Jurnal Sumberdaya Lahan Vol. 16 No. 2, Desember 2022: 135-148
DOI: http://dx.doi.org/10.21082/jsdl.v16n2.2022.135-148

ISSN 1907-0799
E-ISSN 2722-7731

Makalah Review

A Review of the use of Web-based Climate Information Systems for Agriculture Purposes

Tinjauan Penggunaan Sistem Informasi Iklim Berbasis Web untuk Pertanian

Rachmat Abdul Gani[1], Rizatus Shofiyati[1], Aris Pramudia[2]*

[1]) Research Center for Geospatial, National Research and Innovation Agency (BRIN), Cibinong Science Centre, Cibinong, Bogor, 16911 Indonesia

[2]) Research Center for Climate and Atmosphere, National Research and Innovation Agency (BRIN, Bandung, Indonesia

**Email : rach031@brin.go.id*

Diterima 07 November 2022, Direview 06 Desember 2022, Disetujui dimuat 27 Desember 2022, Direview oleh Muhrizal Sarwani dan Popi Rejekiningrum

Abstract. The development of information system technology is needed in facing current and future agricultural challenges. An integrated agricultural information system is needed based on climate information system technology in answering this challenge. Indonesian Agency for Agricultural Research and Development Ministry of Agriculture has developed a web-based Indonesia Integrated Cropping Calendar Information System (ICCIS/KATAM Terpadu). The ICCIS provides information for users in preparing planting plans. Likewise, the JASMIN-Jaxa web application that uses a satellite database covers all provinces in South, Southeast Asia and East Asia. This paper aims to review the use of climate information systems in the ICCIS and the JASMIN-JAXA web-based application. Integrated climate information system in ICCIS, among others: flood estimation, drought and crop pests, prediction and rainy season, district level monthly rainfall prediction map. While JASMIN-JAXA is a map (rainfall, drought index, soil moisture, groundwater index, solar radiation, surface temperature, and vegetation index) with time series and data sources. Both are able to monitor climate developments for agricultural purposes, dynamic and growing. The importance of updating and verifying data in accordance with field conditions and equipment maintenance in the system to be continuously improved to get benefits and accuracy of results in accordance with the interests of the agricultural world. Each system has advantages and disadvantages that can continue to develop in accordance with the increasing opportunities and challenges of the need for climate information in the future. Apart from the ongoing development process, ICCIS and JASMIN-JAXA provide knowledge, understanding and action at a scale relevant for decision-making in response to current and future climate change.

Keywords: Integrated Cropping Calendar, JASMIN-JAXA, Satellite Data, Climate Information System.

Abstrak.*Teknologi sistem informasi telah berkembang pesat dan dibutuhkan dalam pertanian saat ini dan masa depan. Sistem informasi iklim untuk pertanian berbasis website mutlak dibutuhkan dalam menjawab tantangan ini. Badan Penelitian dan Pengembangan Pertanian (Balitbangtan) telah mengembangkan sistem informasi Kalender Tanam (KATAM) Terpadu berbasis website sejak tahun 2011 (dari versi Atlas tahun 2007-2010) mencakup wilayah Indonesia. Sistem ini memberikan informasi bagi pengguna dalam mempersiapkan rencana tanam. Demikian halnya Sistem Informasi JASMIN-JAXA yang berbasis data satelit mencangkup semua provinsi di kawasan Asia Selatan, Asia Tenggara, dan Asia Timur. Makalah bertujuan untuk meninjau pemanfaatan SI KATAM Terpadu dan JASMIN-JAXA pada portal Web. SI KATAM Terpadu berisi estimasi wilayah rawan banjir, kekeringan dan serangan organisme pengganggu tanaman, prediksi curah hujan dan musim, peta prediksi curah hujan bulanan tingkat kabupaten. Sedangkan pada JASMIN-JAXA berupa peta curah hujan, indeks kekeringan, kelembaban tanah, indeks air tanah, radiasi sinar matahari, suhu permukaan, dan indeks vegetasi berseri waktu dan sumber data. Kedua sistem informasi ini mampu memantau perkembangan iklim bersifat dinamis, terupdate dan terus berkembang yang dapat dimanfaatkan untuk perencanaan pertanian. Pemutakhiran dan verifikasi data masih perlu terus ditingkatkan guna mendapatkan manfaat dan keakuratan hasilnya sesuai dengan tujuan kepentingan pemangku kebijakan dan stakeholder lainnya. Masing-masing sistem memiliki kelebihan dan kekurangan yang dapat terus berkembang sesuai dengan peluang dan tantangan kebutuhan informasi iklim yang semakin meningkat di masa mendatang. Terlepas dari proses pembangunan yang sedang berkembang dan terus berlangsung, SI KATAM Terpadu dan JASMIN-JAXA memberikan pengetahuan, pemahaman dan tindakan pada skala yang relevan untuk pengambilan keputusan dalam menanggapi perubahan iklim saat ini dan masa depan.*

Kata kunci: *Kalender Tanam Terpadu, JASMIN-JAXA, Data Satelit, Sistem Informasi Iklim.*

INTRODUCTION

Information System (IS) has become a strategic factor to facing the challenges of global condition and competition (Lu *et al.* 2012). Population growth and advances in information technology have driven major changes in early warning systems and products to deal with extreme climates. In addition, there has been an increasing need for quality services for climate information such as impact based forecasting and risk based warning. Rapid changes and advances in information technology have made it possible to develop an information system that is responsive and reliable between climate and agricultural institutions. Utilization of climate information and its changes in the agricultural sector is to be considered in making plans or patterns of agricultural activities in the medium and long term. For example land use planning, cropping pattern planning, determining the commodities/varieties to be cultivated and anticipatory steps such as preparing adaptation technology which includes agricultural land resource management technology and seed technology (Aldrian 2016).

Quick, easy to understand and reliable short-term climate prediction information is needed to minimize losses due to crop failure and decreased production of agricultural commodities. Currently, this information has been sufficiently well disseminated to policy makers in the agricultural sector. Based on this information, short-term adaptation strategies and operational policies can be formulated and implemented (Surmaini 2016).

The use of remote sensing technology such as satellites is able to obtain relevant and timely information in monitoring plant conditions as an early warning in an area with varying land biophysical conditions (Rembold *et al*. 2019), where remote sensing data can reduce freedom with get the factors that are not produced properly when simulating in a large area (Pagania *et al*. 2019). Gartina's (2015) study on the dissemination of agricultural technology innovations through Web portals mentions the need for packaging information on agricultural technology innovations in popular languages. Its easily to understood by users and also supports information on technological innovations from researchers/instructors/engineers that need to be continuously improved so that collaboration between site managers is needed. Web and researchers who pay attention to three aspects, namely Philosophy (why), Science (what), and Art (how).

This paper examines the advantages and suggestions for future development of two climate information systems for agriculture, namely Indonesia Integrated Cropping Calendar Information System (ICCIS) and Jaxa's Satellite based Monitoring Network system for FAO AMIS Market Monitor-JAXA (JASMIN-JAXA). ICCIS was developed by the Agency for Agricultural Research and Development, Ministry of Agriculture of the Republic of Indonesia, while JASMIN was developed by the Japan Aerospace Exploration Agency (JAXA), Japan. The two products attempt to present and disseminate information and data for the benefit of research and the application of information technology as well as monitoring in the field. The data and information such as: meteorology and climate, floods, droughts, and others in accordance with the interests of users in supporting agricultural activities. This paper also tries to review and examine the use, dissemination of information and data CIS on the ICCIS and CIS on web-based JASMIN-JAXA. Each system has advantages and disadvantages (characteristics) that can continue to develop according to the needs of its users and the greater opportunities and challenges ahead.

