## Chapter 1: Introduction

The Weather-rice-nutrient integrated decision support system (WeRise) is an ICT-based tool for rainfed rice farmers. WeRise can provide relevant information for rainfed rice cultivation such as optimum sowing timing and fertilizer application schedule. WeRise can also show yield predictions of different varieties that can help farmers to choose the most suitable variety according to the weather characteristics of the upcoming cropping season. The target users of WeRise are the AEWs because farmers consider them as trustworthy sources of information. WeRise can be among the measures to prevent the spread of COVID-19 as it can help farmers and AEWs to avoid the three C's while facilitating information exchange to prepare for incoming cropping season.

WeRise is an ICT-based tool hence internet access is a prerequisite. Those who have internet access either through a smartphone or tablet computer can access WeRise to get advisories. WeRise can still be accessed by those who have limited or no connectivity. Smartphone is becoming ubiquitous and those who have this tool can get in touch with WeRise through SNS like facebook. In the Philippines, all network subscribers can avail various services including calling, texting, and facebooking for free. Utilizing available networks among AEWs and farmers can facilitate the access to WeRise. Hence, farmers can get information to prepare for the upcoming season.

After the novel coronavirus disease (COVID-19) began in Wuhan, China and spread rapidly within China and other countries (Shereen et al. 2020), the role of ICT in agriculture became more important than before because of limitation and restrictions by local and national government in terms of field activities. Health Organization (WHO) declared a pandemic on March 11, 2020. To protect people from COVID-19, governments declared states of public health emergency and implemented lockdowns which entailed difficulties and challenges.

This has brought challenges to many sectors including agriculture particularly to farmers who are used to communicating with their fellow farmers to exchange information and update each other, and consulting with agricultural extension workers (AEWs) for crop production advice and new technologies. AEWs are among the major source of information of farmers who trust them for more complex information on the agricultural production (Bugayong et al. 2019). However, conventional communication methods (e.g., face-to-face meetings, trainings) which often entail the three C's, crowded places, closed spaces and close contact settings have become impractical if not limited or impossible due to the new normal. This is the new challenge in agricultural production, especially for farmers and AEWs.

WeRise was developed through the IRRI-Japan collaborative research project on climate change adaptation in rainfed rice areas (CCARA) and climate change adaptation through developing a decision support tool for rainfed rice areas (CCADS-RR) funded by the Ministry of Agriculture, Forestry and Fisheries of Japan. Indonesia, Philippines and Madagascar are the pilot countries for WeRise development. WeRise can provide relevant information to the farmers and AEWs re rice productions and it can support virtual communication between the farmers and AEWs during the period of COVID-19.

## 1. Objectives and target for this manual

This book documents the weather-rice-nutrient integrated decision support system (WeRise) for a user in research and agricultural extension. It consists of two sections: the first section contains the procedures for the development of crop, soil and weather databases for WeRise. Target users of this section are mainly researchers engaged in agronomy, varietal evaluation, and/or evaluation of ORYZA. The second section is a training program aimed at building the capacity of AEWs, farmer leaders/technicians, and other field agents to deliver extension advisories to rainfed rice farmers through the use of WeRise, ultimately facilitating its adoption.

## 2. Overview of WeRise development

WeRise functions through the interfacing of two models, ORYZA for crop growth and the cumulative distribution function downscaling method (CDFDM) for statistical downscaling of seasonal climate predictions from SINTEX-F. ORYZA was developed by IRRI for simulating the agronomic and phenological performances of a new variety or line in different agro-ecological conditions (Bouman et al. 2001). On the other hand, SINTEX-F was developed by JAMSTEC to predict ENSO, which is the main driver for Asian monsoon and has a high correlation with the onset of the rainy season in Asia (Luo et al. 2008). Interfacing these two models could bring a better solution to reduce constraints in rainfed rice production. However, the outputs of SINTEX-F should be downscaled prior to use in ORYZA simulation to reduce systematic errors (bias) (Iizumi et al. 2011, Hayashi et al. 2018). CDFDM was applied to utilize the outputs from SINTEX-F in ORYZA because it is a simple and less expensive model (Iizumi et al. 2011). The outputs from SINTEX-F is a paid product provided by the Forecast Ocean Plus, Inc. (Kudan Bldg. 7F 2-2-5, Kudanminami, Chiyoda-ku, Tokyo 102-0074, Japan).

Prior to running WeRise for predictions, weather and crop databases should be developed as shown in Fig 1.

SINTEX-F outputs (hindcast) and locally observed historical data are used for CDFDM to identify bias, which is used to correct SINTEX-F predictions. On the other hand, crop data should be evaluated and validated using two cropping seasons of on-station field experiment to develop crop database. Using these databases, predictions for certain varieties can be done in productivity as function of sowing periods, fertilizer application schedule and advisory for supplementary irrigation and these information will be stored in Amazon Web Services which a user can access directly to obtain the predictions.

