JOURNAL OF SOILSCAPE AND AGRICULTURE
Volume 2, Number 2, 2024
E-ISSN: 2963-7961
Journal Homepage: http://journal.unej.ac.id/JSA

Evaluating the Potential of Dragon Fruit Cultivation in Banyuwangi District Based on Land Suitability

Sukron Romadhona[a,*], Laily Mutmainnah[b]

[a] Environmental Sciences Program, Diponegoro University, Semarang, Indonesia
[b] Department of Soil Science, Faculty of Agriculture, Jember University, Indonesia

ARTICLE INFO

Article History:
Accepted: 30 - 04 - 2024
Published: 31 - 05 - 2024

Keyword:
Land suitability;
Horticulture;
Dragon fruit;

Corresponding Author:
Sukron Romadhona
*email:
sukronromadhona@gmail.com

ABSTRACT

Among the horticulture commodities with development potential are fruit plants. Purposive sampling was the method used for sampling. With the exception of land uses like mining and settlements, sample points were chosen depending on land use. Each unit of land map created by land resource surveying and mapping activities has features, such as soil characteristics and physical environment features, that can be specifically defined as land characteristics. The purpose of this study is to investigate how suitable the terrain is for growing dragon fruit in the Banyuwangi Regency. This study used a survey methodology with land units serving as the analytical unit. Land units for this study were derived from the slope and overlap of land use maps. With an area coverage of 251,527 Ha, or 42.6%, the majority of Banyuwangi Regency is classified as having land suitability class S1 (very suitable), meaning that it does not have significant barriers to sustainable use or only minor ones that have no discernible impact on production or require an increase in input. Thus, it is critical to conduct this research in order to accurately evaluate the appropriateness of the site and enable the implementation of optimal land management strategies that will boost dragon fruit yield and lower production costs.

INTRODUCTION

Indonesia is a developing country with the agricultural sector as a source of livelihood for the majority of its population (Syamsiyah & Wicaksono, 2023). The agricultural sector is one of the sectors that the Indonesian state still relies on because this sector is able to provide recovery in overcoming the current crisis (Andrea et al., 2021). Apart from that, the agricultural sector is an important sector and has great potential to act as a trigger for national economic recovery. This is proven that the agricultural sector still shows positive growth, namely 0.26 percent, when the national economy is experiencing a crisis (Romadhona & Arifandi, 2020).

Horticulture is one of the agricultural subsectors that plays a large role in developing the nation's economy and increasing the country's foreign exchange. Horticultural products include fruit plants, vegetables, ornamental plants and biopharmaceuticals (Rasheed & Naz, 2017). Optimal land use requires consideration of the characteristics and quality of the land. This is because there are limitations in land use according to its characteristics and quality, when linked to sustainable and continuous land use (Romadhona et al., 2023). On a soil map or land resource map, this is expressed in map units that are differentiated based on differences in their properties, including: climate, landform (including lithology, topography/relief), soil and/or hydrology. The separation of land/soil units is very important for the purpose of analyzing and interpreting the potential or suitability of land for a particular type of land use (Romadhona & Arifandi, 2020).

Among the horticulture commodities with development potential are fruit plants. Fruit is the major contributor to the country's horticultural Gross Domestic Product (GDP), as seen in Table 1. The GDP of fruit crops made up 52.91 percent of the overall GDP of horticulture in 2010. Due to their significant market potential, horticultural commodities have been viewed as one of the new avenues for expansion in the agriculture industry (Hartati et al., 2018). Dragon fruit is among the most well-liked outstanding fruit products in Banyuwangi Regency. This is a result of the high quality and plentiful production of Banyuwangi dragon fruit. Due to the fact that dragon fruit never has a set harvest season, can be harvested weekly, and continues to produce, many people choose to cultivate it. In the past, Banyuwangi was a major producer of citrus fruit, with a sizable citrus fruit acreage. Unfortunately, diseases that target orange plants are already causing a decline in the number of orange trees in Banyuwangi. Dragon fruit is one of the Banyuwangi Regency's potential local economic assets. The Banyuwangi Regency's 2016–2021 Regional Medium-Term Development Plan (RPJMD) lists dragon fruit as one of its main fruit commodities. In addition, the central locations for the development of dragon fruit commodities have been defined by the Spatial Plan Region (RTRW) Banyuwangi Regency 2012–2032.