The ICCIS contains information and data that is displayed on a regional and local basis (province to sub-district level), while The JASMIN-JAXA based on global and regional (country to provincial) levels. Fritz *et al.* (2019) in a study on a comparison of 8 (eight) global agricultural monitoring systems and their current gaps stated that the aim of CIS is to provide up-to-date information on food production for various actors and decision makers in supporting global and national food security where there is some commonality of information in particularly in the use of meteorological data and the use of remote sensing. This article reviews and examines the use of climate information system and data dissemination in Indonesia Integrated Cropping Calendar Information System (ICCIS) and Jaxa's Satellite based Monitoring Network system for FAO AMIS Market Monitor-JAXA, Japan (JASMIN-JAXA) based on Web portal.

CLIMATE INFORMATION SYSTEMS FOR AGRICULTURE IN INDONESIA

The Indonesia Integrated Cropping Calendar Information System (ICCIS)

The Indonesia Integrated Cropping Calendar Information System (ICCIS) is a guide or tool that provides spatial and tabular information about monitoring and predicting the season, early planting time, cropping patterns, potential planting area, drought and flood prone areas, potential pest attacks, and dosage recommendations, fertilizers, suitable varieties of paddy, maize, and soybean (on paddy irrigated, rainfed and swampy rice fields), agricultural machinery, potential livestock feed based on climate forecasts (Apriyana *et al*. 2021; Syahbuddin *et al*. 2007). According to Norasma *et al*. (2019) this system is an information and communication system to users in accessing useful data and information and can improve agricultural management.

The strategic role of ICCIS in adapting to climate change is reflected in the ability of this information system to inform future growing season conditions, which include early planting of food crops, areas prone to floods, droughts, and plant pest organisms (PPO), as well as technological recommendations in the form of varieties, seeds, and balanced fertilization. The web-based ICCIS was first officially launched by the Head of the Agricultural Research and Development Agency on December 27, 2011 with the online publication of ICCIS version 1.0 which contains the Planting Season I ICCIS (MT-I) 2011/2012. Since then, ICCIS version 1.0 has been constantly updating and improving the system and its contents. The Agricultural Research and Development Agency updates this information at least twice a year at the beginning of each planting season for all sub-districts in Indonesia. At the beginning of its development this system also used SMS delivery and android-based smartphone applications. The advantage of the SMS delivery system is that it can be done through each user's personal mobile phone which is connected to the integrated KATAM SMS Center (08-123-565-1111), but currently the SMS system is no longer used. As for the android application as the lightweight version of the ICCIS application, it can be used via a tablet or smartphone with an android operating system The accessible address is *http://play.google.co/store/apps/details?id=com.litbang.katamterpadu* (Runtunuwu *et al*. 2013; Ramadhani *et al*. 2013; Ramadhani *et al*. 2015; Ramadhani *et al*. 2020).

In facing the dry season in 2020 this system has reached version 3.1. Currently, version 3.3 is already used and has undergone many updates and development processes compared to the version that first appeared. In this paper we will review The ICCIS currently with version 3.3. The ICCIS information can be accessed at the website address: http://katam.litbang.pertanian.go.id/. The front page of the ICCIS web portal is presented in Figure 1.

An Overview the Utilization of The Climate information system on the website portal ICCIS version 3.3

The ICCIS website portal version 3.3 is one of the products of the Agricultural Research and Development Agency (Balitbangtan) which continues to grow. Gartina (2015) states that the dissemination of agricultural technology for Balitbangtan products has

source: *http://katam.litbang.pertanian.go.id*

Figure 1. Front view of the ICCIS website version 3.3
Gambar 1. Tampilan depan website Katam Terpadu versi 3.3

not been carried out optimally, so that not many people, especially farmers, have been and can take advantage of it. Dissemination of technology through web portals is the choice of Balitbangtan. The packaging of information on agricultural technology innovations needs to be improved because what is presented can only be understood by certain groups and Balitbangtan has the task and function of disseminating information and technology. Further Aziz *et al*. (2017) in his study of the design of the ICCIS communication campaign in an effort to adapt to climate change, stated that communication through campaigns about ICCIS has basically been carried out by Balitbangtan. This campaign is carried out using the internet and social media. The ICCIS campaign is quite effective because it has an impact on the number of visitors to the ICCIS website in a certain period.

Approach to Development of Cropping Calendar Map compiled based on actual conditions in the field and potential conditions using climatological analysis. Actual conditions are known from planting area and planting intensity, while potential conditions are concluded through analysis of water availability based on rainfall (http://katam.litbang.pertanian.go.id/main.aspx).

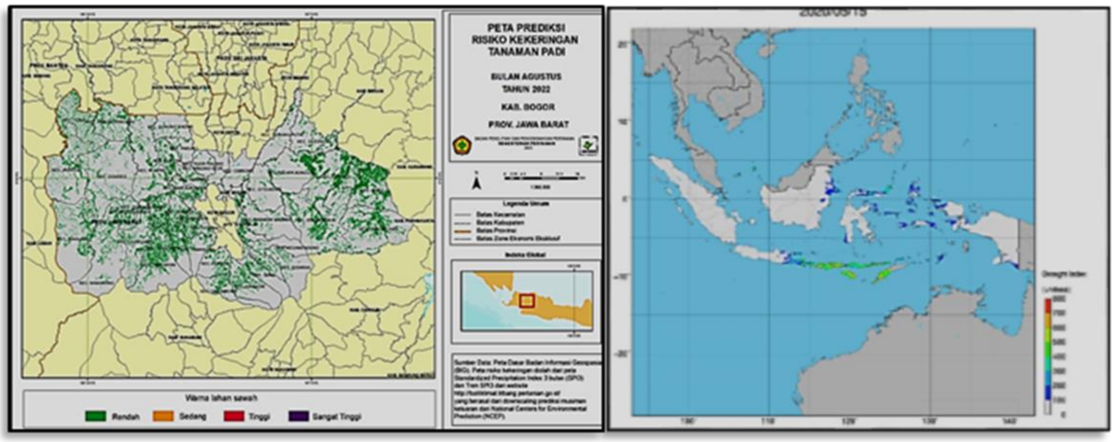
In the latest ICCIS version 3.3 website portal, vary information is presented, among others: Cropping Calendar, Standing Crop, Fertilizer and Variety, Agricultural Machinery and Livestocks, Climate and Prediction, Climate Change Impact, and others in subdistrict sheet. In this paper the information is reviewed on climate-based information system. The information includes predictions of rainfall/climate, drought index map (Figure 2-left), recommendations for fertilizers and fertilization needs, determination of estimated time and planting area, status of seasonal disaster vulnerability (floods and droughts) at the district level (Figure 3), endemic disasters and status of plant pest organisms (Figure 4), determination of variety recommendations, and standing crop (SC). Information on climate classification contained in the ICCIS, namely: Koppen climate classification, rainfall conditions, temperature conditions, and conditions for the number of wet days (http://katam.litbang.pertanian.go.id/main.aspx).

Climate information here can be found up to the sub-district level such as 6 (six) daily rainfall predictions, IRI predictions, IFAD predictions, IFAD Extraordinary predictions, APHR rainfall predictions, CMAP rainfall predictions, GPCC rainfall predictions, CHIRPS rainfall predictions. But unfortunately to process these features require special access. Users must register and create a personal account in order to gain access to their information (http://katam.litbang.pertanian.go.id/main.aspx).

