User guide of "Science based information sharing derived from Earth Observation Satellites for agriculture management in the ASEAN Region"

How to interpret JASMIN in Rice Growing Outlook

December 2021

Content

I. Preface

This guide explains “How to interpret JASMIN for Rice Growing Outlook” to **the officers who are working for the agricultural statistic and rice growing outlook nominated by ASEAN Member States** (hereinafter referred to as “agricultural statistician”) **and Engineers / researchers who are nominated by SCOSA and in charge of delivering satellite-based information for agriculture** (hereinafter referred to as “space engineer”), based on the **project** “Science based information sharing derived from Earth Observation Satellites for agriculture management in the ASEAN Region” (hereinafter referred to as “project”) funded by the Japan-ASEAN Integration Fund (JAIF).

The aim of the project is to enhance the use of agrometeorological information like precipitation, temperature, soil moisture in the ASEAN region through capacity building. These agrometeorological information are provided through the satellite based agricultural weather information system (JASMIN), which was developed to support rice crop outlook information provision of FAO AMIS under the cooperation of the ASEAN Food Security Information System (AFSIS) and JAXA

This guide was designed to demonstrate and instruct participants the appropriate use of JASMIN information to utilize to assess the growth status of paddy.

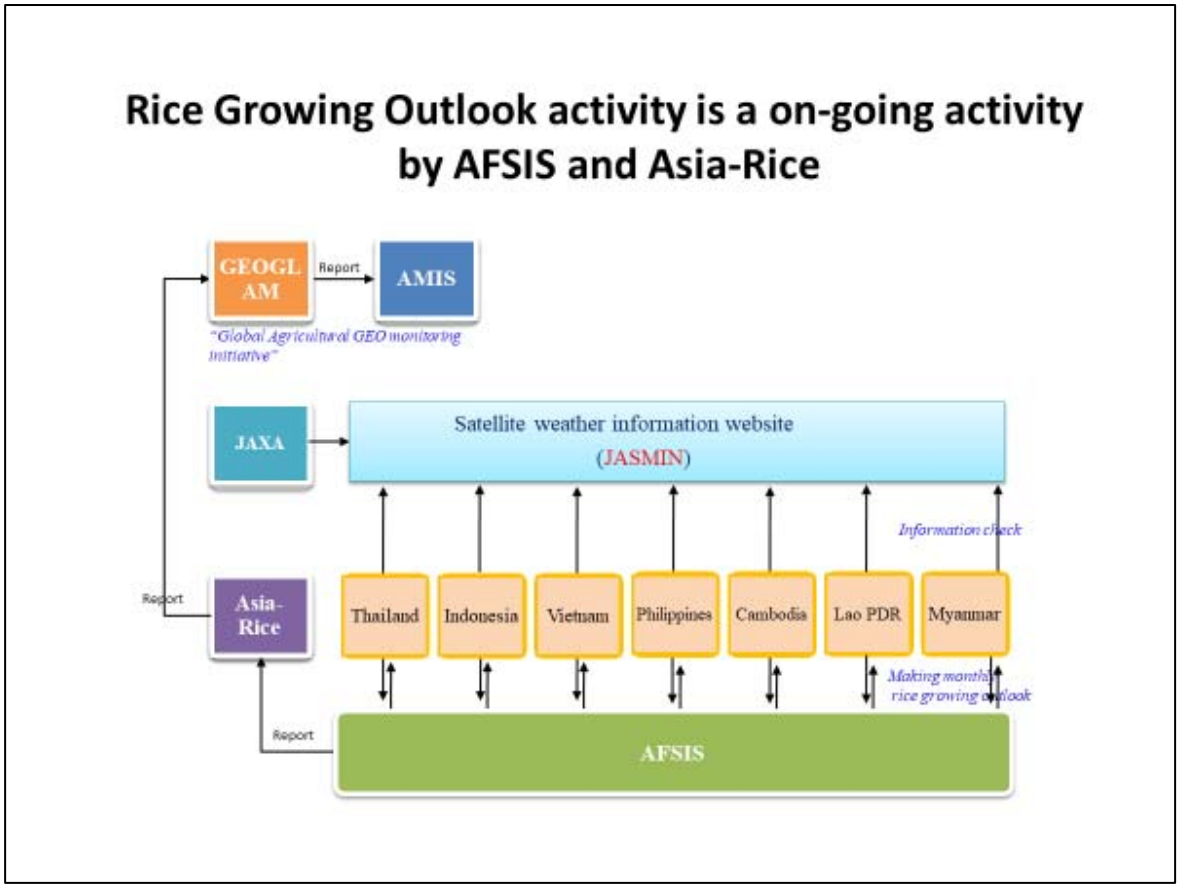
One of the main targets is to establish a technical procedure and then combine the use of weather related information while compiling rice growing outlook reports by agricultural statisticians for their present and future work.

On the other hand, this will help the space technology experts to have a clear understanding of the use of satellite observations in the field of agriculture.

For detail explanation of the operation of JASMIN system and accessing data/information, please refer to Dr. Yessy's lecture materials.

II. Rice growing outlook activity

Figure-1: Rice Growing Outlook Activity by AFSIS



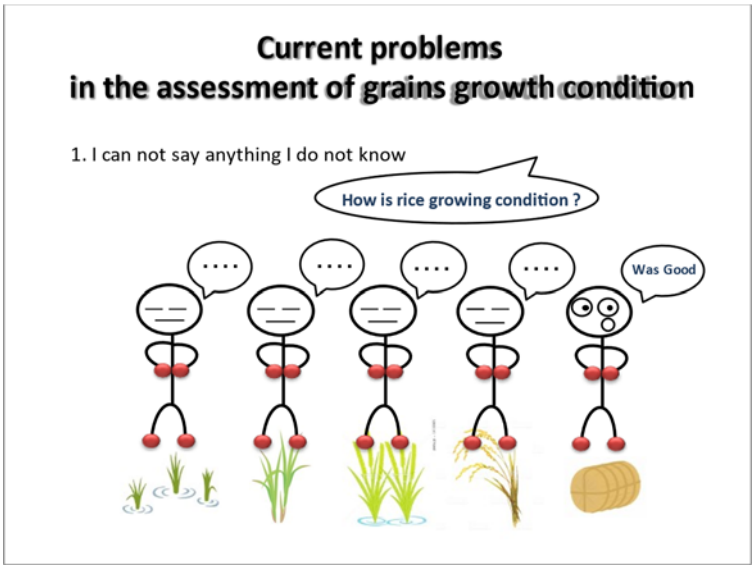
Rice is the staple food as well as the most important commercial crop in South East Asia (SEA). The importance of weather information has proved to be a part of the estimation of rice crop growth, its production, and the probable yield. Therefore, to grasp rice growing condition in timely and more precisely in SEA countries, a satellite- based agricultural weather information system (JASMIN) was developed and launched as part of the Asia-RiCE-GEOGLAM activities. This project was initiated in October 2013 as a collaborative work between Asia-Rice Team and the ASEAN Food Security Information System (AFSIS) .

On the other hand, AFSIS was established by ASEAN countries is to strengthen food security in the region through the systematic collection, analysis, and dissemination of food security related information in ASEAN. Started with the collaboration of few countries, currently 7 member countries generates monthly rice growing outlook reports. These outlook reports are primarily based on actual rice field condition, and the use of JASMIN information was started since the launch of the current project. AFSIS secretariat scrutinizes each country's outlook and shares them with Asia-Rice Team. Subsequently, these outlook reports are pass on to GEOGLAM (Group on Earth Observation developed the Global Agricultural Monitoring) and FAO-AMIS.

The definitions used in this guide conform to the definitions used in this rice growing outlook activity by AFSIS.

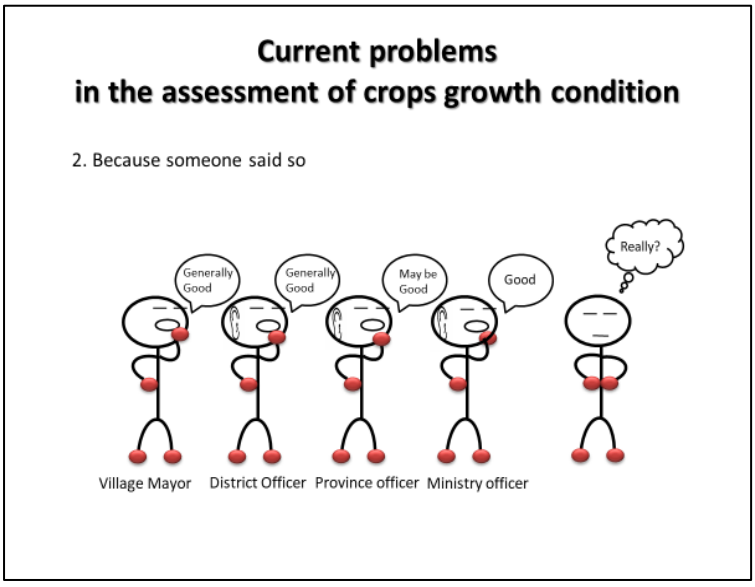
In the agriculture sector, exporters, importers, brokers, insurance companies, food companies, producers, etc. are interested in current condition of a crop in given country. Given this high demand for information, government agriculture statistical authorities have an obligation to publish accurate and timely information of agriculture crops of their jurisdiction.

Figure-2: Current problems in assessment of grains growth condition 1



There are problems in assessing the rice growing status. One problem is to assess and publish the the current situation. This is a problem in many countries, and the reported status may not represent the actual growing status. Or, in most cases it may not be possible to ascertain about the growing status until the final production. The timing of data publication by statistical organization poses problems to appropriate use, but the difficulty that the statistics organization grasping the correct condition during the growing season could set back the timing of the publication and accuracy of information.

Figure-3: Current problems in assessment of grains growth condition 2



This situation could further amplify as the determination of crops growing condition assessment relies mainly on reports from local offices. This mechanism of information gathering by the local offices is valuable and proven system implemented in almost all the countries. Unfortunately, this reporting process is very much subjective and the officers who collect the local information are not provided sufficient and appropriate tools to make rational estimates.

