Analysis of the suitability of rice farming land as an opportunity for determining the agricultural planting calendar in Ajibarang District, Banyumas Regency, Central Java Province

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Abstract. Ajibarang District is one of the areas in Banyumas Regency with a high level of productivity, but the decrease in rainfall in 2017-2019 caused Ajibarang District to have difficulty in developing their agriculture so that farmers experienced crop failure. The impact that occurs from crop failure causes the land to not be cultivated and if it is cultivated, farmers plant secondary crops. It is also greatly influenced by climate change that occurs. In fact, Ajibarang Subdistrict is included in the B2 Climate Zone with an average rainfall of 1000 - 2000 mm/year which is a climate zone business. The purpose of this study was to determine the opportunities for the rice planting that is very suitable for rice farming. In addition, the Ajibarang Sub-district is also drained by a large river, namely the Serayu River and the Tajum River which are tributaries of the river. So, it is necessary to adjust the climate to be able to determine a suitable planting calendar for agricultural calendar in Ajibarang District. Method The research used is the Forward Sampling and Backward Sampling analysis methods. So, the results of this study resulted in a rice and secondary cropping calendar with three planting seasons in one year and two dry seasons in one year.

1. Introduction
Ajibarang District is an area located in the highlands at 109° 0' 23.6" East Longitude to 109° 08' 5.9" East Longitude and 7° 23' 4.3" South Latitude to 7° 27' 50.5" South Latitude [1], so Ajibarang District is included in an area that has regular rainfall every year. However, in 2017 – 2019 there was a seasonal anomaly that caused a drought in Ajibarang District. The drought that hit made it difficult for farmers to develop agriculture, especially in rice because rice is a staple crop with another name Oryza Sativa L. which is the main staple food in Indonesia [2] and residents of Ajibarang sub-district are working as farmers and depend on agricultural production [3]. Rice farming developed in Ajibarang District is irrigated lowland rice farming and rainfed lowland rice farming. The development of rainfed lowland rice and irrigated lowland rice farming is based on land suitability in Ajibarang District. Land suitability is the ability of land that is analysed based on agricultural use specifically for agriculture and other land uses [4]. Land suitability values are largely determined by the calculation of parameters [5]. One of them is the type of soil in Ajibarang Subdistrict has the dominant soil type which is suitable for agriculture,
namely Andosol, Latosol, Alluvial, and Regosol soil. So it is necessary to do a suitable land suitability to support the determination of planting for rice farming. [6] 

In 2017 – 2019 Ajibarang Subdistrict experienced a decrease in rice production. Production agriculture is very related to the suitability of the land so that when the suitability of land that there is not appropriate then need to do the analysis in accordance with the terms suitability of land that exist. Terms suitability of land paddy is very dependent on the availability of water, type of soil, the slope of the slope, and topography [7]. However, the factors main that supports the ability of agricultural rice growing is the availability of water and the availability of water is very in support by precipitation of rain on a region that is in carefully. Productivity of paddy will experience a decline when conditions rainfall rainfall that occurred experiencing the rise around 5% of usual with the average - average decline in production at 0, 33 tons / ha while the increase in the number of productivity would rise if the conditions of climate regularly throughout the year with the average - average amount of summer rain 6 months and seasons dried 6 months [8]. So that there is climate change that affects land suitability in Banyumas Regency. In 2011, based on Oldeman's climate classification, Banyumas Regency was in the agro-climatic zone B2 with an average rainfall of 1000-2000 mm/year and was in the agro-climatic zone C2 with an average rainfall of 3500-4000 mm/year [6]. So that in 2020 Banyumas Regency will experience significant climate change. Weather changes that occur in Banyumas Regency are dominated by rainfall intensity. It is characterized by the large number of dry seasons in one year in a certain time. The following is an analysis of rainfall based on BMKG data in Purbalingga Regency.

