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Meteorological Drought Preparedness Analysis for the Early 2026 Dry Season in South Kalimantan Based on BMKG Rainfall Prediction and SPI Data

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Abstract: *Operational climate information is essential for assessing meteorological drought risk at the beginning of the dry season. This study analyzes the early 2026 dry-season conditions in South Kalimantan using BMKG rainfall prediction, rainfall characteristics, and the 3-month Standardized Precipitation Index (SPI) for June–August 2026. This research employed a quantitative descriptive approach using secondary data from BMKG, the South Kalimantan Climatology Station, and relevant climate literature. The results show that predicted rainfall in July 2026 is dominated by the low category (95.9%), while 4.1% is in the moderate category. Rainfall characteristics are predicted to be 100% below normal, and the 3-month SPI indicates that 85.5% of the region falls into slightly dry to very dry categories. In addition, the Indonesian mean air temperature anomaly in June 2026 reached +0.7°C, which may increase evaporative demand and water stress. These findings indicate the need for early preparedness in agriculture, clean water management, and land-fire prevention in South Kalimantan.*

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Introduction

South Kalimantan is a tropical wetland province whose hydrological system is influenced by monsoon rainfall, maritime atmospheric dynamics, river networks, peatlands, and land-use changes. Water availability in this region is highly dependent on the balance between rainfall, air temperature, evaporation, soil conditions, and the landscape's ability to store water. Small changes in seasonal rainfall distribution can impact agriculture, fisheries, raw water supplies, river transportation, and the potential for land fires (Aldrian & Susanto, 2003; Hamada et al., 2002; Kottek et al., 2006).

The global context demonstrates that climate warming continues to reinforce the urgency of data-driven climate research. The Copernicus Climate Change Service reported that 2024 was the warmest year on record during the ERA5 period and the first calendar year to exceed 1.5°C above pre-industrial levels (Copernicus Climate Change Service, 2025). The World Meteorological Organization also confirmed that the 2015–2025 period was the eleventh warmest year on record, with 2025 being approximately 1.43°C above the 1850–1900 average (World Meteorological Organization, 2026). These global conditions cannot be directly compared to local conditions, but they provide important background for understanding why temperature anomalies and rainfall deviations need to be routinely monitored in humid tropical regions like South Kalimantan.

On the Indonesian scale, climate change has been demonstrated through an increase in the frequency of hot nights, a decrease in the frequency of cold nights, and changes in the extreme rainfall index in various regions (Supari et al., 2017). Previous research in South Kalimantan showed a trend of temperature increases of around 0.2–0.3°C over two decades and an increase in annual rainfall of around 25 mm per year in selected locations (Sukmara et al., 2022). These findings are important because South Kalimantan faces not only the potential for flooding during wet periods but also the risk of meteorological drought when dry periods are more widespread and intense.

This research problem stems from operational information from the South Kalimantan Class I Climatology Station in July 2026, which indicates a predominance of low rainfall predictions, below-normal rainfall characteristics, and drought indications based on the 3-month SPI. This information needs to be written in the form of a scientific article so that operational climate data can be read systematically, not just as warning information. This article's approach positions BMKG data as the primary secondary data and integrates it with the concepts of meteorological drought, temperature anomalies, and climate change literature.

The objectives of this study are to analyze the meteorological and climatological conditions of the early 2026 dry season in South Kalimantan based on predictions of rainfall, rainfall characteristics, and the 3-monthly SPI; interpret the meaning of these indicators for drought preparedness; and formulate guidelines for utilizing the latest climate data for water resource management, agriculture, and environmental risk mitigation. The novelty of this article lies in the use of very recent operational climate information for 2026, the presentation of rainfall and SPI indicators within a single preparedness framework, and a discussion of their implications for the wetland areas of South Kalimantan.

Literature review

Meteorology and Climatology

Meteorology and climatology are two related fields of atmospheric science, but they have different temporal focuses. Meteorology emphasizes the observation and analysis of short-term weather conditions, such as air temperature, rainfall, humidity, air pressure, wind, clouds, and daily atmospheric phenomena. Climatology studies long-term weather patterns, allowing it to understand the climate characteristics of a region based on historical data, climatological normals, and trends in climate change (Barry & Chorley, 2010).