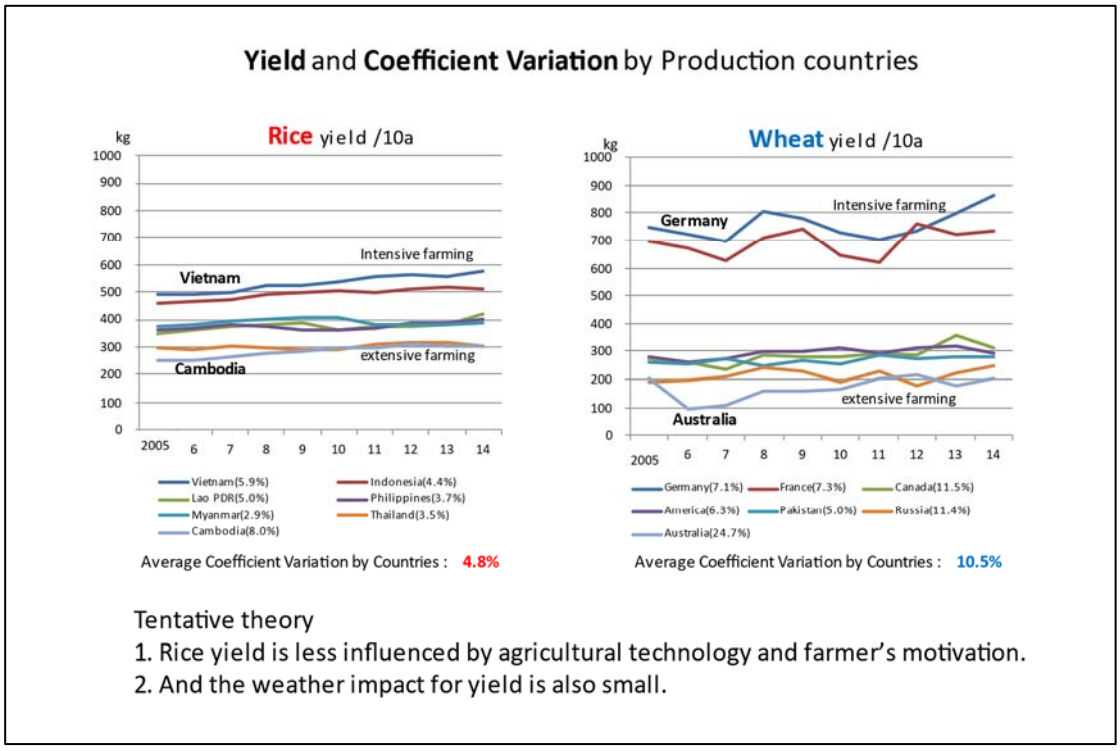
In fact, it would be ideal to provide rationale evidence during the assessment of crop growth condition. One approach to solving these problems is the use of rice growing outlook technique.

III. Characteristics of rice growth in SEA

The below is a very brief summary about the characteristics of rice growth in Southeast Asia.

>Most rice is grown in flooded paddy fields.
>The growing season is roughly divided into the rainy and dry seasons.
>Dry season rice is only planted in fields with irrigation facilities.
>Growth period of rice is about 4 to 5 months.
>The average yield is 3 to 6 tons per hectare.
>SEA's climate is suitable for rice growth.
>When compared to other crops, rice yield is stable, therefore farmers tend to continue growing rice.

Figure-4: Yield and the coefficient Variation of crops by Producing countries



The graphs in the figure are very interesting. These graphs show country specific characteristics, and the changes of different crops for 10 years. It is possible to say the rice yield is less influenced by technological methods and farmers motivation.

Grain-production countries are divided into intensive farming and extensive farming

countries, mainly according to their cultivation conditions. In wheat, Germany is a representative country of intensive farming, and Australia is a representative country of extensive farming. The difference in yield between both farming is about 4 times. In rice cultivation, Vietnam is a representative country of intensive farming, and Cambodia is a representative country of extensive farming. The difference in yield between both farming is less than two times. This means that the rice yield is less influenced by agricultural technology and farmer's motivation. Also, annual variation rate of rice yield is less than half of wheat. During 2005 to 2015, the variations are 4.8% and 10.5% for rice and wheat, respectively. This can be interpreted as the weather impact on rice yield is very marginal and from this it is possible to deduce that the rice yield is stable.

IV. What is outlook

Outlook is a written document that provides crop information as a write-up, but not in numerical figures. If we are given information in a wording like "rice growing condition is good", this sentence is definitely an outlook information since this is an worded statement, which is very subjective and the reader will get very general information about the rice crop.

However, the information that "rice growing condition is good" is too vague for certain readers like planners, administrators, producers, exporters etc.. If we convert the information given here into the 5W2H tool (**When, Where, Who, What, Why, How, How much)**, the sentence of "Rice growing condition is good" becomes "The rice *(who*) growing condition (*what*) in the northern region (*where*) of June (*when*) is good (*how*) than last year (*how much*) due to enough rain (*why*)."

In addition, it is necessary to write "outlook" under common rules in order to publish (open) this sentence as a rice growing outlook. The rules (definitions) need to have a proper background based on crop science, statistics and other related fields. In this guide the rules that are defined for "Rice Growing Outlook Activity" by AFSIS, further described using the 5W2H concept.

IV-1. When

The identification of exact growing stage, "when", is important in the rice growing outlook in addition to simply naming only the month.

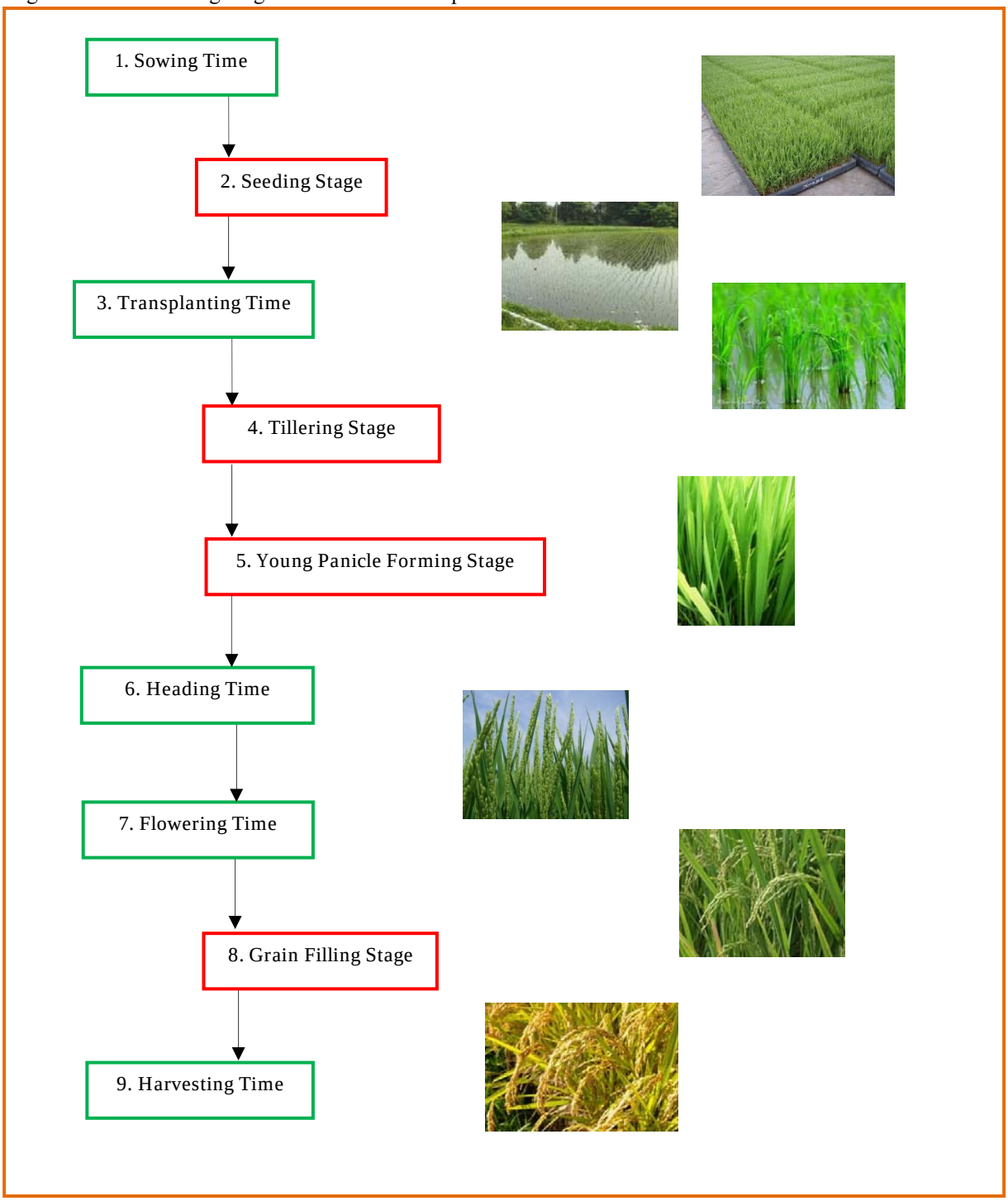
The growing processes of rice crop are classified into the vegetative phase, when the roots, leaves and stems grow up and become enlarged by the changing of weather, water, nutrients etc.; the reproductive phase, and the ripening phase, and so on. These growing processes are named as the "Growing stages". The descriptions of the growing stages are important components for interpreting how the weather condition and disaster affect the projected growing condition as well as how they inform the growing condition at the observation time. Therefore, it is essential to specify the *growing stage* at the observation time as a component of the *growing outlook*. The names of rice growing stage are known widely for the dissemination of proper cultivation management. Four growing stages are described in the

outlook, namely the **"Seeding stage",** the **"Tillering stage",** the **"Young Panicle Forming stage",** and the **"Grain Filling stage".**

Moreover, the rice growing stages also include "Sowing time", "Transplanting time", "Heading time", "Flowering time", and "Harvesting time" as benchmarks showing the time of agricultural work and rice growing activities. These time benchmarks are described at the indication of delay of agricultural work and growing as necessary (this line is not very clear).

The following page shows the symmetric relation between the general rice growing stages.

Figure-5: Rice Growing Stages on Outlook Description



IV-2. Where

This specifies the area from where the information comes. The area classification corresponds to the **defined statistical classification by country**. In the outlook, it is not necessary to specify the exact location such as the province or the district. Below shows the area information provided by GEOGLAM Secretariat on rice growing condition in South East Asia Countries. Similarly, it is sufficient to provide area under these broad localities.

Table-1: Assessment area of rice growing outlook by GEOGLAM

Country	Area	Country	Area
Indonesia	Java	Myanmar	Delta
	Kalimantan		Dry Lands
	Sulawesi		Inland Mountains
	Sumatra		Rakhine
	Lesser Sunda Islands	Philippines	Mindanao
Cambodia	Elephant Mtns		Central Philippines Region
	Eastern		Luzon Urban Beltway
	Mekong Lowlands		North Luzon
	Northwestern	Thailand	Central Plain
Lao PDR	North		Northeastern
	South		Northern Region
		Vietnam	North
			South

IV-3. Who

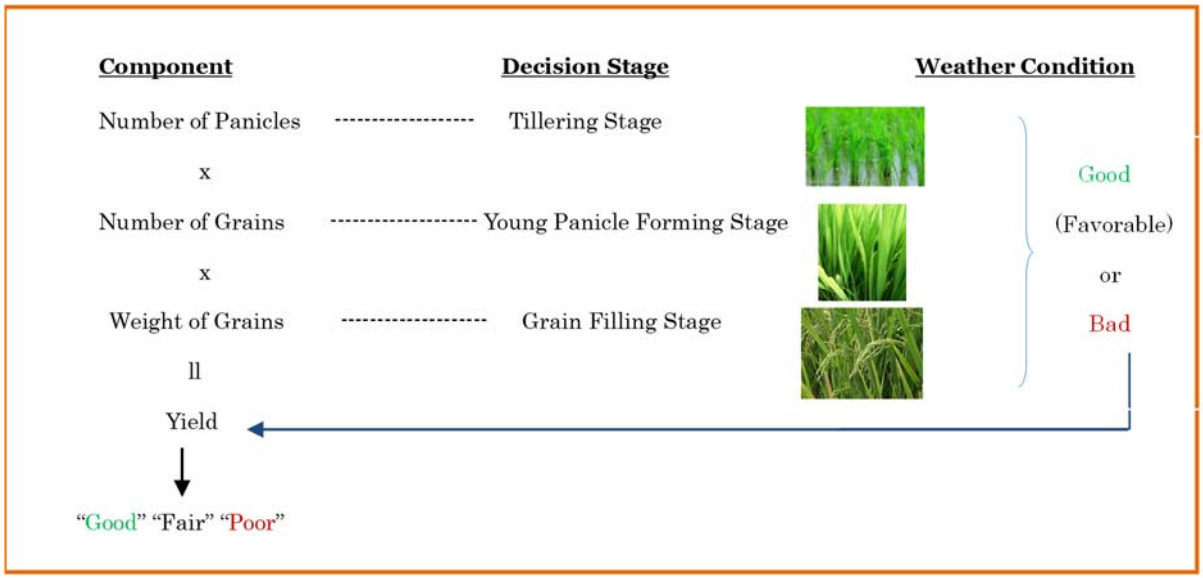
The growing season of rice is roughly divided into wet and dry seasons. Therefore, rice is classified into the “wet season rice” and “dry season rice”. It may be called in the more common name like major rice or summer rice etc., however however it has a priority the rice classification of wet season or dry season.

