

# Asia-RiCE

Phase 2

Work Plan

July 2016



## Work Plan for Phase 2

### Asian Rice Crop Estimation and Monitoring Component of GEOGLAM (Asia-RiCE)

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2016 Update Version 1.0

July 2016

Cover + 15 pages

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# 1. Introduction and Background

## 1.1. Introduction

This 2016 update of the Asia-RiCE Work Plan has been prepared to reflect the latest status of Asia-RiCE and to define Asia-RiCE Phase 2, which aims to greatly increase the scope of the activity – both geographically and in terms of activities.

### GEOGLAM

Asia-RiCE is the rice monitoring component of the Group on Earth Observations Global Agricultural Monitoring initiative (GEOGLAM). GEOGLAM aims to enhance agricultural production estimates through the use of Earth observations. It was developed in response to the G20 Agricultural Ministers’ concern about reducing market volatility for the world’s major crops. The initiative builds on recent advances in Earth observation technologies. These technologies have great potential to contribute to timely forecasts of crop production and early warnings of potentially significant harvest shortfalls.

The initiative’s goal is to strengthen the international community’s capacity to produce and disseminate relevant, timely and accurate forecasts of agricultural production at national, regional and global scales through the use of Earth observations.

### Importance of Rice Crop Monitoring

Rice is the staple food for more than half of humanity - with 90% of the world crop grown and consumed in Asia. Global rice production has increased continuously in the last half-century, since the Green Revolution. In the same period, the use of chemical inputs, the introduction of modern high-yielding varieties with short growing cycles, and the increased access to machinery and irrigation systems have led to a linear growth of the crop yields (+0.05ton/ha/year) as well as to an increase of the number of crops per year (Food and Agriculture Organization of the United Nations, 2012).

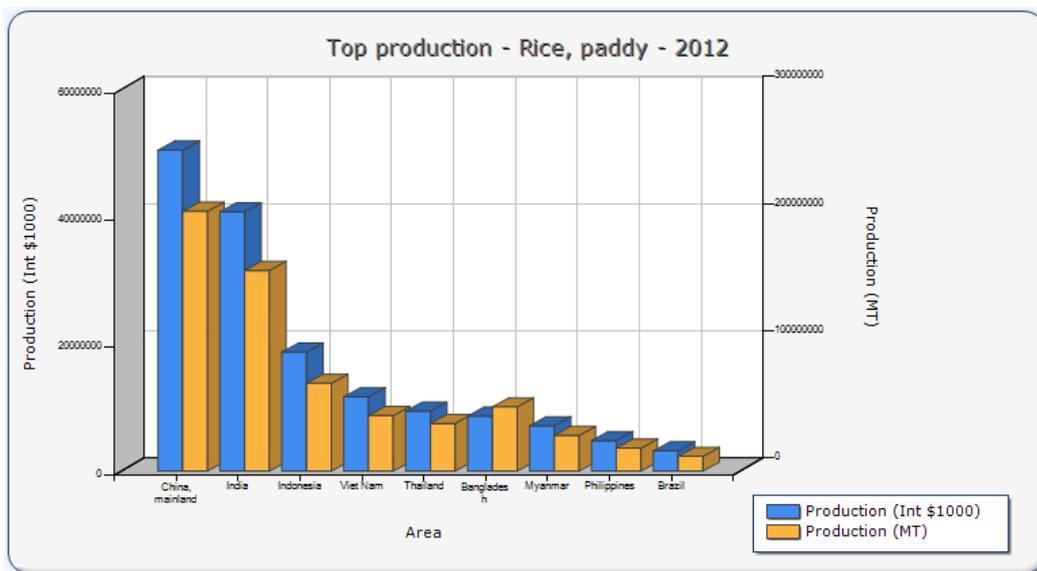


Figure 1 – Paddy rice production of top producing countries (by 1000 USD and MT), 2012 (Source: FAOSTAT, <http://faostat.fao.org/site/339/default.aspx>)

