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Potential and opportunity of rice production improvement through information system of integrated cropping calendar in Riau Province

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ABSTRACT

Development of an integrated cropping calendar is a necessity, which is expected to increase agricultural yields and can reduce crop losses due to drought and flooding. This information system summarized in one data base becomes a need to get various information in a fast time. The cropping calendar provides complete information for farmers. The operational guidelines are set at the sub-district level. The cropping calendar is an important tool in adjusting cropping patterns to climate change. Rice productivity in Riau Province is still low range of 3.5-4 ton/ha and the average planting index is once a year. The production can still be increased to 5-6 tons/ha through introducing rice technology such as superior seeds, VUB, fertilization, amelioration, pest control. Through applying the information system of integrated cropping calendar in WS 2017/2018 and DS 2017 in Riau Province, the planting index for rice can be increased to 167%. The increase in the Planting Index will have a real impact on increasing rice production.

Keywords: *cropping, climate change, planting index, Riau Province*

IINTRODUCTION

Global climate change impacts in agricultural sector are challenges for the national rice production enhancement program and the rice production enhancement program. Climate change is characterized by changes of rainfall patterns and distribution (Surfleet and Tullos, 2013), increase of air temperature (Gunawardhana and Kazama 2012), and increase of sea level (Zecca and Chiari, 2012) which affect directly and indirectly agricultural areas (Kang et al., 2009). One of the implications of climate change is the shift in the beginning and end of the growing season which has a negative impact on cropping patterns and crop productivity, especially seasonal crops.

Naylor et al. (2007) in Runtunuwu et al. (2103) specifically stated that agricultural production in Indonesia is strongly influenced by rainfall, both inter-seasonal and inter-annual variations, due to the Australia-Asia monsoon and El Nino southern monsoon dynamic oscillation (ENSO). To guide farmers in adjusting cropping times and patterns, the Indonesian Agency for

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Agricultural Research and Development since 2007 has arranged an atlas which compiles informations in planting calendar for rice crop in each sub-district for all provinces in Indonesia. The Planting Calendar Atlas for food crops in scale 1:250,000 has been made for Java island (Las et al., 2007; Runtunuwu et al., 2011a), and Sumatera Island. (Las et al., 2008; Runtunuwu et al., 2011b), Kalimantan (Las et al., 2009a; Runtunuwu et al., 2012b), Sulawesi (Las et al., 2009b; Runtunuwu et al., 2012c), and Bali, Maluku, Nusa Tenggara, and Papua (Las et al., 2010; Runtunuwu et al., 2013). This map illustrates the potential cropping patterns and planting times of food crops, especially rice, based on the potential and dynamics of climate and water resources.

Based on Regulation of Minister of Agriculture No. 45 of 2011 concerning the work relationship between technical institutions, research and development, and agricultural extension in supporting the increase of national rice production explains that the development and implementation of planting calendars should be completed with preparation, socialization and field validation Indonesian Agency for Agricultural Research and Development has developed an Information System of Integrated Planting Calendar for food crops which is a reference for policy makers in the preparation of management plans for each sub-district (Runtunuwu *et al.* 2012a). The information system can be accessed through the website address litbang.pertanian.go.id, pertanian.go.id, epetani. pertanian.go.id, cybex. pertanian.go.id, balitklimat.litbang. pertanian.go.id, and katam.info.

Director General of IAARD issues Decree (SK) No. 77.1/Kpts/OT.160/I/3/2012 concerning the Preparation Team of Integrated Planting Calendar (IPC) and Decree No. 178/Kpts/OT.160/I/7/2012 concerning the Establishment of Planting Calendar Task Force and Climate Change at the Assessment Institute for Agricultural Technology. The formation of two teams is very important because the effectiveness of Ministerial Regulation No. 45/2011 really depends on the accuracy, completeness, and speed of reliable data and information flows and information systems.

To facilitate and optimize the implementation of the IPC Team and AIAT Task Force activities, Technical Guidelines for Integrated Planting and Climate Change Task Force Calendar (IAARD 2013a) and Technical Guidelines for Climate Station Management (Agricultural Research Agency 2013b) have been prepared, so that each has a clear framework, both in the implementation of technical activities and coordination and communication. This paper aims to determine the potential and opportunities for increasing rice production in Riau Province through applying information systems of integrated planting calendar in order to support government efforts in increasing national rice production towards rice self-sufficiency.