IV-4. What

"Who + What" defines ~~becomes~~ the growth condition of rice. Outlook writer needs to recognize that the "growth condition" is different by the "growing stage" defining the "When". In fact, the outlook clears the current growing condition by the manifestation of rice growing stage like "Seeding stage", "Tillering stage", "Young Panicle Forming stage", and "Grain Filling stage".

Moreover, it's possible to describe "number of panicles", "number of grains" and "weight of grain" of the rice yield component "What", because rice yield is decided by these components. Multiplications of these three components become the final rice yield. In fact, a paddy with many panicles and grains, and heavy weight grains can certainly provide a good yield. The situation in which there are many panicles and many grains, but light weight grains, is also possible. Growth condition in the outlook provides the attributes of these three components, and it goes without saying that these components can be affected by the weather condition. The following chart shows a basic yield model.

Figure-6: Rice yield component and decision stage



The growing stages that indicate as the yield component stage are Tillering stage, Young panicle forming stage and Grain filling stage. Below is a brief description of each stage

IV-4-1 Tillering stage

In tillering, the number of stems is increased by separating them from the nursery. Tillering starts from about ten days after transplanting. The tillers which are separated from the main stems are called the first tillering, to be followed by the second and the third tillering. The withered tillering (non-productive tillering) increases after the maximum tillering stage. For this reason, water is drained from the field to stop the tillering (mid-summer drainage) after getting the adequate number of stems.

The tillering stage is one in which “the number of panicles” in the rice yield components are formed. Specially, it is necessary to observe the **solar radiation** in this stage. The tillering is increased under good weather (adequate solar radiation), resulting in the proper number of stems (15-20) and therefore securing the necessary number of panicles for a good growth. On the other hand, the number of stems will not be secured, hence the number of panicles will not rise to the expected level if the tillering stage is inhibited by the cloudy weather condition and less solar radiation. The low temperature can also become an obstructive factor for tillering.

Picture-1: Tillering (To separate a new stem from the parent nursery)

IV-4-2. Young Panicle Forming stage

The Young Panicle Forming stage is when the young panicles are formed. After the tillering stage, “the differentiation of the glumaceous flowers” starts approximately one month before the heading, when the young panicles become visible, and the leaves become straight in shape.

The Young Panicle Forming stage is one in which “the number of grains” in the rice yield components is formed. Care must be taken in monitoring the **precipitation** during this stage when water is most needed. The lack of agricultural water inhibits the elongation of panicles, and it also becomes difficult to secure an adequate number of grains. Low temperature also becomes an obstructive factor for panicle growth.

Picture-2: Young Panicle Forming (To generate the archetype of paddy)

IV-4-3. Grain filling stages

Grain filling is the period when rice grains grow in the paddy. Absorbed from the soil and accumulated in the stems and leaves, the nutrients and the moisture are translocated to the paddy during the grain filling stages, and the leaves lose color gradually.

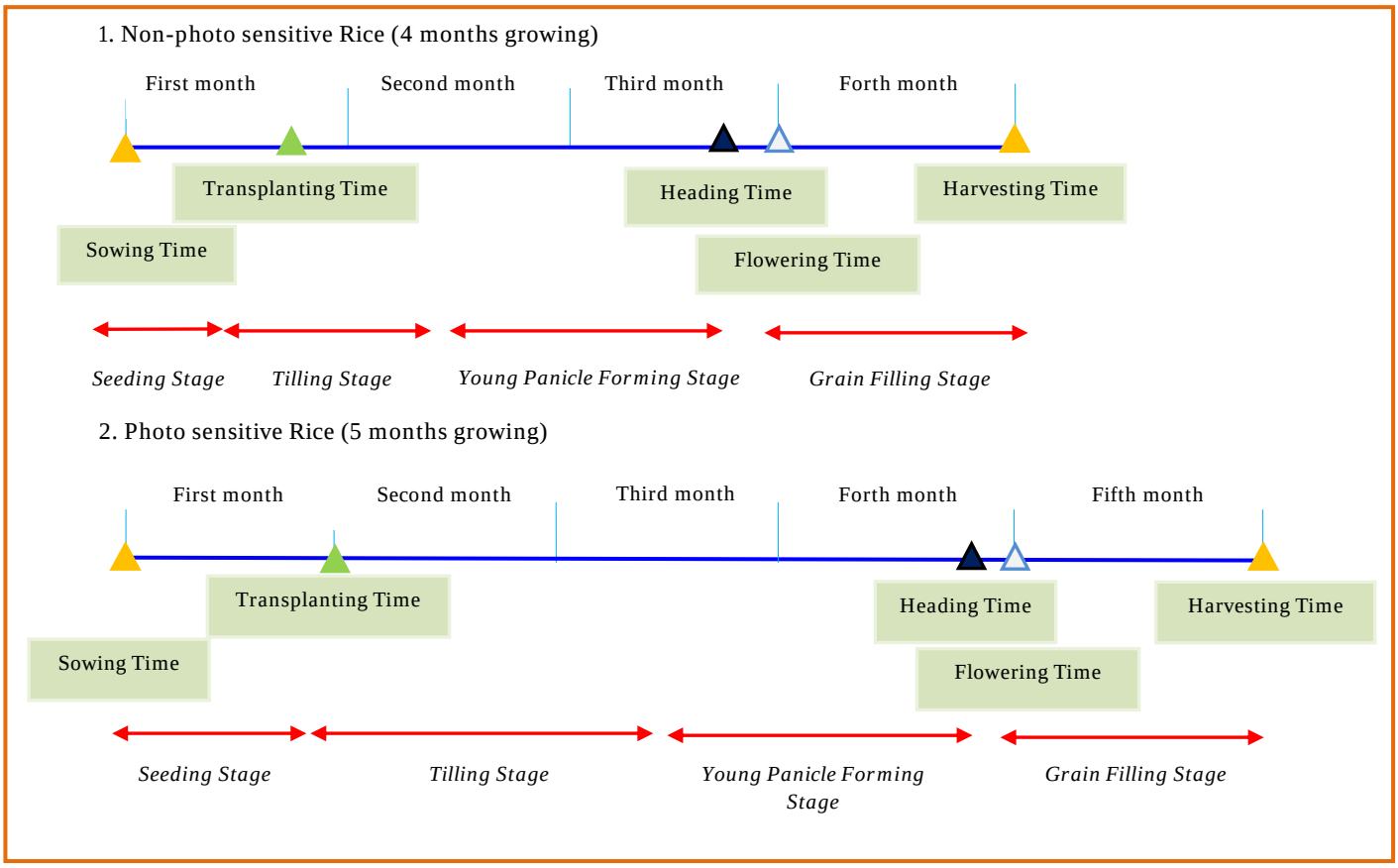
In the grain filling stage, one of the rice yield components, "the grain weight" is formed. The **precipitation** and **solar radiation** must be closely monitored in this stage. During the first half of the grain filling stage, the water supply must be carefully managed for the nutrients and moisture, absorbed from the soil and accumulated in the stems and leaves, to translocate to the paddy. In addition, the active photosynthesis fills the grains by producing starch. Meanwhile, the high temperature at night brings up the risk of yield decrease and rice quality loss.

Picture-3: Grain Filling (Grains grow and enlarge)

IV-4-4. Growing stages of Indica rice

Figure-1 shows the monthly growing stages of Indica rice in Thailand, indicating the period of each growing stage and the time benchmarks of agricultural work and growing activities as defined in this manual in a simple overview. It shows the growing stages of two types of rice: the "Non-photo sensitive Rice" and the "Photo sensitive Rice". It is a basic work to identify the growing stage at the time of writing the outlook. Other countries are also requested to clearly specify the growing stages based on the growing condition in the country in order to write a proper outlook.

Figure-7: Rice Growing Stage (Simple overview)



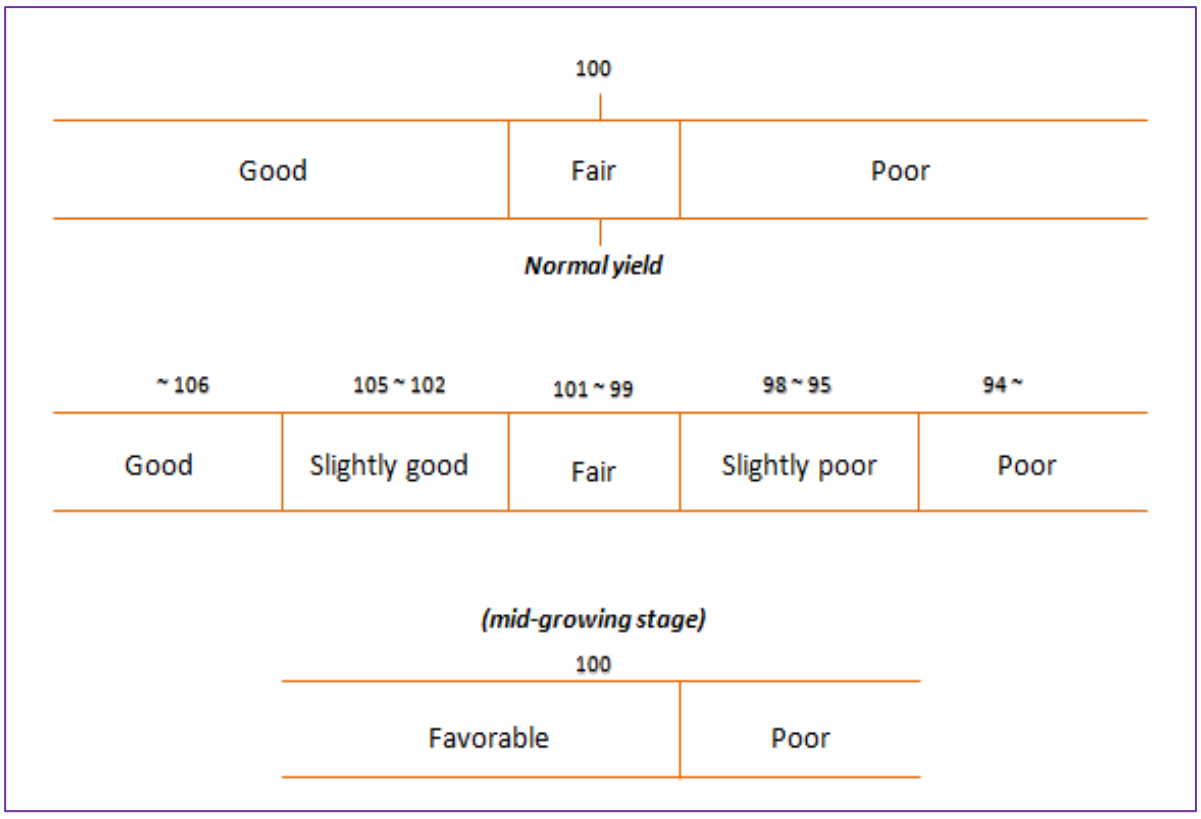
IV-5. How

One of the key information that an outlook reader wants to know is this "How". The rice growing condition of each month can be evaluated as "**Good**", "**Fair**", or "**Poor**". It can also be described as "**Slightly good**" or "**Slightly poor**" as it is necessary. In addition, the depictions like "Early" and "Late (delay)" also are described in rice growing outlook.