Banyuwangi is currently a dragon fruit-producing region. The five sub-districts of Bangorejo, Pesanggaran, Siliragung, Tegaldlimo, and Purwoharjo are home to the Banyuwangi dragon fruit production centers. Areas in the southern portion of Banyuwangi classified as agropolitan areas include these 5 subdistricts. Appropriate technology is needed to optimize the use of land resources in a sustainable way because of the growing demand for land, the shortage of productive and potential agricultural land, the competition with the non-agricultural sector for the use of productive land, and other factors (Mugiyo et al., 2021). Complete data and information about the state of the climate, soil, and other physical environmental characteristics, as well as the growing requirements for the plants to be cultivated—especially those with high economic value—are required in order to be able to use land resources sustainably (Neswati et al., 2021).

Knowledge of the physical properties of land is very important and is the basis for rational land use planning (Sumani et al., 2018). Every crop commodity has specific growth

requirements that need to be taken into account while modifying the land that will be utilized for cultivation. Production will not be at its best on land that is unsuitable for plant development. Selecting superior commodities, understanding the potential of the site to be utilized, and identifying the site to be developed are some of the phases involved in developing horticulture commodities. As a result, it's critical to assess site suitability in order to ascertain the land's true state and match it with plant growth requirements. Determining the land suitability class is the goal of the land suitability evaluation (Taghizadeh-Mehrjardi et al., 2020). The results of land evaluation can be used as a basis for determining land use plans, appropriate commodities to be cultivated, as well as actions needed to improve or optimize land use (Aldababseh et al., 2018). The basic principle of evaluating land suitability for agriculture is the assessment of land characteristics relative to plant growth requirements.

METHODS

There are minimum, optimum, and maximum requirements for growing or land use that are necessary for every type of commodity and each land attribute. In order to conduct the literature study, secondary data was gathered, such as rainfall, air temperature, humidity, and physical features for the previous ten years, as well as geological maps that create overlay maps and slope maps. Using three different map types combined, it generates ten sample points. Making observations in the field and collecting soil samples by digging or drilling to a depth of 50 cm constitute the primary survey step.The soil is put in plastic, air-dried, then analyzed in the laboratory. In a lab, soil composition, organic matter content, and nutrient availability are examined. In this study, the land unit serves as the mapping unit. In the research area, land units are acquired by environmental means. Next, go on to the pre-survey phase, which entails selecting sample locations by fusing three different kinds of maps: an overlay of a landform unit map with maps of the land use, geology, slope, and soil. Every different land unit will be selected to serve as an example (Zakarya et al., 2021). Purposive sampling was the method used for sampling. With the exception of land uses like mining and settlements, sample points were chosen depending on land use. Each land/soil map unit created as a result of land resource surveying and mapping operations has features, both in the form of soil properties and the physical environment, that can be specifically identified as land characteristics. In this study, the data is interpreted and evaluated in relation to land for dragon fruit commodities.

The following classes make up the land suitability class: 1) Very Suitable class (S1): land with only moderate limiting issues that do not substantially lower land production, or land without genuine or major restricting factors for sustainable use 2) The productivity of Sufficiently Suitable class (S2) land is limited by certain variables, necessitating additional input. Farmers may usually still overcome these limits. 3) Compared to land classed as S2, marginal suitable class (S3) land requires greater additional input due to severe limiting characteristics that impair its output. The government or the corporate sector must assist or intervene in order to overcome the limiting factors in S3, as farmers are unable to do it on their

own. 4) Inappropriate class (N) land that is not suitable because it has very severe limiting factors and/or is difficult to overcome (Dharumarajan et al., 2022).

