**The Management of Calendar and Crop Patterns in Rice Fields to Anticipate Drought Risk and to Support Food Security on Dry Season 2021**

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**Abstract.** The Integrated Cropping Calendar is one of the references for farmers in determining the planting schedule for rice, maize, and soybeans that are adjusted to the predicted rainfall conditions. The results of the updated rainfall predictions in April 2021 suggest that the latest rainfall predictions are in lower conditions than the values used in the Integrated Cropping Calendar Information System. Based on the updated prediction of rainfall in May, June, and July 2021, it is known that the latest prediction information for the three months has a value of 13%, 24%, and 20% lower, respectively, than the previous predicted value. The areas of rice, maize, and soybeans that are predicted to experience rainfall <60 mm/month during their growing period are 697,289 Ha, 463,771 Ha, and 216,359 Ha, with a total area of 1,377,419 Ha. This area is predicted to have the potential for droughts due to limited water. To anticipate this condition, about 578,637 hectares of paddy fields that have the potential to be planted with rice are recommended to be converted into maize or soybeans. However, there are also maize or soybean plants covering an area of 99,406 hectares which have been converted into rice cultivation because it is predicted to have increased rainfall.

Keywords: Cropping calendar information, update rainfall prediction, crop pattern management

**Introduction**

Agricultural productivity is basically influenced by many factors. Some things that should be considered include input and output, environmental conditions and regulations, development of technology that can be utilized, and agricultural policies (Lankoski and Thiem 2020). Included in environmental conditions, such as climate/weather. Climate is an exogenous factor that is very dynamic. For agriculture, climate often determines the success or failure of crop yields (Boer 2012; Estiningtyas and Hamdani 2015; Hidayati and Suryanto 2015; Nuraisah and Budi Kusumo 2019). Recently, it is said that in addition to climate variability, a much-discussed issue is climate change. Regarding climate change, agriculture is the sector most affected, especially in food crops. Signs at the local level of climate variability and climate change include; 1) increasing air temperature, 2) changes in rainfall patterns, 3) sea-level rise, 4) increased frequency of extreme events, and 5) irregular climatic conditions. In this condition, local wisdom and natural sign are difficult and even can no longer be used by the community.

Rainfall varies according to space (location) and time (season) which causes rainfall patterns to also vary greatly (Djebou et al. 2021). Changes in rainfall patterns have an impact on shifting planting time in paddy fields (Runtunuwu & Syahbuddin 2007). Thus, information about rainfall/water availability is very much needed by farmers, considering that farmers generally have certain behaviors regarding the selection of crop types to be planted and decisions to irrigate their land (Yuan et al. 2021), as well as being a reference for farmers when to start planting (Pramudia et al. 2021; Djebou et al. 2021).

Climate fluctuation can have an impact on crop production, which can directly or indirectly affect food security. According to Assare-Nuamah (2021), household food insecurity can occur due to a decrease in agricultural production caused by the influence of climate variability on subsystem agriculture (Asare-Nuamah 2021). Several other studies have published the relationship of food security with climate variability and even climate change (Amien et al. 2011; Wossen and Berger 2015; Sumaryanto 2016; Surmaini and Faqih 2016; Wossen et al. 2018; Perdinan et al. 2019; Blackmore et al. 2021; Rasul 2021). Community food security can be obtained by ensuring stable food production. The stability of food production can be pursued by ensuring its availability to the community from time to time for the realization of food security (Saliem and Ariani 2016). To test the stability, 2 things must be considered, namely; 'elasticity' or the ability to return to a previous state; and 'hardness' or the ability to withstand shock (Nicholson et al. 2021).

The integrated cropping calendar is an information system that provides a reference, including the potential for planting time and selected crops based on rainfall conditions or water availability (Dewi et al. 2021). The Integrated Cropping Calendar Information System is a specific location water management policy design because it considers the local rainfall conditions and other supporting components (Apriyana et al. 2021).