Several studies on the effectiveness and validation of the ICCIS have been carried out by Duwijana and Aribawa (2014) where they conducted a study on the production of rice plants with an early planting period using the recommendations of the ICCIS. The results of the study stated that the highest rice productivity was obtained in the treatment of rice plants that used the early planting period produced from the ICCIS. Furthermore, Suharno and Mustaha (2015) have carried out field validation in a survey of rice farmers who have used the recommendations of the ICCIS. The results of the survey of the farmers suggest that in getting the best planting time, it is necessary to validate the planting time recommended by ICCIS compared to the existing planting time in lowland rice centers.

However, several studies have shown results regarding the inaccuracy of the ICCIS. Sabur (2014) in his study related to the application of the ICCIS in terms of recommendations for determining planting time. Likewise, a study conducted by Dewi and Sabur (2016) stated that the level of disaster vulnerability in the ICCIS, such as floods and the level of pest attacks, is still considered to be inadequate according to conditions in the field. Therefore, maintenance and development of the ICCIS system is still needed, to improve the quality of data and information so that it can better meet user needs (Runtunuwu *et al*. 2012). Kelley (2019) in his study relates to the used of data science from tools in expanding agro-meteorological networks and engaging stakeholders in collaboration which offers the result of an open source framework that can increase engagement with the agricultural sector, encourage the application of scientific methods, and garner support for regional agro-meteorology networks.

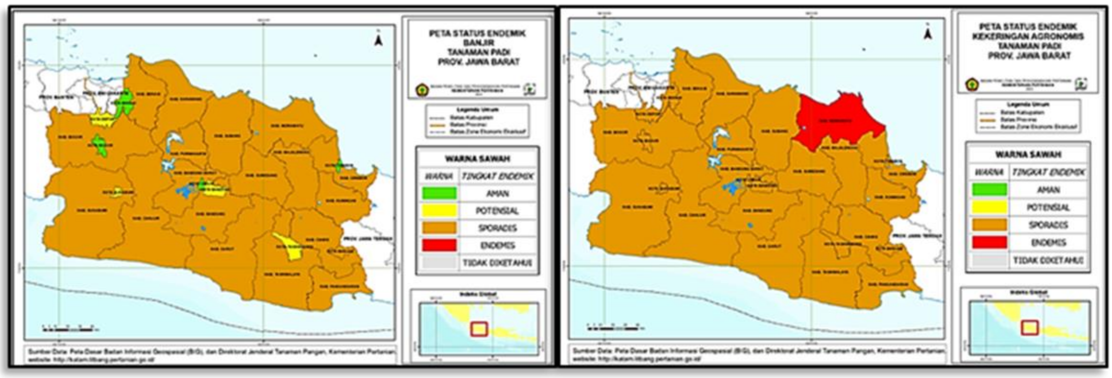
Several studies on the effectiveness and validation of the ICCIS have been carried out by Duwijana and Aribawa (2014) where they conducted a study on the production of rice plants with an early planting period using the recommendations of the ICCIS. The results of the study stated that the highest rice productivity was obtained in the treatment of rice



source: http://katam.litbang.pertanian.go.id/ and
https://suzaku.eorc.jaxa.jp/JASMIN/data/img/indonesia/kbdi/2020/img-kbdi-20200516-indonesia.png

Figure 2. Example of a drought index map display in Bogor regency, West Java province, Indonesia from the ICCIS website portal version 3.3 (left) and the drought index map in the JASMIN-JAXA portal website (right).

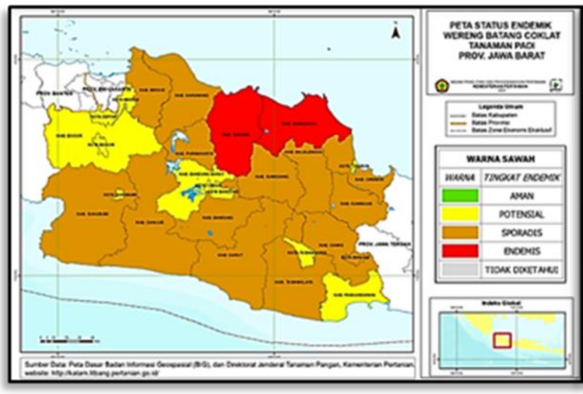
Gambar 2. Contoh tampilan peta indeks kekeringan di kabupaten Bogor, propinsi Jawa Barat, Indonesia dan peta indeks kekeringan dalam portal website JASMIN-JAXA (kanan).



Source:http://katam.litbang.pertanian.go.id/katam_terpadu/predik_kekeringanpdf/MEI2020/PETA%20PREDIKSI%20KEKERINGAN-MEI-2020-32-JAWA%20BARAT.pdf.

Figure 3. Example of a map display of endemic flood status (left) and agronomic drought endemic (right) In the province of West Java on the ICCIS website portal version 3.3 (pdf format file.)

Gambar 3. Contoh tampilan peta status endemik banjir (kiri) dan endemik kekeringan agronomis (kanan) di propinsi Jawa Barat dalam website Katam Terpadu versi 3.1 (format file pdf.)



TINGKAT ENDEMIK TANAMAN PADI
PROVINSI : JAWA BARAT (32)

No	Kabupaten	Induk Adm.	Jenis Bencana: Banjir	Kekeringan	Wereng Batang Coklat	Tikus Sawah	Penggerek Batang Padi	Tungro	Blast	Kresek (HDB)
1	2	3	4	5	6	7	8	9	10	11
1	BANDUNG	3204	SPORADIS	SPORADIS	SPORADIS	SPORADIS	SPORADIS	SPORADIS	SPORADIS	SPORADIS
2	BANDUNG BARAT	3217	SPORADIS	SPORADIS	POTENSIAL	POTENSIAL	SPORADIS	SPORADIS	POTENSIAL	POTENSIAL
3	BEKASI	3216	SPORADIS	SPORADIS	SPORADIS	SPORADIS	ENDEMIS	AMAN	POTENSIAL	SPORADIS
4	BOGOR	3201	SPORADIS	SPORADIS	POTENSIAL	SPORADIS	SPORADIS	SPORADIS	SPORADIS	SPORADIS
5	CIAMIS	3207	SPORADIS	SPORADIS	SPORADIS	SPORADIS	SPORADIS	POTENSIAL	SPORADIS	ENDEMIS
6	CIANJUR	3203	SPORADIS	SPORADIS	SPORADIS	SPORADIS	SPORADIS	ENDEMIS	SPORADIS	SPORADIS
7	CIREBON	3209	SPORADIS	SPORADIS	SPORADIS	SPORADIS	SPORADIS	POTENSIAL	SPORADIS	SPORADIS
8	GARUT	3205	SPORADIS	SPORADIS	SPORADIS	SPORADIS	SPORADIS	SPORADIS	SPORADIS	SPORADIS
9	INDRAMAYU	3212	SPORADIS	ENDEMIS	ENDEMIS	ENDEMIS	ENDEMIS	POTENSIAL	SPORADIS	ENDEMIS
10	KARAWANG	3215	SPORADIS	SPORADIS	SPORADIS	SPORADIS	ENDEMIS	POTENSIAL	POTENSIAL	ENDEMIS
11	KOTA BANDUNG	3273	POTENSIAL	SPORADIS	POTENSIAL	SPORADIS	SPORADIS	AMAN	POTENSIAL	SPORADIS
12	KOTA BANJAR	3279	SPORADIS	SPORADIS	SPORADIS	POTENSIAL	SPORADIS	POTENSIAL	POTENSIAL	SPORADIS
13	KOTA BEKASI	3275	AMAN	SPORADIS	POTENSIAL	POTENSIAL	POTENSIAL	POTENSIAL	POTENSIAL	POTENSIAL
14	KOTA BOGOR	3271	AMAN	SPORADIS	POTENSIAL	POTENSIAL	SPORADIS	POTENSIAL	POTENSIAL	SPORADIS
15	KOTA CIMAHI	3277	AMAN	SPORADIS	POTENSIAL	POTENSIAL	POTENSIAL	POTENSIAL	POTENSIAL	POTENSIAL

Source: http://katam.litbang.pertanian.go.id/main.aspx

Figure 4. Example of a brown leafhopper pest status map (left) and tabular data on plant endemic levels padi (right) on the ICCIS website version 3.3 (pdf format file.)