Meteorological and climatological studies are crucial in tropical regions because the atmosphere is influenced by monsoon circulation, sea surface temperature, local convection, the Madden-Julian Oscillation, ENSO, and local geographic conditions. South Kalimantan, as a coastal region with lowlands, the Meratus Mountains, and wetlands, experiences spatial and temporal climate variation. Therefore, climate studies cannot simply focus on a single element; they must link rainfall, rainfall characteristics, temperature, and drought indicators (Qian, 2008; Zhang, 2013; Loo et al., 2015).

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Rainfall

Rainfall is the amount of rain falling in a given area over a specific period and is generally expressed in millimeters. In environmental studies, rainfall is a key indicator for assessing water availability, flood potential, drought risk, soil moisture, agricultural productivity, and fire vulnerability. Rainfall is also a climatic element that significantly determines wetland dynamics (Barry & Chorley, 2010; Trenberth et al., 2014).

Rainfall distribution is influenced by topography, distance from the sea, wind direction, regional atmospheric dynamics, sea surface temperature, and local convection processes. During the dry season, decreased rainfall can reduce soil moisture and surface water discharge. If the period of low rainfall persists for a long time, this condition can trigger a meteorological drought and impact the agricultural sector and water resources (Aldrian & Susanto, 2003; Hamada et al., 2002; Saji et al., 1999).

The Nature of Rain

Rainfall characteristics are the ratio of rainfall amounts over a given period to the climatologically normal values for the same period. Rainfall characteristics are generally categorized as above-normal, normal, and below-normal. This category is important because the same rainfall amount can have different meanings in areas with different rainfall norms (Meteorology, Climatology, and Geophysics Agency, 2026d; South Kalimantan Class I Climatology Station, 2026a).

In climate research, rainfall characteristics help interpret deviations in rainfall conditions relative to a region's climatological characteristics. Low rainfall is not necessarily extreme if it is a normal pattern of the dry season. However, low rainfall accompanied by below-normal rainfall characteristics indicates that dry conditions are not only seasonal but also below the climatological average (World Meteorological Organization, 2012; McKee et al., 1993).

Standardized Precipitation Index

The Standardized Precipitation Index (SPI) is an index used to measure meteorological dryness and wetness based on standardized rainfall anomalies. Negative SPI values indicate drier-than-normal conditions, while positive SPI values indicate wetter-than-normal conditions. The SPI can be calculated for various time scales, such as 1 month, 3 months, 6 months, 12 months, and longer (McKee et al., 1993; World Meteorological Organization, 2012).

The 3-month SPI is often used to assess seasonal drought conditions related to initial soil moisture, shallow water availability, and critical agricultural phases. In the context of the early dry season, the 3-month SPI helps distinguish whether low rainfall is a temporary condition or is already leading to a broader rainfall deficit. Therefore, the SPI is an important complement to rainfall and rainfall characteristics data (Mishra & Singh, 2010; Vicente-Serrano et al., 2010; Dai, 2011).

Air Temperature Anomaly

An air temperature anomaly is the difference between the actual average temperature and its climatological normal value. A positive anomaly indicates a higher-than-normal temperature, while a negative anomaly indicates a lower-than-normal temperature. Temperature anomalies are an important indicator in climate change studies because they can indicate deviations in thermal conditions from long-term climatological conditions (Meteorology, Climatology, and Geophysics Agency, 2026a, 2026b, 2026c; Intergovernmental Panel on Climate Change, 2021).

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Higher air temperatures can exacerbate the risk of drought by increasing the atmosphere's evaporative demand. During periods of low rainfall, warmer temperatures can accelerate the drying of soil, vegetation, and land surfaces. This impact is particularly important in South Kalimantan, as the region contains wetlands, agricultural land, and several areas prone to land fires during the dry season (Trenberth et al., 2014; Seneviratne et al., 2021).