Limiting factors are the values of land characteristics that influence and reduce land capabilities (Noorolahi et al., 2016). In this way, cultivation recommendations can be obtained to overcome these limiting factors so as to increase the land suitability class. Improvements to slope limiting factors can be done by planting in accordance with conservation principles such as planting in strips (strip cropping), which is a farming system with several types of plants in strips alternating on the land and arranged across the slope or according to contour lines (Hartati et al., 2018). Agro-climatic conditions greatly determine the growth and production results of dragon fruit plants (Kahsay et al., 2018). The air temperature at the research location can be determined from the climate data that has been obtained. Annual rainfall and air humidity reflect land characteristics that indicate water availability to support the growth and production of dragon fruit plants. Local landscape drainage affects the availability of oxygen in the root zone of cultivated plants, soil texture plays a role in root growth (Han et al., 2021).

RESULTS AND DISCUSSIONS

The potential land resources in this region are quite diverse due to differences in climate, parent soil materials, and topography/relief. The diversity of potential land resources indicates the need for appropriate, optimal and sustainable land use planning. To support this planning, land resource data and information is needed which includes distribution or distribution area, development potential and constraints as well as land management technology in accordance with the nature and characteristics of the land. Land evaluation is a process of assessing the potential of land for certain uses. The results of land evaluation are depicted in map form as a basis for rational land use planning.

Table 1. Suitability characteristics of land dragon fruit

Land use requirements/characteristics	**Land suitability class**			
	S1	**S2**	**S3**	**N**
Temperature (tc)				
Average temperature (°C)	19 - 25	25 – 30 - 15 - 19	30 – 35 - 10 - 15	> 35 - < 10
Water availability (wa)				
Rainfall (mm)	1,000 - 2,000	500 - 1,000 – 2,000 - 3,000	250 – 500 - 3,000 - 4,000	< 250 > 4,000
Humidity (%)	> 42 is good	36 - 42	30 - 36	< 30
Oxygen availability (oa)				
Drainage	currently	A bit hampered	hampered, rather quickly	very slow, fast
Rooting medium (rc)				
Texture	fine, somewhat fine, medium		rather rough	rough

Land use requirements/characteristics	Land suitability class			
	S1	**S2**	**S3**	**N**
Coarse material (%)	< 15	15 - 35	35 - 55	> 55
Soil depth (cm)	> 100	75 - 100	50 - 75	< 50
Nutrient retention (nr)				
Clay CEC (cmol)	> 16	≤ 16		
Base saturation (%)	> 35	20 - 35	< 20	
pH H2O	5.5 - 7.9	5.0 - 5.5 - 7.9 - 9.0	< 5.0 - > 9.0	
C-organic (%)	> 1.2	0.9 - 1.2	< 0.9	
Toxicity (xc)				
Salinity (dS/m)	< 4	4 - 6	6 - 9	> 9
Sodicity (xn)				
Alkalinity/ESP (%)	< 15	15 - 20	20 - 25	> 25
Sulfic hazard (xs)				
Sulfide depth (cm)	> 125	100 - 125	60 - 100	< 60
Erosion (eh)				
Slope (%)	< 9	9 - 16	16 - 30	> 30
Danger of erosion	very low	low - medium	heavy	Very heavy
Flood (fh)				
Puddle	F0			> F0

Source: (Sofyan et al., 2007)

Data that has been obtained from analysis in the laboratory, data from the field regarding land characteristics in the research area is arranged in tabular form as data on land quality/characteristics and climate data, then matched with the criteria for land suitability for crops.Dragon fruit is a superior commodity, especially in Banyuwangi Regency. Data on total production of superior fruit commodities in Banyuwangi Regency can be seen in Table 1 showing that the total production of dragon fruit is 202,395 quintals. Dragon fruit has the highest level of production compared to other commodities. Judging from the existing data, dragon fruit production has a tendency to increase from year to year, the peak in the latest data obtained in 2021 reached 44,140 quintals. With this condition, there is certainly a desire for farmers to switch from Other plants for dragon fruit are more profitable and in terms of production are quite high.