In terms of rice growth, it will be helpful to have "good" or "fair" in case of no growth injury. And it will be appropriate to use "poor", in case a damage and delayed growth due to weather disaster and the damage by diseases or pests are confirmed.

The following chart shows a rice yield index which is used by Ministry of Agriculture, Forestry, and fisheries in Japan. This index is used as a guide in this activity.

Figure-8: Rice yield index



The yield assessment is **determined by the rate of the final yield estimation compared with normal yield.** The "Normal yield" is 100, "Good" is ～106, "Slightly good" is 105～102, "Fair" is 101～99, "Slightly poor" is 98～95, "Poor" is 94～. However, this measurement is suitable for objective assessment through the interview or monitoring of the growing condition in the mid-growing stage. Additionally, the growing condition in the mid-growing stage can also be rated as "Favorable", which is a combination of "Good" and "Fair".

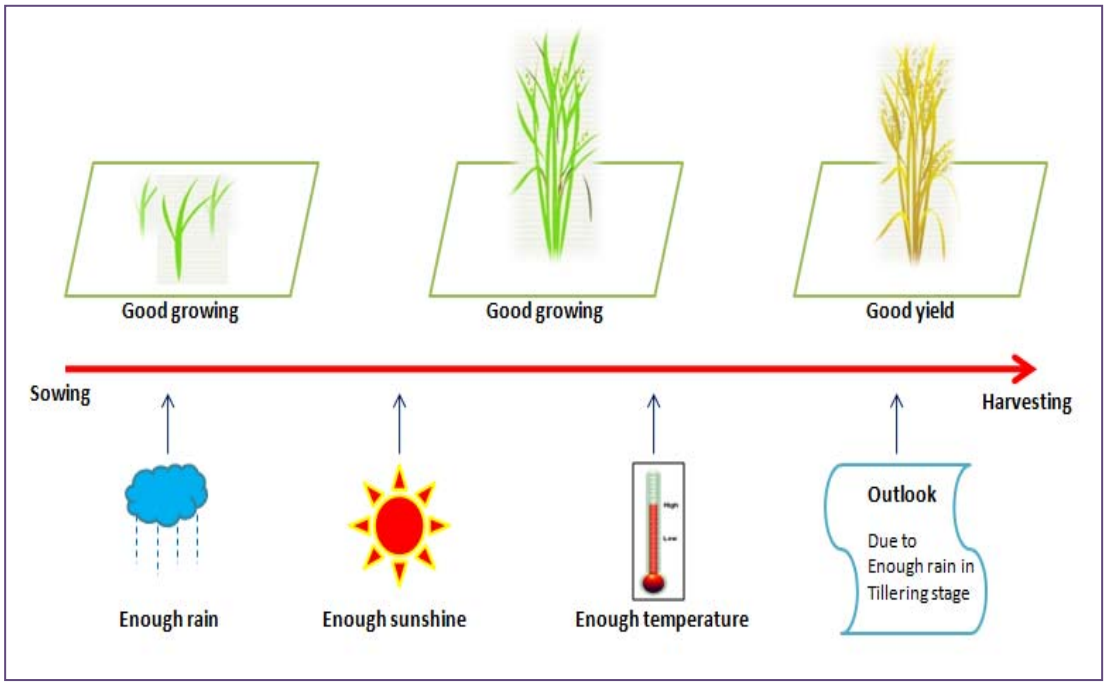
IV-5-1. Attention points on the assessment of rice growing condition

The assessment of the growing condition has to be concluded by different outlook writers through a common perspective and common rules for writing the rice growing outlook. Here are some attention points on the assessment of the growing condition.

The rice growing situation and damage conditions have a causal connection with both the past and the present weather conditions.

Rice growing outlook describes the growing condition in each month, and any sizable damage has happened or forecasted. It should be noted, that the growing condition has a causal connection with both **the past and the present weather conditions**. There are many cases where the past weather conditions can influence the present rice growing condition.

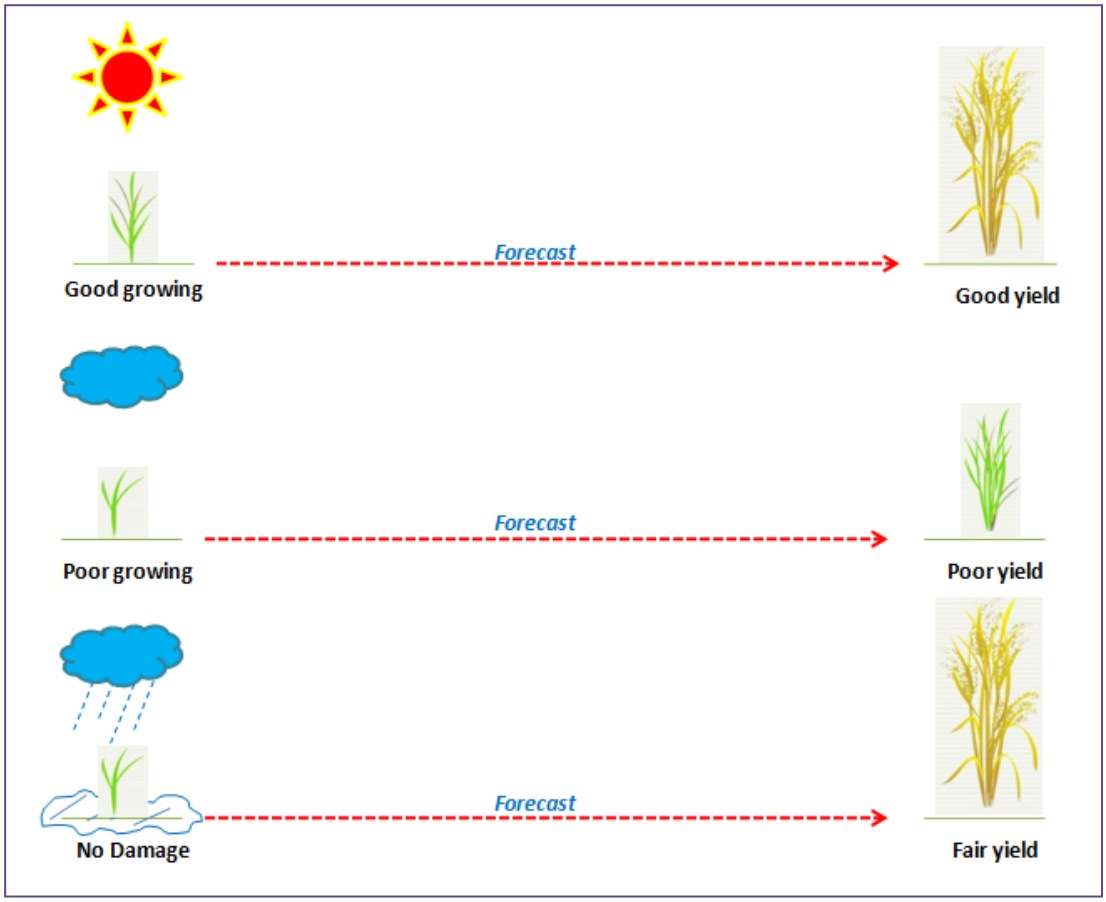
Figure-9: Causal connection with the weather condition in the past time



The growing condition is estimated against the assumed final yield

The growing condition in the mid-growing stage is **estimated against the final yield**. In fact, the good rice growing condition at the mid-growing stage means that a good yield would be forecasted, given the growing trend continues. Conversely, with a poor growing condition at the mid-growing stage, a poor yield would be forecasted. The influence of possible weather related disasters have to be taken into consideration as well. The outlook will not indicate the situation as "Damage", if it is assumed that the weather hazard does not have an impact on the yield (e.g. short time flood).

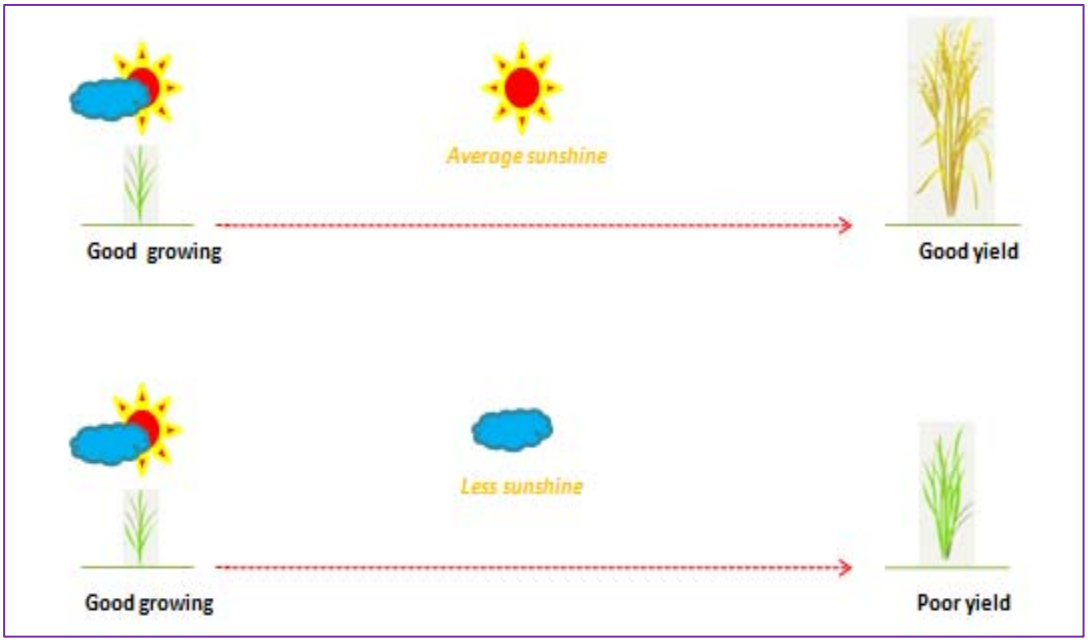
Figure-10: Criterion of rice growing condition



The yield forecast is assessed as “the yield in the absence of damage from this time”. Therefore, the good or poor growing condition in this month does not necessarily result in the good or poor final yield.

The rice growing condition in the mid-growing stages determines the yield forecast at the observation time. In this case, the final yield is forecasted by **the yield in the absence of damage from this time**, in case the future weather condition is assumed to shift to the average condition. It is possible that a yield might become poor through the subsequent weather condition, even though the growing condition has been assessed as good at the observation time. The growing condition assessed in the mid-growing stage does not necessarily determine the final yield.