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Rice crop intensity in Riau Province is currently around 1.00-1.25 in a year, this is one of reasons of low rice production in this area. On the other hand, in the last five years (2008-2103) in Riau Province there was a decrease of rice fields areas about 29,726 hectares (23.31%) from 127,522 hectares to an area of 97,796 ha (BPS Riau, 2014).

INFORMATION SYSTEM OF INTEGRATED PLANTING CALENDAR

Planting calendar maps are prepared based on actual conditions in the field and potential conditions using climatological analysis. Actual conditions are known from the planting area and planting intensity, while the potential conditions are concluded through analysis of water availability based on rainfall as shown Figure 1.

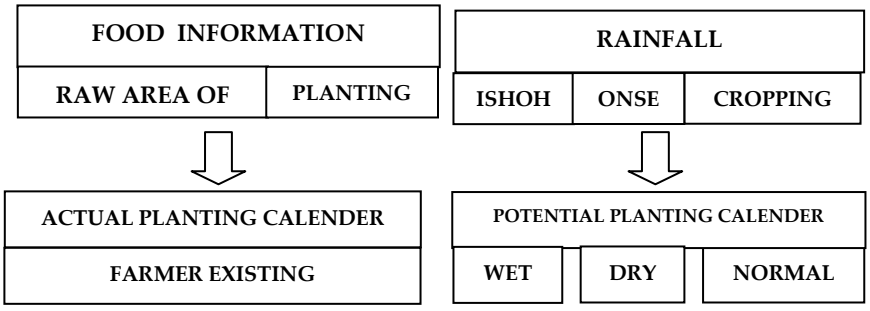

Figure 1. Flow chart for the preparation of actual and potential planting calendar maps

The preparation of the actual planting calendar describes planting calendar that is generally carried out by farmers so far. The analysis was carried out using the average ten daily planting area data per district for last five to nine years period depend on the data availability in each province. The initial planting of cropping season I was determined when 8% of the total areas of the subdistrict rice field in question had been planted with rice. The initial planting of cropping season II was determined when 6% of the total areas of rice fields had been planted with rice. Whereas the initial planting of cropping season III was determined when 2% of the total areas of paddy fields had been planted with rice. The preparation of potential planting calendars uses information of climate/rainfall as the main parameter in determining the onset of planting season. The main components of the planting calendar delineation are rainfall and availability of irrigation water. The activities carried out at the initial stage are inventory of climate resource data, especially rainfall, which are then analyzed to determine rainfall characteristics, namely climate variability, agroclimatic zone, potential onset of planting, and cropping intensity.

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The information system of IPC plays a strategic role in climate change adaptation which is reflected in its ability to inform the condition of the future growing season, which includes the beginning of the planting time of food crops, areas prone to flooding, drought, and plant pest organisms, as well as technology recommendations such as varieties, seed amount, and balanced fertilization. The web-based was first officially launched by the Director General of Indonesian Agency for Agricultural Research and Development on December 27, 2011 with the online publication of System Information Planting Calender Integrated ver 1.0 which contained information on the Integrated Season I Planting Season I (MT-I) 2011/2012. Since then, information system ver 1.0 has been updated five times and has been improved and refined. Indonesian Agency for Agricultural Research and Development updated this information at least three times a year at the beginning of the planting season for all districts in Indonesia.

Each planting calendar atlas contains information on the initial estimates of planting time and the potential planting area of rice plants each season (Runtunuwu and Syahbuddin, 2011a). Estimates are made based on rainfall conditions during excessive (wet), normal, or less (dry) conditions. This rainfall grouping follows the characteristics of rain which are formulated by the Meteorology, Climatology and Geophysics Agency (BMKG, 2012).

The main requirement using planting calendar information is that users need to determine the planting season going forward and the nature of the season's rain (wet or normal or dry). Future planting seasons can be easily set using time periods. The first cropping season starts from September III/October I to January III/February I, the second cropping season is from February II/III to May III/June I, and the third one is June II/III to September I/II. On the other hand, the nature of rain can be known from BMKG which issues regular monthly and seasonal rainfall forecasts every year. The planting calendar Atlas does not contain information on forecasting the nature of this rain so that users have not been able to directly determine the beginning of the planting season ahead (Runtunuwu et al., 2012a)

Development of an integrated planting calendar is a necessity, which is expected to increase agricultural yields and can reduce crop losses due to drought and flooding. Also, an information system summarized in one data base becomes a need to get various information in a fast time. This planting calendar provides complete information for farmers. The operational guidelines are set at the community, and sub-district level.