Table 2. Production of horticultural crops in Banyuwangi Regency

Commodity	**Production**						
Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Dragon fruit	16,630.60	29,920	30,454	39,990	42,349.41	44,140.74	202,395
Mango	20,919.90	22,915.30	22,247	23,742	24,537.36	25,035.17	139,196
Rambutan	13,627.39	14,653.13	10,779	11,156	19643.09	16,346.17	66,662
Durian	9,095.65	11,109.22	11,332	11,659	11,592.12	11,909.67	66,677
Melon	17,430	9,479	9,517	9,924	9,153.10	9,347.13	63,750

Source: Banyuwangi Regency Agricultural Service Data 2022

The potential of this region's superior commodities can be developed by building agribusiness centers. Building a superior commodity agribusiness center is an initial activity to spur economic development in a region, especially in Banyuwangi Regency. In determining land suitability, it is necessary to look at the characteristics of the land. Crop productivity depends on three main determining factors, soil and climate as well as land management practices.

Table 3. Results of actual analysis of land suitability for dragon fruit plants

Conformity Class	**Area (Ha)**	**Percentage**
Very Suitable (S1)	251,527	42.6
Fairly Appropriate (S2)	203.111	34.4
Marginal Compliant (S3)	118,678	20.1
Not Appropriate (N)	23,027	3.9
Total	590,439	100

Source: Primary data processing

The analysis's findings indicate that the land suitable class for dragon fruit plants in Banyuwangi Regency is actually mostly in the S1 (very suitable) land suitability class, which covers 251,527 Ha or 42.6% of the land. This land does not have significant barriers to sustainable use or only minor ones that have no discernible impact on production or require an increase in input. Land that has rather strict borders to preserve the level of management that must be carried out falls under the S2 criteria (very suitable), with an area of 2013,111 Ha, or 34.4%. The land suitability rating is S3 (marginally acceptable) with an area coverage of 118,678 Ha or with a percentage of 20.1% in this condition is land that has very heavy restrictions to maintain the level of management that must be carried out. Barriers will reduce productivity and profits, finally in the land suitability class N (not suitable) with an area of 23,027 Ha or with a percentage of 3.9% on this land the condition is land that has heavier barriers, but it is still possible to overcome it, just not can be improved with the current level of knowledge at a rational cost.

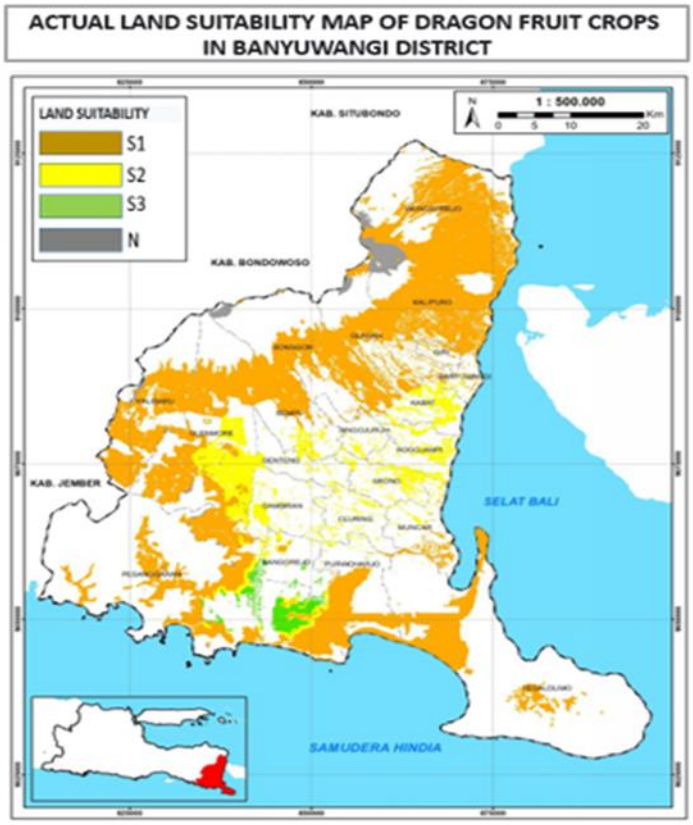

Fig. 1. Map of actual land suitability for dragon fruit plants in Bnayuwangi Regency