Figure-11: The yield in the absence of damage from this time



IV-6. Why

"Why" shows the reason of growth condition. The outlook writer needs to recognize that the outlook value without "Why" the reader may not be able to grasp the whole situation correctly. As explaining in "How" section, "good growth" translate to "high yield is expected". Therefore, the trend factors affecting rice yield become the "Why". Incidentally, the trend factors affecting rice yield are called "**yield requisites** of rice".

IV-6-1. Yield requisites of rice

"Yield requisites of rice" is defined in this manual as the requirements of rice growing condition as "caused by the weather condition". So, is the rice growing condition (yield) determined only by the requisites of weather condition? Table-2 shows the known yield requisites of rice.

Table-2: Yield Requisites of Rice

Requisite	Main Phenomenon or Event	Condition	
		Good (High)	Poor (Low)
Agricultural Technology	・Irrigation ・Breed improvement ・Fertilizer, Agricultural chemical ・Agricultural machine	Increase in yield	Non-increase in yield
Motivation of Farmer	・Market price ・Agriculture policy (Subsidies)	High fertilization management	Low fertilization management
Weather	・Precipitation ・Solar Radiation ・Temperature	Good harvest	Poor harvest ・Weather disaster ・Growth injury ・Other damage (disease and insect)
Others	・Field capacity ・Field environment	High yield	Low yield

In general, rice yields have increased through the progress in **agricultural technologies** such as the irrigation system, use of fertilizers, pesticides, mechanization, and breed improvement. However, these agricultural technologies **should be considered as a long-term** requisite for the mounting rice demand with the increase of the population. It should not be considered as a requisite of the growing condition (yield) in the outlook over an **extremely short period**.

Moreover, a farmer's motivation is also a vital factor for a high yield. It is known that the farmer's motivation for **a fertility management** increases due to the high market prices, subsidy policy by government, and so on. With these incentives, rice production and the yield increase. Although the farmer's increased motivation appears to be directly represented by the increase in planted areas, it is difficult to measure the degree of influence from the farmer's motivation. Therefore, it is not very proper to describe the market price and policy as requisites for the growing condition (yield) in the outlook.

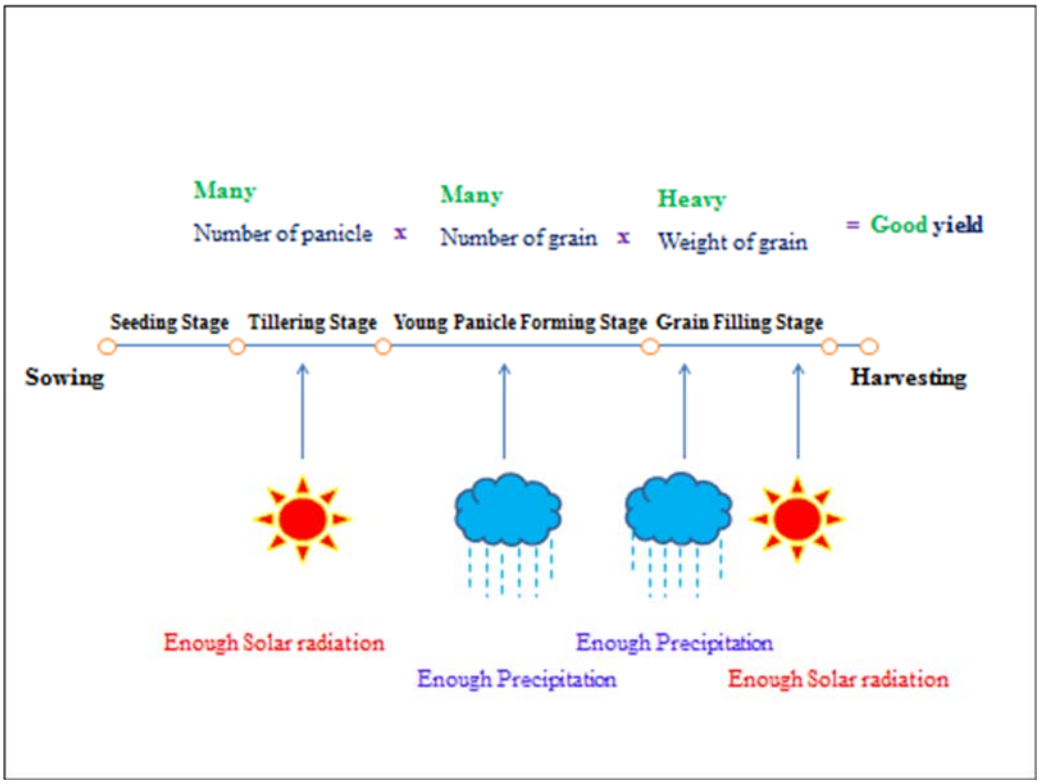
In addition, the field capacity and environment surrounding would also exert some influences to yield -- the so-called "good soil". It is the fundamental capacity of the soil of the paddy field, and it is not an external factor. Therefore, it is not included in the yield requisite in this definition.

However, it is important to understand that the rice growing outlook is a method which clarifies the rice growing condition at an observation time and indicates the forecast of the yield at the harvesting time. **It is not a method of measurement for a whole production of rice**. Therefore, in this guide the requisites of rice growing are defined by the rice growing condition and weather damage condition that are related to precipitation, solar radiation, and temperature.

IV-6-2. Rice growth and weather condition

It is difficult to assess "the good weather for rice growing" by any standard. Although the proper precipitation helps rice growing, high precipitation could be an obstacle. The solar radiation and temperature also present a similar problem for assessment. Moreover, it has to estimate that the "Proper situation" is different by each field condition. It is impossible to assess the rice growing condition by weather condition only, even if the satellite systems can provide remarkable weather data. On the other hand, it is an undisputed fact that the weather condition has a big impact on rice growing. It can imply that **"good growing" means "the weather condition is (was) good for rice"**. In fact, the assessment of rice growing condition is a comprehensive work that needs experience in surveying and observing the surrounding, interviews with local offices and related parties, and the use of weather data.

Figure-12: The relation of rice growing and weather



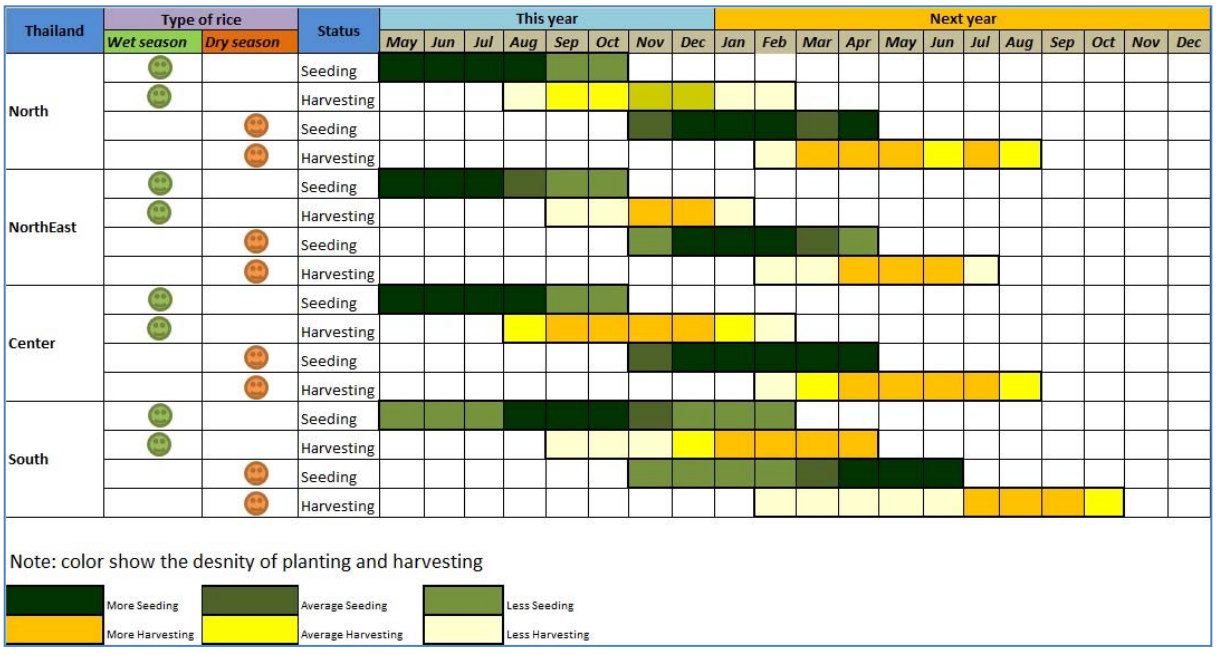
V. Crop Calendar

South-East Asia region is located in the tropical climate zone. Rice is the major crop in this region and it is a year-round crop. In fact, all season rice is in sowing season, growing season or harvesting season on any month and in any area. The outlook provides an update on the situation monthly.

In the growing outlook, it is important to describe accurately the components indicated in Section IV. For this reason, it is useful to prepare a crop calendar which shows the annual rice growing periods by each main planted area and rice growing season. The crop calendar is prepared by general agricultural statistics institutions for their monitoring work to greater or lesser degrees.

Below is an example of the crop calendar prepared by the Center of Agricultural Information, Thailand. By establishing a division of high-season and low-season sowing and harvesting, this crop calendar proficiently facilitates the assessment of what should be described as the rice growing target according to the outlook of a given month.

Figure-13: Thailand crop calendar



VI. Damages

The damage to the rice yield can be classified into 3 categories; weather disaster, growth injury, and insects and disease.

The **weather hazard** can cause direct damage to rice cultivation through flood, drought, etc. It is relatively easy to gather information on weather disasters through newspapers specific reports, etc. The weather condition at the disaster areas can be observed as an anomalous value in the meteorological satellite data. However, these weather disasters might have less impact on the growing condition on the national level, except when they affect wide geographical areas and are seriously destructive. Therefore, the weather disasters and potential weather hazards are important to describe as damage factors in the outlook.

The lack of precipitation and solar radiation have indirect impacts on the growing condition and are classified as **growth injury**. The growth injuries occur widely, and they are weather damages which bear the most impact on the rice growing condition. It is an essential and important that rice growing outlook writer assesses growth injuries that are caused by precipitation, solar radiation and temperature conditions in each yield component stage. The growth delay by weather condition also falls within this category of growth injury. Further, it is requested to monitor the growing condition as well as the growing speed.

The last damage type is the damage caused by **diseases and insects**. There are many cases in which the weather condition causes disease and insect damages. It is valuable to assess in the outlook as growing condition factor if these damages extend to wide areas and are expected to impact the yield. However, it is necessary to note that, depending on the damage level, **these damages do not always result in yield decrease**.

Picture-4: Flood and Drought damage for paddy

VII. Interpretation of Meteorological Satellite data

The previous section explained the relationship between rice growth and the weather condition mainly considering the formation of rice growing outlook. This section will explain the specific way of interpreting the meteorological satellite data. It is important to note that the weather condition and growing condition are entirely assessed by observed data, therefore, it is mandatory to **complement the interpretation by an actual surveys and interviews** for actual practice and real usage. In this exsample, time series data of Nakhon Sawan province, Thailand were used. Further, this example targets wet season where the sowing was done in the middle of June and harvesting in the middle of November.