Rank	Area	Production (Mt)
1	China, mainland	204236000
2	India	157800000
3	Indonesia	69056126
4	Viet Nam	43661569
5	Thailand	37468903
6	Bangladesh	50497000
7	Myanmar	28080000
8	Philippines	18032422
9	Brazil	11549881
10	Japan	10654000
11	Pakistan	9400000
12	United States of America	9051265
13	Cambodia	9290940
14	Republic of Korea	5934000
15	Egypt	5911086
16	Nepal	5072248
17	Nigeria	4833000
18	Sri Lanka	3845950
19	Madagascar	4550649
20	Lao People's Democratic Republic	3489210

*Table 1 – 2012 Top 20 rice producing countries by megatonne (Mt) (Source: FAOSTAT)*

This higher cropping intensity (from single to double or triple crop) together with the conversion of non-arable land to arable land have resulted in a drastic increase of rice harvested areas in the 60s and 70s (+1.4Mha/year) which slowed down in the 80s and 90s (+0.46Mha/year) and has tended to stabilize over the last ten years as a result of approaching the limits of land use and of cropping intensity, however there is a large inter-annual variability due to climatic conditions and socio-economic factors. As both the increase in yield and in planted areas will be facing limitations in the next decades, it is unlikely that rice production can keep increasing at the same rate.

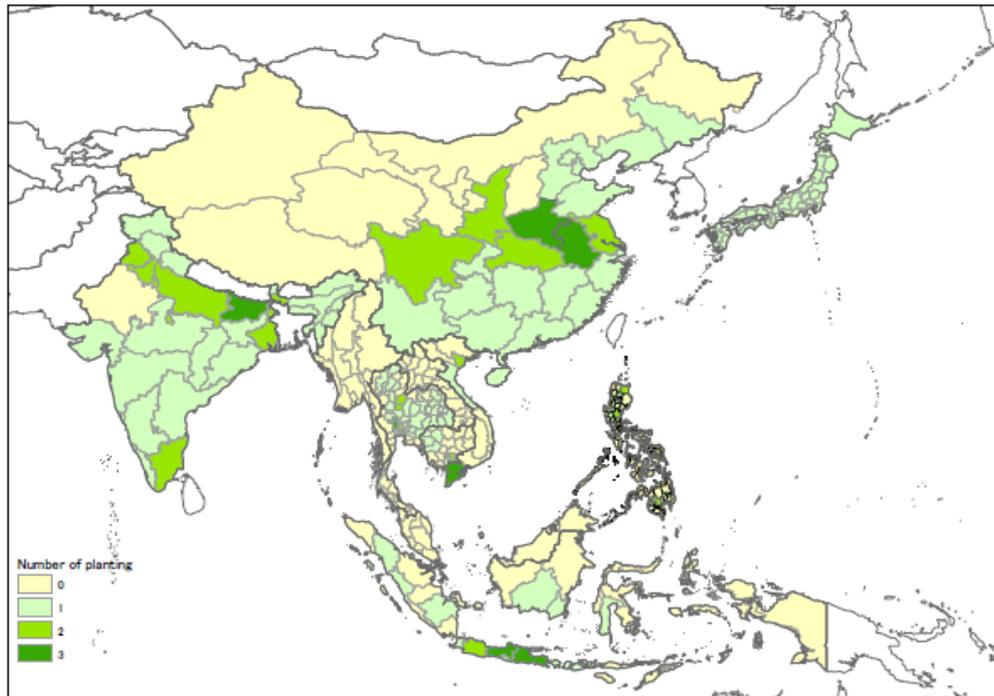


Figure 2 – An example of a cropping intensity map (number of cycles) in the Asian region (Source: JAXA).

Meanwhile, world population, and therefore demand for food, has increased linearly over the last fifty years (+80M/year), and is projected to keep growing until around 2050 up to 9 billion inhabitants (United Nations Department of Economic and Social Affairs, Population Division, 2004). This conjuncture is prone to create tensions in food markets that could lead to world food price crises – as in 2008 when the price of rice more than doubled in only seven months – and eventually to famines. In this context of price instability and threatened food security, tools to monitor rice production in real-time are highly needed by governments, traders and decision makers.

