ASEAN Guidelines on the Promotion of Climate Smart Agriculture (CSA) Practices

ASEAN climate resilience network

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The ASEAN Secretariat is based in Jakarta, Indonesia.

For inquiries, contact:
The ASEAN Secretariat
Community Relations Division (CoRD)
70A Jalan Sisingamangaraja
Jakarta 12110
Indonesia
Phone : (62 21) 724-3372, 726-2991
Fax : (62 21) 739-8234, 724-3504
E-mail : public@asean.org

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Glossary and Abbreviations

4Ps	Public-Private-Producer Partnerships
ACCI	ASEAN Climate Change Initiative
AFCC	ASEAN Multi sectoral Framework on Climate Change: Agriculture, Fisheries and Forestry towards Food Security
AFSI	ASEAN Food Security Information System
AIFS	ASEAN Integrated Food Security Framework
AMAF	ASEAN Ministers of Agriculture and Forestry
AMS	ASEAN Member States
APAARI	Asia Pacific Association of Agricultural Research Institutions
APAN	Asia-Pacific Adaptation Network
ASCC	ASEAN Socio-Cultural Community
ASOEN	ASEAN Senior Officials on Environment
ASEAN	Association of Southeast Asian Nations
ASEANCOF	ASEAN Climate Outlook Forum
ASEAN-CRN	ASEAN Climate Resilient Network
ASWGC	ASEAN Sectoral Working Group on Crops
ATWGARD	ASEAN Technical Working Group on Agricultural Research and Development
AWD	Alternate Wetting and Drying
BPH	Brown planthopper
CBM	Community-based Management
CBCRMD	Community-based Conservation of Rice, Maize Diversity
CCA	Climate Change Adaptation
CCAC	Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants
CCAFS	Climate Change and Food Security
CIAT	International Center for Tropical Agriculture
CORDEX	Coordinated Regional Climate Downscaling Experiment
CSA	Climate Smart Agriculture
CSM	Crop simulation models
DAR	Department of Agricultural Research (Myanmar)
DOA	Department of Agriculture (DOA)

DSSAT	Decision Support System for Agrotechnology Transfer
FAF	Food, Agriculture and Forestry
FSSP	Food Security and Staple Food Program
GCF	Green Climate Fund
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GLH	Green leafhopper
HYV	High-yielding varieties
IARCs	International Agricultural Research Centers
IEC	Information, education and communication
IRC	International Research Centers
IRRI	International Rice Research Institute
KU	Kasetsart University
LGU	Local government unit
M&E	Monitoring and Evaluation
MARD	Ministry of Agriculture and Rural Development
MONRE	Ministry of Natural Resources and Environment
NARES	National Agricultural Research and Extension Systems
NARS	National Agricultural Research System
NGO	Non-governmental organization
OPV	Open pollinated varieties
PIRCCA	Policy Information and Response Platform on Climate Change and Rice in ASEAN and its Member Countries
QTL	Quantitative trait loci
RCM-FAF	Regional Cooperation Mechanism for Food, Agriculture and Forestry RD&E Research, development and extension
RIMES	Regional Integrated Multi-hazard Early-warning System
SCOPSA	Sustainable maize production in sloping areas
SEA	Southeast Asia
SEARCA	Southeast Asian Regional Center for Graduate Study and Research in Agriculture

SOM AMAF	Senior Officials Meeting ASEAN Ministers of Agriculture and Forestry
STR	Stress tolerant rice
UN	United Nations
UNEP	United Nations Environment Programme
UNFCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
WIBI	Weather Index-Based Insurance
WII	Weather Index Insurance
WMO	World Meteorological Organization

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ATWGARD Focal Persons

- **Mrs. Fuziah Haji Hamdan**, Brunei Darussalam Ministry of Industry and Primary Resources - Department of Agriculture and Agrifood Assistant Director for Agriculture
- **Mrs. Hajah Suria Zannudin**, Brunei Darussalam Ministry of Industry and Primary Resources, Department of Agriculture and Agrifood Senior Agriculture Officer
- **Dr. Ouk Makara**, Cambodian Agricultural Research and Development Institute (CARDI) Director
- **Dr. Dedy Nursamsi,** Indonesian Agency for Agricultural Research and Development (IAARD), Indonesian Centre for Agriculture Land Resource Research and Development (ICALRRD) Director
- **Dr. Nyoman Widiarta**, IAARD ICFORD Deputy Director for Research Planning and Evaluation
- **Dr. Mohamad Zabawi bin Abdul Ghani,** Malaysia Agriculture Research and Development Institute (MARD) Deputy Director
- **Mr. Viengsavanh Phimphachanvongsod**, Laos National Agriculture and Forestry Research Institute (NAFRI), Deputy for Planning and Cooperation Division
- **Dr. Aung Moe Myo Tint**, Myanmar Department of Agricultural Research Officer, and the Department of Agricultural Planning
- **Dr. Teodoro Solsoloy,** Philippines Department of Agriculture - Bureau of Agricultural Research (DA-BAR) Assistant Director
- **Dr. Suwit Chaikiattiyos,** Thailand Department of Agriculture (DOA) Deputy Director General, and the Field Crops Research Institute and Rice Department
- **Dr. Nguyen Kim Chien**, Vietnam Ministry of Agriculture and Rural Development, Deputy Head for Department of Science, Technology and Environment – General Affairs Division

National Partners

- **Dr. Men Sarom** and **Mr. Sothat Leng,** Royal University of Agriculture (Cambodia)
- **Dr. Perdinan** and **Ms. Kiki Kartikasari**, Bogor Agricultural University (Indonesia)
- **Dr. Outhai Soukkhy** and **Mr. Xayavong Chanthasone**, Northern Agriculture and Forestry College (Laos)
- **Dr. Khin Lay Swe** and **Ms. Aye Kyawt Swe**, Centre for Southeast Asian Studies (Myanmar)
- **Dr. Romeo V. Labios** and **Ms. Donna Bae** Malayang, University of Philippines Los

Banos (UPLB)
- **Dr. Margaret C. Yoovatana**, DOA (Thailand)
- **Dr. Tran Cong Thang** and **Dr. Do Lien Huong**, Vietnam Institute of Policy and Strategy for Agriculture and Rural Development (IPSARD)

Regional Partners

- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
- Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA)
- **Mr. Paul Hartman,** USAID Mekong Adaptation and Resilience to Climate Change Project (Mekong ARCC)
- **Dr. Bjoern Ole Sander** and **Michael Sheinkman**, International Rice Research Institute (IRRI)
- International Center for Tropical Agriculture (CIAT)

Regional Steering Committee

- Thailand Department of Agriculture (DOA)
- Association of Sotuheast Asian Nations (ASEAN) Secretariat
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Structure of the Guidelines

This document is divided into 3 sections.

An introduction to the formation of the ASEAN Climate Resilience Network--which is in effect, the author of this guiding document--and the objectives of this compilation of guidelines, are firstly given.

The Guidelines are then further divided into: 1. a regional cooperation guideline, or how ASEAN Member States can efficiently conduct south-south knowledge exchange to promote climate smart agriculture practices; and 2. Technical Guidelines on five selected practices.

Please note that the technical guidelines are a living document. The sections on the recommended practices have been provided through the initial partnerships of the ASEAN-CRN. It is recognized that a variety of practices are already known and will be explored for inclusion in the next edition of the guidelines, based on demand and consultations within the ASEAN-CRN.

Introduction
The establishment of the ASEAN Climate Resilience Network (ASEAN-CRN)

Rationale and Background

Southeast Asia (SEA) is one of the world's most vulnerable regions to climate change, due to its long coastlines, high concentration of population and economic activity in coastal areas, and heavy reliance on agriculture, fisheries, forestry and other natural resources[1]. Climate hazards, such as a temperature increase, erratic rainfall patterns and extreme climatic events (like strong typhoons and severe droughts), affect ecosystems, livelihoods and on many other aspects of human societies. In particular, climate change threatens agricultural production and indirectly food security, ecological stability, and sustainable development. The most vulnerable countries of SEA have to respond through measures that will reduce the adverse effects of climate change (adaptation) and by significantly reducing greenhouse gas emissions (mitigation).

Rice, maize and cassava are the key staple crops in SEA, and their sustainable production is adversely affected by climate hazards resulting in reduced yields and productivity. Strategies and measures to cope with and adapt to climate change are imperative to enhance resilience of crop production systems[2] to the vagaries of the weather and the adverse impacts of a changing climate. Climate-smart agriculture, forestry and fisheries (CSA)[3] integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate change. CSA is composed of three main pillars: (1) sustainably increasing agricultural productivity and incomes; (2) adapting and building resilience to climate change; and (3) reducing greenhouse gas emissions from agricultural production and processing.

A number of CSA practices applied to crop production in SEA, ranging from indigenous practices and field-tested crop management measures to knowledge-based options, are already well documented and proven to enhance climate resilience. While the suitability of these practices is location- and situation-specific, they may be adapted to other areas with more or less similar conditions. To ensure the wide implementation of CSA practices (scaling-up), it is necessary to take into account technical issues as well as institutional limitations. Documented CSA practices as well as recently developed and tested climate adaptation measures form the knowledge base in ASEAN from which effective and cost-efficient strategies to promote climate resilience in rice and other crops throughout SEA can be formulated.

ASEAN Frameworks and Structures relevant to Climate Change in Agriculture

ASEAN leaders recognized that the impacts of climate change are affecting all sectors and that close cross-sectoral collaboration and coordination is essential when planning and implementing climate change responses. Trans-boundary impacts of climate change, but also potential responses, call for a coordinated regional framework, strategy and mechanism to cope with climate change and its impacts. Hence, close cooperation between the relevant stakeholders in the ASEAN region is vital.

