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Determination Of Paddy Planting Time-Based On Analysis Of Rainfall Data In TenggarongSeberang District

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Abstract
TenggarongSeberang District is one area with the potential to develop rainfed lowland paddy plants. However, due to global warming and the nature of the humid tropical climate, which has higher rainfall than other regions, there are differences in rainfall patterns that affect crop production. One way to overcome this is to know the rainfall trend and determine the proper start of planting. The study aimed to determine the start time and planting season for lowland paddy and cropping patterns that can be applied in TenggarongSeberang District. The research was conducted in TenggarongSeberang District for three months, from December 2021 to March 2022. The data used is rainfall data for TenggarongSeberang District from 2007-2021. The research used the accumulation method of forward and backward rainfall from 10 days (decades). Accumulation of bold rain of 75 mm marks the beginning of the crop planting season, and the collection of 200 mm marks the beginning of mudding for paddy fields. The end of the growing season is determined through the accumulation of 500, 300, and 100 mm rainfall. Based on the results of the calculation of the collection of forward and backward rain over the past 15 years, it is known that as much as 200 mm of rainfall is expected to accumulate on February 1st, which marks the beginning of the lowland paddy planting season and the end of the lowland paddy planting season is characterized by the accumulated rainfall of 300 mm which is expected to occur in November, Dasarian I. Lowland paddy can be planted 2 to 3 times a year within nine months. Cropping patterns that can be applied based on plant water availability are paddy-paddy-secondarycrops (palawija)/vegetables and paddy-paddy-paddy.

Keywords: Rainfall, Planting time, Paddy Field

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I. Introduction

The East Kalimantan region, especially the TenggarongSeberang District, has potential land for the development of food crops, especially paddy in paddy fields and dry land. Most of the paddy cultivation in TenggarongSeberang comes from rain-fed paddy fields (BPP, 2020). Water availability is essential in the cultivation of lowland paddy on rainfed land. Water has a role as a constituent of plant protoplasm, as a nutrient solvent, as a medium for transporting nutrients in the plant body, as one of the ingredients needed in the process of photosynthesis and various biochemical reactions, and has a role in keeping plant temperatures stable (Koryati et al., 2021).

Global warming causes changes in climate behavior, such as changes in air temperature, rainfall variations, and solar radiation. Modifications to these climatic elements will significantly affect the agricultural sector, such as planting time, cropping patterns, plant growth periods, and crop yields (Surmaini and Faqih, 2016). Climate uncertainty in several growing seasons will be perilous in agriculture, and it can even cause crop failure if it is not correctly anticipated (Surmaini et al., 2018).

Variations in rainfall patterns and distribution between seasons and between years mean that the growing season cannot be determined the same every year. Therefore, choosing the planting time needs to consider the amount of rainfall required at the beginning of the growing season and the amount and distribution of rain during the growing season, especially during the early planting phase (Surmaini and Syahbuddin, 2016).

Efforts to reduce the impact of high variations in rainfall due to climate change are by building irrigation canals or determining the right time and pattern of planting. However, this irrigation system

development activity requires a lot of money and effort, so choosing the right time and cropping pattern can be an inexpensive and efficient way to reduce the risks caused by the high rainfall variability (Laux et al., 2010).

The time for planting paddy in each village in TenggarongSeberang District, East Kalimantan, is determined based on the results of deliberations between farmers and extension workers (BPP, 2020). The timing of paddy planting in East Kalimantan varies greatly. Still, in general, the peak of paddy planting occurs twice a year, in the January I/II period and again in June II/III (Runtunuwu et al., 2012). The planting calendar for the Tenggarong District area for 2021/2022, the first planting season occurs in September on the third basis/October on the 1st, and the second planting season appears on January on the 3rd/February on the 1st basis (Agricultural Research and Development Agency, 2021). Based on the two sources above, the timing of paddy planting in East Kalimantan is different. Therefore research on determining planting time still needs to be developed to become a reference for farmers in choosing the proper planting time (Hasnuri et al., 2019).

