LAND EVALUATION AND SUITABILITY FOR DEVELOPMENT OF SORGHUM (*SORGHUM BICOLOR* L.) ON THREE TYPE OF PEAT LAND

Juniarti*[1)], Sandi. N[1)], Sari. A[2)], Agustar. A[3)], Sari. D.P[4)]

[*1)] Dept. of soil science Fac. of Agriculture, Universitas Andalas, Indonesia, postcode: 25163 , phone: 0751- 72701 -72702, fax : (0751) 72702

[2)] Dept. of Agronomy Fac. of Agronomy, Universitas Andalas, Indonesia postcode: 25163 , phone: 0751- 72701 - 72702, fax : (0751) 72702

[3)] Professor at Livestock Development and Business, Andalas University. Indonesia, phone : 0751-71464, 74755, 74208, dan 72400. Fax : 0751-71464

[4)] Department of Plantation Plant Cultivation, Payakumbuh State Agricultural Polytechnic, West Sumatera, Indonesia. Phone : (0752) 7754192, fak : 0752-7750220

(*) *correspondence author email:* yuni_soil@yahoo.co.id, yuni_soil@agr.unand.ac.id

Orcid Id: 0000-0002-5938-9327

ABSTRACT

Sorghum (*Sorghum bicolor* L.) is an annual cereal crop with high adaptability to marginal and acidic environments, making it a promising option for peatland development in Indonesia. This study evaluated land suitability for sorghum cultivation in West Sumatra, Indonesia, using purposive sampling and field survey methods at the regency scale, following FAO land evaluation criteria. Land characteristics were analysed based on climatic, soil, and hydrological parameters. The results show that three peatland types in the study area are classified as moderately suitable with nutrient retention limitations (S2nr). These peatlands are characterised by average temperatures of 25–27 °C, annual rainfall below 2,000 mm, relative humidity below 75%, good drainage, peat depths exceeding 60 cm, and acidic soil conditions (pH 4.4–5.1). Low availability of nitrogen, phosphorus, and potassium was identified as the primary limiting factor for sorghum cultivation. Overall, the findings indicate that peatlands in West Sumatra have substantial potential for sustainable sorghum development, provided that appropriate soil fertility and nutrient management strategies are implemented.

Keywords: land evaluation, land suitability, peat land, Sorghum (*Sorghum biholor* L)

ABSTRAK

Sorgum merupakan tanaman pangan tahunan yang memiliki potensi besar untuk dikembangkan pada lahan gambut di Indonesia. Pengembangan sorgum akan meningkatkan produktivitas lahan, mendukung pengembangan pertanian berkelanjutan dan meningkatkan produksi pangan Indonesia. Hasil penelitian menetapkan sorgum sebagai pilihan ideal untuk meningkatkan produktivitas lahan kering, masam, atau lahan yang tidak produktif, termasuk lahan bekas tambang yang telah direklamasi. Melalui penilaian karakteristik lahan yang sesuai untuk pengembangan sorgum sebagai tanaman energi biomassa di Sumatera Barat, Indonesia, penelitian ini berupaya untuk memfasilitasi pertumbuhan budidaya sorgum yang berkelanjutan di wilayah tersebut. Penelitian ini bertujuan untuk mengevaluasi kesesuaian lahan untuk tanaman sorgum (Sorghum bicolor L.) di Sumatera Barat, Indonesia. Kabupaten menggunakan metode purposive sampling dan survei. Hasil penelitian menunjukkan bahwa tiga jenis lahan gambut di Sumatera Barat, Indonesia sesuai dengan faktor pembatas retensi hara (S2nr) memiliki potensi untuk pengembangan tanaman sorgum dengan karakteristik suhu rata-rata 25-27 º C, curah hujan <200 mm, kelembaban udara <75%, drainase yang baik, kedalaman tanah gambut > 60 cm, pH 4,4 - 5,1 namun ketersediaan hara N, P dan K rendah.