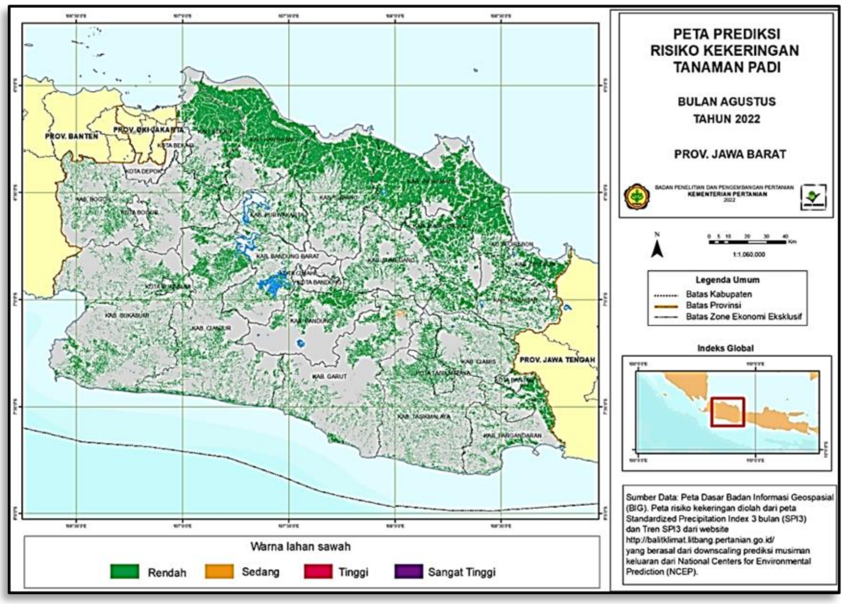
Gambar 4. Contoh tampilan peta status hama wereng coklat (kiri) dan data tabular tingkat endemik tanaman padi (kanan) dalam website Katam Terpadu versi 3.3 (format file pdf.)

plants that used the early planting period produced from the ICCIS. Furthermore, Suharno and Mustaha (2015) have carried out field validation in a survey of rice farmers who have used the recommendations of the ICCIS. The results of the survey of the farmers suggest that in getting the best planting time, it is necessary to validate the planting time recommended by ICCIS compared to the existing planting time in lowland rice centers.

However, several studies have shown results regarding the inaccuracy of the ICCIS. Sabur (2014) in his study related to the application of the ICCIS in terms of recommendations for determining planting time. Likewise, a study conducted by Dewi and Sabur (2016) stated that the level of disaster vulnerability in the ICCIS, such as floods and the level of pest attacks, is still considered to be inadequate according to conditions in the field. Therefore, maintenance and development of the ICCIS system is still needed, to improve the quality of data and information so that it can better meet user needs (Runtunuwu *et al*. 2012). Kelley (2019) in his study relates to the used of data science from tools in expanding agro-meteorological networks and engaging stakeholders in collaboration which offers the result of an open source framework that can increase engagement with the agricultural sector, encourage the application of scientific methods, and garner support for regional agro-meteorology networks.

In relation to site-specific nutrient management or balanced fertilization, Azwir and Winardi (2015) in their study concluded that the ICCIS is an integrated information system including recommendations and fertilizer needs to the sub-district level and suggests cross-checking with other methods in the field. Likewise, Fahri *et al*. (2019), the results of his research show that referring to the Recapitulation of the Potential Calendar of Rice Planting in Indragiri Hulu Regency for the 2017/2018 rainy season (MH) and dry season (MK) April - September 2018 planting seasons, it is known that the rice planting area is 5,029 hectares with a Cropping Index (CI) of 269%. The recommendation for the rice planting potential of the ICCIS is 862 ha wider than the existing planting area of 4,167 ha with an CI value of 118%.

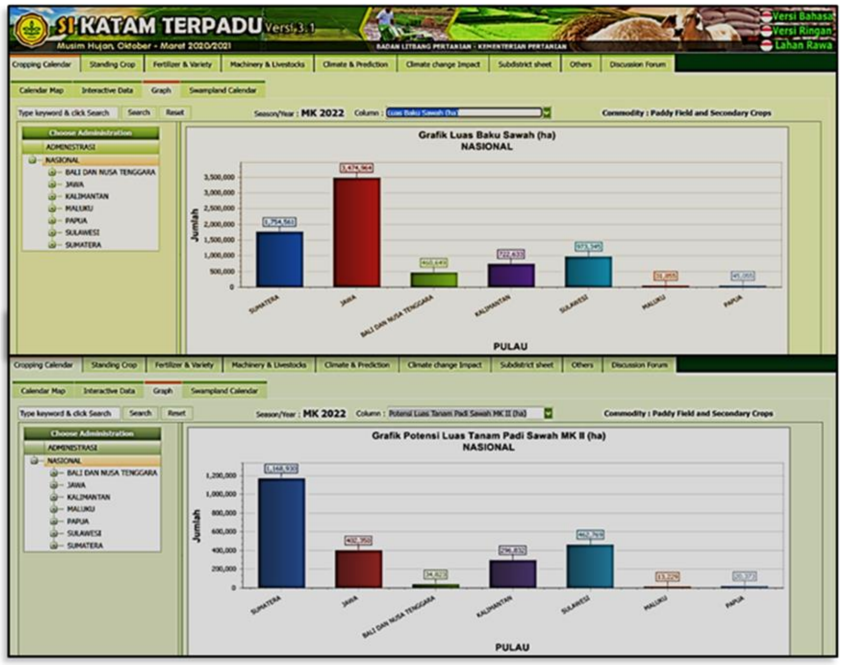
The results of the ICCIS Team's analysis are based on rainfall prediction data from the BMKG (Meteorological, Climatological, and Geophysical Agency). An example of the application of this analysis is illustrated in the drought risk prediction map for rice



Source: http://katam.litbang.pertanian.go.id/katam_terpadu/prediksi_kekeringanpdf/AGUSTU 2022/PETA%20PREDIKSI%20KEKERINGAN-AGUSTUS-2022-32 JAWA%20BARAT.pdf

Figure 5. Example of a drought index map display in West Java province, Indonesia from the ICCIS website portal version 3.3

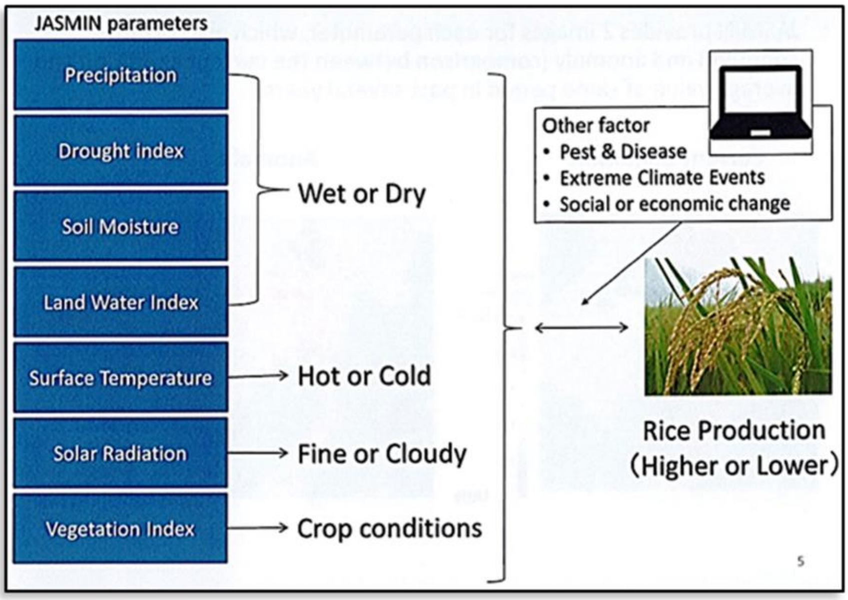
Gambar 5. Contoh tampilan peta indeks kekeringan di propinsi Jawa Barat, Indonesia dalam portal website ICCIS versi 3.3