Based on the results of the evaluation of actual land suitability for dragon fruit plants, land suitability classes S2 and S3 (marginal according to) were obtained where the land has severe limiting factors in water availability (wa), namely rainfall, rooting media (rc), namely texture, nutrient retention (nr) namely soil pH, and available nutrients (na) namely P-total and slope. Land limiting factors are rainfall, texture, soil pH, P-total, slope and erosion hazard. Limiting factors can be improved to improve land class by providing input in the form of high capital so that government and private sector assistance is needed to help overcome this.

Organic matter in the soil functions to improve the physical properties of the soil, improve chemical properties and improve soil microbiology(Abdullah et al., 2020). A high organic material content will make land processing easier, because the soil structure becomes more crumbly, the growth of microorganisms is better, and root growth is more optimal. Efforts to fertilize with organic materials are an action to maintain soil fertility and productivity both physically, chemically and biologically. Fertilizing organic matter is also one way to overcome dependence on chemical fertilizers (Karimi et al., 2018). Organic matter tends to increase the amount of water that can be held in the soil and the amount of water available to plants. Organic materials are also a source of energy for microorganisms and without organic materials all biochemical activities will stop.

Table 4. Results of land suitability class assessment and improvement efforts

Land Characteristics	Data Value	Actual	Repair Efforts	Potential
Temperature (tc)				
Average annual temperature	22.8	S1		S1
Water availability (wa)				
Rainfall (mm year-1)	2141	S2	Irrigation improvements	S1
Humidity (%)	75	S1		S1
Root Media (rc)				
Drainage	Good	S1		S1
Texture	currently	S2	Addition of organic materials	S1
Soil depth	113	S2		S2
Nutrient retention (nr)				
Land CEC	26.11	S1		S1
pH	7.48	S1		S1
C-organic	1.02	S3	addition of organic materials	S1
Base Saturation	23.17	S2	Liming and adding organic materials	S1
Toxicity (xc)				
Salinity (Ds/m)	2	S1		S1
Sulphidic Hazard (cm)				
Sulfide Depth (cm)	110	S2	Arrangement of the ground water system	S1
Sodicity (xn)				
Alkalinity/esp (%)	25	S3	Repair by reclamation	S1
Nutrient availability (na)				
N-total	0.07	S1		S1
K2O available	0.66	S1		S1
P2O5 available	2.30	S1		S1
Erosion danger (eh)	Light	S2	making terraces, planting parallel to contours	S1
Slope (%)	2	S1		S1

Source: Primary Data

Slopes and the danger of erosion, improvement efforts that can be made are by cutting the actual slopes with a bund terrace or bench terrace system to reduce soil erosion. Consideration of factors that influence the treatment of bench terraces, namely (a) biophysical factors, where bench terraces are not suitable for use in shallow effective soil depths and soils that are prone to landslides and for plants that are sensitive to slow drainage, it is necessary to make high raised beds in the cultivated field, (b) socio-economic factors, where limited capital and labor sometimes make it difficult for farmers to implement bench terraces. Slope limiting factors can be improved by applying conservation techniques on sloping land. One of the applications of conservation techniques on sloping land is by making terraces on the land thereby reducing the slope (Romadhona et al., 2020).

Soil texture is also a limiting factor. Improvement efforts that can be made are by providing organic material in the form of manure, compost so that the soil texture becomes smoother. According to (Albaji & Alboshokeh, 2017) soil organic matter also plays a role in the availability of water in the soil, because organic material can hold water well and can increase the total porosity of the soil. Providing organic material in the form of compost will form more micro pore spaces, where micro pores are pores that the soil uses to bind water.