Kata kunci: evaluasi lahan, kesesuaian lahan, lahan gambut, Sorghum (*Sorghum bicholor* L.),

INTRODUCTION

Sorghum (*Sorghum bicolor* L.) is an annual cereal crop recognised for its adaptability to marginal environments, including acidic and low-fertility soils. These characteristics make sorghum a potential candidate for cultivation on peatlands, which represent a major sub-optimal land resource in Indonesia. West Sumatra contains approximately 153,859 ha of peatland (Histosols), accounting for 1.60% of the provincial area (Ditjen PPKL–KLHK, 2017). However, the agricultural utilisation of these peatlands remains limited due to constraints such as high soil acidity, low nutrient availability, and variable peat depth. For sorghum cultivation, dry terrain with gradients below 8% is considered suitable for farming operations (Sihono, 2013). Indonesian farmers have traditionally grown and recognized sorghum for many years, particularly in regions like Java, West Nusa Tenggara, and East Nusa Tenggara, where it is typically cultivated using intercropping methods alongside various other food crops.

The challenge lies in the fact that acidic soils are prevalent across much of these dry areas. Furthermore, West Sumatra has seen minimal activity in sorghum farming, research, and advancement, primarily because of insufficient knowledge regarding high-quality seeds, sorghum applications and farming practices, as well as proper cultivation techniques. Studies have demonstrated that sorghum represents an optimal solution for improving the yield of dry, acidic, or generally non-productive territories, such as rehabilitated post-mining sites (Juniarti et al., 2012). Sorghum stands out as a crop well-suited for cultivation in peat soil environments (Lestari & Andrian, 2017). A crucial consideration involves understanding the viewpoints, needs, and constraints that farmers and interested parties face concerning sorghum harvests and output levels (Ostemeyer et al., 2022). As a drought-tolerant crop, sorghum has traditionally served as a primary food source in the arid and semi-arid regions of Africa and Asia, contributing to food availability and nutritional stability. Nevertheless, ongoing climate variations are progressively impacting sorghum development, particularly during the flowering phase when moisture is vital for grain development, consequently reducing overall grain production (Mwamahonie, 2024).

The Vision for Adapted Crops and Soils (VACS) Project has recognized sorghum as a climate-adaptive crop opportunity because of its efficient water utilization and resistance to dry conditions and elevated temperatures. Globally, sorghum ranks as the fifth-leading cereal grain following corn, wheat, rice, and barley, with a long history of cultivation in water-scarce and semi-dry regions (Pixley et al., 2023). Sweet sorghum (*Sorghum bicolor* (L)) shows promise as a crop particularly suited for cultivation in peripheral and water-limited regions. This plant serves a significant function as a carbohydrate provider and is anticipated to be a viable option for farming on peat soils. The utilization of peatlands for sorghum cultivation is also anticipated to promote environmental consciousness through the adoption of more ecologically sustainable agricultural practices (Lestari and Adrian, 2017).

Agricultural utilization of peatlands involves substantial areas, though these lands present various constraints such as acidic conditions, nutrient deficiencies, and poor fertility that make them unsuitable for conventional crop cultivation like rice farming (Andriani, 2024). Peatlands exhibit considerable diversity in characteristics, including variations in depth, decomposition stage, and nutrient content Earlier studies on sorghum have been conducted by Cereal Maros in collaboration with the Isotope and Radiation Technology Application Center (PATIR) under the National Nuclear

Energy Agency (BATAN). These investigations concentrated on enhancing existing genetic materials through the application of gamma radiation from Cobalt-60 sources, with the objective of developing improved crop varieties that meet specific desired characteristics (CRISAT, 1990).

From an agricultural perspective, ten promising varieties have been developed, featuring characteristics such as enhanced yield, resilience to water scarcity, and distinctly white grains. Several mutant sorghum varieties from the PATIR-BATAN germplasm collection underwent evaluation for their tolerance to acidic soil conditions (Hosen, 2006). This research took place in Lampung, Indonesia, in locations where soil acidity levels varied between pH 4.2 and 4.7, with aluminum saturation ranging from 30% to 39%. Findings revealed that various sorghum varieties demonstrated exceptional tolerance levels, while others exhibited moderate resistance to acidic environments. These acid-tolerant sorghum varieties are currently undergoing refinement processes and seed multiplication procedures (House, 1995).