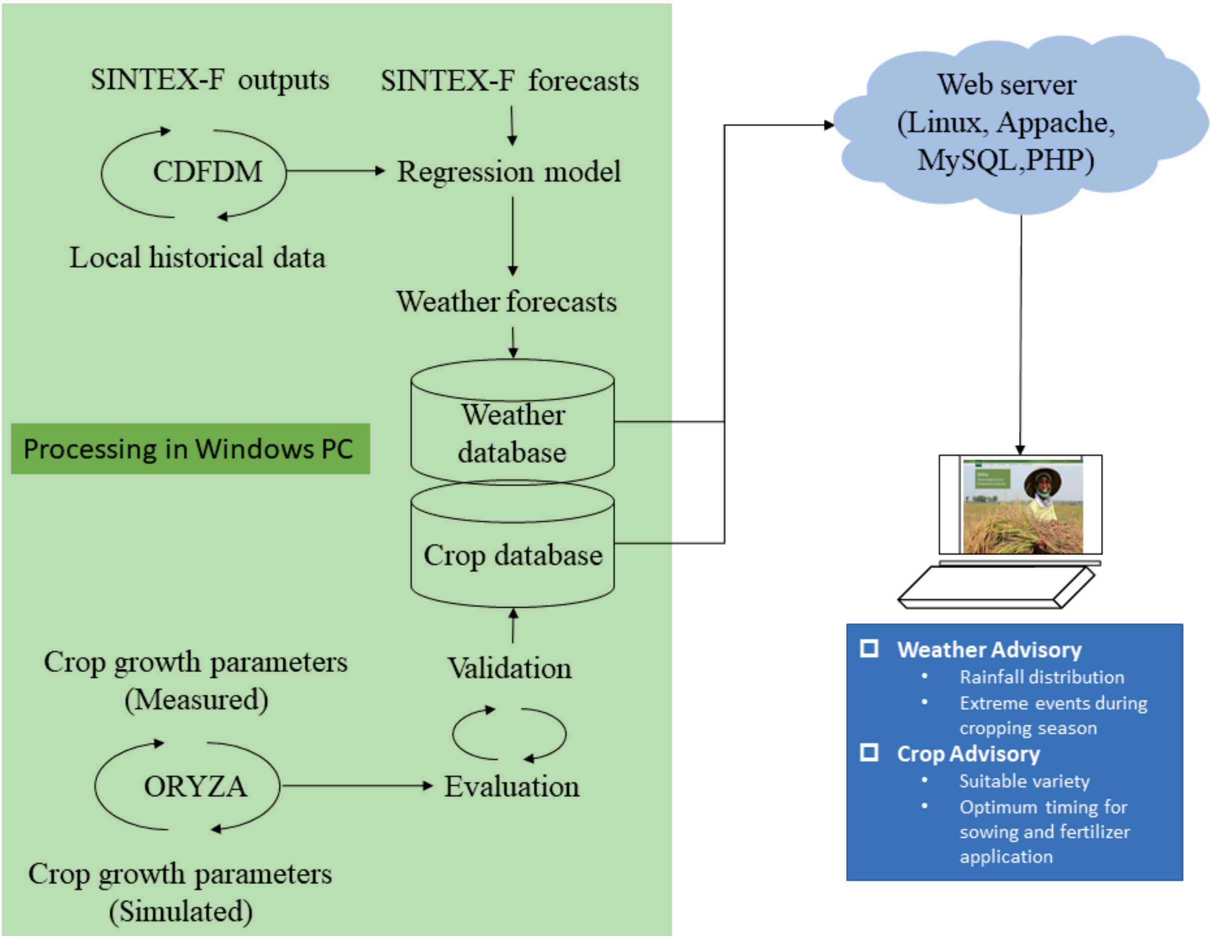


**Fig 1. Conceptual flow of database development for WeRise** (Any version of windows is accessible, and no macro is used for operation of WeRise)

## 3. File organization

In developing the required databases for WeRise, we need to deal with many files which are key for the preparation of the principal files (EXPERIMENTAL, SOIL, WEATHER files) which will be used to run each model. Hence, organizing files is crucial for efficient and accurate database development. Fig. 2 shows a sample structure of file organization.

