitability classes for cayenne pepper in Tapin Regency are varied and dominated by S3 class (d, p, ch) hectares with limiting factors in the form of drainage, pH and rainfall in Candi Laras Selatan covering an area of 15,679.02 hectares and Candi Laras Utara covering an area of 21,099.04 hectares. The suitable and available land area for cayenne pepper in Tapin Regency is 60,282.97 ha or 28.13% of the total land area.

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