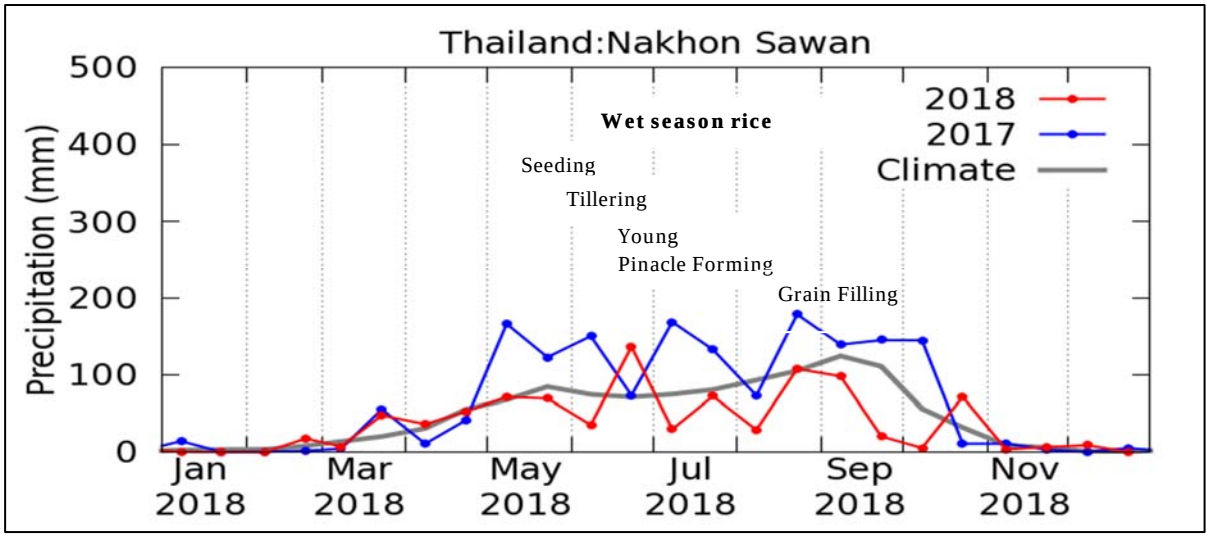
VII-1. Time series graph

First, the time series graphs of the climate must be examined to find the climate trend of the rice cultivation. These graphs present the data on the climatic conditions of the past years and from them the average values, or the "normal-values", for the climatic condition can be derived. Use of long-term data will answer the question whether these normal-values represent a suitable climatic condition for rice growing or not. To determine whether the climatic condition in a given year is normal, and whether climatic condition is going to affect the growing condition, values of a given year can be compared with these normal-values. The growing condition is considered normal if the climatic condition values of a given year has similar values of the normal-values.

The "climate" time series graphs are also used for verification of the climate data in the event of a weather disaster. On the other hand, although the time series graphs of "last year" facilitate the comparison of the growing condition in this year, the weather condition of this year is basically assessed against the normal-values.

VII-1-1. Precipitation

Graph-1: Precipitation (JAXA-JASMIN: Time series graph)

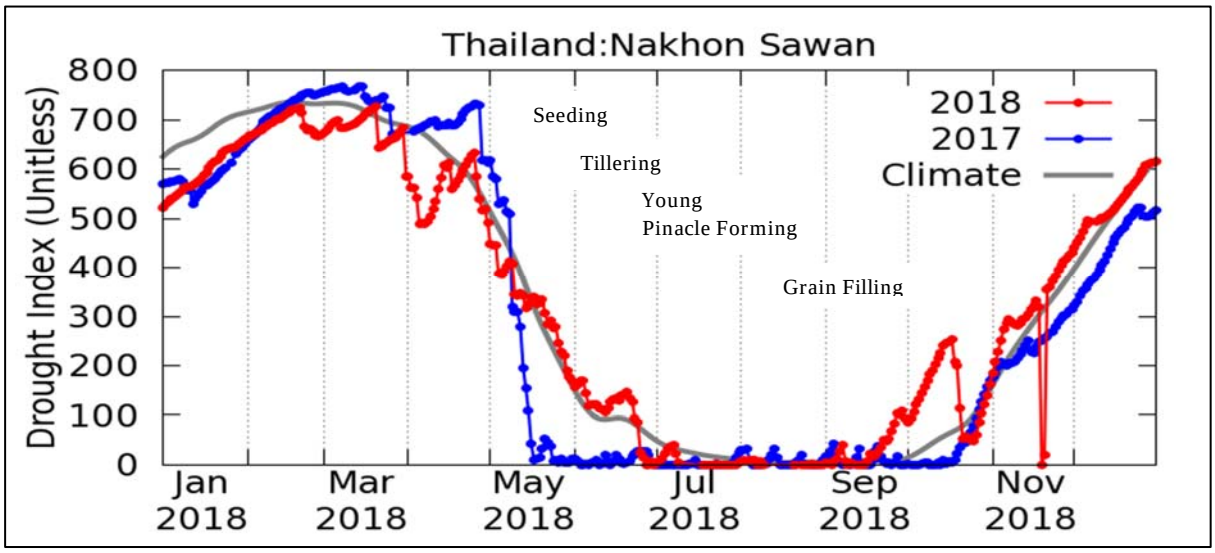


The precipitation trend is a weather condition that affects the growing condition considering the rice cultivation by flood irrigations. Specifically, The precipitation condition for the wet season rice must be monitored because the rice cultivation in rain-fed paddy fields that relies on the level of flooding paddy fields are prevalent in the region.

In 2018, it was feared that Nakhon Sawan province might experience a difficult condition with inadequate agricultural water need due to the less rainfall during the rice growing season. Although sowing is concerned about the shortage of agricultural water, it is thought that it was carried out almost with normal year. On the other hand, the lack of rainfall after sowing was a dominant condition. Always there is a concern securing enough agricultural water during the young panicle forming stage, which requires the most water in paddy cultivation. In the harvesting time, harvesting work was estimated to run smoothly due to the good field condition.

VII-1-2. Drought Index

Graph-2: Drought Index (JAXA-JASMIN: Time series graph)

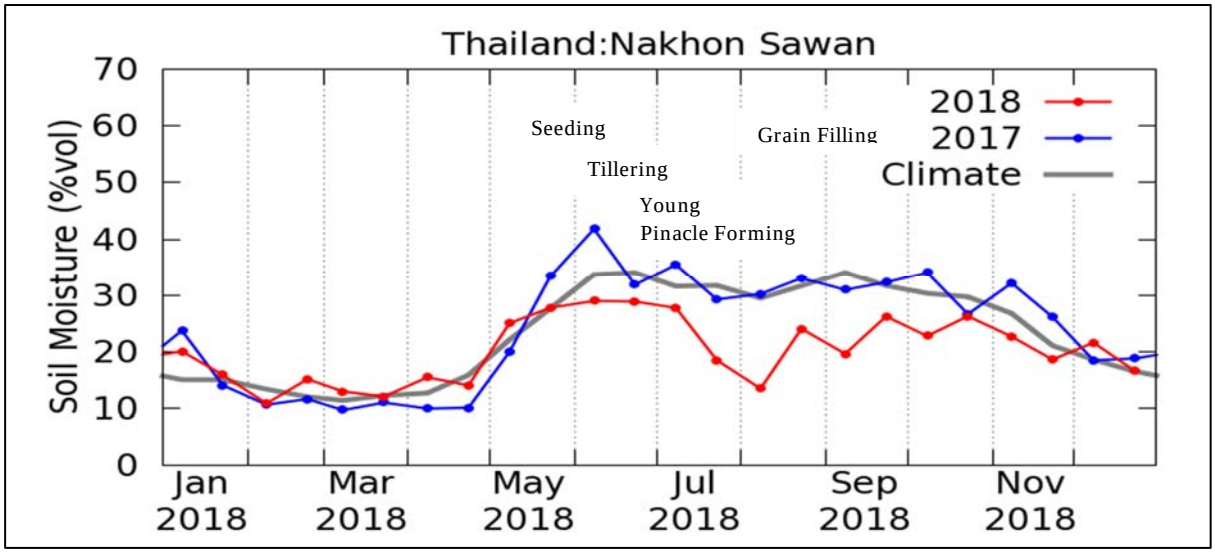


Graph-2 shows the distribution of the drought index using satellite observations. Interpretation of these curves to identify whether a given situation is normal or approaching a drought period needs expert knowledge.

The drought index of the Graph-2 indicates the year 2018 followed a normal state during the rice growing season. Although there was concern about sowing condition, it can be interpreted using drought index the situation was not critical on the rice cultivation. In addition, it can be clearly understood from the movement of the index in October that precipitation and drought index are highly correlated.

VII-1-3. Soil Moisture

Graph-3: Soil Moisture (JAXA-JASMIN: Time series graph) [note 1]

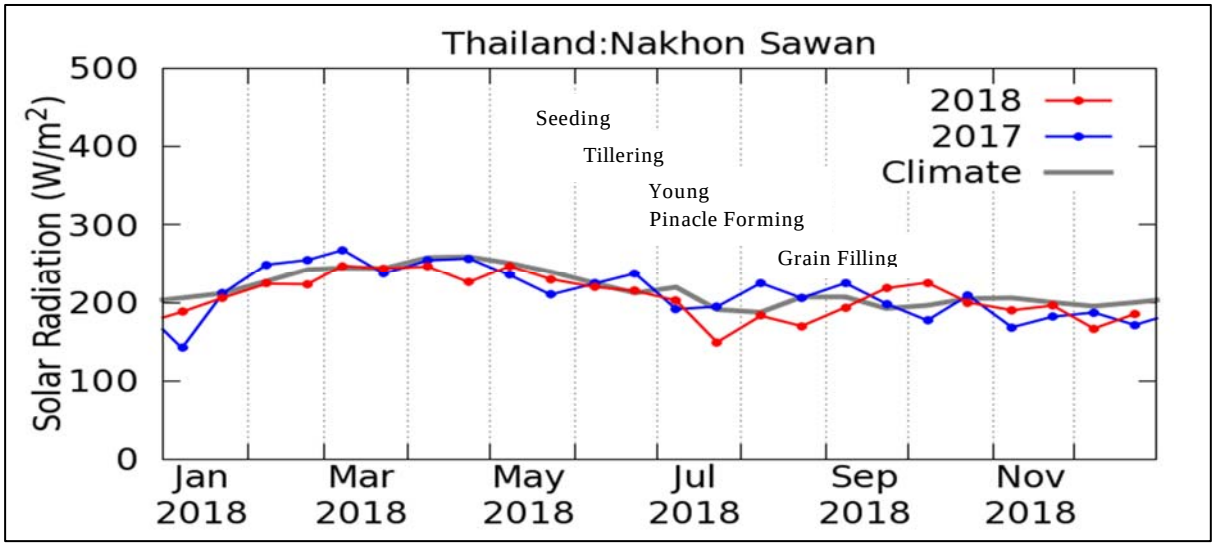


The soil moisture trend given in the Graph-3 represented the satellite observation and derived drough index representing the soiul moisture status of the earth surface, hence the moisture state of paddy fields. Changes of the moisture situation (or the flooding in paddy fields) can easily be interpreted with these graphs allowing the identification of normal situation and drought situations.