Peatlands are defined by high organic matter content and are commonly found in lowland wetland environments, although they may also occur in upland areas. Their suitability for agriculture depends strongly on physical and chemical properties, including peat thickness, drainage conditions, and nutrient status. Previous studies indicate that food crop cultivation is generally feasible only on shallow peat deposits (<100 cm), where appropriate management practices are applied (Hadianto et al., 2018). Sorghum is agronomically suited to gently sloping land (<8%) and has demonstrated tolerance to acidic soil conditions, suggesting its potential compatibility with selected peatland environments.

Despite this potential, sorghum cultivation in West Sumatra remains limited, and comprehensive land suitability assessments for sorghum on peatlands are lacking. Most previous sorghum studies in Indonesia have focused on crop improvement and varietal development, with relatively little emphasis on spatially explicit land evaluation under peatland conditions. As a result, decision-makers lack robust information to support targeted and sustainable sorghum development in the region.

Therefore, this study aimed to evaluate land characteristics and suitability for sorghum cultivation on peatlands in West Sumatra, Indonesia, using field surveys and FAO-based land evaluation criteria. The results are expected to provide a scientific basis for sustainable land-use planning and the development of sorghum on sub-optimal peatland environments.

MATERIALS AND METHODS

Study Area

The study was conducted in peatland areas across three regencies in West Sumatra, Indonesia, representing the dominant peatland types used or potentially suitable for agricultural development. The region has a humid tropical climate with mean annual temperatures of 25–27 °C and annual rainfall ranging from 1,800 to 2,200 mm. The method involved conducting experiments and surveys in the designated area at Pesisir Selatan Regency, West Sumatra, Indonesia). The data consist of primary data (production data obtained from interviews with farmers) and secondary data (analyzing reference materials from available reports). Conducting surveys and collecting soil samples were done. The selection of soil sample locations was based on information from geological maps, slope maps, and soil maps of the research area.

Sampling Design and Field Survey

A purposive sampling approach was applied at the landscape level to select representative peatland areas based on peat depth, land use, and accessibility. Within each selected area, land mapping units were delineated based on peat thickness, drainage class, and surface morphology. A total of **three**

land mapping units were identified across the study area. Three land mapping units (LMUs) were delineated using field observations and existing peatland maps. Within each LMU, soil sampling points were distributed systematically to capture spatial variability. A total of **30 soil sampling points** were established across the study area, with **10 sampling points per LMU**. At each sampling point, peat depth, drainage condition, slope gradient, and land cover were recorded. Soil profiles were examined using auger observations to a depth of 100 cm or until the underlying mineral layer was reached.

The study was conducted on the land planted with sorghum. Composite soil sampling was done at a depth of 0-30 , 30-60, 60-100 cm. on peatland in West Sumatera, Indonesia. Soil profiles were excavated to a depth of 100 cm or until the mineral subsoil was encountered. Peat depth was measured in situ at each observation point.

Soil Sampling and Laboratory Analysis

Soil samples were collected from peat horizons at depths of **0–30 cm and 30–60 cm, 60-100 cm**, which represent the active root zone for sorghum cultivation. Composite sampling across the entire peat profile was avoided to preserve depth-specific chemical variability.

Laboratory analyses were conducted using standard soil analysis procedures. Soil pH was measured in a 1:5 soil–water suspension. Total nitrogen (N) was determined using the Kjeldahl method. Available phosphorus (P) was extracted using the Bray I method, while exchangeable potassium (K) was extracted using 1 N ammonium acetate (NH_4OAc) at pH 7. Organic carbon content was determined using the Walkley–Black method. All analyses were performed in duplicate to ensure analytical accuracy. A 1 N ammonium acetate washing method is employed for CEC (Cation Exchange Capacity) and determining base cations.

Land Suitability Evaluation

Land suitability for sorghum (*Sorghum bicolor* L.) was assessed using the FAO land evaluation framework (FAO, 1976; FAO, 2007), applying the matching approach between land characteristics and crop growth requirements. Climatic (temperature, rainfall, relative humidity), physical (slope, drainage, peat depth), and chemical (pH, nutrient availability) parameters were used as evaluation criteria.