Accurate information is needed on the spatial distribution of rice fields, water resource management, risk occurrence and annual production projections. However, most agricultural surveys rely mainly on statistics based on limited ground samplings at which data are extrapolated on a national scale. Although the census can provide statistical estimates, slow and unsystematic collection of data can limit the ability to make timely decisions.

Moreover, rice agriculture is strongly linked to environmental issues, from water management to climate change (methane emission). For these reasons, long term inter-annual monitoring is also required in order to study the production and cultural impacts of these factors. Satellite remote sensing can support this long term monitoring requirement at regional and global scales.

Given the importance of rice, Asian participants in GEOGLAM formed an *ad hoc* team to ensure the appropriate representation of rice crop monitoring in the GEOGLAM initiative.

## 1.2. Asia-RiCE & The Phased Approach

The goal of Asia-RiCE is to foster the widespread use of EO for ‘wall-to-wall’, whole country, timely and accurate forecasts of rice production at national, regional, and global scales, as an input to the GEOGLAM Crop Monitor and AMIS Market Monitor.

Asia-RiCE is leveraging existing agricultural monitoring programs and initiatives at local levels (which serve as the Asia-RiCE Technical Demonstration Sites (TDS)) to develop, exercise and refine processes – from stakeholder engagement, through resource marshaling and deployment, and on to trial implementation and product generation using SAR (i.e. radar) and other Earth observation data for rice crop monitoring.

To achieve the overall goal of timely and accurate forecasts of rice production, TDS should develop and refine the generation of a number of key products, including rice crop area and yield estimations (for a full product table see Section 2.1).

The activities of Asia-RiCE have been arranged into phases. Phase 1A (2013-2014) consisted of four TDS in three countries: Indonesia, Thailand and Vietnam). Each of these was focused on the development of provincial-level estimations. Note: Phase 1A only covered rice area statistics, maps, and yield estimates.

In Phase 1B (2014-2015), additional technical demonstration sites in Chinese Taipei, Japan, and Malaysia were added. The scope of target products remained mostly the same.

*For a full summary of Asia-RiCE Phase 1 activities and achievements, please refer to the Asia-RiCE Phase 1/2015 Implementation Report: [http://asia-rice.org/files/Asia-RiCE-2015-Implementation-Report\\_v1.pdf](http://asia-rice.org/files/Asia-RiCE-2015-Implementation-Report_v1.pdf)*

## 1.3. Objectives of Asia-RiCE Phase 2

Asia-RiCE is now entering its second phase, and this chapter describes the work plan for the constituent activities. The overall objectives of Asia-RiCE Phase 2 are to:

- Prepare rice growth outlooks for Indonesia, Philippines, Thailand, and Vietnam, and provide them to AMIS (managed by FAO) and related agencies via GEOGLAM in collaboration with the ASEAN Food Security Information System (AFSIS);
  - Add rice growth outlooks for Laos, Cambodia, and Myanmar;
  - Manage and expand the agro-meteorological data distribution system “JASMIN” (<http://suzaku.eorc.jaxa.jp/JASM/index.html>) in support of preparing rice growth outlooks.
- Expand from TDS-level to country/region-level estimates (initially Vietnam (Mekong River Delta) and the top-10 rice producing provinces in Indonesia);
- Include representation from Cambodia, Laos and Myanmar;
- Advance R&D around:
  - Fusing optical and SAR data (including multi-frequency SAR) for rice growth monitoring at country-scale;

- Standardization of an *in situ* measurement procedure for essential rice variables (paddy/non paddy, plant height, yield, etc.) and the selection of sampling points for validation;
- The management and processing of very large optical and SAR data archives that are needed to support country-wide monitoring; and,
- Start to investigate methane emission and soil salinity measurements in Vietnam.
- Secure and coordinate further satellite data acquisitions via the Committee on Earth Observation Satellites (CEOS);
- Increase collaborations with stakeholders and donors; and,
- Investigate new data distribution architectures.

#### 1.4. Stakeholders

Asia-RiCE aims to coordinate the evolution of a system of systems which will be greater than the sum of the individual parts and which will facilitate the sharing of know-how, develop capacity and support region-wide capabilities that reflect the inter-dependent nature of food price and security challenges.