The overall ASEAN cooperation on climate change is guided by the ASEAN Socio-Cultural Community (ASCC) Blueprint (Section D10 on Responding to Climate Change and Addressing Its Impacts)[4] , under the purview of ASEAN Senior Officials on the Environment

[1] The Economics of Climate Change in Southeast Asia: A Regional Review. ADB, Manila, April 2009

[2] Though scientific assessments have shown that climate change threatens food security throughout the supply chain from production to distribution and consumption, the ASEAN CRN focuses largely on food production (and post harvest).

[3] Defined and presented by FAO at the Hague Conference on Agriculture, Food Security and Climate Change in 2010 http://www.fao.org/climate-smart-agriculture/72611/en/

[4] The blueprint was officially launched in 2009 as part of a roadmap of the ASEAN Community. It presents a plan

(ASOEN). The *ASEAN Climate Change Initiative* (ACCI)[5] provides a regional framework on cooperation on climate change issues in ASEAN.

The *ASEAN Multi-Sectoral Framework on Climate Change: Agriculture, Fisheries and Forestry towards Food Security (AFCC)*was developed under the purview of the ASEAN Senior Officials Meeting on Agriculture and Forestry (SOM AMAF)[6] to provide the mechanism for coordinated action to address threats to food security due to climate change. The AFCC, with its focus on the agriculture, fisheries and forestry sectors, pursues a cross-sectoral approach for effective policymaking and implementation. It furthermore provides an arena for ASEAN to better coordinate the support from its partners. Contribution and linkages of sectoral working groups under the AFCC (including ATWGARD and ASEAN-CRN) are highlighted in the *Guidance Note on Mainstreaming Climate Change in the Sectoral Working Groups of the AFCC*[7], which are in line with the *Guidelines for Regional Cooperation on Climate-Smart Agriculture Practices developed by the ASEAN Climate Resilience Network.*

The increasing importance of climate change at the regional level is furthermore reflected in the *Vision and Strategic Plan for ASEAN Cooperation on Food, Agriculture and Forestry (FAF) 2015--2025,* under the purview of SOM AMAF[8]. The FAF Vision 2025 Statement[9] is for "a competitive, inclusive, resilient and sustainable FAF sector integrated with the global economy, based on a single market and production base contributing to food and nutrition security and prosperity in the ASEAN Community". The Strategic Plan of FAF and relevant sectors' SPAs address issues of climate change.

Under the Economic Community, Food Security has been a long-standing agenda in ASEAN. With the global food crisis 2007/08 ASEAN made food security an integral part of community-building and adopted the *ASEAN Integrated Food Security Framework (AIFS)*[10] as a regional umbrella for food security related initiatives, which includes emerging threats of climate change.

Recognizing the importance of cooperation and networking to confront global issues such as climate change in agriculture, the Thai government proposed to establish an ASEAN Climate Resilience Network (ASEAN-CRN) in rice and other crops under the direct auspices of the ASEAN Technical Working Group on Agricultural Research and Development (ATWGARD)[11] with initial funding from German Federal Ministry for Economic Cooperation and Development (BMZ) and technical support from the ASEAN-German Programme on Climate Change (GAP-CC), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, facilitated by the Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA).

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for building regional identity grounded on 10 priority areas of regional importance, one of them being climate change.

[5] In November 2007, the ASEAN heads of state for the first time recognized climate change as a threat in their *ASEAN Declaration on Environmental Sustainability.* Following the recognition that the ASEAN region is highly vulnerable to the adverse impacts of climate change, the ASEAN leaders agreed to enhance cooperation in addressing it by adopting the ACCI in 2009.

[6] The ASEAN Ministers on Agriculture and Forestry (AMAF) endorsed AFCC at their 31st Meeting on 10 November 2009 in Brunei Darussalam.

[7] Formulated in March 2015

[8] Together with the Sectoral FAF strategies, the FAF Vision is finalised, endorsed, and adopted by SOM AMAF in September 2015.

[9] Presented at the Preparatory SOM-36th AMAF and the 36th AMAF held on 20-21 September 2014 and 23 September 2014, respectively, in Nay Pyi Taw, Myanmar

[10] ASEAN adopted the AIFS in 2009 and is now in its second phase (2015-–2020).

[11] Under the Senior Officials Meeting of the ASEAN Ministers of Agriculture and Forestry (SOM AMAF)

Objectives of the ASEAN-CRN

Under the purview and guidance of the above ASEAN frameworks and bodies, the ASEAN-CRN was established with the following objectives[12]:

1. To promote a common understanding on climate change and the agriculture sector amongst ASEAN Member States (AMS);
2. To facilitate mutual learning and promote resiliency of agriculture within the region, through the scaling-up of identified good practices and policies at the AMS level, which address climate-related threats and opportunities (climate-smart practices)[13] to agriculture;
3. To identify common concerns and capacity needs and propose regional support strategies and instruments to address these in a coherent manner; and
4. To support ASEAN decision-making and implementation by providing input based on policy-oriented research on climate change and agriculture.

Objectives of the Guidelines for Regional Cooperation on Climate Smart Agriculture Practices

Based on the objectives and outcomes of the ASEAN-CRN, the ATWGARD agreed to formulate *Guidelines for Regional Cooperation on CSA Practices as well as Technical Guidelines on Scaling-up Prioritized CSA Practices*. The objective of these guidelines is:

1. To facilitate and formalise the exchange and sharing of knowledge and information on CSA practices to enhance climate resilience and improve agricultural productivity. (Guidelines for Regional Cooperation);
2. To promote the scaling-up and the scaling out of CSA practices and policies throughout the ASEAN region (Technical Guidelines on Scaling-up). These guidelines are based on selected CSA practices and experiences[14] from the AMS level. They outline the enabling conditions necessary for scaling up these practices.

The *Guidelines* aim:

1. To generate the scientific data and information needed for the efficient implementation and scaling-up of CSA practices;
2. To develop scientific expertise and provide technical experience on the identified CSA practices;
3. To promote an exchange of field data and information for the cross-location analysis of CSA practices; and
4. To provide opportunity for capacity building and technical exchange and assistance among participating countries in the ASEAN-CRN to promote institutional and enabling factors necessary for upscaling CSA practices in AMS.

These Guidelines for Regional Cooperation provide seven (7) agreed upon principles of regional cooperation necessary for fast-tracking the upscaling efforts in the regions.

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[12] For further details on objectives and working modalities of the ASEAN CRN, please refer to Annex 5: ASEAN-CRN Terms of Reference

[13] http://www.fao.org/climate-smart-agriculture/en/

[14] Methodology and criteria for selection are highlighted in Sections 1.4 and 1.5 of this document.

Methodology and Process of developing the Guidelines

A two-tiered approach was taken when developing the Guidelines: (1) national and sub-national assessments and studies were undertaken and national multi-stakeholder consultations held to feed into the (2) regional-level discussions taking place through the ASEAN-CRN.

At the national level, the ASEAN-CRN coordinated assessments and studies in collaborating AMS (Cambodia, Indonesia, Lao PDR, Myanmar, Philippines, Thailand, Vietnam) and two participating AMS (Brunei Darussalam and Malaysia). This entailed assessing climate change impacts and identifying existing CSA practices in crop production systems of rice, and maize or cassava. Each practice is documented in terms of its technical requirements as well as institutional and enabling factors necessary for scaling-up. Multi-stakeholder national consultation-workshops were conducted to prioritize and fully document the country-specific CSA practices.

A 6-step methodology was used to assess and identify vulnerabilities in the production of the selected crops (rice, maize and cassava) in ASEAN, as well as to identify pockets of CSA practices with potential for being scaled up in the region.

6-Step Methodology for assessment of adaptive capacity

Step 1 – Crop Selection & Value Chain Mapping: Selection of area of focus in AMS.

Step 2 – Review Climate Change Impacts: Review of information sources on current and future climate change impacts.

Step 3 – Identify areas where action is needed: Locate points in the value chains that are vulnerable to climate change impacts (focusing on those areas that could benefit from regional cooperation).

Step 4 – Identify areas for godd CSA practices: Determine CSA practices and enabling conditions (e.g. enabling environment, policies etc.) relevant to the selected value chains.

Step 5 – Reporting structure: Allow direct comparison and collective analysis by using data from multiple countries.

Step 6 - Report consultation and endorsement: National and project consultation process prior to official endorsement and sign-off by responsible AMS ministry.

A detailed account of the above methodology is available in the *Guidance Manual to Determine Adaptive Capacities in ASEAN Member States (2014).* It can be applied to other contexts by using the value chain mapping approach to achieve the following objectives:

- To identify where vulnerabilities exist or are likely to exist, in the supply of the identified food crops, with a primary focus on production and related inputs and a secondary focus on post-production activities; specifically drawing out where regional collaboration could be most valuable to address those vulnerabilities; and

- To identify good practices of CSA, which address climate change-related vulnerabilities that could lead to food insecurity in critical regional food crops;
- To use the learning to stimulate and spread meaningful action across the region to facilitate knowledge-sharing, cooperation and communication on building adaptive capacities for food security.

Selection of Crops and CSA Good Practices

A regional vulnerability index[15] was developed to prioritise sectors/ crops critical for food security in the region with regards to their vulnerability to climate change. The index included production, consumption and distribution factors of major crops. Based on the index, rice, maize and cassava were prioritised as sectors most important to food security, yet vulnerable to climate change in ASEAN. Focus regions within ASEAN were also identified.