Secondary Meteorological and Climatological Data

Meteorological and climatological data can be obtained through primary measurements and secondary sources. Primary data is collected directly through measuring instruments or field observations, while secondary data is obtained from official institutions, scientific publications, climate databases, and satellite imagery. In climate studies, secondary data is often used because it has broad coverage, covers a relatively long time period, and can be compared across regions (Fick & Hijmans, 2017; Karger et al., 2017; NASA POWER Project, 2026; Huffman et al., 2023).

The use of secondary data requires consideration of source credibility, data period, category definitions, units, spatial resolution, and temporal resolution. The Meteorology, Climatology, and Geophysics Agency (BMKG) and regional climatology stations are the primary sources of official climate data in Indonesia. Data from official institutions can be used for descriptive research, adaptation planning, and the development of hydrometeorological disaster preparedness recommendations (Meteorology, Climatology, and Geophysics Agency, 2026d; NASA POWER Project, 2026).

The Relationship between Rainfall, Temperature, and Meteorological Drought

Meteorological drought begins with reduced rainfall compared to normal conditions. When rainfall deficits persist for weeks to months, the impacts can develop into agricultural and hydrological droughts. This relationship suggests that drought analysis needs to be conducted in stages, moving from meteorological indicators to environmental implications (Mishra & Singh, 2010; World Meteorological Organization, 2012).

Low rainfall occurring simultaneously with positive temperature anomalies has the potential to increase water deficits. Warmer temperatures increase evaporation and evapotranspiration, causing water availability on the surface and in the soil to decrease more rapidly. Therefore, integrating rainfall, rainfall characteristics, SPI, and temperature anomalies provides a more comprehensive picture than analyzing a single variable (Trenberth et al., 2014; Vicente-Serrano et al., 2010; Dai, 2011).

Previous Research and Conceptual Framework

Previous climate research has shown that variations in Indonesian rainfall are influenced by a combination of monsoon, ocean-atmosphere, and intraseasonal dynamics. Studies in tropical regions also confirm that temperature changes can amplify hydrological stress, especially when rainfall is below normal. In this context, the SPI has become a widely used index due to its simplicity, comparability, and rainfall-based nature (Aldrian & Susanto, 2003; Hamada et al., 2002; Qian, 2008; Zhang, 2013; Loo et al., 2015).

The conceptual framework of this study positions rainfall as an indicator of rainfall amount, rainfall characteristics as an indicator of deviation from normal, SPI as an indicator of meteorological drought, and temperature anomalies as an indicator of thermal stress. The combination of these four indicators is used to assess the level of preparedness for the 2026 dry season in South Kalimantan (McKee et al., 1993; Seneviratne et al., 2021; South Kalimantan Class I Climatology Station, 2026a).

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Research methods

This research uses a quantitative descriptive approach based on secondary data. The study area is South Kalimantan Province, which administratively comprises coastal areas, alluvial lowlands, riverine areas, swamps, peatlands, and hilly areas. This geographic characteristic results in a heterogeneous regional response to rainfall deficits. Therefore, the analysis in this article is positioned at the provincial level as a preliminary reading, rather than as a detailed risk map at the sub-district or village level.

The primary data used is information from the South Kalimantan Class I Climatology Station regarding the monthly rainfall prediction for July 2026, the rainfall characteristics prediction for July 2026, and the 3-monthly SPI prediction for June-August 2026. Supporting data includes information on Indonesian air temperature anomalies for April-June 2026 from the Meteorology, Climatology, and Geophysics Agency (BMKG), as well as scientific literature on climate change, satellite data, and climate research in South Kalimantan. Data collection was conducted through searches of official online documents and relevant scientific articles.

Table 1. Data used in the research

Data/Variables	Sources and functions of analysis
Rainfall prediction for July 2026	The South Kalimantan Meteorology, Climatology, and Geophysics Agency (BMKG) assesses the dominance of low and medium rainfall categories.
Rainfall forecast for July 2026	South Kalimantan BMKG Climate Monitoring; reading deviations from climatological normal.
3-month SPI forecast June–August 2026	South Kalimantan Climate Monitoring Agency (BMKG) identifies indications of seasonal meteorological drought.
Air temperature anomalies April–June 2026	BMKG Center; provides context for temperature pressure and water needs.
Climate change literature and satellite data	Journal, WMO, Copernicus, and NASA POWER; strengthening scientific interpretation.