According to the above graph, the soil moisture trend during 2018 rice growing season reflects below normal level of precipitation. As far as the drought index is concerned, it can be presumed that the impact on the cultivation of wet season rice was not appreciable. On the other hand, it is not possible to say there will be an abundance of water during the growing season of the wet season rice, and it could be reported that the growing situation need to be monitored while paying attention to drought index.

VII-1-4. Solar Radiation

Graph-4: Solar Radiation (JAXA-JASMIN: Time series graph)

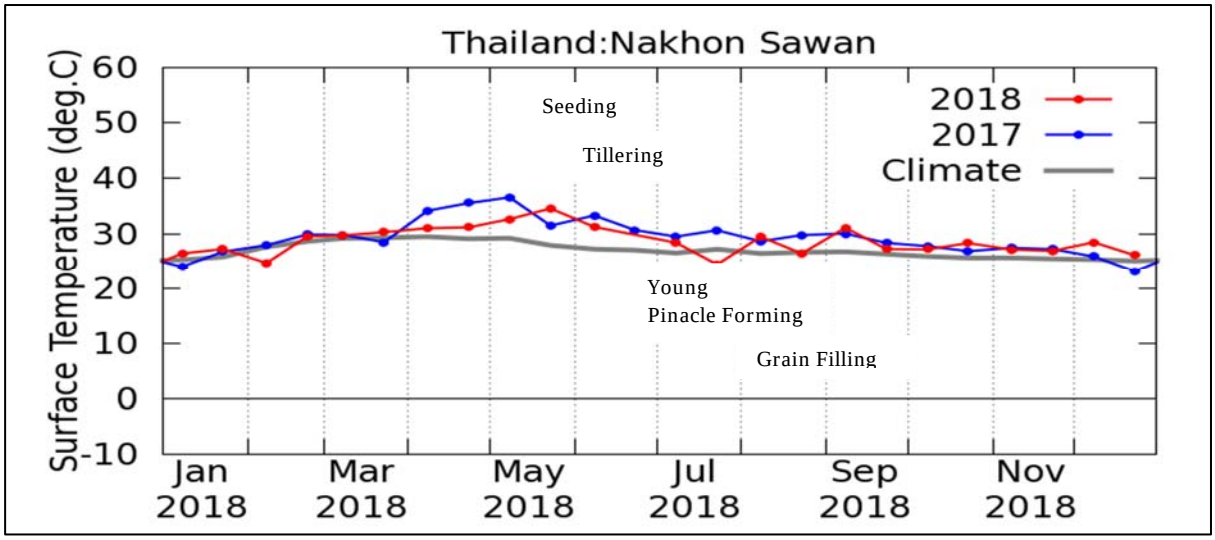


Solar radiation is a necessary weather condition for a stimulation of photosynthetic process of the panicle number during the tillering stage and grain weight during the grain filling stage.

In 2018, the solar radiation trend remained normal during the seeding stage and tillering stage. With this solar radiation trend, it was estimated that the panicle number would be within the normal value. On the other hand, there was some concern about light of grain weight due to lack of sunshine in grain filling stage.

VII-1-5. Surface Temperature

Graph-5: Surface Temperature (JAXA-JASMIN: Time series graph)

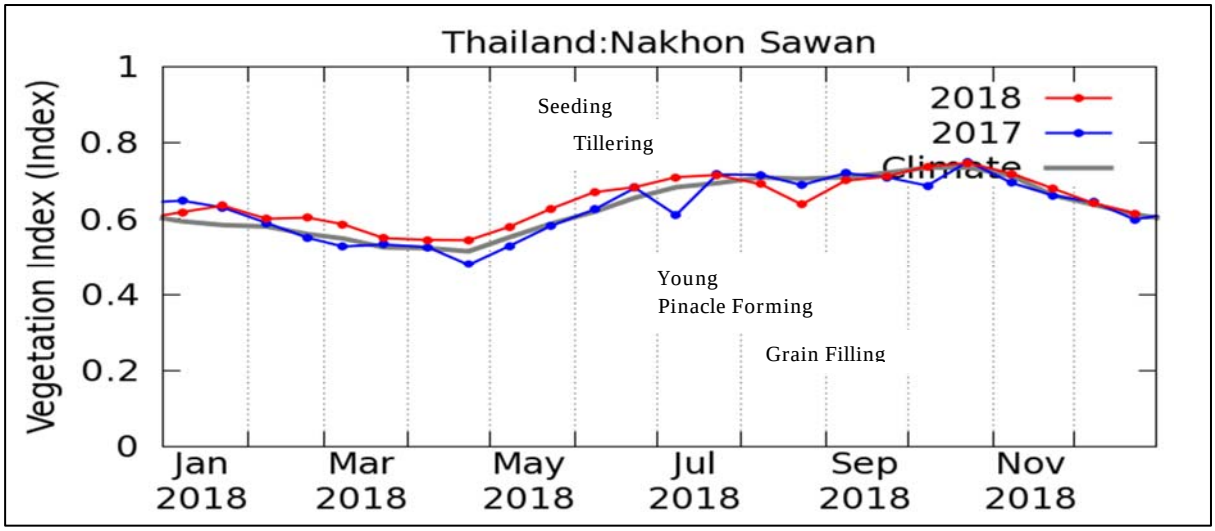


With the warm and stable climate condition in the South-East Asia region, it is estimated that the influence on rice growing due to temperature would be uncommon, even though the cold resistance ability of Indica rice may be low. On the concerns on temperature, it would be suffice to say that there may be possible delay of tillering during the tillering stage due to low temperature and there may be some quality loss during the grain filling stage because of high temperature at night.

In 2018, high temperature had continued during the early growing season of wet season rice, but may not have faced dramatic loss of production, if the agricultural water management have been properly done.

VII-1-6. Vegetation Index

Graph-6: Vegetation Index (JAXA-JASMIN: Time series graph)



Vegetation index is a processed data which requires a certain amount of experience to decipher the actual rice growing condition by the trend of the graph. Although vegetation index shows dense planting degree and activity, it is necessary to note this index is not limited to the growth of paddy. It is better to combination use with Map, such as confirming the situation of the main production area of paddy rice. Although it is not limited to rice, the index decline in August may be affected by shortage of precipitation in summer.

VII-1-7. Assessment of 2018 wet season rice in Nakhon Sawan province

So far, we have considered the growing condition of wet season rice in 2018 of Nakhon Sawan province by using six meteorological indicators of the time series graph of JASMIN. When the amount of precipitation, solar radiation and temperature are evaluated, it can be said that it is difficult to say that the weather of 2018 year was a very suitable weather for growing rice. In particular, the tendency of low rainfall during the rice growing season is a concern with a chance of a drought spell. However, since the drought index is showing a normal trend, it is assumed that the growth of wet season rice has not been significantly affected due to low rainfall. On the other hand, there it is possible to anticipate some loss of grain weight due to lack of sunshine in grain filling stage.

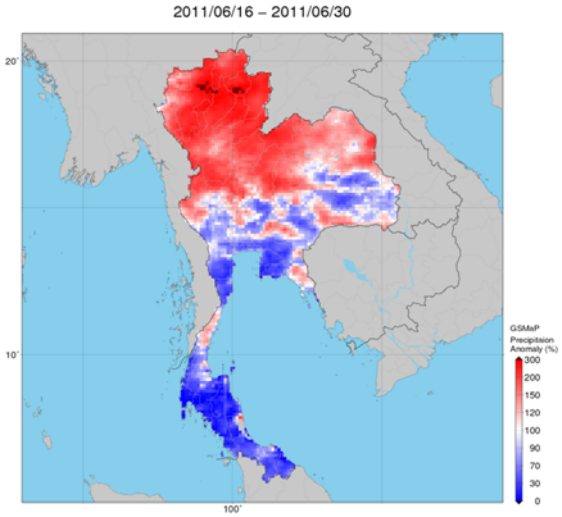
Based on these indications, it is difficult to assess that the final yield of 2018 year wet season rice is “good”, and it may be appropriate to make the assessment “fair” to “slightly poor”.

VII-2. JASMIN map

Apart from time-series graphs, JASMN website provides various weather and crop related index maps and their anomaly maps on country basis. Examination of each weather condition map is a important visual reference and an evidence base justification when assessing the degree of influence of weather conditions on rice growing condition.

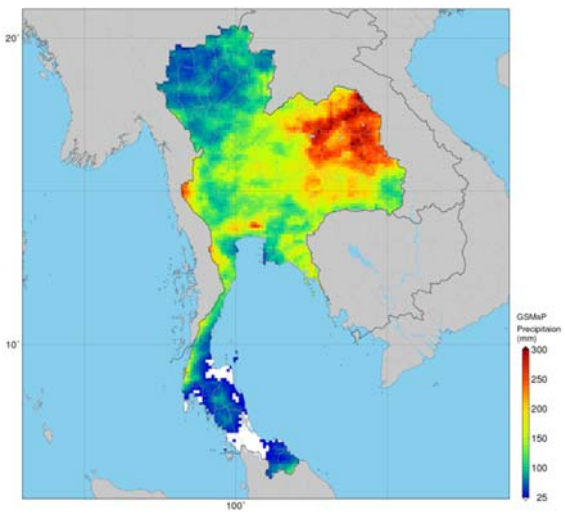
The next exampl is the use JASMIN map to explain the flood situation which occurred in Thailand, 2011 as an example of weather disaster. In 2011, a serious flood was occurred making sever impact on rice cultivation in whole Thailand.

Map-1: Precipitation Anomaly 2011 June



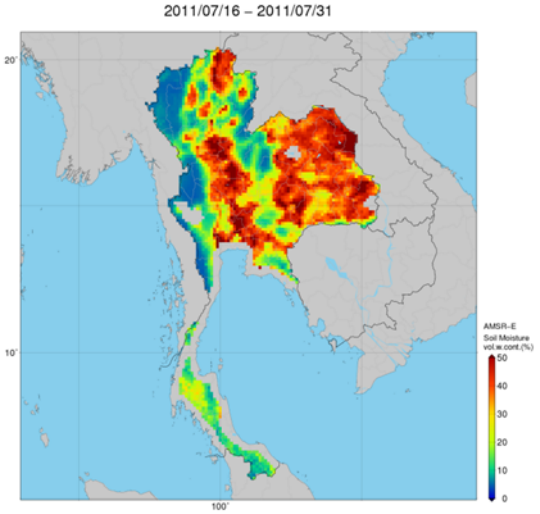
The flood in 2011 was said to have caused by heavy rain in the second half of July brought by Typhoon No.8 named Nock-ten, but it can be observed that the precipitation in the northern region was already higher than normal year as of second half of well before the Typhoon.

Map-2: Precipitation Current 2011 July



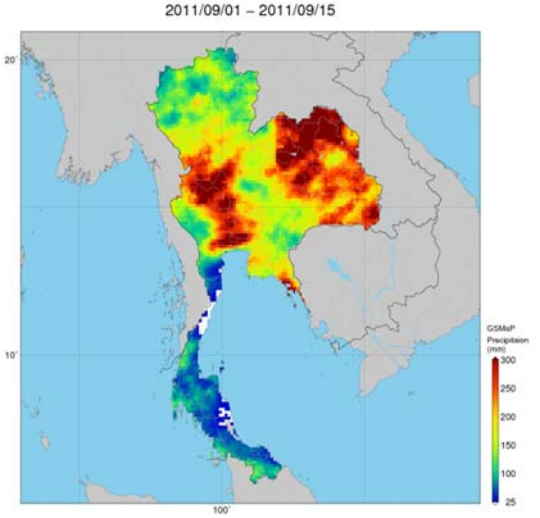
The heavy rain brought by Typhoon, Nock-ten can be observed by second-half of July precipitation map. The map shows that there was rain mainly in the northeastern region, but not in the northern area that has been widely recognized as the cause for flood.