In addition to determining the planting time, cropping patterns in a year in each region will also vary. The cropping pattern suggested by Katam is paddy-paddy plants, namely planting paddy in two growing seasons in the rainy season and planting crops in the first growing season in the dry season (Agency for Agricultural Research and Development, 2021). The East Kalimantan region is characterized by a short dry and long rainy season. Its location near the equator makes it possible to plant up to three growing seasons (Tukidi, 2010). However, in several other areas, some apply a paddy-paddy, paddy-secondary crops (palawija), or paddy-vegetables cropping pattern, and then the land will fallow during the dry season. Several factors that influence the choice of cropping pattern are water availability, local soil conditions, economic benefits, labor availability, and farmers' habits (Tukidi, 2010; Rahma et al., 2018)

Based on Meteorology Climatology and Geophysics Council(BMKG) criteria, it takes one month to determine the start of the rainy season in an area. The beginning of the rainy season is determined by repeated rains of ≥50 mm for three consecutive months, and then it can be ascertained that the first month of the month is chosen as the beginning of the rainy season (Surmaini and Syahbuddin, 2016). In addition to using these criteria, the start of the growing season can also be predicted using rainfall data from previous years. This method was developed by Oldeman and Frère (1982) and is used to determine planting time by accumulating forward and backward rainfall every ten days until a certain amount is reached. The forward calculation of existing rainfall data determines the beginning of the growing season. Rain that has accumulated as much as 75 mm can indicate the start of the increasing season on dry land and 200 mm for paddy fields. The end of the rainy season can be determined by counting backward until 300 and 500 mm accumulation. These figures indicate the accumulation of sufficient rainfall for planting twice for paddy or other short-lived crops. The calculation of forward collection starts in January because the average high monthly rain is >100 mm, and there is no consecutive dry bottom (<30 mm) (Supriyanto, 2012).

This study aimed to determine the growing season, planting time, and cropping pattern based on the analysis of rainfall data by calculating forward and backward rainfall accumulation methods.

II. Research Methods

A. Time and Place

The research was conducted for three months, from December 2021 to March 2022, in TenggarongSeberang District, KutaiKertanegara Regency, East Kalimantan.

B. Materials and Tools

The material used in this research is the daily rainfall data of TenggarongSeberang District for 2007-2021. The tools used are laptops and calculators.

C. Data Collection Methods

The data used is daily rainfall data for TenggarongSeberang District from 2007-2021. The data is from the TenggarongSeberang District Agriculture and Livestock Extension Service Unit.

D. Data Analysis

Data analysis uses the method of counting forward and backward rainfall accumulation, and the stages are as follows (Oldeman and Frère, 1982 in Supriyanto, 2012):

1. The daily rainfall data from 2007-2021 is transferred to the table with a division per basis from the first year to the last year.
2. After that, a forward count was carried out by adding up the data per basis starting from the beginning of the first month until rainfall accumulated ≥75 mm and ≥200 mm, as well as data in the following year until the last year.

3. Then a countdown is performed by adding up the data starting from the most recent month on the third basis and adding up with the ground above until the accumulated rainfall is ≥100 mm, ≥300 mm, and finally up to the limit ≥500 mm.
4. After that, the numbers that show the results of the forward calculation are ≥75 mm, and ≥200 mm, and the results of the backward analysis ≥100 mm, ≥300 mm, and ≥500 mm are marked to make it easier to scan the following data.
5. Then the data from the forward and backward calculations are entered into the forward accumulation and back accumulation tables.
   a. Numbers and months subject to the above calculation's limits, namely ≥75 mm and ≥200 mm, are transferred to the forward accumulation table.
   b. Furthermore, the numbers and months subject to the bottom calculation's limits, namely ≥100 mm, ≥300 mm, and ≥500 mm, are entered into the backward accumulation table.
6. In the forward and backward accumulation tables, there is also a calculation of the probability of rain to estimate how much rain can accumulate in a certain period. Formula (Wisnubroto, 2015): Fa(m) =(100 m)/((n+1))

Description: Fa = Opportunity; m = Data sequence; n = Number of data. The probability of determining the growing season's start and end is 80%.

7. After all the data has been transferred, the next step is moving the data into the graphical form using data from the forward and backward accumulation.

III. Results And Discussion

A. Determination of the Start and End of the Growing Season

The calculation results for the accumulation of forward and backward rainfall in TenggarongSeberang District, along with the probability values for their occurrence, are presented in Table 1, and the Count Forward and Countdown Graphics for TenggarongSeberang District (2007-2021) are shown in Figure 1.