Suitability classes were assigned as highly suitable (S1), moderately suitable (S2), marginally suitable (S3), or not suitable (N). Limitation subclasses were identified based on dominant constraints, with nutrient retention limitations designated as "nr". Final land suitability classes were determined using the most limiting factor principle.

Analysis of Land Suitability for Sorghum (Data Interpretation)

Data is analyzed by comparing land characteristics with the production of sorghum as a biomass energy crop, based on land condition and production of sorghum: a. The measurement of land suitability is conducted at a semi-detailed level using a map scale of 1:50,000. In this category of semi-detail, the following data is required; b. Climate data includes the mean duration of sunlight (n, hours/day), the mean maximum air temperature (Tmax, °C), the mean minimum air temperature (Tmin, °C), the mean humidity (RH, %), and the mean wind velocity (U, m/s). Additionally, it encompasses the total monthly rainfall (P, mm) and the total number of rainy days (RD); c. Environmental data related to soil, such as drainage, soil depth, flood duration, land slope, and surface rock (rock outcrop), are important factors to consider; d. Data on soil characteristics, including KTK, pH, total nitrogen (N), available phosphorus (P_2O_5), available potassium (K_2O), salinity, aluminum saturation, structure, and consistency.

RESULTS AND DISCUSSION

Land Characteristics of Peat Types

The study area comprised three peatland types: fibrist, hemist, and saprist, each representing a distinct degree of organic matter decomposition. Fibrist peat was characterised by low bulk density, high organic matter content, and weakly decomposed plant residues. Hemist peat exhibited intermediate decomposition, while saprist peat showed advanced decomposition, higher bulk density, and greater mineral influence.

Across all land mapping units, mean annual temperature ranged from 25 to 27 °C, and average annual rainfall ranged from 1,800 to 2,200 mm. Slope gradients were below 8%, and drainage conditions were classified as moderately well-drained to well-drained. Peat depth exceeded 60 cm at all sampling points.

Soil chemical analyses indicated acidic conditions across all peat types, with soil pH values ranging from 4.4 to 5.1. Total nitrogen, available phosphorus, and exchangeable potassium levels were low in all peat types, although saprist peat showed slightly higher nutrient availability compared to fibrist and hemist peat.

The peatland regions of West Sumatra experience tropical weather patterns, characterized by temperatures ranging between 21°C and 33°C and annual precipitation averaging 2,451 millimeters. Based on Oldeman's climatic classification system (as shown in West Sumatra's Climate Map), these areas fall under category B2, experiencing 3 to 4 months of reduced rainfall annually. These climatic patterns create challenges for agricultural producers attempting to achieve double rice harvests annually (200% cropping intensity) in rain-dependent lowland fields. Additionally, the water-related characteristics of West Sumatra's peatlands show significant variation across different locations. This variability stems from several factors including local climate variations, terrain features, and the thickness of peat deposits.

Limiting Factors for Sorghum Cultivation

Based on FAO land evaluation criteria, nutrient retention emerged as the dominant limiting factor across all peat types. Low soil pH and limited availability of nitrogen, phosphorus, and potassium constrained nutrient retention capacity. No severe climatic or physical limitations were identified, as temperature, rainfall, slope, drainage, and peat depth were within acceptable ranges for sorghum cultivation.

The limiting-factor analysis resulted in classification of all three peat types as moderately suitable with nutrient retention limitations (S2nr). Fibrist peat exhibited the strongest nutrient constraints due to minimal decomposition and weak nutrient-holding capacity, followed by hemist peat. Saprist peat showed relatively improved nutrient status but remained constrained by acidic conditions and low base saturation.

The soil sample analysis findings from sorghum cultivation sites across three peatland categories in West Sumatra are presented in Table 2. The land characteristic observations detailed in Table 1, combined with soil sample evaluation, indicate that West Sumatra's peatlands offer promising conditions for sorghum farming development. These areas feature mean temperatures between 25-27°C, precipitation levels below 200 mm, atmospheric moisture under 75%, inadequate drainage systems, peat soil depths less than 3 meters, and a pH value of 5.19. However, the concentrations of essential nutrients including nitrogen, phosphorus, and potassium remain limited (Table 2).