The crop intensity reflects number of maximum crop rotation which can be done for a year based on climate resource information. This determination is closely related to the amount of ten-daily (10 days) for a year which has a rainfall of more than 35 mm/day (LGP, length growth period).

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Rice farming is done by planting rice-fallow or rice-pulses. But the pattern of planting rice-fallow is more dominant than the pattern of planting rice-secondary crops. Efforts to increase land productivity and at the same time welfare of farmers, need a strategy/program that is supported by appropriate technology that leads to improvement of farm management through increased productivity and farm efficiency, as well as maintaining soil fertility through soil and water conservation measures (Abdurachman et al., 2004).

Fertilizer recommendation considers the actual soil nutrient status in the field and plant nutrient requirements. Status of phosphate (P) and potassium (K) in the soil can be determined by using the Soil Test Tool, soil analysis in laboratory, and Map of Soil P and K for rice with scale of 1:50,000. Based on the test value of soil nutrient status of N, P, K, a dosage of fertilizer for paddy rice is determined.

Fertilizer recommendations for high yielding variety or hybrid rice plants are predicted to be around 20% higher than that of ordinary superior varieties. If information of soil nutrient status is not available, the fertilizer dosage can refer to fertilizer recommendations or Regulation of Ministry of agriculture No. 40/2007 and the revision or reference to other recommendations recommended by the local agencies/extension agencies/AIAT Information of fertilizer recommendations in the revised Regulation of Ministry of Agriculture No. 40/2007 provides the option to use a single fertilizer or compound NPK fertilizer combined with organic fertilizer.

Rice fields in Riau province are mostly swamp land that are located in areas along major watersheds, namely Indragiri river, the river Kampar and Rokan river, Siak River. Riau Province swamp area covers 34,766 ha, consisting of 33,610 ha of tidal swamp land, 953 hectares of swampy swamp land and 203 hectares of other swampland (Table 2).

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Table 1. Recapitulation of Riau Province Cropping Potential Calendar .

No.	district	Adm Index	Large raw rice fields (Ha)	WS 2017 / WS 2018 (Oct 2017 - March 2018)				DS 2018 (April – Sept 2018)				Plant Index (%)
				First Plant		Second Plant		First Plant		Second Plant		
				Early planting time	Area (ha)	Early planting time	Area (ha)	Early planting time	Area (ha)	Early planting time	Area (ha)	
1	Kuantan Singingi	1401	12,255	Sep III - Dec III	11,035	Jan III-Feb III	8.001	April II - June III	7,892	Aug II-IIII	2,587	217
2	Indragiri Hulu	1402	1,866	Sep III-Dec III	1 .690	Jan III-Feb I	586	Mar III - Jun I	1,570	Jul III - Aug III	1,187	19 6
3	Indragiri Downstream	1403	26,302	Nov III- Dec I	24.108	Jan III-Feb I	0	Mar III - Apr I	20,811	Jul III - Aug I	23,411	171
4	Pelalawan	1404	7.211	Sep III - Dec I	6,493	Jan III-Feb I	106	Mar - Jun I	6,819	Jul III - Aug I	1,890	139
5	Siak	1405	4,673	Nov III- Dec III	4,207	0	0	Mar III - Apr III	4,673	Jul III - Aug III	4,673	124
6	Kampar	1406	7,574	Sep III-Dec III	6,820	Jan III-Feb III	5,101	Apr II - Jun III	7,345	Aug II – III	1,425	19 8
7	Rokan Hulu	1407	3,095	Okt II- III	2 .793	Feb II – III	2,630	Jun II - III	1,826	0	0	1 80
8	Bengkalis	1408	6,648	Nov III- Dec III	6.316	0	0	Mar III - Apr III	6,648	Jul III - Aug III	4,253	232
9	Rokan Hilir	1409	13.406	Nov III- Dec I	12,085	0	0	Mar III - Apr I	12,586	Jul III - Aug I	6,892	193
10	Meranti Islands	1410	4,599	Nov III- Dec I	4, 494	0	0	Mar III - Apr I	4,551	Jul III - Aug I	4,599	198
11	Pekanbaru City	1471	10	Dec II - III	1 0	0	0	Apr II – III	10	Aug II - III	10	50
12	City of Dumai	1473	301	Nov III- Dec I	272	0	0	Mar III - Apr I	301	Jul III - Aug I	301	1 6 1
Amount			87,940		80,233		16,424		75,032		51,228	167

Source: IPC for Riau Province (Period of April-September 2018)

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Table 2. Recapitulation of rice swamp planting area. Riau Province. DS 2018.