The list of major crops selected by each of the participating AMS is shown in Table 1. Most of the AMS have chosen to focus on the combination of rice and maize, while only two countries have chosen rice and cassava. The selection of the crops and the scope of assessment were based on current relative economic importance of the crop, importance of the crop for national food security and its vulnerability to climate change both currently and in the future.

Table 1. Summary of priority crops selected by ASEAN Member States.

Priority Crops	Participating Countries
Rice and Maize	Brunei, Lao PDR, Indonesia, Myanmar, Philippines, Thailand, Vietnam
Rice and Cassava	Cambodia, Malaysia

In a next step, CSA practices to consider for case studies in national reports of each AMS where selected. The selection was based on criteria and indicators that took into account a) potential for enhancing climate resilience and effectiveness of good CSA practice, b) ease of adoption and acceptance by farmers under local conditions, c) economic efficiency of the measure and d) suitability of framework conditions, including institutional set-up for scaling up the CSA practice[16]. Furthermore, institutional and human capacity measures relevant to the replication and scaling-up of these practices are identified in the national reports.

Figure 1 gives an overview of the selected CSA practices in the respective case studies of each national report. The selected CSA practices include use of climate stress-tolerant varieties that are resistant to drought, salinity, pest and diseases, and other stresses. Other selected CSA practices pertain to improved crop management during crop growth and management, recent scientific knowledge and advances in technologies. Crop diversification, including switching crops or agricultural products (e.g. shrimp farming in the Mekong River Delta), has also been selected as an option. Innovative agri-insurance was also selected as a promising CSA practice. While some good practices are similar across AMS, their implementation may be adjusted to local conditions.

[15] Vulnerability Index: Food Security in ASEAN and Climate Change (An assessment of Vulnerabilities of Staple Food Crops in ASEAN Member States), CCROM, Climate Sense and GIZ, 2014

[16] More detailed matrices on indicators and enabling factors that were used as criteria for selection are found in: *Guidance Manual to determie Adaptive Capacities in ASEAN Member States (2014)*

Good Practices Identified in National Studies	BN	KH	ID	LA	MY	MM	PH	TH	VN
1. Rice									
- *Alternate Wetting and*						x	x	X	x
- *System of Rice*				x		x			
- *Integrated Crop*				x		x			
- *Crop Insurance*			x					x	
- *Cropping Calendar*	x		x		x			x	x
- *Crop Diversification*				x		x			
- *Optimal Row Spacing*			x						x
- *Rice Shrimp Farming*									x
- *Nutrient Management*	x				x				
- *Stress-Tolerant Varieties*	x	x	x	x	x	x	x		
- *Short-duration Varieties*						x			x
2. Maize									
- *Improved Varieties*			x			x	x	x	x
- *Site-Specific Nutrient*						x	x		
- *Cropping Pattern /*			x	x		x			x
- *Cropping Calendar*			x			x			
- *Using Crop Residues*			x			x			
- *Diversification*						x			
- *Appropriate Row Spacing*			x						x
- *Post-Harvest Handling*			x	x			x		
- *GAP in Sloping Areas*							x		x
- *Seed Production and*				x			x	x	
3. Cassava									
- *Healthy Planting Material*		x			x				
- *GAP in Sloping Areas*									

Figure 1. Summary of identified and prioritized good practices employed by collaborating ASEAN Member States to enhance climate resilience of rice, maize, and cassava.[17]

It should be noted that these good practices are already being piloted and promoted in selected countries in the ASEAN region. For example, in recent years, alternate wetting and drying (AWD) technology developed at IRRI is now being tested and promoted by the national agricultural research systems (NARS) throughout most of the region. Contour farming in maize production in developing countries is being implemented in several Southeast Asian countries under the so- called sustainable maize production in sloping areas (SCOPSA), particularly in upland areas to address accelerated soil erosion as part of the strategy for soil and water conservation. Moreover, climate risk management via Weather Index-Based Insurance (WIBI) products (e.g. rainfall-based drought insurance) has been found attractive and efficient except for the high premiums. Nonetheless, some of these practices are already being implemented and have proved to be effective in enhancing climate resilience in crop production.

[17] Source: Makara, O. (2014), Promotion of Climate Resilience of Rice and Other Crops. *2nd Mekong River Climate Change Forum,* Siem Reap, Cambodia

1 Guidelines on Regional Cooperation

1. Guidelines on Regional Cooperation

1.1. Regional Cooperation on Scaling up Climate-Smart Agriculture Practices

In order to promote the scaling-up of CSA practices and enhance regional cooperation, effective and efficient coordination of activities is required. The ASEAN-CRN has been established as a regional platform to serve this purpose. It is comprised of experts and planners from ATWGARD and national and regional partners. They have agreed on the following seven (7) principles (and related activities) to formalise regional cooperation on scaling up CSA practices and strengthening the capacity of AMS respectively[18]. In scaling up CSA practices, the ASEAN-CRN approach will focus on context-specific priorities and solutions, aligned with national policies and priorities. They will be determined based on the social, economic and environmental conditions at the site, including the diversity in the type and scale of agricultural activity, as well as by evaluating potential synergies, trade-offs and net benefits[19].

1.1.1 Establishment of the ASEAN-CRN as a Regional Knowledge Platform.

Dissemination and exchange of scientific data and information through a common knowledge platform (ASEAN-CRN) by following agreed working principles and sharing protocols.

1.1.1.1. The ASEAN-CRN will continue to act as a common platform for the exchange and sharing of knowledge and expertise on CSA practices amongst the network's members, for their scaling-up and to promote climate resilience in the region.

1.1.1.2. The ASEAN-CRN will take a two-tiered approach, at the regional and national level. At the regional level (all AMS), overall capacity-building activities, trainings and studies, which go beyond national initiatives (refer to Annex 3: ASEAN-CRN Operational Plan 2015) will be undertaken, following the agreed working principles set out in these *Guidelines on Regional Cooperation* (and the (to be developed) protocols).

1.1.1.3. Furthermore, ASEAN-CRN will provide support and mutual learning at the national and-sub national level on specific areas of cooperation on the prioritised CSA practices, under the *Technical Guidelines on Scaling-Up prioritised CSA Practices.*

1.1.2. Sharing of knowledge, data and information

The CRN promotes the sharing of knowledge, data and information to promote the scaling-up of CSA practices, following an agreed protocol.

1.1.2.1. The ASEAN-CRN will stimulate CSA research, information sharing, and technology transfer within and amongst AMS. Relevant research institutes and ministries will be encouraged to contribute and share field and research data and information on CSA practices.

1.1.2.2. Scientific contributions and intellectual property rights will be properly observed and acknowledged. It is expected that participating country teams will freely share data and information on technology transfer to the

[18] For details and implementation of the principles please refer to Annex 3 for the work plan of regional activities of the ASEAN-CRN. Please note that specific areas of cooperation based on the scaling up of the identified CSA practices are elaborated in Section 3 (*Technical Guidelines*) of this document, with accompanying details on implementation.

[19] FAO, Climate-Smart Agriculture Sourcebook, http://www.fao.org/docrep/018/i3325e/i3325e.pdf

network for comparative analysis and synthesis. The ASEAN-CRN provides a means for sharing and exchanging scientific information following a shared procedure, template or protocol for data acquisition, processing and analysis.

1.1.2.3. The ASEAN-CRN will not only focus on technical aspects but also exchange information on (1) institutional and enabling factors to facilitate the implementation and up- scaling of the CSA practices, (2) international and regional negotiations, (3) financing opportunities and procedures as well as (4) economic valuations of climate change risks and adaption options.

1.1.3. ASEAN Policy Briefs, Joint Statements and Protocols on Promotion of CSA

Formalising regional collaboration and ASEAN community-building through joint statements, policy briefs and protocols on the promotion of CSA

1.1.3.1. The ASEAN-CRN will pursue the formulation of ASEAN policy guidelines and briefs on CSA. This could include policy briefs for CSA practices in staples and other crops / sectors, relevant regional policy briefs on good practices for CSA, prioritization of R&D activities e.g. Climate Field Schools, mobilisation and allocation of funding; expert dispatch and technical assistance, and sustainable financing of CSA practices.

1.1.3.2. The ASEAN-CRN will facilitate and support the AMS in developing common positions on agriculture and climate change in regional and international forums. This is urgently needed, because climate change and agricultural concerns are not yet given appropriate attention in international negotiations.

1.1.3.3. It will also streamline CSA into national development planning, given that CSA is not yet included in important AMS climate change policy documents in particular regarding access to funding[20]. Similarly, not all agricultural national policy documents include references to climate resilient practices.

1.1.3.4. Mechanisms among participating AMS on the sharing of knowledge, expertise and good practices will be based on the *ASEAN Guidelines on Regional Cooperation*, which includes the *ASEAN Technical Guidelines on prioritised CSA Practices*. The *Technical Guidelines* are a working document to be updated annually including additional prioritised CSA practices in selected AMS. Corresponding protocols and agreed working modalities will be further developed to facilitate this process.

1.1.4. South–South Collaboration

Exchange of knowledge and provision of technical assistance and capacity building via south-south collaboration amongst AMS

1.1.4.1. The ASEAN-CRN will help relevant institutions in AMS identify necessary technical support and opportunities for capacity building on the scaling-up of the selected CSA practices.

1.1.4.2. Capacity-building measures will be provided at different levels: regional (all AMS), and multilateral (selected AMS) at both the national and sub-national level. This includes regional symposia for development of common positions, executive forums for planners and experts, technical

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[20] For example - the UNFCC Technical Needs Assessment (TNA) for Cambodia does not include technical needs in the agriculture sector despite agricultures featuring prominently in the NAPA of Cambodia. The TNA acts as a “roadmap” for donors involved in financing climate change / climate resilience activities and practices.

exchanges between agricultural research institutes, technical workshops for the development of procedures and protocols and trainings for trainers of extension workers.