In March 2021, The Cropping Calendar Information System had been analyzed and uploaded to the web. The cropping calendar information was compiled based on information on rainfall predictions based on the season forecast zone from the BMKG which was issued in January 2021 (Prasetyaningtyas 2021). The use of the rainfall prediction results from the BMKG is one way to minimize errors in making early planting decisions. As stated by Nyamekye et al. (2021) that in decision making, the use of weather and seasonal predictions is a form of managing uncertainty (Nyamekye et al. 2021). Given the critical time for crops, rainfall forecast information is needed to reduce the risk of crop failure (Gbangou et al. 2019).

The objectives of the paper are (1) to compare the initial rainfall predictions for MK 2021 with an updated rainfall prediction 3 months later, (2) to implement the results of the latest rainfall predictions on planting calendar information compiled at the beginning of MK 2021, (3) to recommend crop management updates based on the updated rainfall prediction on April 2021.

**Methodology**

***Study Location and Data Compilation***

The study location is an area that will be discussed in the Integrated Planting Calendar Information System for Dry Season 2021, covering 7062 sub-districts throughout Indonesia. The area which is the survey location for field validation is Indramayu Regency, West Java Province.

The data compiled for the study is information on cropping calendar prediction for Dry Season 2021, including planting time and potential planting area of rice, maize, and soybeans in paddy fields, which is accessed through the web katam.litbang.pertanian.go.id. The latest rainfall prediction information is obtained from the Center of Climate Change Information, the Indonesian Agency for Meteorology, Climatology, and Geophysics.

***Evaluation of Rainfall Prediction Information***

Comparing the results of the January 2021 issue of rainfall predictions with the April 2021 issue. Comparing by making a data scatter plot between the rainfall predictions issued in January 2021 on the X-axis and those issued in April 2021 on the Y-axis. Next, a trend line is drawn between the X-axis with the Y-axis and the mathematical relationship between them. If the trend line has a slope of <1, it means that the latest updated rainfall prediction is lower than the previous prediction. If the trend line has a slope of >1, it means that the latest updated rainfall prediction is higher than the previous prediction.

***Identify the Updated Rainfall Predictions on the Cropping Calendar Information for Dry Season 2021***

Identify the updated rainfall prediction values, on rice, maize, and soybeans cropping calendar which have planting times of May I-II, May III-Jun I, Jun II-III, Jul I-II, Jul III-Aug I, Aug II-III, and Sep I-II, by following these steps:

1. Calculate the value of the average rainfall during the planting period (4 months) in each sub-district that has the planting time.
2. Classify the average rainfall during the planting period, into 5 classes, namely: <60, 60-75, 75-100, 100-150, and >150 mm/month.
3. Calculate the cumulative potential area of ​​rice, maize, and soybeans with rainfall <60 mm/month. The obtained area values are determined as the area of ​​rice, maize, and soybeans that have the potential to experience drought.
4. Calculate the cumulative potential area of ​​rice plants that have an average rainfall between 60-100 mm/month. This value is defined as the recommended area of ​​rice to be converted into maize or soybean crop area.
5. Calculate the cumulative potential area of ​​maize plants that have an average rainfall of >150 mm/month. This value is defined as the recommended area of ​​maize to be converted into rice.
6. Calculate the cumulative potential area of ​​soybean plants that have an average rainfall of >100 mm/month. This value is defined as the recommended area of soybean to be converted into rice.
7. Calculating the cumulative potential area of ​​rice plants that have an average rainfall of >100 mm/month, and the area of ​​maize or soybeans which have an average rainfall of 60-100 mm/month. This value does not change the recommendation.

***Field Validation***

Field validation was carried out to determine the actual conditions in the field related to rainfall conditions, the application of the planting schedule in paddy fields, as well as the problems of cropping arrangements in the field. The methods used to obtain information from the field are collecting secondary data (rainfall), information on the realization of planting in the field, interviews with extension workers regarding planting behavior, and direct observations in the field. Validation was carried out in 3 sub-districts in the Indramayu District.