Source: http://katam.litbang.pertanian.go.id/main.aspx?lang=en

Figure 6. Example of a graphic display of the national standard area of rice fields (above) and a graph of the potential for rice planting area rice fields MK II (below) on the ICCIS

Gambar 6. Contoh tampilan grafik luas baku sawah nasional (atas) dan grafik potensi luas tanam padi sawah MK II (bawah) dalam website SI KATAM Terpadu versi 3.3

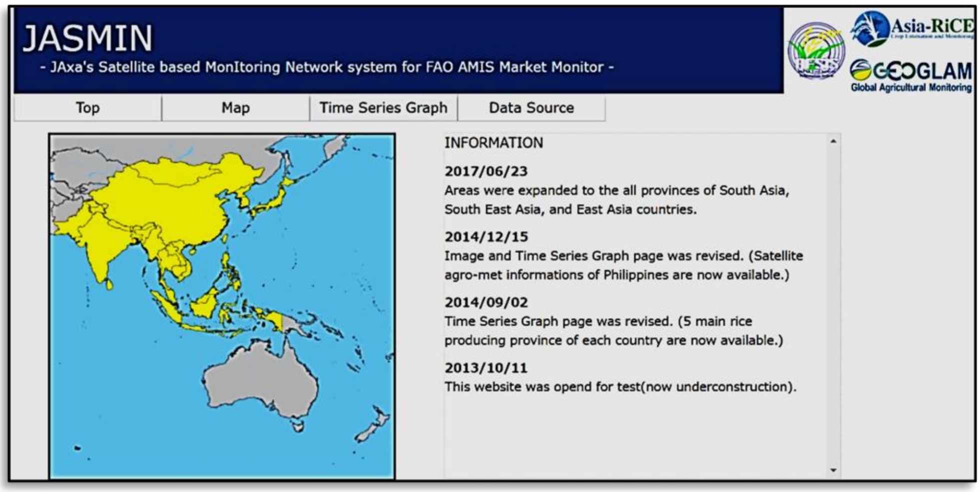


Source: Arvelyna (2019)

Figure. 7. Parameter information used in the JASMIN-JAXA website portal

Gambar. 7. Parameter informasi yang digunakan dalam portal website JASMIN-JAXA.

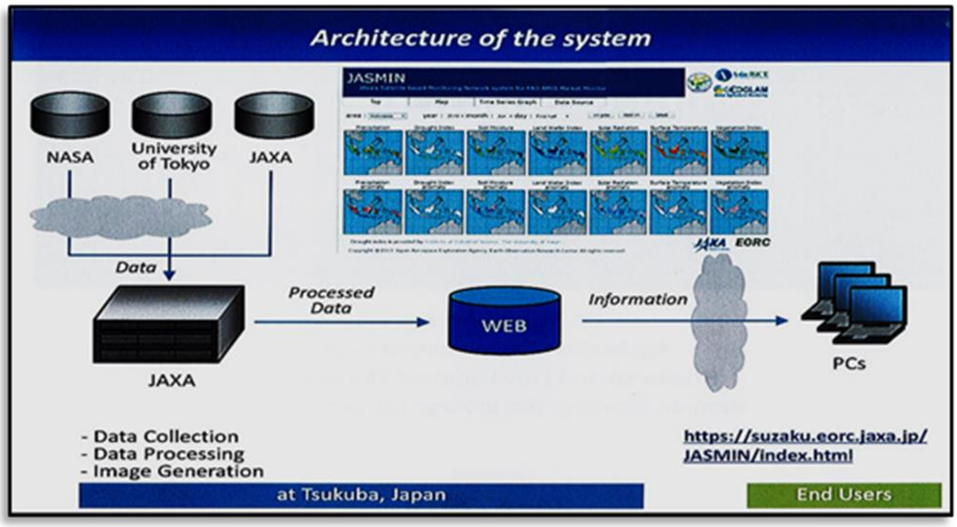
plants which is presented in Figure 5. The sub-district planting area data is estimated from the results of the ICCIS Team's calculations which refer to the standard area of rice fields by BPS (Statistics Indonesia), so that the potential planting area in a season will not be greater than the standard area of rice fields. However, planting can be recommended up to 2-3 times according to the predicted rainfall conditions. The graphic of the national standard area of rice fields and the potential



Source: https://suzaku.eorc.jaxa.jp/JASMIN/index.html

Figure. 8. Front view of the Japanese JASMIN-JAXA website portal

Gambar 8. Tampilan depan portal website JASMIN-JAXA Jepang.



Source: Arvelyna, 2019

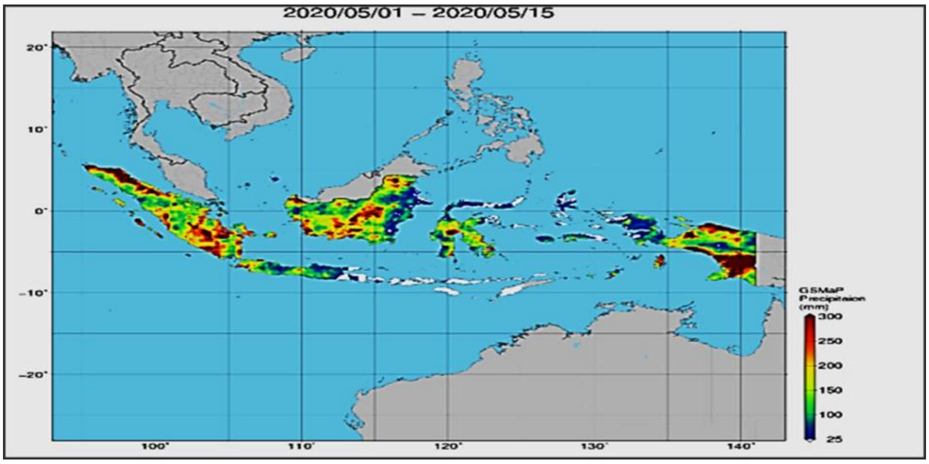
Figure. 9. Flowchart of website-based information system development on the JASMIN-JAXA website portal

Gambar. 9. Diagram alir pengembangan sistem informasi berbasis website pada portal web JASMIN-JAXA

area for rice cultivation in the ICCIS version 3.3 is presented in Figure 6.