Table 2 shows that the agricultural areas on West Sumatra's peatlands possess favorable conditions for sorghum cultivation development, provided that appropriate soil management practices are implemented due to the predominance of Histosol soils. Additionally, land management strategies incorporating organic matter supplementation show promise for sorghum production achieving yields of 10 tons per hectare. However, continuous cultivation without organic matter replenishment would lead to land quality deterioration, making fertilizer application essential. As anticipated, no-till (NT) practices exhibited the greatest soil organic carbon (SOC) levels and minimal bulk density (BD) values among four different biomass harvest rates, achieving the maximum SOC percentage increase during the 51-year simulation study. In this research, a 75% biomass harvest rate proved sustainable for NT-based energy sorghum cultivation systems, producing yearly harvestable biomass of 18.0 ± 0.9 Mg ha^{-1}, residual biomass of 6.2 ± 0.3 Mg ha^{-1}, and root biomass measuring 7.2 ± 0.4 Mg ha^{-1} (Maryowa and Meki, 2013).

Beyond its role as a food source, sweet sorghum presents significant opportunities for bioenergy production. As a C4 photosynthetic crop requiring minimal agricultural inputs, it stores substantial sugar concentrations within its stems (Mathur, 2017). Sorghum [*Sorghum bicolor* (L.) Moench] serves multiple agricultural purposes including human consumption, animal feed, livestock forage, and energy production, positioning it as a viable biofuel resource that doesn't compromise food or fodder availability (Oluwatoyin et al., 2016).

Figure 1. Petland of West Sumatera in Pesisir Selatan Regency, Indonesia.

Table 1.Characteristic of Land use requirements / Land suitability class for sorghum.

Requirements of land use/Land Characteristics	Classification of Land Suitability			
	S1	S2	S3	N
Temperature (t)				
- Temperature Average (ºC)	25- 27	18 – 25 / 27 - 30	15-18 / 30-35	<15 / >35
Water availability (w)				
-Dry season (month)	8-4	2.5-4/8-8.5	1.5-2.5/8.5-9.5	<1.5/>9.5
- Rainfall (mm)	<200	200-1200	1200-2000	> 2000
Air humidity (%)	< 75	75-80	> 85	td
Oxygen availability (o)				
- Drainage	b, at	s	t	st, sc
Rooting medium (r)				
- Texture	h, s	ah	ak	k
- Coarse material (%)	< 15	15 - 35	35 - 55	> 55
- Depth of soil (cm)	> 60	40 - 80	25 - 40	< 25
Nutrient retention (n)				
- CEC (cmol)	> 16	≤16	td	td
- Base saturation (%)	> 50	35- 50	< 35	td
- pH H_2O	5.5 – 8.5	5.3-5.5 / 8.2-8.3	< 5.3 / > 8.3	td
- N-Total	st, t, s	r	sr	
- K_2O	st, t, s	r	sr	td
- P_2O_5	st	t , s	r	sr
- C-organic	> 0,4	≤0,4	td	
Toxicity (xc)				
- Salinity (dS/m)	< 8	8 - 12	12 -16	> 16
Sodositas (xn)				
- Alkalinity/ESP	< 20	20 -28	28-35	> 35
Erosion hazard (e)				
- Slope (%)	< 8	8 - 16	16-30/16-50	>30/>50
- Erosion hazard	sr	r,s	b	sb
Flood (f)				
- Flood	f0	f1	f2	> f3
Land preparation (lp)				
- Rocks at the surface (%)	< 5	5 - 15	15 - 40	>40
- Rock outcrop (%)	< 5	5 - 15	15 - 25	>25

Source: (Siswanto, 2006).

st = very high, t = high, s = medium, r = low, sr = very low, td = no data, k = rought, ak = little rought, ah = little smooth, h = smooth

Table 2. Characteristic of Peat land for development of Sorghum in West Sumatera, Indonesia.