***Cropping Pattern Management Recommendations***

Prepare recommendations for the management of rice, maize, and soybeans as an effort to anticipate drought in the Dry Season 2021 to support food security.

**Results and Discussion**

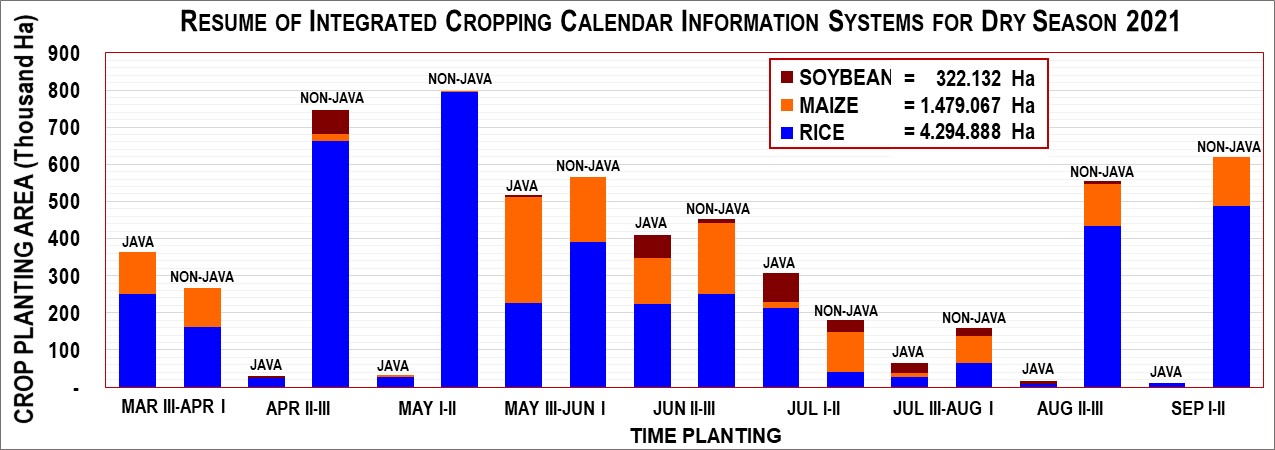
***Information on potential planting areas for rice, maize, and soybeans in the Integrated Cropping Calendar Information System for Dry Season 2021***

The Indonesian Ministry of Agriculture through the Agency for Agricultural Research and Development has developed an Integrated Cropping Calendar Information System. At the beginning of its publication, Cropping Calendar information was presented three times a year from Planting Season I, Planting Season II, and Planting Season III, each before the start of the growing season (Runtunuwu et al. 2012, 2013). However, since 2015 it has been adjusted according to climate prediction issued by the BMKG to be 2 times a year, ie before the rainy season and dry season (Pramudia et al. 2020).

This information system provides information on predicting the planting time of rice, maize, soybeans in paddy fields for the next planting season and their potential area at the sub-district level in 7062 sub-districts throughout Indonesia. To complete the information on prediction of planting time and potential planting area, it is also informed about potential damage due to flooding, drought, pests of rice, maize, and soybeans, recommended varieties, fertilizer recommendations, agricultural machinery balance at the site, and potential for animal feed as a by-product of rice, maize, and soybean waste (Pramudia et al. 2020).

Figure 1 presents a summary of the potential planting area of rice, maize, and soybeans according to the recommended planting time in Java Island and outside Java Island in Dry Season 2021. It can be seen that the high potential for rice planting area in Java is in March III-April I, May III -June I, June II-III, and July I-II. While outside Java, the potential for a high rice planting area is found in April II-III, May I-II, May III-June I, August II-III, and September I-II. The potential for rice planting area outside Java is higher than in Java Island in April II-III, April III-May I, August II-III, and September I-II.