A broad range of stakeholders are of relevance to Asia-RiCE:

- **National governments** and their agencies responsible for their various rice crop monitoring and food security systems and capabilities;
- **Regional intergovernmental coordination bodies** with ambitions in this domain, such as ASEAN. Asia-RiCE works with the ASEAN Food Security Information System (AFSIS) to provide crop condition overview information and outlooks to the GEOGLAM Crop Monitor and AMIS.
- **Remote sensing organisations** and their coordination groups that can support supply of the necessary space data – these include the space agencies of Japan, China, India, Indonesia, Korea, Thailand, Vietnam and others; as well as the regional space agency forum APRSAF, SERVIR Mekong, and the international Committee on Earth Observation Satellites (CEOS);
- **UN agencies** and their regional activity groups, such as FAO and ESCAP; and,
- **Key donor organisations** including global (e.g. World Bank), regional (e.g. Asian Development Bank), and national (e.g. JICA) bodies.

Participation in the *ad hoc* team has to date been predominantly by national implementing agency and space agency representatives. However, the intention is to ensure that the full spectrum of stakeholders are further engaged in implementation of Asia-RiCE Phase 2. Appendix A details the current membership of the *ad hoc* team.

#### 1.5. Contents

**Section 2** defines the target products and information requirements related to rice crop monitoring. **Section 3** is the work plan for Asia-RiCE Phase 2. A conclusion is presented in **Section 4**.

## 2. Rice Crop Monitoring Products & Data Supply

### 2.1. Target Products and Services

The target crop and agricultural products are summarised in Table 2. It is expected that these products will be generated with national resources as input to crop forecasting systems.

ID	Product/Information	Description
P1	Rice Planted/Harvested Area and Mapping	Cultivated area (every year); inventory of agricultural facilities; planted area progress (every month) during the growing season.
P2	Crop Calendars/Crop Growth	Timing of sowing, planting, growing and harvesting; growth status (phenological stage if possible).
P3	Crop Damage Assessment	Detection of flooding and other disaster impacted areas; agro-meteorology; detection of areas impacted by drought or saline water intrusion; detection of pest and disease infestation.
P4	Agro-meteorological Information	Agro-meteorology anomaly (e.g. precipitation, solar radiation and high/low temperature); crop growth anomaly for early warning, growth outlook, and impact on future yield.
P5	Yield/Production Estimation* and Forecasting	Empirical-statistical model estimates; crop-growth simulation model estimates.

Table 2 – Target Rice Crop Products (\* required by AMIS)

### 2.2. Satellite Data Sources

There are a wide variety of satellite data sources required for the generation of these products. Asian rice crop monitoring is heavily dependent on SAR, driven by unique Asian conditions (i.e. rain, consistent cloud cover) as well as the unique signal response characteristics of rice which facilitates growth stage analysis. A set of instruments of interest, along with some example missions, are listed below. Please note that data policies differ between missions. For example Aqua, Terra, Landsat, and Sentinel data are free and open, whereas other data might be available for free via CEOS for R&D purposes, and a small number must be acquired on a commercial basis (e.g. COSMO-SkyMED).

Instrument Type	Missions/Instruments of Interest
Atmospheric Sounder	NOAA (ATOVS), Metop, JPSS, Suomi NPP, FY-3
Cloud and Precipitation Radar	Cloudsat, GPM, EarthCARE (2018)
Optical Imagers, Spectral Radiometer, VIS/IR Radiometer	Aqua, FY-3, GCOM-C1, DMSP, EO-1, Formosat, GOES, IRS-P4, JPSS, Landsat-7/8, Meteosat, Metop, MTSAT, NOAA (ATOVS), PROBA, Sentinel-2, Sentinel-3, SPOT, Terra, THEOS, Venus, VHRR, VNREDSat1
Imaging Radar (SAR)	C-Band: RADARSAT-2, RISAT-1, Sentinel-1A/1B, RCM L-Band: ALOS-2 X-Band: COSMO-SkyMed, TerraSAR-X/TanDEM-X
Microwave Radiometer	Aqua, GCOM-W1, Megha-Tropiques, SMOS, GPM, FY-3