**Table 1. Total rainfall rain Ajibarang District 2017-2019.**

| Month    | 2017 | 2018 | 2019 |
|----------|------|------|------|
| January  | 363  | 404  | 364  |
| February | 537  | 430  | 252  |
| March    | 369  | 342  | 441  |
| April    | 463  | 353  | 249  |
| May      | 200  | 88   | 117  |
| June     | 93   | 49   | 11   |
| July     | 0    | 2    | 3    |
| August   | 0    | 2    | 6    |
| September| 0    | 52   | 3    |
| October  | 455  | 38   | 1    |
| November | 570  | 420  | 8    |
| December | 764  | 348  | 197  |
| Amount   | 318  | 211  | 138  |

Based on BMKG rainfall data in Purbalingga Regency, there was a significant decrease in the months that should be included in the wet month category, especially in 2019 there were seven dry months. Meanwhile, the climate type according to the Oldeman climate classification using agro-climatic zones B2 and C2 should only occur 2 -3 months in a year [8]. Agricultural areas, both rainfed and irrigated, are experiencing drought. This is because there is not enough rain intensity for the growing season with an average of 75 mm per basis [9]. Thus, the purpose of this study is to determine the planting season calendar based on one of the land suitability parameters, namely rainfall.

2. Materials and methods

2.1. Rainfall and land samples

Ajibarang sub-district is a sub-district with various variations of land suitability so that the parameters used in determining land suitability use the parameters of rainfall, soil type, topography, peat thickness, slope, and soil texture. Meanwhile, for the rainfall parameters, the main rain gauge stations are the Tajum.
Weir station and the Sumbang Weir station. However, the researchers took samples from one of the stations, namely the Bendung Tajum station. Researchers took samples from the Tajum Weir station because Kali Tajum is a tributary of the Serayu River which provides water supply for irrigated rice farming activities in Ajibarang District.

2.2. Data analysis techniques
In determining the land suitability analysis, a scoring and overlay of the predetermined parameters is carried out [10], then an overlay and spatial analysis is carried out based on the parameters from the Ministry of Agriculture [11]. Meanwhile, in determining the planting calendar, rainfall data for the last ten years is used which is calculated based on one basis or equal to ten days using the Forward Accumulation and Backward Accumulation analysis techniques Oldeman (1972). Furthermore, the analysis process is carried out in tabular form by sorting the year and month for the last ten years. In the table analysis, the calculation system for forward accumulation and backward accumulation will be carried out [12]. In the Forward data analysis, the forward calculation data is carried out on each basis up to a coefficient \( \geq 75 \) and a maximum coefficient \( \geq 200 \) while in the Backward Analysis, the calculation is carried out until it reaches the coefficient limits \( \geq 100, \geq 300, \) and \( \geq 500 \). Furthermore, the data is compared in two tables, namely Accumulation Forward and Accumulation Backward which are then sorted from the data included in the predetermined coefficient numbers. The ranking is then carried out according to the initial month of rainfall.

3. Results and discussion

3.1. Suitability of rice farming land in Ajibarang District
Based on the results of the analysis and data processing on the land suitability map above. Land with a very suitable level (S1) for irrigated rice farming is located in part of Sawangan Village, part of Kracak Village, part of Karang Bawang Village, Ajibarang Kulon Village, Jingkang Village, part of Tipar Kidul Village, and a small part of Darma Kradenan Village. Land with the appropriate level (S2) is located in part of Tipar Kidul Village, part of Karang Bawang Village, part of Lesmana Village, part of Kalibenda Village, Ciberung Village, part of Banjarsari Village, part of Darma Kradenan Village, part of Kalibenda Village, and part of Jingkang Village. Land with marginally suitable level (S3) is located in all areas in Ajibarang District. Meanwhile, land with an unsuitable level (N) is located in part of Darma Kradenan Village, part of Jingkang Village, part of Lesmana Village, part of Ajibarang Kulon Village, part of Ajibarang Wetan Village, part of Ciberung Village, part of Kraacak Village, part of Pancasan Village, part of Sawangan Village, part of Jingkang Village, and part of Tipar Kidul Village. In addition, this study also analyzed for rice farming land with a rain-fed system. Rainfed agriculture system uses rainfall as the main supply for agriculture and all forms of rainfed agriculture in Ajibarang Subdistrict depend on rainfall. The following is a map of the results of the analysis of the suitability of rainfed lowland rice farming in Ajibarang District.
Figure 1. Map of land suitability for irrigated rice fields.