1. Create a working folder, e.g. ***D:\Experiment,*** where all the simulation related files could be stored systematically. ①
2. In the working folder, create subfolders in following order: Country/Region or Province/ Station/ Year/ Season. ②
3. Each region/province has Soil folder. ③
4. Calibration folder should be under year.
5. Template folder contains the excel templates to format crop, weather, and soil data. ④

6. For example;
   - Create a subfolder for different countries, e.g. ***INDO,PHL,MADA, Template***
   - Create a subfolder for Regions, e.g. ***Region3, Rgeion6***
   - Create subfolder year, e.g. ***2019***
   - Create subfolder season, e.g. ***DS, WS, Calibration, Validation, Data***

7. Create another subfolder for the simulation outputs, e.g. ***D:\ Experiment\Outputs***.

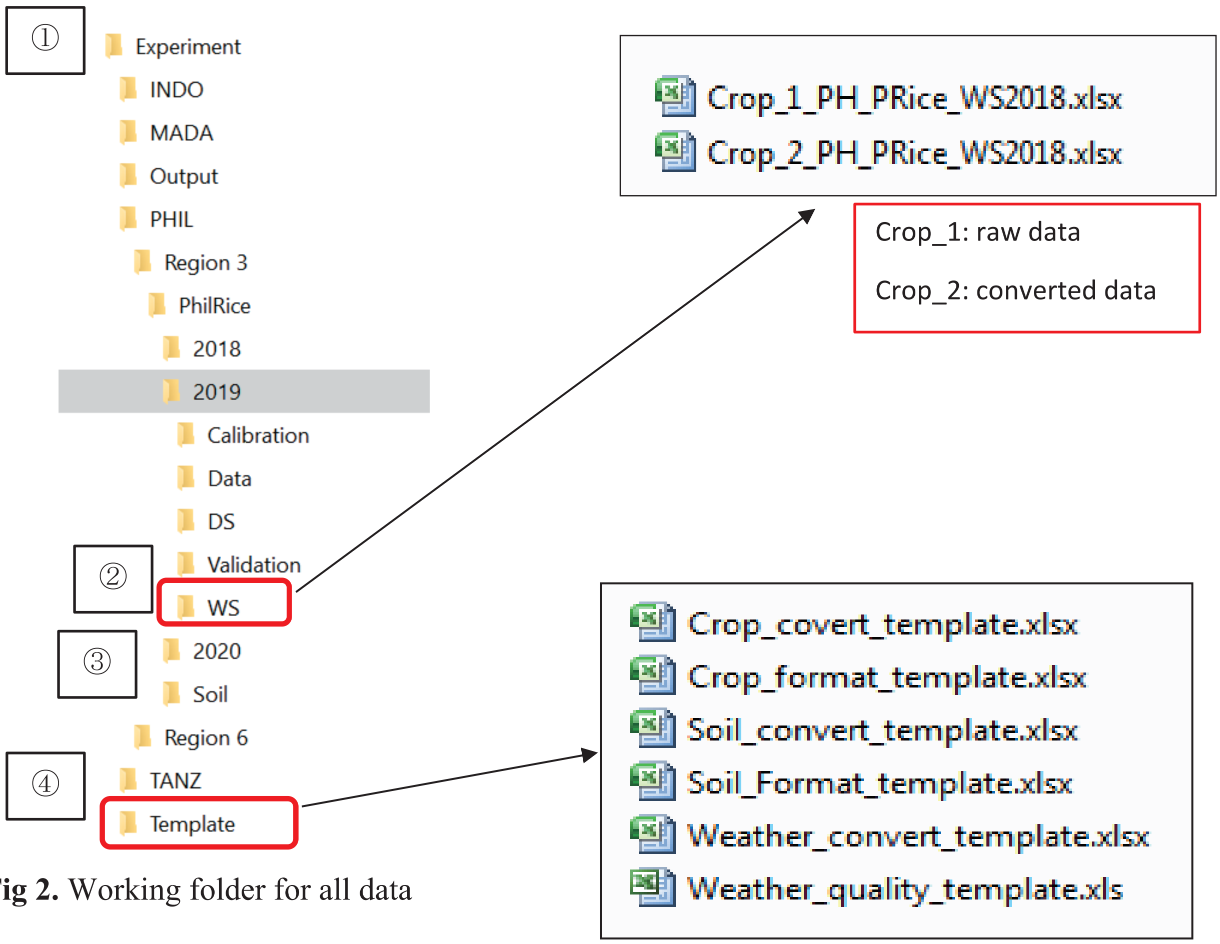


**Fig 2.** Working folder for all data

## 4. File naming

The general Excel file templates should be named as:

Raw data: Crop_format_template.xlsx
Converted/formatted file: Crop_convert_template.xlsx

Raw soil data: Soil_1_PH_Maligaya
(*filename description: 1 – raw data , PH –Philippines, Maligaya – Municipality)
Converted/formatted file : Soil_2_PH_Maligaya_2018.xlsx

Weather data: Weather_quality_template.xlsx
Formatted file: Weather_convert_template.xslm