Table 3 – List of potentially useful instruments for Asian rice crop monitoring

### 3. Asia-RiCE Phase 2 Work Plan

#### 3.1. Introduction & Overview

This section describes the work plan of Asia-RiCE Phase 2, and aims to:

- Formalise the plan for expansion from TDS to whole country level monitoring and crop estimations;
- Provide a new focus for the underlying R&D and technical targets related to rice crop monitoring;
- Confirm the focus for data providers to better communicate requirements and coordinate data supply; and,
- Outline a strategy for closer engagement with stakeholders and donor agencies.

Activities initiated in Phase 1 are expected to continue as-is and will not be covered in detail in this document. Asia-RiCE will continue working with Phase 1A/1B TDS to generate target products using data from CEOS agency missions including RADARSAT-2, Sentinel-1/2, ALOS-2, COSMO-SkyMed, TerraSAR-X/TanDEM-X, RISAT-1, Landsat-8 etc. and continue working closely with ASI, CSA/MDA, DLR, ESA, JAXA, ISRO and other CEOS agencies to ensure continuity of data supply for the TDS. Asia-RiCE members will also continue to work with AFSIS and international donors to produce crop outlooks for Asia (and to promote the practical use of rice crop area and production estimates).

*For further details on Phase 1 work please see the original Asia-RiCE Work Plan, which was published in 2013.*

#### 3.2. Activity Area #1: Scale-up Activities

**Activity 1-1, Whole Country Estimates:** with an initial focus on Vietnam (Mekong River Delta) and Indonesia (top-10 rice producing provinces), the Asia-RiCE team will work to ensure the necessary acquisitions, data distribution mechanisms, and ground data collection coordination to support whole country rice-planted area and production estimation.

**Activity 1-2, Standardised ground data collection methodology:** working with CNES/CESBIO, Asia-RiCE to help define, adopt and promote an agreed standard for rice crop field surveys and data collection.

**Activity 1-3, Asia-RiCE Analysis Ready Data (ARD) definition:** discuss the definition of ARD for rice monitoring at country scale. The aspects to be covered include primarily geometric and radiometric pre-processing of the images. Geometric rectification including geolocation is needed for the use of *in situ* and multisource EO data. Relative radiometric calibration is required for classification and mapping, whereas absolute calibration is necessary for detection of anomaly and for the retrieval of biophysical parameters. For optical data, correction of atmospheric and BRDF effects, and for SAR data, reduction of speckle noise or incidence angular effect are the main operations.

#### 3.3. Activity Area #2: Data Distribution and Management Systems

**Activity 2-1, Space Data Management System:** Asia-RiCE will continue supporting ICT application development (e.g. JASMIN, INAHOR) and will work with CEOS (i.e. SEO) and

potential donors (e.g. SERVIR-Mekong supported by USAID-NASA) to investigate options for continuity of the SDMS for Asia-RiCE post-2016. Expansion of the SDMS for use in whole-country activities by end users such as ministries of agriculture is envisioned.

**Activity 2-2, South East Asia Data Cube:** working with CEOS partners such as CSIRO, GA and the SEO, investigate the possibility of establishing a South East Asia Data Cube for the management and processing/integration of large optical and SAR (ALOS-2, Sentinel-1) datasets for the generation of whole country rice crop monitoring products.

**Activity 2-3, JASMIN expansion:** JAXA's Satellite based Monitoring Network system for FAO AMIS outlook (JASMIN) will be expanded to cover the entirety of South East Asia – providing agro-met information for the whole region.

### 3.4. Activity Area #3: Research and Development

**Activity 3-1, Investigate each of the sources of optical and SAR data, and determine schemes for integrating them in support of rice crop growth monitoring at whole-country scale:** Asia-RiCE members will prioritise research for phenology studies at whole-country scale.

**Activity 3-2 Development of joint experiments across Asia-RiCE countries,** for the testing of standardised ground data collection methods and the evaluation of software developed during Phase 1. Methodologies will be evaluated through standardised validation across Asia-RiCE countries to assess their robustness.