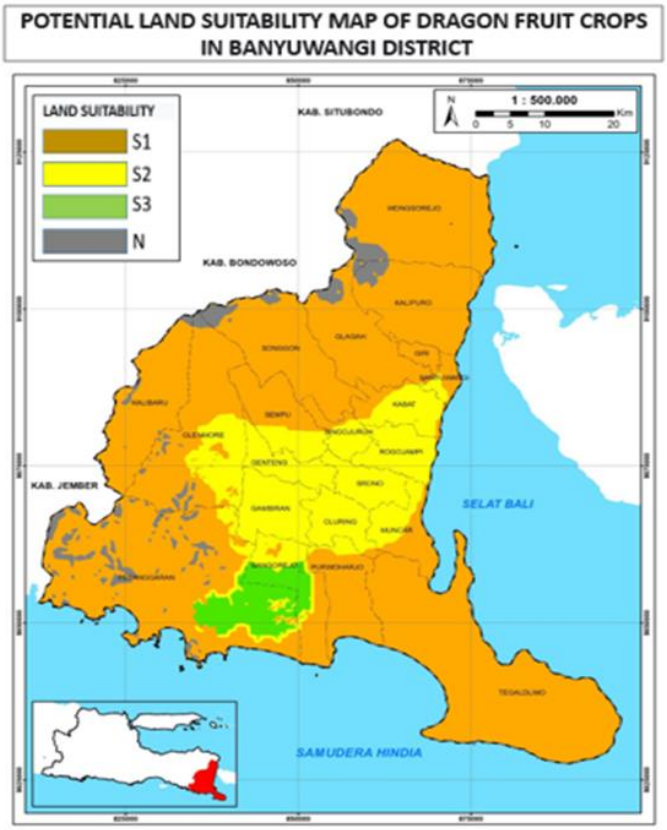

Fig. 2. Suitability of potential land for dragon fruit plants in Banyuwangi Regency

Determining superior commodities is a necessity so that the use of resources in a region is more efficient and focused, because only commodities that are cultivated efficiently are able to compete sustainably. Commodities that have high stability of comparative and competitive advantage show the potential to increase productivity to achieve a higher level of competitiveness. The results of the data values from processing the analysis of land characteristics are that in the research area there are several criteria results which are limiting factors, namely rainfall with a value of 2141 mm/year. This condition is included in quite suitable conditions although efforts must be made to make it optimal. Next is the soil texture with the current assessment included in The criteria are quite suitable, in the C-Organic condition there needs to be high improvement efforts with a value of 102 entering the criteria according to marginal. More than part of the agricultural land area has a relatively low C-organic content (Abd El-Maaboud et al., 2019).

Organic carbon plays an important role in soil fertility and productivity because it greatly influences the physical, chemical and biological properties of the soil. The next limiting factor is the laclinity condition in the research area, namely with a value of 25%. This condition has marginal land suitability criteria that require high efforts to improve. in order to have optimal values, the last is the danger of erosion which is a limiting factor in the research area, namely under these conditions, high rainfall will increase the potential for landslides. The increasingly steep slope is directly proportional to the speed of surface flow so the potential for erosion increases. Erosion will reduce the level of soil fertility because the nutrients contained in the soil will be carried away. Improvements to land with high slopes can be made by making terraces.

Table 5. Results of potential land suitability analysis for dragon fruit plants

Conformity Class	**Area (Ha)**	**Percentage**
Very Suitable (S1)	299,330	51.6
Fairly Appropriate (S2)	199,275	34.2
Marginal Compliant (S3)	75,702	13
Not Appropriate (N)	7,132	1,2
Total	590,439	100

Source: Primary data processing

Although there is obviously a lot of work involved in achieving the ideal land suitability class in Table 5, the improvement efforts made can offer varying insights on the predicted land suitability class. The potential land suitability analysis results are shown here, and they can be tailored to different improvement initiatives that farmers, institutions, and local governments can undertake. The results fall into three categories: class S1 (very suitable), which covers an area of 299,330 Ha or has a percentage of 51.6%; class S2 (quite suitable), which covers an area of 199,275 Ha or has a percentage of 34.2%; class S3 (marginally suitable), which covers an area of 75,702 Ha or a percentage of 13%; and land suitability class (not suitable) with an area coverage of 7,132 Ha or a percentage of 1.2%.