1. After encoding all the raw crop data in ***Crop_format_template.xlsx,*** the file should be saved as ***Crop_1_PH_Price_DS2018.xlsx*** ("1" means raw data, Price means PhilRice)
2. Raw data need to be converted to a format acceptable to ORYZA. The template ***Crop_convert_template.xlsx,*** maybe used. Once converted, the file should be saved as ***Crop_2_PH_Price_DS2018.xlsx*** ("2" means converted data for ORYZA use)
3. File renaming will be done for all data files as in ***Soil_1_PH_Price_DS2018.xlsx, Soil_2_PH_Price_DS2018.xlsx , Weather_1_PH_Price_DS2018.xlsx and Weather_2_PH_Price_DS2018.xlsx***

** Note: Windows usually limits file names to 260 characters. But the file name must actually be shorter than that, since the complete path (such as C:\Program Files\filename.txt) is included in this character count.*

## 5. Data requirements for ORYZA v3

The following data sets are required to run ORYZA v3. These are the basic requirements for a successful model application and evaluation (Table 1). The completeness of data will determine the level of confidence in model outputs. Microsoft Excel 2010 was used to prepare all datasets describe in this manual.

- **Daily weather data**
  - Geo-coordinates and altitude
  - Precipitation or rainfall (mm)
  - Maximum and minimum temperature ($^{o}$ Celsius)
  - Solar radiation (KJ/m2) or sunshine duration (hr)
  - Wind speed (m/s)
  - Vapor pressure (kPa)

- ❖ Daily weather data is a prerequisite for an area where experiments are conducted.
- ❖ Yields are largely affected by the weather conditions during the growing seasons.
- ❖ Measured data will be converted to its required unit format.
- ❖ Weather_convert_template will be used to format the weather file for ORYZA v 3.
- ❖ The weather data file is made up of three components: CNTR denotes the (acronym of the) country name (PHIL), ISTN denotes the weather station number (1), and IYEAR.

- **Soil characteristics**

Soil characteristics include the general soil profile. Soil data simulates the dynamics of soil water content and soil water tension to compute the effects of drought on crop growth and development.

- Soil texture (sand, silt, and clay)
- Soil organic carbon
- Soil organic N (=SOC/CN) *CN: C/N ratio

❖ To estimate soil hydraulic parameters, tool **SoilHydrau.exe,** a tool of ORYZA, will be used.

- **Crop measurements**

The following crop measurements are crucial in providing relevant information for crop growth.

- Date of sowing/planting
- Date of emergence
- Phenological stages
- Above-ground biomass (dry weight)
  a. Green Leaves and dead leaves
  b. Stem
  c. Panicle
- Fertilizer application date and dosage
- Grain yield and yield components

❖ Phenology dates should be inputted as Julian days.
❖ Fertilizer timing should be counted from days after sowing (DAS).
❖ The mean of the replicates of measured raw data will be used.

**Table 1**. Data requirement according to levels of accuracy (✓shows required data).
Protocol for experimental and data collection for modeling studies using ORYZA2000 (Li et al., 2012).

**Data requirement for ORYZA v3 simulations**

| # | Data | Ideal data (High) | Adequate data (Acceptable) | Usable data (Uncertain) |
|---|---|---|---|---|
| 1 | Nursery density | √ | √ | √ |
| 2 | Field density | √ | √ | √ |
| 3 | Sowing date | √ | √ | √ |
| 4 | Planting date | √ | √ | √ |
| 5 | Daily radiation/sunshine | √ on-site | √ | √ |
| 6 | Maximum temperature | √ on-site | √ on-site | √ |
| 7 | Minimum temperature | √ on-site | √ on-site | √ |
| 8 | Rainfall | √ on-site | √ on-site | √ |
| 9 | Wind speed | √ on-site | √ | |
| 10 | Vapor pressure | √ on-site | √ | |
| 11 | Phenology | PI, FL, PM | FL, PM | PM |
| 12 | Biomass accumulation | >3 measurements, component | 1 measurement, component | Final, total |
| 13 | N uptake | >3 measurements, component | | |
| 14 | Final grain yield | √ | √ | √ |
| 15 | Harvest index | √ | √ | √ |
| 16 | Grain weight | √ | √ | |
| 17 | Transpiration | √ | | |
| 18 | Soil texture | √ | √ | |
| 19 | Soil organic carbon | √ | √ | |
| 20 | Soil organic N | √ | | |
| 21 | Soil mineral N | √ | | |
| 22 | Irrigation | √ | √ | √ |
| 23 | Soil water | √ | √ | |
| 24 | Fertilizer application | √ | √ | √ |
| 25 | Pest & disease control | √ | √ | |
| 26 | Nutrient deficiency | √ | | |

## References


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