Requirements of land use/Land Characteristics	Characteristic of Peat land	Classification of Land Suitability			
		S1	S2	S3	N
Temperature (t)					
- Temperature Average (ºC)	21-33	25- 27	18 – 25 / 27 - 30	15-18 / 30-35	<15 / >35
Water availability(w)					
-Dry season (month)	3-4	8-4	2.5-4/8-8.5	1.5-2.5/8.5-9.5	<1.5/>9.5
- Rainfall (mm)	2451	<200	200-1200	1200-2000	> 2000
Air humidity (%)	60-80	< 75	75-80	> 85	td
Oxygen availability (o)					
- Drainage	b	b, at	s	t	st, sc
Rooting medium (r)					
- Texture	-	h, s	ah	ak	k
- Coarse material (%)	-	< 15	15 - 35	35 - 55	> 55
- Depth of soil (cm)	>60	> 60	40 - 80	25 - 40	< 25
Soil dept of peat land (m)	< 3				
Nutrient retention (n)					
- CEC (cmol)	35.69	> 16	≤16	td	td
- Base saturation (%)	7.18	> 50	35- 50	< 35	td
- pH H_2O	5-5.19	5.5 – 8.5	5.3-5.5 / 8.2-8.3	< 5.3 / > 8.3	td
- N-Total	0.25-0.29	st, t, s	r	sr	
	t,s,r,sr				
- K_2O	0.3-0.5	st, t, s	r	sr	td
- P_2O_5	4-6	st	t , s	r	sr
	sr, st				
- C-organic	12.6-13.9	> 0.4	≤0.4	td	
	s				
Toxicity(xc)					
- Salinity (dS/m)	0.11	< 8	8 - 12	12 -16	> 16
Sodositas (xn)					
- Alkalinity/ESP	140	< 20	20 -28	28-35	> 35
Erosion hazard (e)					
-Slope (%) .	8->40	< 8	8 - 16	16-30/16-50	>30/>50
- Erosion hazard	b	sr	r,s	b	sb

Flood (f)					
- flood	f2	f0	f1	f2	> f3
Land preparation (lp)					
- Rocks at the surface (%)	-	< 5	5 - 15	15 - 40	>40
- Rock outcrop (%)	-	< 5	5 - 15	15 - 25	>25

st = very high, t = high, s = medium, r = low, sr = very low, td = no data, k = rought, ak = little rought, ah = little smooth, h = smooth.

Table 3. Soil`s Chemical on three type of Peat land at Pesisir Selatan Regency, West Sumatera, Indonesia.

Soil`s Chemical	Fibrist*	Hemist*	Saprist*
pH	5.0 m	5.1 m	5.19 m
C-organic (%)	12.6 t	13 t	13.9 t
N- tot (%)	0.25 s	0.27 s	0.29 s
P (ppm)	4.00 sr	5.00 sr	6.00 sr
CEC (me/100 g)	3.46 r	14.29 r	35.7 st
Base saturation (%)	4.94 sr	6.23 sr	7..2 sr
K (me/100 g)	0.3 r	0.4 r	0.5 r
Na (me/100 g)	1.0 s	1.1 s	1.2 s
Ca (me/100 g)	0.1 sr	0.2 sr	0.25 sr
Mg (me/100 g)	0.33 r	0.47 r	0.5 r

* m = acid, sr = very low, r = low, s = medium, t = high, st = very high

The data presented in Tables 1, 2, and 3 indicate that the peatland areas shows suitability classification with nutrient retention limitations (S2nr) for sorghum cultivation at the study sites within West Sumatra's peatlands, Indonesia. Peatland environments typically exhibit severe to extreme acidic properties. Laboratory results revealed pH values between 3.95 and 4.53. As noted by Barchia (2017), the majority of peat soils display pH levels below 4.0. Elevated cation exchange capacity (CEC) values correlate with increased clay composition. This relationship is evident in the soil analysis findings, which indicate textural classifications ranging from clay loam through sandy silt. Furthermore, elevated CEC measurements suggest substantial organic matter presence, enhanced nutrient-holding capacity, and improved moisture retention properties of the soil.