Map-3: Soil moisture 2011 July second half



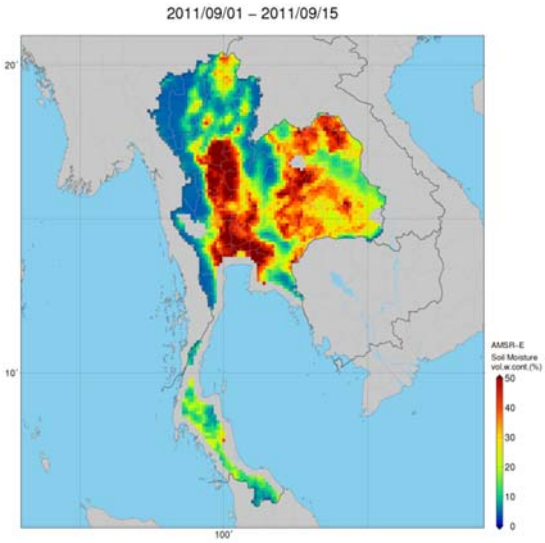
The flooded area can be estimated by soil moisture map. Dark red in the second half of July 2011 map indicates the areas with soil moisture above 50%. The flooding area spread from northeastern region to central region due to heavy rain in July second half.

Map-4: Precipitation 2011 September first half

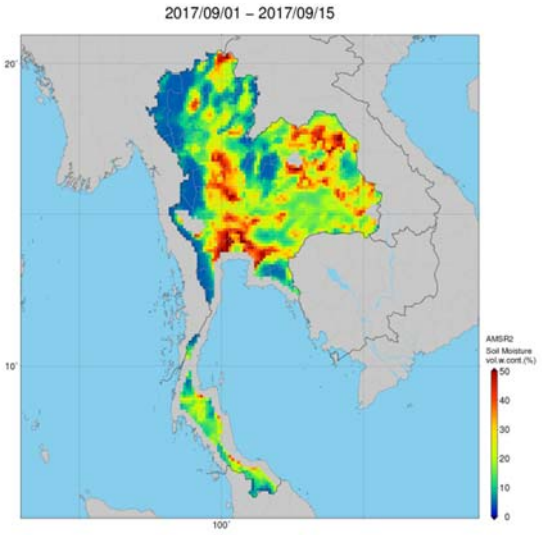


In August, the rain stopped once, but northeastern region and central region were suffered by heavy rain again in first half of September. The occurrence of flood was decisive due to this rainfall.

Map-5: Soil moisture 2011 September first half

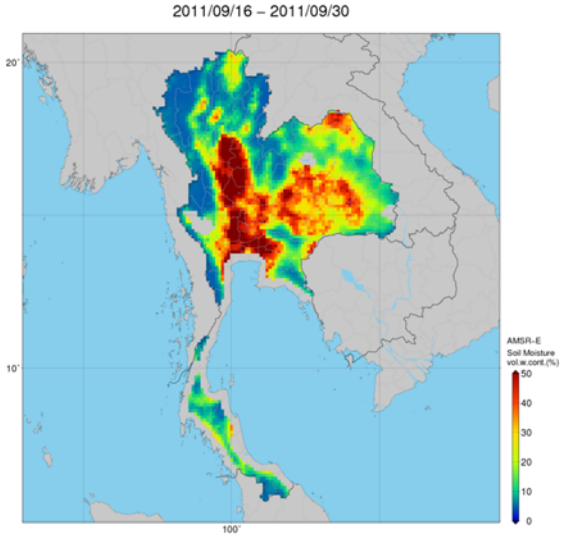


Map-6: Soil moisture 2017 September first half



The soil moisture difference is clearly visible when compared soil moisture maps of first half of September 2011 and 2017.

Map-7: Soil moisture 2011 September second half



The second half of September 2011 shows the recovery of the flood condition in northeastern region, but the central region continued to be flooded in September.

This demonstrates that the JASMIN user can grasp the weather condition and degree of damage and recovery with “Current Map” and “Anomaly Map” of JASMIN.

However, what is important in rice growing outlook is to grasp accurately the influence for the rice growth due to hazards. For this reason, the user needs to determine the degree of the damage based on the type of disaster.

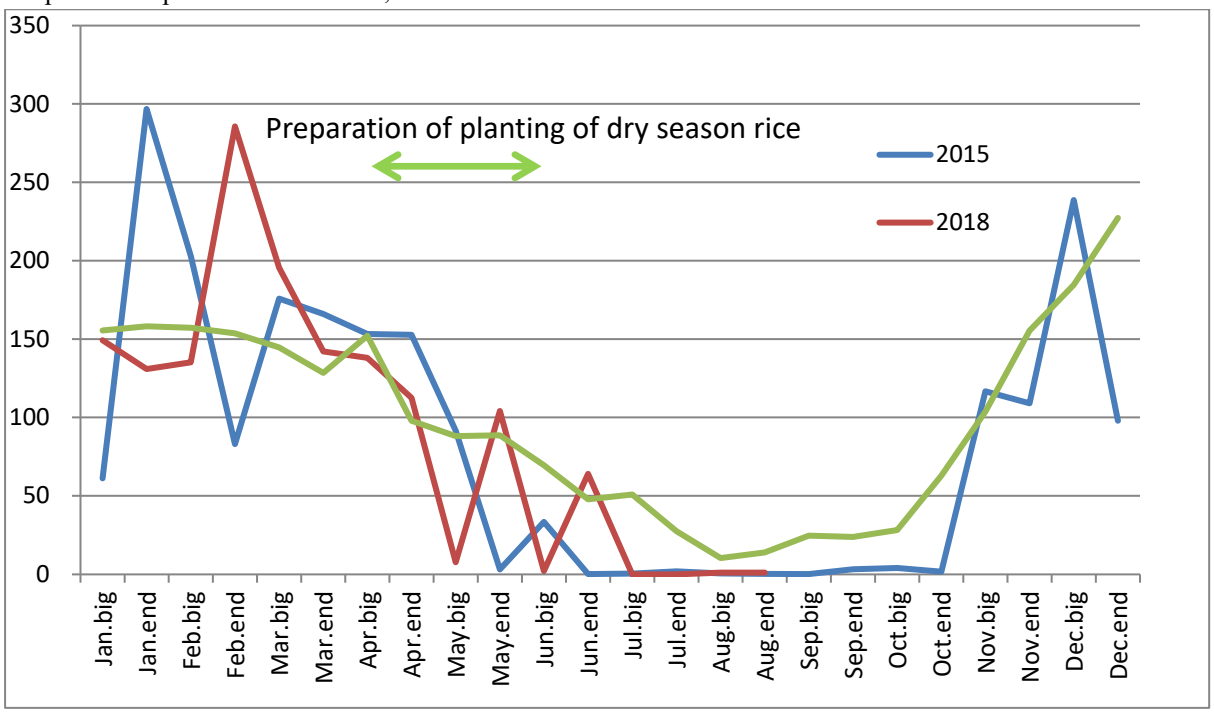
VII-3. Past data

In some cases, it is possible to predict the weather damage occurrence that leads to decrease of rice yield at a certain degree by comparing the trend of past weather conditions that caused rice damage (growth injury) with the current weather conditions.

Indonesia Rice Growing Outlook, Jun 2018
June is the third month of planting dry season rice. The planting is far behind with normal year due to low level of precipitation. This lack of irrigation water condition seems to be recovered somewhat in Sumatra and Sulawesi Islands due to the rainfall in late May. And, the planting has already started in irrigated area. However, Java Island where the main paddy production area continues low precipitation condition and some farmers changed the planting crop from rice to other crops.

It should be noted that the rainfall condition from the beginning of 2018 was similar to the condition of rainfall in 2015 which was a serious drought year. The production of dry season rice in 2015 has decreased by about 40% when compared to normal year due to draught. Therefore, given the rainfall pattern of 2018, a drought can be predicted in 2018, but luckily, the drought condition has been evaded by the late-season rainfall.

Graph-7: Precipitation of Indonesia, West Java



VIII. Conclusion

The final rice yield (Good, Fair and Poor) can be explained almost 100% by the weather condition in each yield component stage (tillering stage, young panicle forming stage and grain filling stage). Conversely, the weather condition in each yield component stage can assist estimating the final rice yield (Good, Fair and Poor) with some confidence. Because, the rice has the tolerability for weather changes and there is different water securement methods in irrigated rice fields and rain-fed fields. In addition, the paddy fields have the different capacity for rice growing.

However, we can confidently assess the rice yield (growing condition) by observing weather condition (information). In order to do this, we have to study the basic rice growing mechanism and define the rice yield (growing condition) in order to properly reflect the weather condition on the assessment of rice yield (growing condition).

JASMIN provides weather information necessary for the growth assessment of rice, but in order to make a correct growth assessment using this information, it is necessary the user to have the ability to interpret the weather conditions. Proper training and regular usage of JASMIN data will make the user apprehend the correct use of JASMIN data and applying them in the rice yield assessment process.

I hope that this guideline will help the assessment of crop growing condition using meteorological information by agricultural staffs in South East Asia countries.

- Shoji Kimura -

Agriculture Specialist

For implementing “Science based information sharing derived from Earth Observation Satellites for agriculture management in the ASEAN Region”

Annex

Growing Outlook Example Form

【General】

The (Season rice) is in the time of (Growing stage) in the (Area).

The growing condition is (assessment of growing condition) due to the (Weather condition).
The growing condition is (assessment of growing condition) due to the (Condition of Rice yield component) by

(Weather condition).
(Past weather condition).

The (Condition of Rice yield component) is (assessment of growing condition) by (Weather condition).

The (Season rice) is in the time of (Tillering stage or Young panicle forming stage) is favorable due to (Weather condition).

【In case of Damage】

The (Season rice) is in the time of (Growing stage) in the (Area).

The (Damage situation) due to (Weather disaster) in the (Area).
The (Weather disaster) due to (Weather condition) in the (Area).
The (Growth injury) due to (Weather condition) in the (Area).

The growing condition is estimated (assessment of growing condition) from the influence of (Damage situation) or (Weather disaster) or (Growth injury).

However, (Damage) or (Weather disaster) won't give a big influence to growing condition.

The yield is expected to become (assessment of growing condition) due the (condition of Rice yield component) by (Weather condition) in (Past growing stage).

How to interpret JASMIN in Rice Growing Outlook

Reference literature

Statistical Dictionary on Agriculture, Forestry and Fisheries
Agriculture and Forestry Statistics Association, JAPAN

Attached material

Center for Agricultural Information, Office of Agricultural Economics,
Ministry of Agriculture and cooperative, THAILAND
Statistics Department, Ministry of Agriculture, Forestry and Fisheries, JAPAN

Publication

Japan Space Forum

Author: Shoji KIMURA