1.1.4.3. As much as possible, local experts will be tapped, and will be coordinated through local agencies in the participating AMS.

1.1.4.4. Linking research to implementation through partnerships of agricultural R&D institutions with local agencies is promoted to facilitate capacity building and enhance climate resilience of local communities and crop production systems. Other stakeholders, including the private sector (e.g. crop insurance companies, trading and marketing entities) will also be involved.

1.1.4.5. In addition to the CSA practices outlined in the *Technical Guidelines*, South-South collaboration has been identified in the following thematic areas: regional and country- level climate scenarios; UNFCC negotiations (with a focus on climate change and agriculture); regional climate projections and seasonal forecasts; economic valuations of climate risks and adaptation options; food systems resiliency; and mainstreaming climate change policy in the AMS at the national and local level.

1.1.4.6. The ASEAN-CRN will coordinate its efforts with the "Regional Cooperation Mechanism for Food, Agriculture and Forestry (RCM-FAF)" of ASEAN[21]

1.1.5. Partnerships

The ASEAN-CRN will help to connect stakeholders and forge partnerships

1.1.5.1. The ASEAN-CRN will broker partnerships and tap into networks and online platforms to fast-track exchange of information, expertise and experiences on CSA. Such networks currently include organisations linked to the Consultative Group for International Agricultural Research (CGIAR), such as IRRI[22], CIAT[23], CCAFS[24], and others such as SEARCA[25] and APAN[26]. Further linkages should be identified.

1.1.5.2. The ASEAN-CRN will take into account and promote linkages to regional and international processes related to climate change, agriculture and food security (such as the UNFCCC and funding options under the Green Climate Fund).

1.1.5.3. The ASEAN-CRN will also exert efforts to connect AMS initiatives with regional and international agencies and projects. This includes other relevant ASEAN technical working groups ASEAN (ASEAN Sectoral Working Group on Crops[27], AFCC Steering Committee); CGIAR[28] centres already involved (IRRI, CCAFS); UN institutions (UNEP and UNFCCC); donors (GIZ[29], USAID[30], SDC[31]) and other relevant

[21] An initiative being support by the ASEAN-German Programme on Response to Climate Change (GAP CC) of GIZ

[22] For example, the Rice Knowledge Bank (maintained by IRRI-http://www.knowledgebank.irri.org/); Cereals Knowledge Bank (maintained by CIMMYT and IRRI for rice, wheat and maize - http://www.knowledgebank.irri.org/csisa/) and the axFS website (http://ccafs.cgiar.org/)

[23] International Center for Tropical Agriculture

[24] Climate Change in Agriculture and Food Security Programme of the CGIAR group

[25] Southeast Asian Regional Center for Graduate Study and Research in Agriculture

[26] Asia Pacific Adaptation Network

[27] Under auspices of SOM-AMAF

[28] Consortium of International Agricultural Research Centers (CGIAR) http://www.cgiar.org/

[29] ASEAN – German Programme on Response to Climate Change (GAP CC) http://www.gapcc.org/

institutions and networks (SEARCA[32], APAN[33]) that are relevant to the scaling-up of the specific CSA practice. This refers to collaboration in terms of technical assistance but also relevant training courses, regional symposia, forums and conferences relevant to the ASEAN-CRN goals and objectives. For example, cooperation on training programmes has been proposed with CCAFS (and other relevant CGIAR centres and partners) on food systems resilience, seasonal forecasting, weather-based index insurance and economic valuations.

1.1.5.4. Concerning climate impacts, the ASEAN-CRN could collaborate with existing climate and seasonal forecast mechanisms, for example the Regional Integrated Multi- hazard Early-warning System (www.RIMES.int), to support dissemination and analysis of seasonal climate forecasts through regular meetings, such as the ASEAN Climate Outlook Forum (ASEANCOF) supported by the World Meteorological Organization (WMO)[34]. ASEAN-CRN could also support the dissemination and analysis of regional and country-level climate scenarios through the Coordinated Regional Climate Downscaling Experiment (CORDEX): a regional centre that contributes to the downscaling of climate projections for agriculture use.

1.1.6. Sustainable Financing

Identify and support access to sustainable financing sources through a combination of national counterpart funding and investments as well as international funding sources

1.1.6.1. The ASEAN-CRN works towards stimulating both public and private investments and promoting the integration of CSA investments into the business plans of farmers and agribusinesses. Furthermore, the ASEAN-CRN will promote the economic valuation of climate risks and adaptation responses in agriculture in order to mobilise national investments.

1.1.6.2. Local or counterpart funding for in-country scaling-up of CSA practices is to be provided by AMS. The level of commitment of local agencies regarding in-country scaling-up should be ascertained.

1.1.6.3. The ASEAN-CRN will identify and facilitate existing and new funding sources for capacity-building activities necessary for AMS to upscale CSA practices. It will explore the provision of funds to cover regional implementation/ collaboration costs including meetings, trainings and workshops, if necessary. This includes mobilizing support and engaging relevant partners working in the field of CSA and tapping into existing and planned programmes[35].

1.1.6.4. A particular focus will be on providing capacity to AMS to access the Green Climate Fund (GCF) by lobbying national climate finance institutions to include focus on CSA.

1.1.6.5. Furthermore, there will be a focus on leveraging private-sector CSA investments (i.e. input providers, insurance providers, marketing and

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[30] USAID Mekong Adaptation and Resilience to Climate Change (ARCC) http://www.mekongarcc.net/

[31] ASEAN Social Forestry Network (ASFN) Strategic Response Fund (or ASFN Flexible Funding Mechanism)

[32] Southeast Asian Regional Centre for Graduate Study and Research in Agriculture (SEARCA) http://searca.org/

[33] Asia Pacific Adaptation Network (APAN) http://www.apan-gan.net/

[34] http://www.weather.gov.sg/wip/web/ASMC/ASEANCOF

[35] Existing secured funding: GAP-CC, as knowledge broker for international and national agro-finance opportunities, will continue its support to the ASEAN CRN and ASEAN. This will include capacity- building in AMS for developing investment proposals to enhance climate resilience. Other potential donors include the Swiss Adaptation Fund for integrated landscape approach adaptation measures in ASEAN, CIAT

distribution of products) through the promotion of inclusive and sustainable business models.

1.1.6.6. The ASEAN-CRN envisions an increase in financial and technological capacity of AMS to scale up CSA practices in their respective countries. The ASEAN-CRN will identify entry points for investment opportunities on CSA practices in selected agricultural/ forestry value chains.

1.1.7. Regional Steering and Monitoring and Evaluation

Regional coordinating structures are in place for steering, monitoring & evaluating the ASEAN-CRN and its efforts to scale up CSA practices.

1.1.7.1. ASEAN-CRN will initiate a mechanism to effectively and efficiently coordinate and monitor the regional activities and those of participating AMS for selected CSA practices (as outlined in the *Technical Guidelines)*.

1.1.7.2. The chair for the ASEAN-CRN for the initial years (3 years) is Thailand (Department of Agriculture). Thereafter, upon agreement by the members of the ASEAN-CRN, a chairing country amongst the founding members will be appointed on rotational basis (duration to be determined).

1.1.7.3. Objectives, scope of tasks and working modalities of the ASEAN-CRN are detailed in the Terms of Reference (Refer to Annex 5)

1.1.7.4. Efforts will be made to ensure the sustainability of the network in the SEA region through ATWGARD and with support from the ASEAN and its agency (or agencies) mandated to increase climate resilience of vulnerable communities and agricultural ecosystems.

1.1.7.5. The ASEAN-CRN and its progress will be monitored for its effectiveness and efficiency in promoting resilience. This will involve specifications and measurement of key indicators for monitoring resilience[36]. The evaluation will be coordinated by the ASEAN-CRN, undertaken by independent consultants under the purview of contributing AMS and development partners.

*Special attention will continue to be given throughout the workings of the ASEAN-CRN to the impact upon and role of women in climate change and agriculture. For example, when reviewing vulnerability and sharing technical and scientific information, **gender-specific** issues shall be looked at, such as gender-specific risks from the climate impacts based on differing roles of women and men, and impacts of recommended improvements in food production on women.*

[36] This will include the identification of key indicators and an assessment of socio-economic aspects of climate resilience of communities, and biophysical aspects of ecosystems, considering factors such as economic efficiency and scale of outreach.

2 Technical Guidelines on Good Practices

2. Technical Guidelines on Good Practices

Section 3 describes the *Technical Guidelines* on selected good CSA practices. Based on the country case studies and national assessments, the following five measures were selected by ASEAN-CRN/ ATWGARD as priority good practices of CSA practices, to scale up across the region via the Network:

1. Stress-Tolerant Maize Varieties
2. Stress-Tolerant Rice Varieties
3. Agri-Insurance using Weather Indices
4. Alternate Wetting and Drying
5. Cropping Calendar for Rice and Maize

The *Technical Guidelines* are a tool for knowledge exchange and recommended guidelines for the specific CSA practice based on experiences in Member States. They are intended to garner and amalgamate the knowledge, experiences and practices in the AMS and develop guidelines to promote the scaling-up and replication of the practices throughout the region. These regional *Technical Guidelines* aim to serve as a benchmark to AMS in developing specific CSA practices. This includes the elements of implementation of scaling-up as components of regional cooperation and the need for capacity building for climate resilience in the AMS. A lead country is identified in advance to coordinate each of the regional activities that have been elaborated. The *Technical Guidelines* are working documents that will be regularly updated with the piloting and implementation of upscaled CSA practices and with the selection of additional CSA practices.