Climate Information System on Jaxa's Satellite based Monitoring Network system for FAO AMIS Market Monitor –JAXA, Japan (JASMIN-JAXA) Website Portal

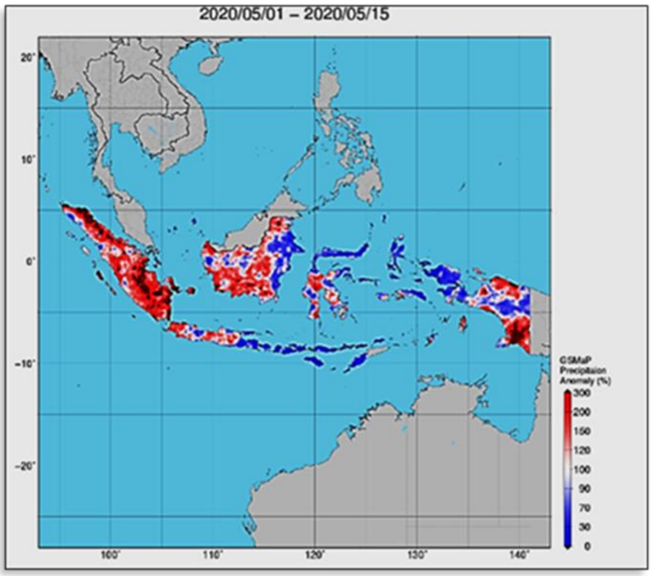
The Information system on Jaxa's Satellite based Monitoring Network system for FAO AMIS Market Monitor-Japan Aerospace Exploration Agency (JASMIN-JAXA) and Information system developed by the JAXA regarding climate information based onsatellite network information in several Asian countries including Indonesia. This system can be seen on the website:https://suzaku.eorc.jaxa.jp/JASMIN/index.html which is the result of a collaboration between the National Aeronautics and Space Administration (NASA) with the University of Tokyo and JAXA. In JASMIN-JAXA information system there are 7 (seven) information parameters presented, namely: rainfall, drought index, soil moisture, groundwater index, surface temperature, solar radiation, and vegetation/plant index in the form of



Source: https://suzaku.eorc.jaxa.jp/GCOM_W/JASMINE/data/tsg/indonesia/smc/tsg-smc-2020-indonesia-Jawa_Barat.png

Figure 10. Example of rainfall information on map view and annual rainfall grap based on time series in the province of West Java, Indonesia in the website portal JASMIN-JAXA.

Gambar 10. Contoh Informasi curah hujan pada tampilan peta dan grafik curah hujan tahunan berdasarkan deret waktu di propinsi Jawa Barat, Indonesia dalam portal website JASMIN-JAXA.



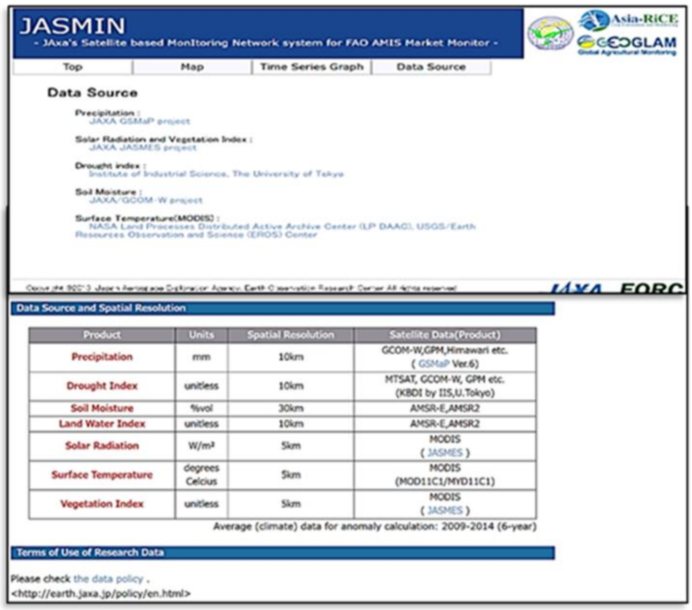
Source: https://suzaku.eorc.jaxa.jp/GCOM_W/JASMINE//data//img/indonesia/prc/2020/img-prc-20200501-indonesia.png

Figure 11. An example of anomaly information on rainfall patterns in the territory of Indonesia on a map display in the JASMIN-JAXA website portal.

Gambar 11. Contoh informasi anomali pola curah hujan di wilayah Indonesia pada tampilan peta dalam portal website JASMIN-JAXA.

maps, graphs, data sources, resolution spatial, and tabular data as well as the probability of occurrence of anomalies in these parameters (Figure 7). The information system had covers regions to all provinces in South Asia, Southeast Asia, and East Asian countries (Arvelyna 2019). The system is consist of 4 (four) main pages (Top, Map, Time Series Graph, and Data Source). The front page view of the JASMIN-JAXA website portal is presented in Figure 8.

The Information system JASMIN-JAXA website portal provides satellite data based on MODIS



JASMIN
- JAxa's Satellite based MonItoring Network system for FAO AMIS Market Monitor -

Asia-RiCE
GEOGLAM
Global Agricultural Monitoring

Top | Map | Time Series Graph | Data Source

Data Source

Precipitation :
JAXA GSMaP project

Solar Radiation and Vegetation Index :
JAXA JASMES project

Drought index :
Institute of Industrial Science, The University of Tokyo

Soil Moisture :
JAXA/GCOM-W project

Surface Temperature(MODIS) :
NASA Land Processes Distributed Active Archive Center (LP DAAC), USGS/Earth Resources Observation and Science (EROS) Center

JAXA EORC

Data Source and Spatial Resolution

Product	Units	Spatial Resolution	Satellite Data(Product)
Precipitation	mm	10km	GCOM-W,GPM,Himawari etc. (GSMaP Ver.6)
Drought Index	unitless	10km	MTSAT, GCOM-W, GPM etc. (KBDI by IIS,U.Tokyo)
Soil Moisture	%vol	30km	AMSR-E,AMSR2
Land Water Index	unitless	10km	AMSR-E,AMSR2
Solar Radiation	W/m²	5km	MODIS (JASMES)
Surface Temperature	degrees Celcius	5km	MODIS (MOD11C1/MYD11C1)
Vegetation Index	unitless	5km	MODIS (JASMES)

Average (climate) data for anomaly calculation: 2009-2014 (6-year)

Terms of Use of Research Data

Please check the data policy .
<http://earth.jaxa.jp/policy/en.html>

Source: https://suzaku.eorc.jaxa.jp/JASMIN/index.html

Figure 12. Example of data sources and references in the JASMIN-JAXA website portal
Gambar 12. Contoh sumber data dan referensi dalam portal website JASMIN-JAXA.

(Moderate Resolution Imaging Spectroradiometer) satellite imagery. Faisol *et al*. (2018) stated that the use of MODIS satellite imagery in generating

evapotranspiration information has an accuracy of 82.56% compared to climate data processing methods or has a deviation rate of 17.44% so that MODIS satellite imagery can be used as an alternative solution in generate information. The information system provides not only satellite data to users but also information on the current status of climatic variables such as solar radiation reaching the earth's surface (photosynthetic available radiation), turbidity, snow and sea ice sheets, vegetation drought (pressure trends water), soil moisture, wildfire, rainfall, land and sea surface temperatures (Arvelyna 2019). The Flowchart of website-based information system development on the JASMIN-JAXA website portal show in Figure 9.

Information that can be obtained and accessed on the JASMIN-JAXA website portal are: maps and graphs of rainfall (precipitation), drought index, soil moisture, solar radiation, surface temperature, land water index, and plant index (vegetation index). JASMIN provided 2 (two) images for each parameter, which are current condition and anomaly (comparasion between the current condition average value of the same period in the past several years). Graphs can be displayed up to the provincial level and data is obtained per 15 days from satellite recordings with intervals/time intervals every 1-15 and 16-30/31 in each month, except for the drought index only 1 (one) time in a month, namely every date 15 (Arvelyna 2019). The information we can get on precipitation spatial maps is an average of the parameters within the specific province selected by user website portal are presented in Figure 12 are provided as time series graph (Figure 10) and also the probability of rainfall anomalies (Figure 11) as well as the satellite data sources used on the JASMIN-JAXA website portal are presented in Figure 12.