No.	district	Index Adm	Swamp area (ha)				Estimated Area of Planting (ha)	
			Tidal	Lebak	Others	Total	Rainy season	Dry season
1	Indragiri Hilir	1403	25,491	0	0	25,491	25,491	25,491
2	Indragiri Hulu	1402	964	228	9	1,192	964	1,192
3	Kampar	1406	0	0	75	75	75	75
4	Pelalawan	1404	6,419	100	0	6,519	6,419	6,519
5	Rokan Hilir	1409	736	625	0	1,361	736	736
6	Siak	1405	0	0	128	128	128	128
Amount			33,61	953	203	34,766	33,813	34,141

Source: IPC for Riau Province (Period of April-September 2018)

SWAMP FARMING AND PLANTING PATTERNS

Tidal areas suitable for rice plant development are areas that have a type of waterlogging A, B, and C with a *surjan* system and overlay. The cropping pattern-based paddy field which adjust type of outflow A is rice-rice, while the arrangement of paddy fields or surjan with type of overflow water B is rice-rice and rice-pulses/horticulture (Table 3).

Table 3 . Reference to land arrangement for each land typology and type of overflow in tidal land .

Land Typology	Type of water overflow			
	A	B	C	D
Potential	Rice fields	Rice fields / grain	Rice fields / grain / gardens	Rice fields / fields / gardens
Wry Sulfate	Rice fields	Rice fields / grain	Rice fields / grain / gardens	Rice fields / fields / gardens
Peat	Rice fields	Rice fields / grain	Rice fields / grain / gardens	Rice fields / fields / gardens
Shallow peat	Rice fields	Rice fields / grain	Rice fields / grain / gardens	Rice fields / fields / gardens
Medium Peat	Rice fields	Conservation	Gardens/Plantation	Plantation
Deep peat	Rice fields	Conservation	Gardens / Plantation	Plantation
Copy	Rice fields/ponds	Rice Fields / Ponds	-	-

Source; Widjaya Adhi (1995) and Alihamsyah et al . (2000)

Rice productivity in Riau Province is still low with ranging of 3.5-4 ton/ha and the average planting index is once a year. Increased rice production can be achieved through increasing the quantity of crops, through the expansion of the area and increasing the cropping index. The productivity can be increased through using new high-yielding varieties, increase in irrigation networks,

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fertilization application according to plant nutrient requirements, plant maintenance (control of plant-disturbing organisms) and reduce the loss of rice yields at harvest.

Increased rice production can reach 5- 6 ton/ha through introducing rice science technology such as new superior seeds , fertilization, amelioration, pest control (Alihamsyah et al., 2003). According to Abdullah et al. (2008), one of reasons of low rice production is the achievement of optimum yield potential from new high yielding varieties planted by farmers or limited genetic capacity of superior varieties that exist for higher production (Balitpa, 2003).

Refer to the Rice Planting Calendar Potential recapitulation of Riau Province, the first index cropping in WS 2017/2018 (October 2017-March 2018) and the Constitutional Court in 2018 obtained rice cropping index of 167%. With the increase in the index of planting and use of fertilizers according to the recommendations it is expected that it will be followed by an increase in rice yield.

CONCLUSIONS

1. Rice filds in Riau Province have great potential and prospects for agricultural development, especially in supporting national food security. Refer to the Recapitulation of Riau Province cropping potential calendar, planting season WS 2017/2018 (October 2017-March 2018) and DS 2018, rice cropping index was 167%. Increasing cropping index is expected to be followed by an increase in rice yield.
2. The application of cropping calendar fertilizer recommendations can increase rice yield by 24 percent in Riau Province. Indonesian Agency for Agricultural Research and Development has produced Information System of Integrated Cropping Calendar ver 1.3 which is accessed through litbang.pertanian.go.id or balitklimat.litbang.pertanian.go.id. This system is a guideline or tool that provides spatial and tabular information about prediction of season, beginning of planting, cropping patterns, potential planting area, flood and drought-prone areas, pest attack potential, rice varieties and seed requirements, as well as dosage recommendations and fertilizer-based requirements, prediction of climate variability and change at the sub-district level in Indonesia.
3. Regulation of Minister of Agriculture No. 45/2011 explains that the IAARD is responsible for the development and implementation of the planting calendar, both in the formulation, socialization, field validation, and climate change adaptation and mitigation efforts.

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