The high potential for maize planting area is found in March III-April I, May III-June I, and June II-III. The high potential for maize planting area in Java is in May III-June I, while outside Java occurs in May III-June I and June II-III. High potential for soybean planting area is found in April II-III, June II-III, and July I-II. The high potential for soybean planting area in Java is in June II-III and July I-II, while outside Java is in April II-III and July I-II.



**Figure 1.** Resume of Integrated Cropping Calendar Information Systems for Dry Season 2021 that issued Februari 2021.

***Updated rainfall forecasting on May, June, and July 2021***

Every month BMKG, through the Climate Variability Analysis Division of the Climate Change Information Center, updates the rainfall predictions for the next ten days for the next 6 months which are presented based on the season forecast zone (ZOM). This rainfall prediction information is used in the analysis of the planting calendar in the Integrated Cropping Calendar Information System. In the dry season 2021, the rainfall prediction information used is information issued in January 2021. Several researchers have revealed that the accuracy of rainfall prediction becomes weaker if the prediction is made for a longer period. Thus, updating the rainfall prediction information in the following months can be used to evaluate the previous rainfall prediction information and the cropping calendar information that uses rainfall prediction information as input data. Considering predictions, especially seasonal predictions, you can estimate rainfall conditions and other weather variables on a time scale of one to several months (Andersson et al. 2020).

Figure 2 presents a scatter plot of the predicted rainfall values ​​between those reported in January 2021 and the updated predictions in April 2021 for May, June, and July 2021. The horizontal X-axis is the rainfall values ​​reported in January 2021, while the upright Y-axis is the rainfall values ​​that are issued in January 2021. Each point describes a rain station that has a predicted value of the rainfall issued in January 2021 in the direction of the X-axis and the predicted value of the issued rainfall in April 2021 in the direction of the Axis -Y. From the set of plots of these points, a trend line is drawn which describes how big the ratio is between the latest predicted values ​​compared to the previous values ​​used in the planting calendar analysis. The data plot in Figure 2 illustrates that the latest rainfall prediction values ​​for May 2021 have a ratio of around 0.872 compared to previously issued. This means that the latest predictive information has a value of 13% lower than the previous value. The latest rainfall prediction values ​​for June 2021 have a ratio of about 0.764 compared to previously reported, or the latest predictive information has a value of 24% lower than the previous value. The latest rainfall prediction values ​​for July 2021 have a ratio of about 0.809 compared to previously reported, or thus the latest prediction information has a value of 20% lower than the previous value.



**Figure 2.** The scattering plot of rainfall prediction plot for May, June, July 2021 between the issued January 2021 and April 2021.

***The updated rainfall prediction conditions on the cropping calendar Dry Season 2021***

The Cropping Calendar information presented in the Integrated Cropping Calendar Information System Dry Season 2021 is valid for the period March III to September II. To obtain information on the extent of the risks faced if following the planting recommendations in the Integrated Cropping Calendar Information System Dry Season 2021, an identification of the average rainfall value during the growing season (4 months) is carried out using the latest rainfall prediction value based on the planting period that has been set on Integrated Cropping Calendar Information System Dry Season 2021. Identification is carried out in the planting period of May I-II, May III-June I, June II-III, July I-II, July III-August I, August II-III, and September I-II. The bulk values identified were classified into 4 classes, namely <60, 60-100, 100-150 and >150 mm/month. Class <60 mm/month describes very dry conditions, so that rice, corn, and soybeans have the potential to drought if no further anticipation is carried out. Class 60-100 mm/month describes dry conditions, recommended for cultivation of secondary crops (maize or soybeans). Class 100-150 mm/month describes moderate conditions, the potential for planting maize or rice. Class >150 mm/month represent wet conditions and are recommended for rice cultivation.