Source: Compiled from BMKG, South Kalimantan Climate Monitoring, WMO, Copernicus, NASA POWER, and related literature, 2026

The analysis was conducted in four stages. First, data on the percentage of rainfall categories, rainfall characteristics, and SPI were extracted into a worksheet. Second, the meteorological drought category was calculated by summing the slightly dry, dry, and very dry categories in the 3-month SPI. Third, the calculation results were interpreted by comparing indicators of rainfall, rainfall characteristics, SPI, and temperature anomalies. Fourth, preparedness implications were formulated by linking the analysis results to the characteristics of South Kalimantan's wetlands.

This study's limitations include the lack of direct primary measurements at rainfall stations or field sites. The article also lacks detailed spatial modeling, as the data available on the operational page is a summary of provincial percentages. Therefore, the results are best interpreted as a preliminary provincial-level analysis that requires further analysis with rainfall station data, discharge data, soil moisture data, field observations, and district/sub-district-level spatial mapping.

Results and Discussion

Current Meteorological and Climatological Data Conditions

The latest climate information published by the South Kalimantan Class I Climatology Station shows three main signals. First, the predicted July 2026 rainfall is predominantly low. Second, the July 2026 rainfall is predicted to be below normal across the region. Third, the 3-month SPI for June-August 2026 shows a predominance of moderately dry to dry rainfall (South Kalimantan Class I Climatology Station, 2026a).

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Climate interpretation is not sufficient using just one indicator. Low rainfall indicates a small amount of rainfall, but it does not explain whether the rainfall deviates from normal conditions. The nature of the rainfall explains these deviations, while the SPI provides information on the level of meteorological drought based on rainfall accumulation. Temperature anomalies complement the analysis because higher temperatures can increase water loss (McKee et al., 1993; Mishra & Singh, 2010; Vicente-Serrano et al., 2010).

Rainfall Prediction for July 2026

Table 2. Predicted rainfall categories for July 2026 in South Kalimantan

Category	Percentage and climatological meaning
Low	95.9%; low monthly rainfall dominates almost all provinces.
Intermediate	4.1%; only a small portion of the area is predicted to receive moderate rainfall.

Source: Class I Climatology Station of South Kalimantan, 2026

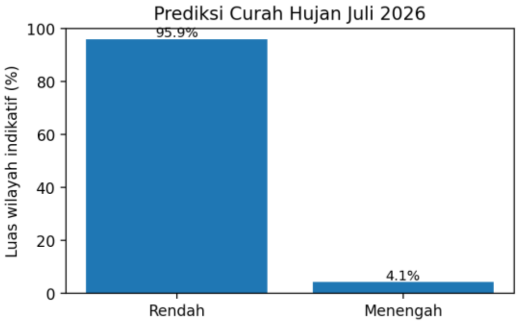

Figure 1. Composition of predicted rainfall in July 2026 in South Kalimantan

Source: Processed data from the Class I Climatology Station of South Kalimantan, 2026

Table 2 and Figure 1 show that the predicted rainfall for July 2026 is almost entirely in the low category. The 95.9% prediction indicates that dry conditions will not only be a local phenomenon but also have the potential to become dominant at the provincial level. This condition needs to be anticipated because July overlaps with the dry season in many parts of southern Indonesia (South Kalimantan Class I Climatology Station, 2026a; Meteorology, Climatology, and Geophysics Agency, 2026e).

Low rainfall in July can be a seasonal phenomenon, but it still requires attention if it is accompanied by deviations from climatological norms. In areas dependent on rainfall for agriculture and surface water, low rainfall can reduce soil moisture, reduce the flow of small rivers, and increase irrigation needs. Therefore, rainfall information should be interpreted in conjunction with rainfall characteristics (Meteorology, Climatology, and Geophysics Agency, 2026d; Loo et al., 2015).