2.1 Stress-Tolerant Maize Varieties

2.1. Stress-Tolerant Maize Varieties

Under the ASEAN-CRN, six participating AMS, namely Indonesia, Laos, Myanmar, Philippines, Thailand and Vietnam provided input related to initiatives on promoting maize climate resilience in their respective countries.

Table 2. Maize yield (metric tons/hectare) in AMS, 2013-2014

Country	2013 (2012/13)	2014 (2013/14)	Change 2014 over 2013	
			Absolute	%
ASEAN	4.16	4.20	0.04	0.96
Brunei Darussalam	-	-	-	-
Cambodia	4.42	4.27	-0.15	-3.39
Indonesia	4.84	4.90	0.06	1.24
Lao PDR	5.27	5.44	0.17	3.23
Malaysia	-	-	-	-
Myanmar	3.64	3.70	0.06	1.65
Philippines	2.88	29.2	0.04	1.39
Singapore	-	-	-	-
Thailand	4.41	4.44	0.03	0.68
Vietnam	4.43	4.44	0.01	0.23

Source: AFSIS Commodity Outlook Prospects Report, June 2014

The AFSIS (2014) reported on the maize yield in AMS maize producers during 2013—2014 (Table 2). Laos has the highest yield of 5.44 tons/ha, followed by Indonesia (4.90 tons/ha); Thailand and Vietnam have the same yield at 4.44 tons/ha, similar to Cambodia's at 4.42 tons/ha, while Myanmar's is 3.70 tons/ha and that of Philippines 2.92 tons/ha.

The change in yield as compared to the year 2013 however, showed a different trend. Except for Cambodia (-3.39%), all countries increased their yields from 2013 to 2014. The highest increase was reported in Laos with 1.24%, followed by Myanmar (1.65%), Philippines (1.39%), Indonesia (1.24%), Thailand (0.68 %) and Vietnam (0.23 %).

Table 3. Maize balance sheet of ASEAN countries, 2014

Country	Supply				Demand			
	Beginning Stocks	Production	Imports	Total	Domestic Utilization	Exports	Ending Stocks	Total
ASEAN	4,821,733	40,948,337	10,436,526	56,206,597	47,611,065	2,615,149	5,980,383	56,206,597
Brunei	n.a.	-	4,635	4,635	4,635	-	n.a.	4,635
Cambodia	6,471	926,846	-	933,917	210,683	718,700	3,934	933,317
Indonesia	1,722,927	19,325,025	3,260,000	24,307,953	21,600,170	10,000	2,697,783	24,307,953
Laos	30,717	1,096,000	2,310	1,129,027	832,477	231,550	65,000	1,129,027
Malaysia	396,885	-	4,450,000	4,846,885	4,450,000	7,000	389,885	4,846,885
Myanmar	228,635	1,626,290	101	1,855,026	593,604	1,061,028	200,394	1,855,026
Philippines	208,800	7,618,247	250,000	8,077,047	7,891,525	-	185,522	8,077,047
Singapore	-	-	49,000	49,000	47,000	2,000	-	49,000
Thailand	2,019,570	5,061,133	220,000	7,326,822	4,772,571	550,000	2,004,251	7,326,822
Vietnam	207,728	5,193,500	2,200,480	7,676,885	7,208,400	34,871	433,614	7,676,885

Source: AFSIS Commodity Outlook Prospect Report, June 2014

The total maize production in AMS in 2014 is shown in Table 3. Indonesia has the highest volume of production at 19.33 MT, followed by Philippines (7.62MT), Vietnam (5.19 MT), Thailand (5.06 MT), Myanmar (1.63 MT), Laos (1.09 MT) and Cambodia (0.93 MT).

As of June 2014, the total supply of maize in ASEAN reached 56.21 MT, with Indonesia having the highest supply (24.31 MT) attributed to its highest production and imports, followed by Philippines (8.08 MT), Vietnam (7.68 MT), Malaysia (4.85 MT), which came mainly from imports, Myanmar (1.86 MT), Laos (1.13 MT), Cambodia (0.93 MT, mainly from production), Singapore (0.049 MT, mainly from imports), and Brunei Darussalam with the lowest supply of maize (0.005 MT, mainly from imports).

The total utilization of maize in ASEAN reached 47.61 MT, led by Indonesia (21.60 MT) and followed by Philippines (7.89 MT), Vietnam (7.21 MT), Thailand (4.77 MT), Malaysia (4.45 MT), Laos (0.83 MT), Myanmar (0.59 MT), Singapore (0.047 MT) and Brunei Darussalam with the lowest demand at 0.005 MT.

2.1.1. Synthesis of Technical Issues

Table 4. Climate-related constraints to maize production in six ASEAN Member States, 2014

Climate –related constraints	BRU	IND	LAO	MAL	MYA	PHI	SIN	THA	VIE
Temperature (high temperature, extreme heat days)		+		+	+	+			+
Solar radiation (intense solar radiation)						+			
Precipitation by season (typhoon, floods, drought, soil erosion, salinity)		+	+	+	+	+		+	+
Relative humidity (emergence of pests and diseases, seed deterioration)		+		+	+	+		+	
Wind speed						+			

Table 4 shows the climate-related constraints to maize production as identified by the participating AMS in 2014, such as high temperatures, extreme heat days, intense solar radiation, increasing incidence of typhoons, floods, drought, soil erosion or salinity, increasing relative humidity that contributes to pests, diseases and seed deterioration, high wind speed during the wet season particularly during the flowering stage resulting in seed infertility.

Table 5. Recommendations to improve maize production in the AMS.

Recommendations	BRU	IND	LAO	MAL	MYA	PHI	SIN	THA	VIE
Improve farmer-based seed supply system		+	+		+	+		+	+
Conservation of traditional maize diversity			+		+				
Production of drought tolerant varieties		+	+	+	+	+		+	+
Production of flood tolerant varieties		+						+	
Production of saline resistant varieties		+							
Production of pests and disease resistant varieties						+		+	
Enhancing maize quality (good eating quality)				+		+			
Breeding of Open Pollinated Varieties (OPV)					+	+			
Breeding of hybrid varieties		+	+	+	+	+			+
Breeding of early maturing varieties		+			+	+		+	
Improved postharvest practices and facilities				+		+			
Seed storage/dryers						+		+	
Improved cultural practices				+		+			
Improved row spacing		+							+
Cropping calendar		+			+	+		+	+
Direct mulching			+						
Crop rotation and diversification			+			+			+

Recommendations	BRU	IND	LAO	MAL	MYA	PHI	SIN	THA	VIE
Construction of small farm reservoirs						+			
Zero tillage						+			
Prevention of soil erosion						+			
Specific nutrient management for hybrid maize (SSNM)			+		+	+			+
Sustainable maize production in sloping areas (SCOPSA)						+			
Quality Protein Maize (QPM)					+				
Good Agricultural Practices				+				+	

Table 5 shows the summary of good practices recommended by the participating AMS to improve maize production in the ASEAN region. Most of the participating AMS mentioned government involvement in the development of a farmer-based seed supply system and the need to educate the farmers on the multiplication of quality seeds to improve maize productivity. Breeding of stress-tolerant varieties (drought, flood, saline, pests and diseases), as well as early-maturing varieties was also suggested among the priority areas of interest. The improvement of post-harvest and cultural practices is also a significant factor in the enhancement of maize productivity.

Table 6. Maize seed supply system in the participating AMS

Brunei Darussalam	-
Indonesia	• Maize planted both as staple food and livestock feed Collector provides a loan in the form of seed and fertilisers • Leader of GAPOKTAN may provide loan or credit for seeds and other production inputs, payment in harvesting with an interest rate of 7-10% • Koperasi Unit Desa – KUD (Village Cooperative Agency) • Kios (Small Agricultural Shop) – to supply production inputs and tools for farming activities • Government (Agricultural Agency) – may provide subsidy for production inputs, e.g. fertilizers and seeds. The national government also often work with the agricultural agency to introduce new varieties produced by the research and development institution of the Ministry of Agriculture
Laos	• Types of maize planted are yellow maize and sweet maize • Use of hybrid varieties such as LVN 10 from Vietnam and CPs 888,999 Pioneer Thailand • The extinction or depletion of traditional maize varieties and their distinct species population have accelerated at an alarming rate. The principal cause of genetic erosion has been the widespread use of high-yielding varieties or HYVs.
Malaysia	• Seed companies and seed suppliers.
Myanmar	• Sources of input are seed companies, commercial seed breeders (e.g. CP), government seed production farm (DAR, Yezin, and Tatkone), and local distributors. • Widespread adoption of hybrid maize varieties in response to high demand for animal feed. • Maize productivity is still considered low due to degeneration of seeds and unavailability, increased cost for seeds and fertilizers, poor advisory and extension system, etc. • Hybrid varieties dominate the local varieties, with 84% and 16% of the total sown areas, respectively. • In Tatkone most farmers prefer hybrid varieties of the CP Company such as 888 (4 months), 301 (110 days), 101 (115 days), and 989 (120 days). Few farmers grow Yezin-6 and Yezin – 10 varieties. The CP-888 variety is mostly cultivated due to its higher drought