Arvelyna (2019) also states limitations data information on drought index and soil moisture data. These limitations are since this drought index is only calculated by accumulated rainfall and land surface temperature, there is no correlation with available land water. This means that this drought index may not be correct in a region where there is irrigated area with enough available water for rice crop growing. While, soil moisture value are too high around water area and too low in the forest, mountain, and heavy precipitation are. So, we cannot use it in those area. In addition, satellite based soil moisture values in rice paddy field area during planting season may be also too high since paddy field are flooded and soil moisture value in that area may not be useful.

IMPLICATIONS IN AGRICULTURE AND FUTURE UTILIZATION PROSPECTS

A climate information system platform model for the world of agriculture based on web portals that continues to grow, such as ICCIS and JASMIN-JAXA, is urgently needed and important in the future. In agriculture, key knowledge service technologies such as automatic information acquisition, large-scale data intelligent processing, optimized knowledge organization and integration to build multidimensional knowledge service systems and supporting technology platforms based on providing one-stop integration services for scientific research. The need for innovation by providing in-depth knowledge services for various research institutions, and professional fields, as well as user-oriented research collaborations (Ji-fang *et al*. 2016).

Externally provided weather and climate information has an important role to play in building local knowledge to shape understanding of climate risk and guide decision-making across scales. Aggregating information across time scales, decision makers can implement transformative coping and adaptation strategies, thereby making communities more resilient to current and future climate risks (Singh *et al*. 2018). Owusu *et al.* (2021) stated that it is important to facilitate the formation of farmer-based organizations and increase the ratio of farmers to extension workers to facilitate the use of climate information and the design of climate change adaptation interventions.

Accurate information and more intensive dissemination can enrich farmers' knowledge, enable a better understanding of climate hazards and maintain agricultural production (Apriyana *et al.* 2021). Pulwarty *et al*. 2014, also reminded that an effective early warning system depends on multisectoral and interdisciplinary collaboration among all relevant actors at every stage in the warning process from monitoring to response and evaluation. Each system has advantages and disadvantages that can continue to develop in accordance with the increasing opportunities and challenges of the need for climate information in the future as we have explained above. Apart from the ongoing development process, the ICCIS and JASMIN-JAXA provide knowledge, understanding and action at a scale relevant for decision-making in response to current and future climate change.

CONCLUSION

Updating the latest data is a must in a climate information system based on a website portal which is obtained from the results of field validity, both in the Integrated Cropping Calendar Information System (ICCIS) and JAXA's Satellite based Monitoring Network system for FAO AMIS Market Monitor-JAXA (JASMIN-JAXA). In the ICCIS, the information and data displayed are based on a local to sub-district level, while in JASMIN-JAXA it is based on a regional to provincial basis. The ICCIS updates its information every 6 (six) months, while JASMIN-JAXA is based on satellite every 15 (fifteen) days. Each system has advantages and disadvantages that can continue to develop in accordance with the increasing opportunities and challenges of the need for climate information in the future. Apart from the ongoing development process, The ICCIS and JASMIN-JAXA provide knowledge, understanding and action at a scale relevant for decision-making in response to current and future climate change.

ACKNOWLEDGEMENT

All of the authors are the main contributors to this paper. The data and images used for this paper have been provided through of the Japan Aerospace Exploration Agency and the National Aeronautics and Space Administration. Credit: XXXX (*JAXA/NASA*). The authors are very grateful to Dr. Husnain, M.P., M.Sc. as the Director of the Indonesia Center for Agricultural Land Resources Research and Development (ICALRRD) for involving the authors in the First Training Program for Sharing Information Base on the Asean-Japanese Project Originating from the Earth Observation Satellite for Agricultural Management in the ASEAN Region in Sri Racha, Chonburi, Thailand on July 4-5, 2019.

REFERENCES

Apriyana Y, Surmaini E, Estiningtyas W, Pramudia A, Ramadhani F, Suciantini S, Susanti E, Purnamayani R, Syahbuddin H. 2021. The integrated cropping calendar information system: a coping mechanism to climate variability for sustainable agriculture in Indonesia. Sustainability Journal, Vol. 13, 6495. https://doi.org/10.3390/su13116495.

Aldrian E. 2016. Sistem peringatan dini menghadapi iklim ekstrem. Jurnal Sumberdaya Lahan. 10 (2): 79-90.

Arvelyna Y. 2019. Agro-met monitoring methods and implementation. Hand-on training of Jasmin, July 2019. Chonburi. Thailand.

Aziz A, Isnaini M, Idris N, Fahrimal Y, Alhafidz MA. 2017. Perancangan kampanye komunikasi Kalender Tanam (KATAM) dalam upaya adaptasi perubahan iklim. Jurnal Avant Garde, 5 (1): 54-76.

Azwir, Winardi. 2015. Pemupukan spesifik lokasi padi sawah dan kaitannya dengan penerapan Katam Terpadu di Sumatera Barat. BPTP Sumatera Barat http://bengkulu.litbang.pertanian.go.id/ind/images/dokumen/tanaman-pangan/azwir-winardi.pdf. (Accessed 8 Juni 2020).

Dewi DO, Sabur A. 2016. Kajian validasi system informasi kalender tanam dinamis terpadu padi sawah di Kabupaten Sanggau Kalimantan Barat. Prosiding Seminar Nasional: Inovasi Teknologi Pertanian, Banjarbaru, 20 Juli 2016. Sorong, 9 Nopember 2017. Hlm: 392-396.

Duwijana IN, Aribawa IB. 2014. Tampilan tanaman padi dengan awal tanam menggunakan rekomendasi Kalender Tanam Terpadu di Kecamatan Mendoyo, Jembrana Bali. Buletin Teknologi dan Informasi Pertanian. 12 (36): 116-121. ISSN: 1693-1262.

Fahri A, Syuryati, Yulfida A, Yusuf R. 2019. Implementation of the planting calendar information system (SI Katam) supports the increase of the rice planting index of Indragiri Hulu Regency. Jurnal Dinamika Pertanian Edisi Khusus, 3:1-8. P ISSN 0215-2525. E ISSN 2549-7960.

Faisol A, Atekan, Shofiyati R, Budiyono. 2018. Pemanfaatan citra satelit multi spectral untuk membangkitkan informasi evapotranspirasi guna mendukung sistem pertanian yang presisi di Kabupaten Manokwari. Prosiding Seminar Nasional: Mewujudkan Kedaulatan Pangan Melalui Inovasi Teknologi Pertanian Spesifik Lokasi Pada Kawasan Pertanian. Hlm: 469-475. http://repository.pertanian.go.id/handle/123456789/8854.

Fritz S, See L, Bayas JCL, Waldner F, Jacques D, Becker-Reshef I, Whitcraft A, Baruth B, Bonifacio R, Crutchfield J, Rembold F, Rojas O, Schucknecht A, Van der Velde M, verdin J, Wu B, Yan N, You L, Gilliams S, Mucher S, Tetrault R, Moorthy I, Ian M. 2019. A comparison of global agricultural monitoring systems and current gaps. Agricultural Systems Journal, Vol. 168: 258-272. https://doi.org/10.1016/j.agsy.2018.05.010.

Gartina D. 2015. Diseminasi inovasi teknologi pertanian melalui portal web Badan Penelitian dan Pengembangan Pertanian. Jurnal Informatika Pertanian, 24 (1): 121 – 132.

Kelley J. 2019. Using Data Science Tools to Expand Agro-meteorological Networks and Engage Stakeholders in Collaboration. American Geophysical Union, Fall Meeting 2019, abstract #H44D-06. Pub. Date: December 2019. https://ui.adsabs.harvard.edu/abs/2019AGUFM.H44D..06K/abstract. (Accessed June 5, 2020).