Rain Characteristics and Drought Indications Based on SPI

Table 3. 3-month SPI prediction for June-August 2026 in South Kalimantan

SPI Category	Percentage and interpretation
A bit dry	54.0%; light–moderate rainfall deficit is starting to become dominant.
Dry	25.5%; rainfall deficit needs to be anticipated.
Normal	14.5%; conditions are relatively normal.
Very Dry	6.0%; heavy rainfall deficit in some areas.

Source: Class I Climatology Station of South Kalimantan, 2026

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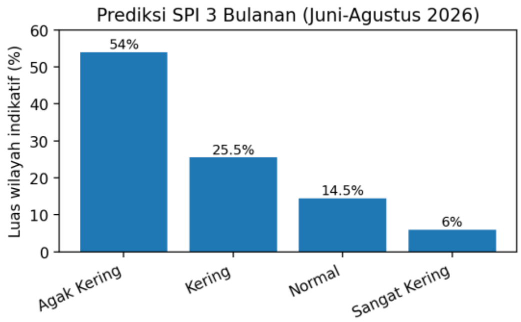

Figure 2. Composition of the 3-month SPI prediction for June-August 2026

Source: Processed data from the Class I Climatology Station of South Kalimantan, 2026

The 3-month SPI forecast for June-August 2026 indicates that 54.0% of the region is classified as slightly dry, 25.5% as dry, 14.5% as normal, and 6.0% as very dry. Combining the slightly dry, dry, and very dry categories results in 85.5% of South Kalimantan experiencing a rainfall deficit. This dominance indicates that meteorological drought risk should be interpreted as a cross-regional seasonal issue (South Kalimantan Class I Climatology Station, 2026a; McKee et al., 1993).

The 3-month SPI forecast for June-August 2026 shows that 54% of the region is classified as slightly dry, 25.5% as dry, 14.5% as normal, and 6% as very dry. If the slightly dry, dry, and very dry categories are combined into a group of regions with meteorological dryness indications, the percentage reaches 85.5%. This value indicates that most areas of South Kalimantan should be prioritized for monitoring. While the slightly dry category does not necessarily indicate serious impacts, it can be an early stage before the impacts develop into agricultural drought or a local water crisis if rainfall remains low in the following period.

The 3-month SPI is relevant for assessing seasonal conditions because it accumulates the effects of rainfall over three months. The June-August period is crucial because it overlaps with the dry season and a period of increased land vulnerability to drought. In such conditions, actual rainfall monitoring is still necessary to update predictions according to atmospheric changes (World Meteorological Organization, 2012; Vicente-Serrano et al., 2010).

Context of Air Temperature Anomaly

Table 4. Indonesian air temperature anomalies as a thermal context in 2026

Month 2026	Average, normal, and anomalous temperatures
April	27.5°C; normal 26.9°C; +0.6°C anomaly.
May	27.5°C; normal 27.0°C; +0.5°C anomaly.
June	27.3°C; normal 26.6°C; +0.7°C anomaly.

Source: BMKG, 2026

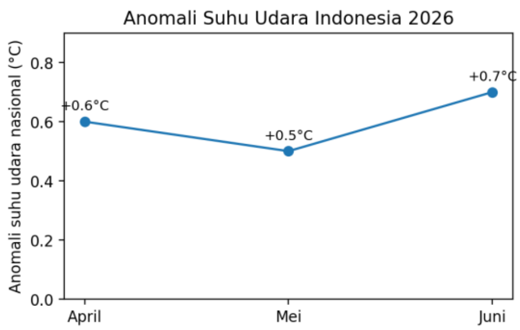

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Figure 3. Air temperature anomalies in Indonesia April-June 2026
Source: Processed BMKG data, 2026

BMKG data shows that Indonesia's average air temperature in June 2026 reached 27.3°C, while the climatological normal for June from 1991 to 2020 was 26.6°C. Therefore, the June 2026 air temperature anomaly was +0.7°C, marking the first highest anomaly.

throughout the observation period since 1991. In April and May 2026, the anomalies were also positive at +0.6°C and +0.5°C, respectively (Meteorology, Climatology, and Geophysics Agency, 2026c).