	tolerance compared to other varieties. • Hybrids have a yield advantage of 35--40% over the existing Open Pollinated Varieties (OPVs) • Seeds are usually acquired from seed dealers or traders. • Chin State has the largest acreage for local varieties of maize. As a tradition, the Chin Nationals, especially in rural areas, eat maize as a staple food instead of rice. They believe that maize is more nutritious than rice for upland livelihoods. They like the soft and sticky grain quality of local varieties, which are suitable for eating compared to other high-yield varieties that are tough and hard. • Most of the farmers keep their maize seeds on their own for growing next year. Continuous cultivation of the same varieties for decades will degenerate the seed quality, leading to a poor yield potential.
Philippines	• Two maize varieties commonly grown are yellow maize, mainly used and traded for animal feeds (almost 70% of national maize produced), and white (flint type) maize as main food staple for about 15% of the total population, mostly in major islands of Visaya and Mindanao. • There are very few seed companies working on white maize hybrid, basically because of lack of market. The farmers, marginal at that, could not afford to buy hybrid seeds or fertilizers. Native varieties are mostly early maturing, low yielding, and tolerant to stresses, but of good eating quality.
Singapore	-
Thailand	• The most popular hybrid maize varieties during the 1990s were the DK 888 varieties, which were first released in 1991. • The farmers then switched to hybrid maize varieties, mostly produced and sold by private companies. By 1997, only 4.7% of all maize areas were under public sector hybrids and OPV. • By 2000, the farmers were reporting that the hybrid varieties gave higher yields, big pods, small cobs, and large grains, and were tolerant to diseases and drought. Good grain colour for better marketability was also reported. • The C919, C717, and C949 hybrids from the Pioneer Hi-Bred company were the popular varieties in Pachong, Nakhon Ratchasima. The variety C919, reported to be early maturing, was suitable for double cropping of maize popular in the areas. C717 was reported to be cheaper in its seed prices relative to other hybrids. In Loei, CP-DK 888 hybrid was popular because it provided good weight grain. • All over the country, there were more than 10 popular hybrid varieties from different companies. Each hybrid variety had different advantages and disadvantages. Most are yellow, flint hybrid varieties used mostly for animal feeds. OPV are hardly found these days even in remote areas. Some farmers in the northern and central regions were found to plant F2 hybrid with cheaper seed price, but this was not evident among farmers in the north-eastern region. • Since 1975, several open pollinated varieties have been released, such as Suwan 1, Suwan 2, Suwan 3, and Suwan 5, Nakhon Sawan 1, Population 28 and also testcross using the promising inbreeds or hybrids as testers. • Kasetsart University (KU) programmes have continuously released inbred lines (Ki 1 to Ki 60), several hybrids with three-way crosses and single crosses, such as Suwan 2301, Suwan 2602, Suwan 3101, Suwan 3601, Suwan 3851, and Suwan 4452, which yielded 7.5--8.5 tons/ha. These varieties have shown excellent performance with downy mildew resistance. • DOA released inbred lines Nakhon Sawan 1, Nakhon Sawan 2, Tak Fa 1, Tak fa 2 and Tak fa 3. Several high-yielding hybrids with downy mildew resistance were released, such as Nakhon Sawan 72, Nakhon Sawan 2 in 205 and Nakhon Sawan 3. • Hybrid seeds are estimated to be used on some 98% of total maize growing area, with the other 2% using open-pollinated varieties in 2013. • Private firms are a major supplier of hybrid seeds. Much of private research, however, depends heavily on public-sector maize germplasm, especially

	stress-tolerant materials.
Vietnam	• One feature of the maize value chain in Vietnam is the lack of input providers. • Farmers mainly use their own seeds and hardly use other inputs, such as fertilizer and insecticide.

The state of the maize seed supply system in the participating AMS is summarized in Table 6. Each AMS has different means in terms of seed acquisition, use and storage. There are also different preferences regarding the type and variety, depending on the desired nutrition and quality and the intended use, for instance as a staple food or as raw material for animal feed.

Although it became evident that there is a widespread adoption of hybrid varieties, there are still concerns about the conservation of traditional of local varieties, particularly of the OPVs, since the majority of the maize farmers are subsistence farmers. Therefore, it is worthwhile to point out that R&D thematic areas on the development of OPVs that are tolerant to biotic (pest and diseases) and abiotic stresses like drought, to improve nutrition as food. Improving the farmer-based seed supply system is also relevant at the national and ASEAN level; the ASEAN seed supply system could be addressed in the future.

2.1.2. Institutional and Technical Challenges

Proposal for the establishment of an ASEAN maize seed improvement and supply system

Among the constraints to maize production and productivity are the lack of training and knowledge transfer to the resource-poor farmers, availability of quality seeds for stress-tolerant varieties, high seed input cost for the purchase of hybrid seeds, and inadequate access to improved seeds. Concerted efforts are required at the policy level to create an enabling environment for long-term R&D investments in breeding, capacity building and the application of a community-based management (CBM) approach in partnership with the public and private sector for the establishment of a community seed supply system.

2.1.3. Regional Cooperation

Based on the synthesis of the national case studies in the six participating AMS, the following areas are recommended for incorporation as ASEAN regional guidelines for the establishment of an ASEAN maize seed improvement and supply system.

- Widen the genetic base of the existing elite maize germplasm through multi-institutional efforts and enhanced exchange of germplasm in partnership with International Research Centers (IRCs), and multilateral regional platforms

- Concerted and accelerated breeding efforts using novel techniques, such as double haploids, molecular market-assisted selection and precision phenotyping, for developing improved maize varieties (especially single-cross hybrids) with high yield, stress resilience and better nutritional quality, and adaptability to diverse agro- ecologies

- Concerted effort to produce higher-quality seed through strong public-private-producer partnerships (4Ps), conduct a regional assessment and inter-country demand for hybrid seeds vis-à-vis availability, and develop a strategy to produce enough seed by empowering the farming communities to produce good-quality seeds of improved varieties (especially hybrids) and linking them to the markets

- Conduct insightful analysis and better seed quality monitoring, regulatory system, delivery system of improved maize seeds, opening access of farmers at affordable price

- Create a conducive policy environment as well as enhance investment to facilitate stakeholders in the region in scaling up and scaling out innovations in maize-based cropping systems through public-private-producers partnerships (4Ps)

- Establish and strengthen maize innovation platforms and initiate regional and sub-regional networks on strengthening maize seed sector and deploying climate-resilient maize germplasm through public-private partnerships. Integrate breeding techniques for improved stress resilient genotypes, strengthen the maize seed sector and provide access to quality seed through public-private-producer partnerships (4Ps)

- Catalyse existing networks to derive synergies among the international and national agricultural research institutions to facilitate improved germplasm development in the ASEAN region. Explore partnership with the Asia Pacific Association of Agricultural Research Institutions (APAARI) and CGIAR centres.

The ASEAN-CRN in partnership with the ASEAN Technical Working Group on Agricultural Research and Development (ATWGARD) will support both the scaling-up and the scaling-out of the seven (7) areas recommended for the establishment of the ASEAN maize seed improvement and supply system, through institutional collaboration and capacity-building initiatives, joint activities such as research, exchange platforms, south-south technical expert exchange, linking value chain actors and joint funding proposals.

2.1.4. Mechanism to Address Implementation

This initiative on the establishment of the ASEAN maize seed improvement and supply system will be implemented in all ten AMS through the related National Agricultural Research System (NARS) under the Ministry of Agriculture and Forestry (AMAF), in partnership with the ASEAN Dialogue partners, international donors, International Agricultural Research Centers (IARCs), regional networks such as SEARCA, APAARI (Asia-Pacific Association of Agricultural Research Institutions), etc.

2.2 Stress-Tolerant Rice Varieties

2.2. Stress-Tolerant Rice Varieties

Stress-tolerant rice cultivars (STR), with greater tolerance to abiotic stresses (i.e. drought, heat, increasing risks from typhoon- and rainfall-induced floods, sea-level rise, and salt-water intrusions) and biotic like pest infestation problems brought about by the changing climate are "entry point" technologies to reduce risk and raise productivity in rice systems affected by these type of stresses (Wassman et al., 2009a, b; Mackill et al., 2012). According to reports, short-term flash floods (for up to 2 weeks), moderate or severe drought or salinity can occur at any stage of plant development, sometimes more than once, resulting in severe yield losses. Modern rice varieties are not adapted to these conditions, which are probably the reason these varieties are not widely adopted in areas that are often flooded, dried, with levels of salinity; thus farmers helplessly continue to grow their local landraces even with low yield (Mackill et al., 2012; Manzanilla et al., 2011).

To mitigate losses due to abiotic stress, IRRI developed submergence-, saline-, heat-, and drought-tolerant rice breeding lines. The SUB1A gene, derived from FR13A, a rice variety from Odisha, India, confers tolerance of up to 2 weeks of complete submergence. Varieties with the SUB1A gene have the same yield and other characteristics as the original varieties, and they can be used to replace these varieties in flood-prone areas (Singh et al., 2009; Mackill et al., 2012; Manzanilla et al., 2011). Saline-tolerant rice, aided by the Saltol gene can survive in saline-prone environments with salt level of at least EC 4 dS/m (0.3% salt) (Gregorio et al., 2002; Islam et al., 2011; Gregorio 2010; Thomson et al., 2010; Ismail et al., 2010). Combining Saltol and SUB1 in one genetic background seems feasible with no apparent negative impacts on agronomic traits. This will help develop more stable varieties adapted to coastal zones (Gregorio et al., 2002). Rice breeding lines with tolerance to drought conditions conferred by drought quantitative trait loci (QTLs) are also available, and some materials have been released as varieties in India and the Philippines. QTLs for heat tolerance at the flowering stage have been mapped (Ye et al., 2010; 2012). For direct seeding, particularly where water is applied to suppress weeds, tolerance of anaerobic germination (AG) can improve early seedling establishment (Ismail et al., 2012). Materials with stronger tolerance for adverse soil conditions of excess Fe, deficient P, and deficient Zn are also in development. The isolation of the Pstol1 gene (Phosphorus starvation tolerance) from variety Kasalath has shown its role in improving root growth and distribution in phosphorus-deficient soils and increasing yield by as much as 20% (Gamuyao et al., 2012). However, all these important traits can help farmers only through smart breeding by fast- tracking introgression into high-yielding rice followed by evaluation for their adaptation at target sites in the country.