Figure 2. Map of suitability of rainfed rice fields.
Based on the land suitability map for rainfed lowland rice above, areas with a very suitable level of suitability (S1) and suitable (S2) are located in Ciberung Village, Pandansari Village, Lesmana Village, Kalibenda Village, Ajibarang Kulon Village, Ajibarang Wetan Village, Sawangan Village, Village Jingkang, Banjarsari Village, Tipar Kidul Village, Darmakradenan Village, Pancurrendang Village, Kracak Village. Meanwhile, land with suitable marginal (S3) and unsuitable (N) levels are in Pancasan Village, Tipar Kidul Village, Sawangan Village, Jingkang Village, Kracak Village, and Darmakradenan Village.

3.2. Calendar of rice farming in Ajibarang District

Based on BMKG data, the starting of the planting season is marked by an average rainfall of >= 35 mm for three times starting from September [13]. So that if it is based on land suitability according to rainfall in Ajibarang District in 2019 it has decreased and has a dry month on average. Irregular rainfall makes it difficult for farmers to determine when to plant. The following is a table of rainfall for the last 10 years based on the Tajum Dam Station [14]:

| Table 2. Forward accumulation and backward accumulation calculations. |
|---------------------------------------------------------------|
| Year | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
|------|------|------|------|------|------|------|------|------|------|------|
| JAN I | 6 | 41 | 27 | 19 | 74 | 39 | 68 | 54 | 6 | 28 |
| JAN II | 6 | 21 | 37 | 36 | 20 | 11 | 22 | 10 | 135 | 0 |
| FEB | 10 | 12 | 104 | 40 | 93 | 85 | 29 | 45 | 143 | 59 |
| MAR | 56 | 23 | 75 | 9 | 105 | 20 | 40 | 13 | 9 | 20 |
| APR | 287 | 0 | 250 | 16 | 0 | 44 | 30 | 0 | 2 | 7 |
| MAY | 45 | 3 | 23 | 36 | 31 | 10 | 30 | 23 | 72 | 160 |
| JUN | 8 | 8 | 26 | 47 | 50 | 6 | 18 | 15 | 19 | 91 |
| JUL | 3 | 6 | 13 | 73 | 59 | 3 | 2 | 31 | 36 | 239 |
| AUG | 23 | 6 | 10 | 73 | 59 | 3 | 2 | 31 | 36 | 239 |
| SEP | 35 | 83 | 26 | 40 | 46 | 151 | 82 | 31 | 46 | 101 |
| OCT | 34 | 88 | 24 | 38 | 75 | 53 | 18 | 18 | 48 | 111 |
| NOV I | 32 | 130 | 32 | 30 | 8 | 37 | 26 | 1 | 21 | 2 |
| NOV II | 28 | 10 | 85 | 29 | 45 | 113 | 20 | 40 | 13 | 9 |
| DEC | 287 | 0 | 250 | 16 | 0 | 44 | 30 | 0 | 2 | 7 |

| Table 3. Comparison of forward accumulation and backward accumulation. |
|---------------------------------------------------------------|
| Year | 75 mm | 200 mm | 300 mm | 500 mm | Forward Accumulation | Backward Accumulation |
|------|-------|--------|--------|--------|----------------------|----------------------|
|      | 75 mm | 200 mm | 300 mm | 500 mm | 75 mm | 200 mm | 300 mm | 500 mm | 75 mm | 200 mm | 300 mm | 500 mm | 75 mm | 200 mm | 300 mm | 500 mm |
| 2011 JAN III | 2012 JAN II | 2013 JAN I | 2014 JAN | 2015 JAN | 2016 JAN | 2017 JAN | 2018 JAN | 2019 JAN | 2020 JAN |
| FEB | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| MAR | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 |
| APR | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
| MAY | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 |
| JUN | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 |
| JUL | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
| AUG | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 | 160 |
| SEP | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 | 160 | 170 |
| OCT | 90 | 100 | 110 | 120 | 130 | 140 | 150 | 160 | 170 | 180 |
| NOV | 100 | 110 | 120 | 130 | 140 | 150 | 160 | 170 | 180 | 190 |
| DEC | 110 | 120 | 130 | 140 | 150 | 160 | 170 | 180 | 190 | 200 |