**Activity 3-3, Methane emission evaluation:** working with CNES/CESBIO, investigate the options for evaluating methane emissions from Mekong Delta paddy fields using SAR and dedicated GHG missions (e.g. GOSAT).

### 3.5. Activity Area #4: Related Projects

**Activity 4-1, Establish new Joint Experiment of Crop Assessment and Monitoring (JECAM) reference sites for Asia-RiCE.** At present, paddy rice is present in 3 sites in China and 1 site in Taiwan. There is an agreement to select the Mekong Delta (as many rice monitoring projects are taking place).

**Activity 4-2, ALOS-2 K&C (Kyoto & Carbon Phase 4) reference site:** continue ALOS-2 reference site collaboration with Asia-RiCE members. ALOS-2 data is provided via the Kyoto & Carbon ALOS-2 PALSAR-2 data distribution system for Asia-RiCE:

<http://www.eorc.jaxa.jp/paddy/Asia-RiCE/ALOS2/index.php>

**Activity 4-3, Sentinel-1 reference sites:** continue Sentinel-1 reference site collaboration with GEORICE, VAST, ESA, CNES, JAXA, and local universities; work with ESA on the possibility of expanding to whole country coverage for Asia-RiCE. Continue working with GEORice to maximise the mutual benefits of the ESA DUE Innovator III programme.

**Activity 4-4, Laos, Cambodia and Myanmar:** leveraging the new APRSAF SAFE Prototypes and working with AFSIS, facilitate outlook reporting for Cambodia and Myanmar. Outlook activities will also be initiated in Laos in collaboration with AFSIS.

### **3.6. Activity Area #5: Stakeholder Engagement**

**Activity 5-1, Continued international engagement for space data coordination via CEOS:** Asia-RiCE will continue to engage with key CEOS groups to explore opportunities to supplement regional data sources and ensure that the necessary acquisition capacity is available, using EO satellites of the U.S., Europe and others, as available.

**Activity 5-2, Establish improved linkages to stakeholders and donor agencies:** Asia-RiCE requires strong institutional support to ensure continued activity into the future. Asia-RiCE will seek to establish closer linkages to the World Bank, Asian Development Bank, AFSIS, ESCAP, Mekong River Commission, APRSAF, and SERVIR Mekong, among others.

## 4. Governance

### 4.1. Schedule

Asia-RiCE Phase-2 will be implemented between January 2016 and December 2017, with the following related meetings in 2016:

- 2<sup>nd</sup> June: APRSAF SAFE Mini-Workshop, Jakarta, Indonesia;
- 18<sup>th</sup> October: GEORICE/ NASA LULCC Meeting , Ho Chi Minh City, Vietnam; and,
- 15<sup>th</sup>-18<sup>th</sup> November: APRSAF-23, Manila, Philippines.

### 4.2. Structure

- Lead: Dr. Shinichi Sobue, JAXA;
- Vice-lead: Dr. Thuy Le Toan, CESBIO, Dr. Kei Oyoshi, JAXA;
- General Secretariat: Dr. Lal Samarakoon, AIT; and,
- Secretariat: Mr. Matthew Steventon, Symbios for JAXA.

### 4.3. Responsibilities

1) The Lead and Vice-leads have the following responsibilities, which are supported by in-kind agency contributions:

- Coordinate the Asia-RiCE crop team activity as described in this work plan;
- Participate in the GEOGLAM Implementation Team to coordinate and promote Asia-RiCE crop team activities including rice crop growth estimation using SAR and optical data, as well as the monthly rice crop outlooks;
- Participate in the CEOS ad hoc Working Group for GEOGLAM to coordinate Asia-RiCE crop team data and system requirements;
- Coordinate Asia-RiCE face-to-face team meetings; and,
- Coordinate the publication of joint papers, the hosting of conference sessions, and other outreach activities with related organizations.