Marker-assisted breeding allows breeders to introduce a gene of interest into a commercial variety in two backcross generations, thereby speeding up product development by two to three years. Aside from the traits mentioned above, markers have been available for resistance to biotic factors. For planthoppers, the genetics of resistance to brown planthopper (BPH), white backed planthopper (WBPH), green leafhopper (GLH) and other leafhoppers has been studied, and many resistance genes have been identified (Brar et al., 2009).

In spite of flash floods or submergence and long-term inundation in rice-producing areas in Southeast Asia, rice productivity can be sustained and even improved with science.

Strategies that are systematically and participatory in nature can be used in the identification and selection of appropriate and adopted varieties of rice under local conditions. Improved crop and natural resource management options have been developed to complement advances in varietal development that contribute to yield stability, improve productivity, encourage input use and, in some cases, facilitate the emergence of diversified cropping patterns. Rice cultivars with greater tolerance to stress have been validated with National

Agricultural Research and Extension Systems (NARES) and are being rapidly adopted in some areas of South and Southeast Asia together with a range of management options. STR cultivars are ready for wider testing and out-scaling in Southeast Asia (Tables 7-10).

Table 7. Recently released stress-tolerant rice (STR) varieties from IRRI and Southeast Asian NARES partners in 2011.

Country	Local name of the variety	Designation	Ecosystem
Brunei Darussalam	-	-	-
Cambodia	-	-	N/A
Lao PDR	N/A	N/A	N/A
Indonesia	INPAGO 7	B12498E-MR-1	Upland
	INPAGO 8	TB409B-TB-14-3	Upland
Malaysia	-	-	-
Myanmar	YENAELO-1	IR 54402-01	Drought prone
Philippines	NSIC Rc296 (Salinas 9)	IR71896-3R-8-3-1	Saline prone
	NSIC Rc290 (Salinas 6)	PR28377-AC97-54	Saline prone
	NSIC Rc294 (Salinas 8)	PR28378-AC96-36	Saline prone
	NSIC Rc23 (Katihan 1)	IR79913-B-176-B-4	Upland
	NSIC Rc274 (Sahod Ulan 3)	IR81412-B-B-82-1	Rainfed lowland
	NSIC Rc272 (Sahod Ulan 2)	PR34363-4-Pokkali/AC-45-M5R-19	Rainfed lowland
	NSIC Rc274 (Sahod Ulan 4)	C8108-B-10-2-2-1	Rainfed lowland
	NSIC Rc276 (Sahod Ulan 4)	C8108-B-10-2-2-1	Rainfed lowland
	NSIC Rc 278 (Sahod Ulan 5)	IR81023-B-116-1-2	Rainfed lowland
	NSIC Rc280 (Sahod Ulan 6)	IR72667-16-1-B-B-3	Rainfed lowland
	NSIC Rc282 (Sahod Ulan 7)	C8231-B-1-1	Rainfed lowland
	NSIC Rc284 (Sahod Ulan 8)	IR74963-262-5-1-3-3	Rainfed lowland
	NSIC Rc286 (Sahod Ulan 9)	C6392-2B-3-3-1-2	Rainfed lowland
	NSIC Rc288 (Sahod Ulan 10)	PR25769-B-9-1	Rainfed lowland
Singapore	-	-	-
Thailand	CP 304	KHR20120-12-20-7-4-2-2	Hybrid rice
	RDH 1	PTT06001H	Hybrid rice
	Niaw Dam Cham Mai Pai 49	PTNC96004-49	Rainfed upland (Glutinous rice)
Vietnam	OM5629	OM5629	Irrigated, Saline prone
	OM5981	OM5981	Irrigated, Saline prone
	OM6071	OM6071	Brown plant hopper resistance
	OM6377	OM6377	Irrigated, Saline prone

Table 8. Recently released stress-tolerant rice (STR) varieties from IRRI and Southeast Asian NARES partners in 2012.

Country	Local name of the variety	Designation	Ecosystem
Brunei Darussalam	-	-	-
Cambodia	-	-	N/A
Indonesia	INPARI 28 KERINCI	RUTTST85B-5-2-2-O-J	Upland
	INPARI 29 RENDAMAN	B13138-7-MR-2-KA-1	Submergence prone
	INPARI 30 CIHERANG SUB1	IR09F436	Submergence prone
	INPARA 7	B11844-MR28-7-1	Swampy
	INPAGO 9	B12151D-MR-4	Upland
Lao PDR	N/A	N/A	N/A
Malaysia	-	-	-
Myanmar	Yemyokekhan-1 (Swarna-Sub1)	IR05F102	Submergence prone
Philippines	NSIC 2012 Rc298 (Tubigan 23)	PR34159-13-1	Irrigated lowland (inbred)
	NSIC 2012 Rc300 (Tubigan 24)	PR31379-2B-10-1-2-1-2	Irrigated lowland (inbred)
	NSIC 2012 Rc302 (Tubigan 25)	IR79643-39-2-2-3	Irrigated lowland (inbred)
	NSIC 2013 Rc308 (Tubigan 26)	PR35766-B-24-3	Irrigated lowland (inbred)
	NSIC 2012 Rc304 SR (Japonica 3)	PR34126-B-1 (J)	Irrigated lowland (special rice)
Singapore	-	-	-
Thailand	Leum Pua	Pure line selection	Rainfed upland (Glutinous rice)
	Khao Bahn Nah 432	PCRC92001-432	Deepwater rice
Vietnam	OM7398	OM7398	Drought prone
	OM11270	OM11270	Acid sufate soil
	OM11271	OM11271	Acid sufate soil
	OM6677	OM6677	Saline prone prone
	OM8928	OM8928	Drought prone
	OM7347	OM7347	Drought prone

Table 9. Recently released stress-tolerant rice (STR) varieties from IRRI and Southeast Asian NARES partners in 2013.

Country	Local name of the variety	Designation	Ecosystem
Brunei Darussalam	-	-	-
Cambodia	Damnoed Sbai Mongkul	Improved traditional variety	Rainfed lowland, drought and flood prone
Indonesia	N/A	N/A	N/A
Lao PDR	N/A	N/A	N/A
Malaysia	-	-	-
Myanmar	Myaungmya May	PRAM BEI KOUR	Rainfed Lowland
	Sangankhan	Yn 3220 MAS 62-2-	Saline prone

Country	Local name of the variety	Designation	Ecosystem
	Sinthwelatt	4	
	Yeanelo -2	UPLRi -7	Aerobic/Upland
Philippines	NSIC 2013 Rc346 (Sahod Ulan11)	PR34350-4-POKKALI-24-M5R-10-DrS88	Rainfed lowland
	NSIC 2013 Rc348 (Sahod Ulan 12)	IR81047-B-106-2-4	Rainfed lowland
	NSIC 2013 Rc324 (Salinas 10)	PR31607-2-B-B-B-B	Saline
	NSIC 2013 Rc326 (Salinas 11)	IR84084-B-B-1-1	Saline
	NSIC 2013 Rc328 (Salinas 12)	IR62700-2B-9-2-3	Saline
	NSIC 2013 Rc330 (Salinas 13)	PR37435-30-1	Saline
	NSIC 2013 Rc332 (Salinas 14)	PR38566-WAGWAG V9-3- 2-15-2	Saline
	NSIC 2013 Rc334 (Salinas 15)	IR83410-6-B-4-1-1-2	Saline
	NSIC 2013 Rc336 (Salinas 16)	IR84095-AJY3-8-SD01-B	Saline
	NSIC 2013 Rc338 (Salinas 17)	PR30665-1B-1-B-B-Cg	Saline
	NSIC 2013 Rc340 (Salinas 18)	IR84096-AY4-2-SD04-B	Saline
Singapore	-	-	-
Thailand	RD49		Irrigated (MR BHP Blast)
	RD51	RGDU99003-1012-B-2-6-B	Rainfed (Flash flood tolerance)
	RD53	PRE01017-10-1-1-1	Irrigated
	RD55	PTL00042-B-B-18-2-1-1-2	Irrigated
	RD18		Rainfed (resistance to Blast)
	RDH3	PTT06008H	Hybrid rice
Vietnam	OM 5166	IR75494-11-1-1-2-2-1-2/Jasmine 85	Saline prone

Table 10. Recently released stress-tolerant rice (STR) varieties from IRRI and Southeast Asian NARES partners in 2014.