*Rice*

Table 1 presents the latest updated rainfall conditions for rice plants based on the recommended planting time in the Integrated Cropping Calendar Information System Dry Season 2021. During the planting schedule period of May I-II to September I-II, the total potential area for rice planting in Indonesia is 3,195,482 Ha. From this area, it is predicted that the area of rice plants that are predicted to rainfall <60 mm/month (very dry) during its growing period is 697,289 Ha, which is predicted to rainfall between 60-100 mm/month during its growing period, which is estimated to be around 578,631 Ha, and which is predicted to rainfall between 100-150 mm/month or >150 mm/month during its growth period is estimated at 1,919,555 Ha. The area of rice that is predicted to rainfall <60 mm/month during its growing period (697,289 Ha) is predicted to have the potential to drought due to limited water. For this reason, more careful water management planning is needed in these areas to avoid drought. The area of rice that is predicted to experience rainfall of 60-100 mm/month during its growing period (578,631 Ha) is recommended to be shifted to planting maize or soybeans which require less water than rice. The area of rice that is predicted to have rainfall of 100-150 mm/month or >150 mm/month during its growing period (1,919,555 Ha) is still recommended for planting paddy because the predicted water conditions are adequate. Determination of accurate field-scale water requirements is very important because rice requires a lot of water (Reavis et al. 2021). Surmaini et al. (2015) stated that high and regular water availability is required for rice planting in paddy fields, more than for other food crops (Surmaini et al. 2015). To save irrigation water for lowland rice, one strategy is to use predictive information about rainfall. This can be implemented through the application of irrigation by considering the rainfall that may occur after irrigation (Cao et al. 2019).

*Maize*

Table 2 presents the latest updated rainfall conditions for corn plants based on the recommended planting time in the Integrated Cropping Calendar Information System Dry Season 2021. During the planting schedule period from May III to September I-II, the total potential area for maize planting in Indonesia is 1,239,552 Ha. From this area, it is predicted that the area of maize that rainfall <60 mm/month (very dry) during its growing period is 463,771 Ha, which is predicted to rainfall between 60-100 mm/month or 100-150 mm/month during its growing period. It is estimated at around 684,910 Ha, and those predicted to rainfall >150 mm/month during the growing period are estimated at around 90,870 Ha. The area of maize that is predicted to have rainfall <60 mm/month during its growing period (463,771 ha) is predicted to have the potential to drought due to limited water. In this area, more precise water management planning is needed to avoid drought. The area of maize that is predicted to have rainfall of 60-100 mm/month or 100-150 mm/month during its growing period (578,631 Ha) is still recommended for planting maize because water conditions are predicted to be adequate for maize plants. The area of maize that is predicted to rainfall >150 mm/month during its growing period (90,870 Ha) is recommended to be shifted to rice cultivation because of the sufficient water conditions available for rice cultivation.

**Table 1**. The updated rainfall prediction conditions for rice based on the cropping calendar recommendations on Dry Season 2021.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Planting Schedule of Rice** | **The Class of Rainfall (mm/month)** | | | | |
| **<60** 1 | **60-100** 2 | **100-150** | **>=150** | **TOTAL** |
|  | -------- hectares ------- | | | | |
| MAY I-II | 9.245 | 17.712 | 157.882 | 635.770 | 820.609 |
| MAY III-JUN I | 145.153 | 326.931 | 84.339 | 60.455 | 616.879 |
| JUN II-III | 233.143 | 174.249 | 2.307 | 63.688 | 473.388 |
| JUL I-II | 242.111 | 11.439 | 0 | 0 | 253.550 |
| JUL III-AUG I | 67.636 | 19.132 | 1.362 | 3.984 | 92.113 |
| AUG II-III | 0 | 29.175 | 47.673 | 364.394 | 441.241 |
| SEP I-II | 0 | 0 | 36.486 | 461.216 | 497.702 |
| TOTAL | 697.289 | 578.637 | 330.049 | 1.589.506 | 3.195.482 |