CONCLUSIONS

With an area coverage of 251,527 Ha, or 42.6%, the majority of the actual land suitability class of dragon fruit plants in Banyuwangi Regency is in the land suitability class S1 (extremely suitable), which is land that does not have heavy barriers. With a total size of 2013,111 Ha, or 34.4% of the S2 requirement (very acceptable), this land has relatively strict borders. With an area coverage of 118,678 Ha, or a percentage of 20.1% in this condition, the land suitability value at S3 (marginal according to) represents territory that is subject to extremely tight constraints. Class N (unsuitable) land suitability, including 23,027 hectares or 3.9% of the total land area, is where this land condition is land that has heavier restrictions. Over half (51.6% or 299,330 hectares) of the land is classified as highly suitable (S1) for the intended use. The next largest area (34.2% or 199,275 hectares) is moderately suitable (S2). Marginally suitable land (S3) covers 13% (75,702 hectares), and a small portion (1.2% or 7,132 hectares) is not suitable (N).

REFERENCES

Abd El-Maaboud, I. M. A., Abbas, H. H., Rashed, H. S. A., Zahra, W. R., Afify, A. A., Al-Shami, A. S. A., & Hassan, F. O. (2019). Land Suitability Analyses for Cultivating Certain Crops in Some Wadies of Southwest Sinai, Egypt, Using Remote Sensing Data and Gis Technique. Egypt. J. of Appl. Sci., 33(5), 184–202.

Abdullah, N., Zolkafli, A., Mansor, N. S., & Chik, N. A. (2020). Farmer's knowledge in land suitability evaluation and farmers' awareness in organic farming for sustainable agriculture: A case study in perlis. IOP Conference Series: Earth and Environmental Science, 616(1). https://doi.org/10.1088/1755-1315/616/1/012041

Aldababseh, A., Temimi, M., Maghelal, P., Branch, O., & Wulfmeyer, V. (2018). Multi-criteria evaluation of irrigated agriculture suitability to achieve food security in an arid environment. Sustainability (Switzerland), 10(3). https://doi.org/10.3390/su10030803

Andrea, R., Aliyah, I., & Yudana, G. (2021). Studi kesesuaian lahan pertanian sawah organik (Studi kasus: Desa Gempol, Kabupaten Klaten). Region : Jurnal Pembangunan Wilayah Dan Perencanaan Partisipatif, 16(2), 333. https://doi.org/10.20961/region.v16i2.25468

Dharumarajan, S., Kalaiselvi, B., Lalitha, M., Vasundhara, R., & Hegde, R. (2022). Defining fertility management units and land suitability analysis using digital soil mapping approach. Geocarto International, 37(20), 5914–5934. https://doi.org/10.1080/10106049.2021.1926553

Han, C., Chen, S., Yu, Y., Xu, Z., Zhu, B., Xu, X., & Wang, Z. (2021). Evaluation of agricultural land suitability based on RS, AHP, and MEA: A case study in Jilin province, China. Agriculture (Switzerland), 11(4). https://doi.org/10.3390/agriculture11040370

Hartati, T. M., Sunarminto, B. H., & Nurudin, M. (2018). Evaluasi Kesesuaian Lahan untuk Tanaman Perkebunan di Wilayah Galela, Kabupaten Halmahera Utara, Propinsi Maluku Utara. Caraka Tani: Journal of Sustainable Agriculture, 33(1), 68. https://doi.org/10.20961/carakatani.v33i1.19298