In fact, producing bioethanol from sorghum biomass proves viable in moderate climate zones without interfering with food crop production, since sorghum cultivation can follow rye harvesting

(Batog et al., 2020). Findings revealed that multiple sorghum varieties demonstrated excellent resistance (or superior tolerance) while others displayed intermediate tolerance levels to acidic soil conditions. These acid-tolerant sorghum varieties are presently in the process of refinement and seed multiplication (Sari and Juniarti, 2023). Aldrian and Susanto (2023) observe that these circumstances benefit agricultural operations needing consistent water availability, though they might create drainage challenges in specific soil classifications. Kusumastuti et al. (2023) emphasize that proper management of water excess remains crucial for preventing soil degradation and maintaining water resource preservation. Studies by Tari et al. (2022) in Indonesia demonstrate that cultivating sorghum on elevated planting beds measuring 30-40 cm in height can reduce the negative impacts of excessive moisture on crop development and productivity. Sorghum flourishes under warm, sun-rich environments, with ideal temperature requirements between 20°C and 30°C during its entire growing cycle (Yang, 2022).

In the Pesisir Selatan District of West Sumatra, Indonesia, marginal agricultural land typically occurs in elevated terrain and shoreline regions. These areas are predominantly planted with long-term crops including coconut palms, rubber trees, and coffee plants. Nevertheless, these crops yield comparatively poor harvests owing to various contributing factors (Sefano et al., 2024). Sorghum demonstrates exceptional flexibility in adapting to diverse growing conditions, particularly in situations of limited water availability (Abreha et al., 2022).

Discussion

The classification of fibrist, hemist, and saprist peatlands as S2nr reflects the dominance of chemical limitations rather than climatic or physical constraints. The observed temperature and rainfall regimes align with sorghum growth requirements, indicating that climate does not represent a major limitation in the study area. Similarly, slope and drainage conditions were suitable for mechanised cultivation. The problem is, some of this dry land is dominated by acid soils. In addition, the cultivation, research and development of sorghum in West Sumatra is still very limited, due to lack of information about (superior seed, sorghum utilization and cultivation and how to grow good and true sorghum). Research findings indicate that sorghum is an ideal choice for enhancing the productivity of arid, acidic, or otherwise unproductive lands, including reclaimed former mining areas (Juniarti et al., 2020).

Differences among peat types influenced nutrient availability and retention capacity. The higher degree of decomposition in saprist peat contributed to slightly improved nutrient status compared to fibrist and hemist peat; however, acidic conditions and low macronutrient availability remained limiting. These findings are consistent with previous studies reporting that nutrient retention is a critical constraint in peat-based agricultural systems.

Unlike yield-based studies, this research did not estimate sorghum productivity or long-term soil carbon dynamics. Instead, it focused on land suitability classification using measured land characteristics. References to yield potential and soil carbon dynamics from previous studies are therefore used solely to contextualise the implications of land suitability rather than as direct results of this study.

Overall, the results indicate that peatlands in West Sumatra have potential for sorghum cultivation under moderate suitability conditions. Targeted soil management interventions, particularly nutrient amendment and pH correction, would be required to overcome nutrient retention limitations and improve land suitability.

CONCLUSIONS

This study evaluated the suitability of peatlands in West Sumatra, Indonesia, for sorghum (*Sorghum bicolor* L.) cultivation using an FAO-based land evaluation framework. Based on measured climatic, physical, and chemical land characteristics, three peatland types—fibrist, hemist, and saprist—were classified as moderately suitable with nutrient retention limitations (S2nr). Climatic conditions, slope, drainage, and peat depth were generally favourable for sorghum growth, whereas low soil pH and limited availability of nitrogen, phosphorus, and potassium were identified as the principal constraints.

Differences among peat types influenced nutrient status, with saprist peat exhibiting relatively better chemical properties than fibrist and hemist peat; however, nutrient retention remained a limiting factor across all land units. These findings indicate that peatlands in West Sumatra have potential for sorghum development under moderate suitability conditions, provided that appropriate soil fertility and acidity management practices are implemented. The results offer a scientific basis for land-use planning and support targeted, sustainable sorghum cultivation on sub-optimal peatland environments.

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