Table 1. Results of Determining the Beginning and End of the Season Based on the Accumulation of Forward and Backward Counts of Dasarian Rainfall, TenggarongSeberangDistrict (2007-2021)

No	Tahun	Forward Accumulation		Backward Accumulation			Forward Accumulation				Backward Accumulation				
		75 mm	200 mm	500 mm	300 mm	100 mm	m	Fa	75 mm	200 mm	m	Fa	500 mm	300 mm	100 mm
		occ. On			occ. On				Ranked				Ranked		
1	2007	JAN II	JAN III	SEP II	NOV I	DES II	1	6.25	JAN I	JAN I	15	93.75	JUN I	AGU III	DES I
2	2008	JAN I	JAN III	NOV III	DES I	DES I	2	12.50	JAN I	JAN I	14	87.50	AGU I	OKT I	DES I
3	2009	JAN III	FEB I	OKT I	NOV II	DES III	3	18.75	JAN I	JAN II	13	81.25	SEP II	NOV I	DES I
4	2010	JAN II	FEB I	NOV III	NOV I	DES II	4	25.00	JAN I	JAN III	12	75.00	OKT I	NOV I	DES I
5	2011	JAN I	JAN III	OKT II	NOV II	DES II	5	31.25	JAN I	JAN III	11	68.75	OKT I	NOV I	DES I
6	2012	JAN I	JAN I	OKT I	NOV III	DES I	6	37.50	JAN I	JAN III	10	62.50	OKT II	NOV I	DES II
7	2013	JAN II	JAN III	OKT III	NOV II	DES II	7	43.75	JAN II	JAN III	9	56.25	OKT II	NOV II	DES II
8	2014	JAN I	JAN I	OKT II	DES I	DES I	8	50.00	JAN II	JAN III	8	50.00	OKT III	NOV II	DES II
9	2015	JAN I	JAN II	JUN I	AGU III	DES II	9	56.25	JAN II	FEB I	7	43.75	OKT III	NOV II	DES II
10	2016	JAN III	FEB III	NOV II	DES I	DES I	10	62.50	JAN II	FEB I	6	37.50	OKT III	NOV II	DES II
11	2017	JAN II	FEB I	OKT III	NOV III	DES I	11	68.75	JAN II	FEB I	5	31.25	OKT III	NOV III	DES II
12	2018	JAN II	FEB I	AGU I	OKT I	DES II	12	75.00	JAN II	FEB I	4	25.00	OKT III	NOV III	DES II
13	2019	JAN II	FEB I	OKT III	NOV I	DES II	13	81.25	JAN II	FEB I	3	18.75	NOV II	DES I	DES II
14	2020	JAN II	JAN III	OKT III	NOV I	DES II	14	87.50	JAN III	FEB I	2	12.50	NOV III	DES I	DES III
15	2021	JAN I	FEB I	OKT III	NOV II	DES III	15	93.75	JAN III	FEB III	1	6.25	NOV III	DES I	DES III

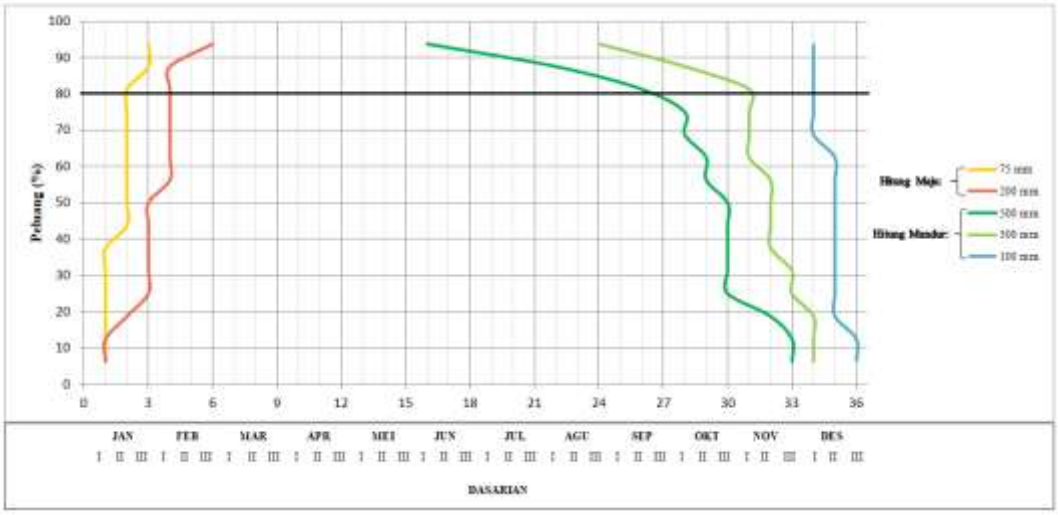

Figure 1. Graph Forward and Countdown of TenggarongSeberang District (2007-2021)

Table 1 and Figure 1 shows that with an 80% chance, it is estimated that 75 mm of rainfall will accumulate in January II and 200 mm of rain will accumulate in February I. Furthermore, with the same Opportunity, 500 mm of precipitation is expected to collect in September. Based on II, 300 mm of rainfall can still be predicted to accumulate in November, based on me, and 100 mm of rain can still be expected to collect in December of the 1st month. The beginning of the growing season in TenggarongSeberang District requires two layers to accumulate 75 mm to 200 mm, while marking the end of the growing season requires three layers to fall from 300 mm to 100 mm. Thus, the growing season lasts from January II to December I, so the growing season is ten months two basis.