Note: 1. The potential area of drought

2. The potential area of rice to be converted into palawija crops

**Table 2**. The updated rainfall prediction conditions for maize based on the cropping calendar recommendations on Dry Season 2021.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Planting Schedule of Maize** | **The Class of Rainfall (mm/month)** | | | | |
| **<60** 1 | **60-100** | **100-150** | **>=150** 2 | **TOTAL** |
|  | -------- hectares ------- | | | | |
| MAY I-II | 4.818 | 1.926 | 1.685 | 1.600 | 10.029 |
| MAY III-JUN I | 171.229 | 168.618 | 112.442 | 10.544 | 462.833 |
| JUN II-III | 137.180 | 164.657 | 741 | 11.645 | 314.222 |
| JUL I-II | 124.758 | 0 | 0 | 0 | 124.758 |
| JUL III-AUG I | 25.787 | 52.673 | 4.086 | 0 | 82.546 |
| AUG II-III | 0 | 11.905 | 67.215 | 34.920 | 114.040 |
| SEP I-II | 0 | 0 | 98.961 | 32.162 | 131.123 |
| TOTAL | 463.771 | 399.779 | 285.131 | 90.870 | 1.239.552 |

Note: 1. The potential area of drought

2. The potential area of maize to be converted into rice

*Soybean*

Table 3 presents the latest updated rainfall conditions for soybeans based on the recommended planting time in the Integrated Cropping Calendar Information System Dry Season 2021. During the planting schedule period from May III to September I-II, the total potential area for soybeans planting in Indonesia is 253,566 Ha. From this area, it is predicted that the area of soybeans that rainfall <60 mm/month (very dry) during its growing period is 216,359 Ha, which is predicted to rainfall between 60-100 mm/month during its growing period, which is estimated to be around 28,671 Ha. It is predicted to have rainfall of 100-150 mm/month or >150 mm/month during its growth period which is estimated to be around 8,536 Ha. Soybean area that is predicted to rainfall <60 mm/month during its growing period (216,359 Ha) is predicted to have the potential to drought due to limited water. In this area, more precise water management planning is needed to avoid drought. Soybean area which is predicted to have rainfall of 60-100 mm/month during its growing period (28,671 Ha) is still recommended for planting soybeans because water conditions are predicted to be adequate for soybean plants. The area of soybean that is predicted to rainfall between 100-150 mm/month or >150 mm/month during its growing period (8,536 Ha) is recommended to be shifted to rice cultivation because sufficient water conditions are available for rice cultivation.

**Table 3**. The updated rainfall prediction conditions for soybean based on the cropping calendar recommendations on Dry Season 2021.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Planting Schedule of Soybean** | **The Class of Rainfall (mm/month)** | | | | |
| **<60** 1 | **60-100** | **100-150** 2 | **>=150** 2 | **TOTAL** |
|  | -------- hectares ------- | | | | |
| MAY I-II | 0 | 0 | 0 | 0 | 0 |
| MAY III-JUN I | 4.612 | 0 | 0 | 0 | 4.612 |
| JUN II-III | 56.252 | 10.571 | 8.536 | 0 | 75.359 |
| JUL I-II | 108.811 | 0 | 0 | 0 | 108.811 |
| JUL III-AUG I | 44.785 | 5.117 | 0 | 0 | 49.902 |
| AUG II-III | 1.900 | 12.982 | 0 | 0 | 14.882 |
| SEP I-II | 0 | 0 | 0 | 0 | 0 |
| TOTAL | 216.359 | 28.671 | 8.536 | 0 | 253.566 |