Based on the table above, it can be seen that the forward accumulation calculation is more than the backward accumulation calculation.
Based on the calculation table above, Ajibarang District is included in the wet month category at coefficients $\geq 100$, $\geq 300$, and $\geq 500$ and the dry month category is in the coefficient coefficient $\geq 75$ and the maximum coefficient is $\geq 200$. So based on the results of the analysis of the probability of rainfall as the beginning of the rainy season with a minimum intensity of $\geq 75$ mm in Ajibarang District, it occurred in January of the second to February of the second basis with a time of one decade [15]. While the determination of the rice planting season is based on an average of 200 mm to 500 mm of rainfall and ends at 100 mm of rainfall, it occurs in March of the second basis and ends in November of the second basis with a rice farming season of nine months in Ajibarang District, the following is a calendar of rice farming planting seasons in Ajibarang District (see Figure 3).

Based on the results of the cropping calendar analysis above, the start of MT I rice farming in Ajibarang District which has the potential to occur in September I to November I with a length of 3 decades for irrigated rice farming and rainfed lowland rice, while the start of MT II agriculture Rice in Ajibarang Subdistrict occurred in February the first to April the first with a length of 3 decades [13]. Furthermore, the third MT starts in April of the second to June of the second with a length of 3 decades for rainfed and irrigated lowland rice farming [16]. Meanwhile, the MK I occurred in July of the second to August of the third basis with a length of 2 decades and the MK II occurred in December of the I to February of the I basis with a length of two decades.

3.3. Agroclimate zone Ajibarang District

Based on the map above (Figure 4), it can be concluded that Ajibarang Sub-district is in the agro-climatic zone B3 with a wet month length of 7 – 9 months in a row with a dry season of 2 – 4 months in a row so that rice can be planted 2 to 3 times a year with short-lived and dry season varieties. Dry months with a short period can be used for Palawija [17]. So, that the calendar is determined by an analysis of land that is in accordance with the probability of rain in the Ajibarang District, based on the results of land suitability variations that are very suitable, the majority are in the very suitable type (S1) with an average rainfall of 2000 - 3000 mm / year [18]. It can be concluded that the need for rainfall based on land suitability can be done three times in one year, this creates optimal conditions for rice farming so that an appropriate planting calendar can be arranged to determine planting in the optimal months for rainfed rice and rice farming irrigated fields. This is evidenced by the existence of variations in land suitability, the majority of which are at the very suitable land suitability level (S1) and have an average rainfall of 2000 – 3000 mm per year. So, that the level of land suitability and the need for rainfall is very sufficient in three planting periods in one year. So that farmers can take advantage of the appropriate planting calendar to regulate agricultural patterns in order to get optimal agricultural results. If experiencing dryness, farmers can also take advantage of the planting calendar by replacing crops with secondary crops because the water needs for crops are suitable for use in dry months with a minimum average rainfall of $\geq 35$ mm per basis.
Figure 4. Map of agroclimate zone of Ajibarang District.

4. Conclusions

Based on the results of the land suitability analysis, the Ajibarang sub-district has a land suitability that tends to be very suitable (S1) and suitable (S2), but the parameters that affect the land mismatch are rainfall and slope. So that the rainfall analysis used to determine the opportunities for the planting calendar in Ajibarang District is carried out to optimize the determination of the planting calendar so that the land can be used in every period, both dry season and rainy season. The Ajibarang sub-district has three growing seasons for irrigated rice, rainfed rice and secondary crops. Meanwhile, in the dry season, Ajibarang District has two seasons that can be planted by palawija.

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