2) The General Secretariat and Secretariat have the following responsibilities, also supported by in-kind agency contributions:

- Host Asia-RiCE team teleconferences (chair, minutes, action items, etc.);
- Host and maintain the Asia-RiCE website; and,
- Maintain the Asia-RiCE Work Plan and other documents.

## 5. Conclusion

Asia-RiCE Phase 1 has demonstrated the great utility of the initiative, with substantial amounts of CEOS data flowing from space agencies to in-country agricultural agencies and researchers – an achievement that would not have been possible without the collective efforts of the group and its connections to both GEOGLAM and CEOS. As a result of Asia-RiCE, improved rice production estimates are being generated at national and regional scales – valuable inputs to the GEOGLAM Crop Monitor and AMIS Market Monitor that would not otherwise be present.

Asia-RiCE Phase 2 will expand these efforts by greatly increasing the scope of activities, both in a geographical and technical sense. The robustness of results will be greatly improved with the creation and adoption of a standardised methodology for ground data collection and the expansion to whole-country reporting. Improved data management and distribution systems are key to allowing Asia-RiCE partners to make use of the ever increasing volume of data available for rice crop monitoring, and further research into the integration of optical and SAR datasets will improve results and accuracy.

**The Asia-RiCE Leads thank all partners and data providers for their continued support of the initiative.**

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## Appendix A – Asia-RiCE Membership

Country	Name	Organisation	Country	Name	Organisation
Australia	George Dyke	JAXA	Lao PDR	Thatheva Saphangthong	MAF
Australia	Matthew Steventon	JAXA	Malaysia	Ezrin Mohd Husin	UPM
Australia	Stephen Ward	JAXA	Malaysia	Rashid Shariff	UPM
Cambodia	Heng Suthy	MRC	Malaysia	Teoh Chin Chuang	MARDI
China	Bingfang Wu	RADI, CAS	Philippines	Nasreen Khan	IRRI
France	Selma Cherchali	CNES	Philippines	Eduardo Jimmy Quilang	PhilRice
India	Jai Singh Parihar	ISRO	Philippines	Mary Rose Mabalay	PhilRice
India	K. R. Manjunath	ISRO	South Korea	Kyung-Do Lee	RDA
India	Panigrahy Sushma	ISRO	South Korea	Sang-II Na	RDA
Indonesia	Agus Hidayat	LAPAN	South Korea	Suk Young Hong	RDA
Indonesia	Dede Dirgahayu	LAPAN	South Korea	Yihyun Kim	RDA
Indonesia	I Made Parsa	LAPAN	Taiwan	Cheng-Ru Chen	CSRSR, NCU
Indonesia	Dedi Nursyamsi	ICALRD, MOA	Taiwan	Chi-Farn Chen	CSRSR, NCU
Indonesia	Orbita Roswintiarti	LAPAN	Taiwan	Horng-Yuh Guo	TARI
Indonesia	Parwati Sofan	LAPAN	Taiwan	Son Nguyen	CSRSR, NCU
Indonesia	Raimadoya Mahmud	IPB	Taiwan	Wei-Shen Lo	TARI
Indonesia	Ratih Dewanti	LAPAN	Thailand	Lal Samarakoon	GIC, AIT
Indonesia	Rizatus Shofiyati	ICALRD, MOA	Thailand	Preesan Rakwatin	GISTDA
Japan	Kei Oyoshi *	JAXA	Thailand	Yuji Niino	FAO
Japan	Okumura Toshio	RESTEC	Vietnam	Doan Minh Chung	VAST, STI
Japan	Seishi Ninomiya	UT	Vietnam	Duong Van Kham	IMH
Japan	Shin-ichi Sobue *	JAXA	Vietnam	Lai Anh Khoi	STI, VAST
Japan	Kazufumi Kobayashi	RESTEC	Vietnam	Lam Dao Nguyen	STAC, VAST
Japan	Tsugito Nagano	RESTEC	Vietnam	Pham Van Cu	ICARGC
Japan	Yutaka Kaneko	JAXA	Vietnam	Thuy Le Toan *	CNES/CESBIO, VAST
Lao PDR	Alounxay Onta	DPC, MAF			

(\* indicates Leads/Co-Leads)