Note: 1. The potential area of drought

2. The potential area of soybean to be converted into rice

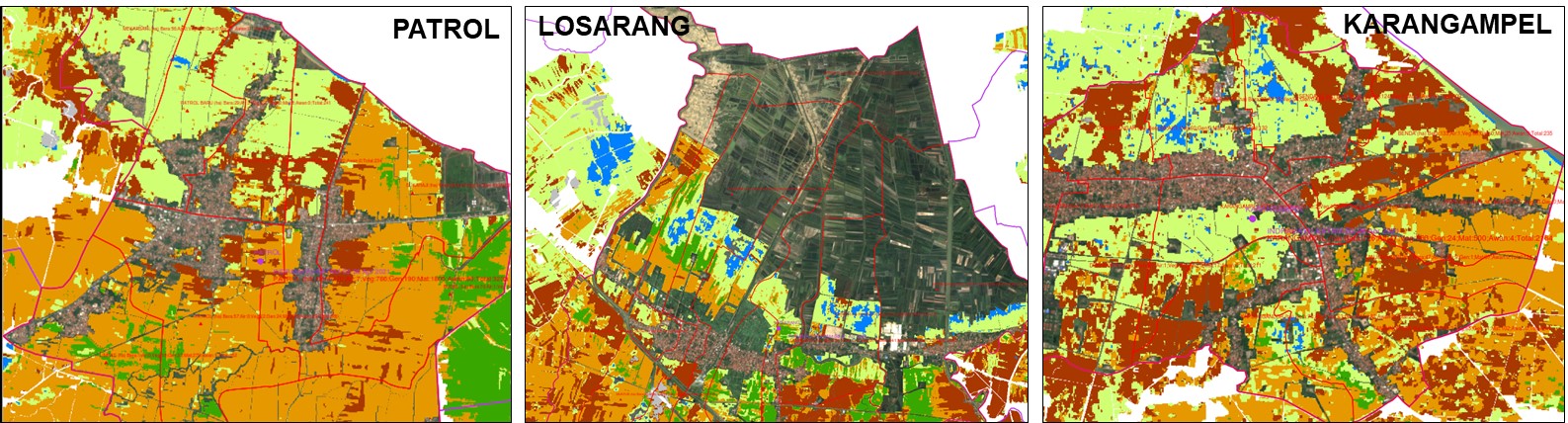
Based on the resumes presented in Table 1, Table 2, and Table 3, thus the area of rice, maize, and soybeans that are predicted to drought is around 1,377,419 Ha. Good planning is needed to anticipate the occurrence of drought in this area. The recommended area of rice plants to be converted into maize or soybeans is 578,637 hectares. The area of maize or soybean which is converted into rice cultivation is 99,406 hectares. Thus, in the planting period of May I-II to September I-II, it is estimated that the potential area for rice plants is 2,018,961 Ha, while the potential area for maize or soybeans is 1,292,218 Ha.

***Comparison with existing conditions in the field***

Existing conditions in the field were obtained from validation activities carried out in Indramayu Regency, especially in 3 sub-districts, namely Patrol Sub-district, Losarang Sub-district, and Karangampel Sub-district. Paddy fields in Patrol Subdistrict, get irrigation water from the Jatiluhur reservoir, while paddy fields in Losarang and Karangampel sub-districts receive water from Rentang and Cipanas weirs. However, due to the position of Losarang and Karangampel sub-districts at the end of the irrigation canal and as a drainage route for irrigation water when there is excess water, there is often a shortage of water during the dry season, especially in the second planting season, and is often flooded during the rainy season. The results of the planting calendar analysis based on rainfall prediction information illustrate that the potential planting time in Indramayu Regency is November III-December I in rainy season 2020/2021, followed by planting times in March III-April I and July II-III, both for rice, maize, and soybeans. The existing conditions in the three sub-districts illustrate that the dominant planting time is around December or January-February. This is due to the delay in the arrival of irrigation water at the location of the three sub-districts, considering that the area is the end of the irrigation area which is the last area to receive irrigation water. In the planting season in February 2021, there was a flood disaster in rice fields in Karangampel Sub-district. Floods are caused by high rainfall intensity, while irrigation canals are poorly maintained.