B. Paddy-Paddy Planting Time

The planting time for lowland paddy begins when rainfall has accumulated as much as 200 mm, on February 1st, because lowland paddy planting requires stagnant and muddy soil conditions. At the same time, the end of the paddy-paddy planting season occurs in November of the first month, so the planting season lasts for nine months. Judging from the average accumulated rainfall in the last 15 years, there has not been a successive dry season (<30 mm); therefore, planting lowland paddy can be done anytime between February, the first, and the first of November.

C. Lowland Paddy Planting Season in One Year

Farmers in TenggarongSeberang District plant paddy-paddy twice a year, namely between November-December for the first planting season and May-June for the second planting season. Based on the calculation of forward and backward rainfall accumulation results, it is known that water availability for lowland paddy cultivation is for nine months. Paddy field paddy can be planted 2-3 times a year during this period. Planting lowland paddy three times a year can be achieved by using paddy varieties <111, carrying out seedbeds outside the field, and carrying out perfect tillage only once a year, namely in the first growing season.

Increasing the paddy planting index for rainfed paddy fields needs to be pursued to increase paddy production in TenggarongSeberang District. Availability of water in TenggarongSeberang District for lowland paddy plants reaches nine months, adequate availability of agricultural machinery, and use of paddy varieties with early maturity that is resistant to pests and diseases have also been applied by farmers, so that the planting index on paddy fields in the area can be increased. However, there are several obstacles, such as the percentage of application of agricultural technology at the lowland paddy farmer level, which is still relatively low at 31.3%, the amount of labor available for planting and harvesting activities is still limited, and the difficulty of changing farmer habits which causes ideal conditions for the implementation of IP 400 has not yet been implemented. Can be realized (BPP, 2020). Therefore, an increase from IP 200 to IP 300 is more feasible to develop than IP 400.

D. Planting pattern

The cropping pattern farmers in TenggarongSeberang District usually apply the paddy-paddy cropping pattern. Currently, the government is working to increase the cropping index (IP) in rainfed lowland areas to IP 300. During the nine months of the lowland paddy planting season, paddy can be planted three times a season or

interspersed with planting secondary crops. The following are alternative cropping patterns based on water availability for plants:

1. Paddy-Paddy-Secondary Crops

The paddy-paddy-secondary crops (palawija) cropping pattern can be applied using varieties generally grown by local farmers, namely those 110-125 HST. The first and second growing seasons are planted with paddy-paddy, followed by planting crops in the third growing season. The first planting season is in early February, the second is in early June, and the third is in early October.

Preparing land in the third growing season for secondary crops/vegetables differs from preparing the ground for planting paddy. The land used for paddy cultivation does not need to be cultivated, but paddy straw must be trimmed short. In addition, it is necessary to make drainage channels with a depth of 25 cm and a width of 20 cm every 3-4 m. Their function is to regulate irrigation so the plants are not stagnant or lacking water. If planting soybeans, they should be given *rhizobium* inoculants or sprinkled with soil used for soybean planting. Furthermore, the planting, caring for, and harvesting stages are adjusted to the plant type (Musaddad, 2008).

2. Paddy-Paddy-Paddy

The second alternative cropping pattern for the TenggarongSeberang District is planting paddy with three growing seasons. If the varieties used are commonly produced by farmers and most are 125 days after planting, they must be planted immediately in the following season after harvest. If so, a cropping pattern like this will be challenging to implement correctly. The cropping pattern can be applied well with early maturing paddy varieties 99-111 days after planting. The first growing season is in early February, the second growing season is in late May, and the third growing season is in mid-September.

Applying the two cropping patterns above has a gap between harvest time and the next planting season for only two decades, so seed sowing can be done outside the land so that after land preparation can be carried out immediately to transfer the seeds.

IV. Conclusion

Based on the results of research and discussion, it can be concluded as follows:

1. Planting time for lowland rice in TenggarongSeberang District begins on February 1st. For nine months, two paddy fields can be planted for varieties aged 115-125 days after planting and three times for varieties aged 99-111 days after planting.
2. The cropping pattern that can be applied in TenggarongSeberang District, namely the paddy-paddy-secondary cropscropping pattern and the paddy-paddy-paddy cropping pattern.

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