Kahsay, A., Haile, M., Gebresamuel, G., & Mohammed, M. (2018). Land suitability analysis for sorghum crop production in northern semi-arid Ethiopia: Application of GIS-based fuzzy AHP approach. Cogent Food and Agriculture, 4(1), 1–24. https://doi.org/10.1080/23311932.2018.1507184

Karimi, F., Sultana, S., Shirzadi Babakan, A., & Royall, D. (2018). Land Suitability Evaluation for Organic Agriculture of Wheat Using GIS and Multicriteria Analysis. Papers in Applied Geography, 4(3), 326–342. https://doi.org/10.1080/23754931.2018.1448715

Mugiyo, H., Chimonyo, V. G. P., Sibanda, M., Kunz, R., Masemola, C. R., Modi, A. T., & Mabhaudhi, T. (2021). Evaluation of land suitability methods with reference to neglected and underutilised crop species: A scoping review. Land, 10(2), 1–24. https://doi.org/10.3390/land10020125

Neswati, R., Baja, S., & Lopulisa, C. (2021). A modification of land suitability requirements for maize in the humid tropics of South Sulawesi. IOP Conference Series: Earth and Environmental Science, 921(1). https://doi.org/10.1088/1755-1315/921/1/012012

Noorollahi, E., Fadai, D., Shirazi, M. A., & Ghodsipour, S. H. (2016). Land suitability analysis for solar farms exploitation using GIS and fuzzy analytic hierarchy process (FAHP) - A case study of Iran. Energies, 9(8), 1–24. https://doi.org/10.3390/en9080643

Rasheed, H., & Naz, A. (2017). Modeling the Rice Land Suitability Using GIS and Multi-Criteria Decision Analysis Approach in Sindh, Pakistan. Journal of Basic & Applied Sciences, 13, 26–33.

Romadhona, S., & Arifandi, J. A. (2020). Indeks Kualitas Tanah Dan Pemanfaatan Lahan Sub Daerah Aliran Sungai Suco Kabupaten Jember. Geography: Jurnal Kajian, Penelitian Dan Pengembangan Pendidikan, 8(1), 37–45.

Romadhona, S., Sri Puryono, K. S., & Mussadun. (2023). Assessment of the potential of organic land for food crops and horticulture in the tropical areas to support SDGS. IOP Conference Series: Earth and Environmental Science, 1266(1). https://doi.org/10.1088/1755-1315/1266/1/012028

Sofyan, R., Wahyunto, Agus, F., & Hidayat, H. (2007). Panduan Evaluasi Kesesuaian Lahan. Balai Penelitian Tanah Dan World Agroforestry Centre, 48. www.worldagroforestrycentre.org/sea.

Sumani, Mujiyo, Winarno, J., Widijanto, H., & Hasanah, K. (2018). Land suitability evaluation for sweet corn in third cropping period at Wonosari Village, Karanganyar, Indonesia. IOP

Conference Series: Earth and Environmental Science, 200(1). https://doi.org/10.1088/1755-1315/200/1/012007

Syamsiyah, K. N., & Wicaksono, K. S. (2023). Evaluasi Retensi Hara Pada Lahan Padi Di Kabupaten Pamekasan. Jurnal Tanah Dan Sumberdaya Lahan, 10(1), 175–184. https://doi.org/10.21776/ub.jtsl.2023.010.1.20

Taghizadeh-Mehrjardi, R., Nabiollahi, K., Rasoli, L., Kerry, R., & Scholten, T. (2020). Land suitability assessment and agricultural production sustainability using machine learning models. Agronomy, 10(4), 1–20. https://doi.org/10.3390/agronomy10040573

Zakarya, Y. M., Metwaly, M. M., Abdelrahman, M. A. E., Metwalli, M. R., & Koubouris, G. (2021). Optimized land use through integrated land suitability and gis approach in west el-minia governorate, upper Egypt. Sustainability (Switzerland), 13(21), 1–21. https://doi.org/10.3390/su132112236