**Table 4**. Resume of the results of cropping calendar analysis at the Wet Season 2020/2021 and Dry Season 2021 and their comparison with existing conditions in the field.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Crop Planting Schedule | Potential of Crop Planting Area (Ha) | | | Exiting Condition | | Standing Crop Monitoring  (Dominant) |
| Rice | Maize | Soybean | Crop Planting Time | Agriculture Hazard |
| ***Wet Season 2020/2021*** | | | |  |  |  |
| Nov III-Dec I | 113.831 | 0 | 0 | November-December,  January, Februari | Flooding on February | - |
| ***Dry Season 2021*** | | | |  |  |  |
| Mar III-Apr I | 10.620 | 2.031 | 0 | Februari, March | Flooding | Generative Stage on April 2021 |
| Jul II-III | 34.223 | 0 | 2.074 | July | Drought | - |



**Figure 3.** The condition of monitoring of rice standing crop on paddy fields on 26 April 2021 in Patrol, Losarang, and Karangampel Subdistrict.

The results of monitoring the standing crop of rice plants in April 2021 illustrate that the dominant rice phase observed in paddy fields is the generative phase. This illustrates that the highest planting time in the three sub-districts is at the end of February 2021. This planting schedule is faster than the recommendations contained in the Integrated Cropping Calendar Information System Dry Season 2021.

***Recommendations for crop management to anticipate drought in paddy fields at dry season 2021***

Various steps are needed to anticipate the risk of failure due to limited rainfall conditions in several locations in the May-September 2021 period, including:

* Follow the planting time guidelines as presented in the Integrated Cropping Calendar Information System for Dry Season 2021 (Pramudia et al. 2020).
* Ensure that there are water infrastructure facilities and infrastructure, such as the provision of water pumps, reservoirs, dams, trenches, long storage, in areas that have the potential to drought.
* If there is no water infrastructure and facilities, it is not recommended to plant, because there is a high risk of failure due to drought.
* Application of appropriate cropping patterns that are adaptive, namely selecting commodities that are suitable for rainfall conditions for planting rice, corn, or soybeans as the results of the analysis conducted above.
* Using high yielding varieties that are drought resistant or high yielding varieties of early maturity, to ensure fewer water requirements or have a shorter growing time. In some paddy fields which are coastal areas, salinity-resistant varieties are also needed.
* In some rice fields, there is a perception of farmers to choose commodities other than rice, corn, and soybeans. For this reason, it is advisable to choose commodities that require less water per growing season, such as beans.

Increasing the role of institutions, such as agricultural offices or extension agencies, to inform the information of cropping calendar to farmers (Fahmid et al. 2018; Arsyad et al. 2021).

**Conclusion**

Based on the updated rainfall predictions for May, June, and July 2021, it is known that the latest updated rainfall prediction values for May, June, and July 2021 have a ratio of less than 1 compared to the previous prediction results. Thus, the latest updated prediction information for the three months has a lower value than the previous value. The latest updated predictions for May, June, and July 2021 have values 13%, 24%, and 20% lower than the previous values, respectively.

The areas of rice, maize, and soybeans that are predicted to rainfall <60 mm/month during their growing period are 697,289 Ha, 463,771 Ha, and 216,359 Ha, respectively. This area is predicted to have a drought potential due to limited water. For this reason, more precise planning for plant and water management is needed in these areas to avoid drought.

The area of rice, maize, and soybeans that are predicted to drought are around 1,377,419 Ha. The recommended area of rice plants to be converted into maize or soybeans is 578,637 hectares. The area of maize or soybeans that have been converted into rice cultivation is 99,406 hectares.

Recommendations for anticipation include following the planting time guidelines as in the Integrated Cropping Calendar Information System for Dry Season 2021, ensuring that there are water infrastructure facilities and infrastructure, applying appropriate adaptive cropping patterns, using high yielding varieties that are dry, early maturing and salinity resistant for certain locations, selecting commodities under the water availability and enhance the role of institutions.

**Conflict of Interest**

There are no conflicts to declare.

**Data Availability**

The data presented in this study are available on request from the corresponding author.

**Ethics Approval**

There are no researches conducted on animals or humans.

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