Positive temperature anomalies can increase pressure on water systems by increasing atmospheric evaporative demand. Under conditions of low rainfall and below-normal rainfall, warmer temperatures can accelerate the drying of soil surfaces and vegetation. This makes drought risk dependent not only on the lack of rainfall but also on the extent of water loss due to temperature (Trenberth et al., 2014; Seneviratne et al., 2021).

The combination of rainfall and temperature data is also crucial for risk communication. People often understand drought simply as the absence of rain, but the impact of drought is influenced by the interaction between rainfall, temperature, humidity, wind, land cover, and water reserves. Therefore, climate information should not only highlight low rainfall predictions but also explain the potential implications of temperature, days without rain, and changes in water demand.

Implications of Preparedness for South Kalimantan

The research findings demonstrate the need for sector-based preparedness. In the agricultural sector, local governments and extension workers need to encourage adjustments to planting calendars, the selection of more drought-tolerant commodities, and water-efficient irrigation systems. In the clean water sector, monitoring of surface water sources and shallow wells is necessary, especially in areas that historically experience water shortages during dry seasons (World Meteorological Organization, 2026; Intergovernmental Panel on Climate Change, 2021).

South Kalimantan's wetlands are characterized by a distinct drought risk compared to dry areas. When water is abundant, the region is prone to flooding; when rainfall is below normal, parts of the wetland landscape can dry out, increasing the risk of fire. Therefore, preparedness focuses not only on water shortages but also on controlling land clearing through burning and patrolling vulnerable areas (Aldrian & Susanto, 2003; Kottek et al., 2006).

From an academic perspective, these results demonstrate the importance of processing operational climate information into scientific articles. Existing BMKG data can be developed into further research using spatial approaches, such as mapping affected sub-districts, analyzing long-term rainfall trends, or integrating satellite vegetation data to assess land surface conditions (NASA POWER Project, 2026; Huffman et al., 2023; Karger et al., 2017).

Comparison with Previous Research

The findings of this article align with the literature stating that climate change in Indonesia is reflected not only in changes in averages but also in changes in extremes and seasonal deviations. Supari et al. (2017) showed changes in extreme temperature and precipitation indices in Indonesia based on station data. Sukmara et al. (2022) specifically showed a trend of increasing temperature and rainfall in South Kalimantan. This article does not replace these trend studies but rather updates the perspective by examining operational signals for 2026.

The main difference in this article is the use of the latest 3-month rainfall prediction data, rainfall characteristics, and the SPI as the basis for preparedness. In other words, the focus is not simply on proving that the climate is changing, but on understanding how the latest climate

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information can be quickly translated into action. This approach is relevant for meteorology and climatology courses because students are trained to use available official data, analyze it scientifically, and write about it in journal article format.

Conclusion

Based on the latest secondary data analysis, the start of the 2026 dry season in South Kalimantan indicates meteorological drought signals that require anticipation. Predicted rainfall for July 2026 is dominated by the low category (95.9%) and the medium category (4.1%). The nature of the rainfall is predicted to be 100% below normal, so this low rainfall condition also represents a negative deviation from the climatological norm. The 3-month SPI prediction for June-August 2026 shows 85.5% of the region in the moderate to very dry category. The context of Indonesia's positive air temperature anomalies in April-June 2026, particularly +0.7°C in June, reinforces the need to monitor water needs and the potential for surface drying.

The practical conclusion of this study is that operational meteorological and climatological data should be used as a basis for cross-sectoral preparedness. Recommendations include intensive monitoring of drought-prone areas, adjustments to planting calendars, water conservation, strengthening early warning systems for land fires, and integrating BMKG data with local spatial data. Future research is recommended to utilize rainfall data, satellite imagery, soil moisture data, and field validation to translate the analysis results into priority maps at the district, sub-district, or village level.

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