Liu J, Wu J, Zhang J, Liu J. 2016. Status and Prospects of Agricultural Information Technology. International Conference on Computer Science and Electronic Technology (CSET 2016). Published by Atlantis Press. p 322-327.

Lu HK, Chun LP, Lo CH, Mei YW. 2012. A review of information system evaluation methods. An International Conference on Software and Computer Applications (ICSCA 2012), Vol. 41: 243-248. IPCSIT Press, Singapore.

Norasma CYN, Shariff ARM. 2019. Development of web-based decision support system for paddy planting management in Tanjung Karang Malaysia. Proceeding International Workshop on ICTs For Precision Agriculture 6-8 August 2019. Selangor Malaysia. p. 34-42.

Owusu V, Ma W, Renwick A, Dorcas E. 2021. Does the use of climate information contribute to climate change adaptation? Evidence from Ghana. Climate and Development, 13(7): 616-629. Publisher: Taylor & Francis _eprint: https://doi.org/10.1080/17565529.2020.1844612.

Pagania V, Guarnerib T, Busettoc L, Ranghettic L, Boschettic M, Movedib T, Campos-Tabernerd M, Garcia-Harod FJ, Katsantonise D, Stavrakoudisf F, Ricciardellig E, Romanog F, Holeczh F, Collivignarellih F, Granelli C, Casteleyni S, Confalonieria R. 2019. A high-resolution, integrated system for rice yield forecasting at district level. Agricultural Systems Journal. Vol. 168: 181-190. https://doi.org/10.1016/j.agsy.2018.05.007.

Pulwarty RS, Sivakumar MVK. 2014. Information systems in a changing climate: Early warnings and drought risk management . Weather and Climate Extremes, (3):14-21.

Ramadhani F, Runtunuwu E, Syahbuddin H. 2013. Sistem teknologi informasi Kalender Tanam Terpadu. Jurnal Informatika Pertanian, 22 (2): 103-112.

Ramadhani F, Syahbuddin H, Runtunuwu E. 2015. Aplikasi android pada system informasi Kalender tanam Terpadu. Jurnal Inkom, 9 (1): 39-44.

Ramadhani F, Las I, Syahbuddin H, Harmanto, Apriyana, Pramudia A, Surmaini E, Estiningtyas W, Susanti E, Adi SH, Kartiwa B, Heryani N, Hamdani A, Sucianti, Dewi ER, Sari K, Setyorini D, Kasno A, Nurhasanah A, Shiddieqy I, Sofiyati R, Hervani A, Misnawati, Muhardiono RI, Nengsusmoyo C, Imansyah MN, Alfiani H, Baroto YA, Kurniawan H, Firda D, Kosawa MRS, Rachmawati N, Agustian M. 2020. Sistem Informasi Kalender Tanam Terpadu Versi 3.1. Badan Litbang Kementerian Pertanian. 45 Hlm.

Rembold F, Meroni M, Urbano F, Csak G, Kerdiles H, Perez-Hoyos A, Lemoine G, Leo O, Thierry N. 2019. ASAP: A new global early warning system to detect anomaly hot spots of agricultural production for food security analysis. Agricultural Systems Journal, 168: 247-257.

Runtunuwu E, Syahbuddin H, Ramadhani F, Pramudia A, Setyorini D, Sari K, Apriyana Y, Susanti E, Haryono, Setyanto P, Las I, Sarwani M. 2012. Sistem informasi kalender tanam terpadu: status terkini dan tantangan kedepan. Jurnal Sumberdaya Lahan. 6(2): 67-78. DOI: http://dx.doi.org/10.2017/jsdl.v6n2.2012.%25p

Runtunuwu E, Syahbuddin H, Ramadhani F, Pramudia A, Setyorini D, Sari K, Apriyana Y, Susanti E, Haryono. 2013. Inovasi kelembagaan sistem informasi kalender tanam terpadu mendukung adaptasi perubahan iklim untuk ketahanan pangan nasional. Jurnal Pengembangan Inovasi Pertanian, 6 (1): 44-52.

Sabur A. 2014. Efektivitas informasi waktu tanam pada system informasi kalender tanam terpadu versi 1.6 tahun 2013 di Kalimantan Selatan. Prosiding Seminar Nasional: Inovasi teknologi Pertanian Spesifik Lokasi. Banjarbaru 6-7 Agustus 2014. Halaman 291-298.

Singh C, Daron J, Bazaz A, Ziervogel G, Spear D, Krishnaswamy J, Zaroug M, Evans K. (2018) The utility of weather and climate information for adaptation decision-making: current uses and future prospects in Africa and India. Climate and Development. 10 (5) : 389-405. DOI: 10.1080/17565529.2017.1318744.

Suharno, Mustaha MA. 2015. Persepsi petani tentang waktu dan pola tanam terbaik di Sulawesi Tenggara. Prosiding Seminar Nasional Swasembada Pangan Jurusan Agribisnis Universitas Halu Oleo. Hlm: 152-159. http://http://ojs.uho.ac.id/index.php/procnaskotim/oai.

Surmaini E, Faqih A. 2016. Kejadian iklim ekstrem dan dampaknya terhadap pertanian tanaman pangan di Indonesia. Jurnal Sumberdaya Lahan, 10(2): 115-128. DOI: http://dx.doi.org/10.2017/jsdl.v10n2.2016.%25p.

Syahbuddin H, Runtunuwu E, Pramudia A, Surmaini E, Shofiati R, Subagyono K, Amien I, Las I. 2007. Identifikasi dan Delineasi Kalender dan Pola Tanam Pada Lahan Sawah Terhadap Anomali Iklim di Pulau Jawa. Laporan Tengah Tahun. Balai Penelitian Agroklimat dan Hidrologi.

http://iridl.ldeo.columbia.edu/maproom/Global/Climatologies/Select_a_Point.html (Accessed 19 Mei 2021)

https://suzaku.eorc.jaxa.jp/JASMIN/index.html (Accessed 19 Mei 2021)

https://suzaku.eorc.jaxa.jp/GCOM_W/JASMINE/data/tsg/indonesia/smc/tsg-smc-2020-indonesia-Jawa_Barat.png (Accessed 19 Mei 2021)

https://suzaku.eorc.jaxa.jp/GCOM_W/JASMINE//data//img/indonesia/prc/2020/img-prc-20200501-indonesia.png (Accessed 19 Mei 2021)

https://suzaku.eorc.jaxa.jp/GCOM_W/JASMINE//data//img/indonesia/prc/2020/img-prc_c-20200501-indonesia.png (Accessed 19 Mei 2021)

https://suzaku.eorc.jaxa.jp/GCOM_W/JASMINE/data/img/indonesia/ndvi/2020/img-ndvi-20200501-indonesia.png (Accessed 19 Mei 2021)

https://suzaku.eorc.jaxa.jp/GCOM_W/JASMINE//data//img/indonesia/swr/2020/img-swr-20200501-indonesia.png (Accessed 19 Mei 2021)

https://suzaku.eorc.jaxa.jp/GCOM_W/JASMINE//data//img/indonesia/kbdi/2020/img-kbdi-20200515-indonesia.png (Accessed 19 Mei 2021) https://suzaku.eorc.jaxa.jp/GCOM_W/JASMINE//data//img/indonesia/lst/2020/img-lst- 0200501-indonesia.png (Accessed 19 Mei 2021)

http://katam.litbang.pertanian.go.id/ (Accessed 19 Mei 2021)

http://katam.litbang.pertanian.go.id/main.aspx (Accessed 19 Mei 2021)

http://katam.litbang.pertanian.go.id/katam_terpadu/prediksi_kekeringanpdf/MEI2020/PETA%20PREDIKSI%20KEKERINGAN-MEI-2020-32-JAWA%20BARAT.pdf (Accessed 19 Mei 2021)