Country	Local name of the variety	Designation	Ecosystem
Brunei Darussalam	-	-	-
Cambodia	-	-	N/A
Indonesia	Inpari 34 Salin Agritan	IR78788-B-B-10-1-2-4-AJY1	Irrigated, saline prone
	Inpari 35 Salin Agritan	CSR90-IR-2	Irrigated, saline prone
Lao PDR	TDK1-Sub1	IR40931-33-1-3-2/3*TDK1	Flood-tolerant
	TDK10		Flood-tolerant
	TDK9		Drought prone

Country	Local name of the variety	Designation	Ecosystem
	TDK11		Drought prone
	TDK12		Drought prone
	Phonegnam1		Drought prone
	Phonegnam3		Drought prone
	Thasano7		Drought prone
	Xebangfai1 (XBF1)	IR07F289	Flood tolerant (release 2014)
	HomXebangfai2 (HXBF2)	ARC-22-42-1-25-38-TDK-41-13	Flood and drought tolerant (release 2015)
	Homexebangfai3 (HX	ARC-85-1-24-41-TDK-12-B	Flood tolerant (release 2015)
Malaysia	-	-	-
Myanmar	Sangakhan-1 (Sinthwelat)	YN 3220, MAS 62-2-4	Salinity prone
Philippines	NSIC Rc25 (Katihan 2)	IR 82635-B-B-47-2	Upland
	NSIC Rc27 (Katihan 3)	IR 86857-101-2-1-3	Upland
	NSIC Rc29 (Katihan 4)	IR 83140-B-36-B	Upland
	NSIC Rc390 (Salinas 19)	IRRI 184	Saline
	NSIC Rc392 (Salinas 20)	IRRI 185	Saline
Singapore	-	-	-
Thailand	RD59	PSL95120-28-5-R-R	Rainfed (resistance to blast)
	RD57	SPR94007-PTT-27-2-9-3	Irrigated (resistance to BPH)
	IR77954-28-36-3	IR77954-28-36-3	Rainfed (resistance to blast)
Vietnam	OM 8232	OM2490/IR72046// OM3556-1-9	Alium prone
	OM6916	OM4900/OM5472	Saline, Alum prone
	OM6904	OM5464/OM5472	Saline, Alum prone
	OM6932	OM4088/OM5472	Alium prone
	OM6893	OM4498/OM5472	Saline, Alum prone (Rice-shrimp)
	OM8108	M362/AS996	Saline, Alum prone
	OM10041	D23/C56//C56	Alium prone

2.2.1. Synthesis of Technical Issues

To address the development and deployment (scaling-up and scaling-out) of the new rice varieties that are tolerant of submergence, salinity and drought, the following activities should be undertaken where these abiotic stresses are a regular problem:

2.2.1.1. *Technology evaluation, adaptation and demonstration*.

- Collection, screening and evaluation of local materials as potential new sources of submergence-, drought- and salinity-tolerant rice varieties under different types of stress in existing and expansion sites.
- Incorporation of the Sub1 gene, Saltol gene and other traits of interest by

MAS/MAB to popular and high-yielding varieties for wider adoption in specific localities.

- Adaptive yield trials of new stress-tolerant rice lines/genotypes in various locations deemed to be susceptible to abiotic and biotic stresses.
- On-farm and on-station field trials to improve the management practices for each location.
- Adaptation and scaling-up of well adopted varieties and best management practices at outreach areas.
- Monitoring and evaluation of feedback results from field and agronomic experiments, data analysis and reporting.

2.2.1.2. *Seed systems and distribution*

- Multiplying large quantities of seed of available varieties at Department of Agriculture research stations and provincial seed production centres and seed growers (public and private) for immediate distribution.
- Distributing seed to target areas: proper time for seed distribution, choice of participating farmers, communication and orientation, etc.
- Establishing seed-multiplication facilities in target areas for local multiplication and distribution: Choice of partners (public and private), agreements, proper training in high-quality seed production and monitoring.
- Mobilization of additional support from international donors or partners in the country and national government and private agencies/institutions.
- Launching of public awareness programmes to speed up the distribution and utilization.

2.2.1.3. *Knowledge management and public awareness.*

- Degree training to develop the next generation rice scientists.
- Training courses on rice breeding and marker-assisted selection/breeding (MAS/MAB).
- Training courses on participatory approach to upscaling the adoption of submergence-tolerant rice and participatory varietal selection (PVS).
- Training courses on data management (statistics and socio- economics).
- Training courses for Agricultural Extension workers and farmers on proper quality seed production, seed health management and storage.
- Publication and distribution of information, education and communication (IEC) materials in print and in videos.
- Initiating public forums, meetings and seminars for increased public awareness of the STR and associated technologies to ensure enabling policies.

2.2.1.4. *Characterization, participatory monitoring, evaluation, out- and up-scaling and impact assessment*

- Characterization of target sites for flooding, drought, salinity and typhoon patterns, water depth, duration and other conditions.
- GIS studies to establish extrapolation domains for these technologies.
- Understanding of interplay among the social, economic and institutional factors, including gender concerns that govern a community- based rice-farming system.
- Participatory monitoring and evaluation (M&E) of existing varieties, new lines and their proper management practices in partnership with farmers and on their fields for widespread community-based diffusion.
- Impact assessment of benefits from technologies, processes, project seed

multiplication systems, capacity-enhancement strategies and other project output

2.2.2. Institutional and Technical Challenges

The key institutional and enabling factors needed for scaling-up and replication of good practices include the following:

2.2.2.1. Research, development and extension (RD&E) strategy on STR - institutionalization in the DOA national research centres; the development, improvement and dissemination of stress-tolerant rice varieties; institutionalization in the DoA of the national participatory adaptive research and extension programme on stress-tolerant rice in the regional research centres.

2.2.2.2. Seed system - the importance of a strong and vibrant seed industry is vital to modernizing agriculture and thus achieving increased rice productivity. Both the formal and informal seed systems are important channels for delivering seeds of new varieties to farmers.

2.2.2.3. Policy on variety registration and release – revision of policy on release system from stress-tolerant rice varieties, particularly those with Sub1, Saltol, Drought tolerance and others with gene introgression through molecular assisted breeding.

The proposed activities for national and regional promotion and dissemination of stress-tolerant rice varieties for each participating SE Asian country are listed in Tables 11 and 12.

Table 11. Proposed activities for national promotion and dissemination of stress-tolerant rice varieties

Country	Proposed National Activities
Brunei Darussalam	-
Cambodia	• Wider adaptation and dissemination of stress-tolerant varieties (drought- and submergence-tolerant in rainfed lowlands) • Policy mainstreaming at national, regional and local levels
Indonesia	• Facilities and financial support to boost the development and deployment of climate- ready rice • Develop the specific cultivation technology for new released variety tolerant to abiotic stresses • Improving the number and knowledge of the extension workers • Supporting the farmers to be sovereign on seed and technologies • Demonstration plot and FGD with farmers in the stress-prone area, especi outside Java to increase their knowledge
Laos	• Wider adaptation and dissemination of stress-tolerant varieties (drought- and submergence-tolerant) • Breeding climate ready rice and maize varieties that are suitable in three ecosyste (upland, irrigated lowland and rainfed lowland)
Malaysia	• Simulating the effect of climate change and water management on rice and evaluating options for adaptation and mitigation • Development of climate-smart agriculture to reduce the effect of climate change and enhance food security • Development of new drought-tolerant variety • Application of AWD technique and early warning system
Myanmar	• Wider adaptation and dissemination of stress-tolerant rice varieties for abiotic stress (submergence-tolerant, salinity-tolerant, drought-tolerant etc.) • Breeding programme for climate ready rice based on indigenous quality rice

Country	Proposed National Activities
	varieties of Myanmar • Policy mainstreaming at national, regional and local levels
Philippines	• Institutionalization in the DoA national research centres of the development, improvement and dissemination of stress-tolerant rice varieties • Institutionalization in the DoA of the national participatory adaptive research and extension programme on stress-tolerant rice in the different regional research centres • Institutionalization of seed system on stress-tolerant rice varieties in the different DoA research stations and seed network • Revision of policy on release system from stress-tolerant rice varieties, particula those with Sub1, Saltol, Drought tolerance and others with gene introgress through molecular assisted breeding
Singapore	-
Thailand	• Wider adaptation and dissemination of stress-tolerant rice varieties for abiotic and biotic stress (submergence-tolerant, salinity-tolerant, drought-tolerant, insect pest and disease tolerance etc.) • Application of environmental friendly practices for rice production (AWD, Low Carbon Production and GAP) • Rice processing for value-added production and market promotion environmentally friendly rice products
Vietnam	• Participate in technical package adaptive research, communication campaigns (workshops, technical exchange meetings) to disseminate results/ information. • Multiply demonstration (technical package) and pilot fields (large scale) at local and national levels • Policy mainstreaming at local level • Communication campaigns (workshops, technical exchange meetings) to disseminate local results • Policy mainstreaming at ministerial/central level

Table 12. Proposed activities for regional cooperation on the promotion and dissemination or scaling-out of stress-tolerant rice varieties

Country	Proposed Regional Activities
Brunei Darussalam	-
Cambodia	• Institutional collaboration and networking for breeding programmes of stress-tolerant rice varieties • Expert exchange programme for promoting and scaling out stress-tolerant rice varieties • Financial and technical support for capacity building on Climate Change Adaptati Mitigation and Climate Resilience
Indonesia	• Expert exchange for technical information and dissemination • Scientist exchange, visiting scientist who focus on breeding, agronomy/physiology • Scholarship for master and doctoral degree • Fellowship for research and training • Financial and technical support on mechanization at the farm level
Laos	• Regional networking and collaboration for action research and development, e.g. Asia Pacific Advanced Network (APAN) on climate change; CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS); SEARCA networks. • Institutional collaboration towards a Community-based Conservation of Rice, Maize Diversity (CBCRMD). • Support Lao Climate Change Adaptation research centre on Human Resources Development (HRD), where in the AMP 2011-2015 the GoLs prioritize activities on HRD • Capacity building on Climate Change Adaptation, Mitigation and Climate Resilienc

Country	Proposed Regional Activities
Malaysia	• Institutional collaboration for technologies sharing • Exchange of scientist and information • Strengthen regional collaboration based on ASEAN frameworks • Capacity building
Myanmar	• Institutional collaboration and networking for breeding programmes of stress-tolerant rice varieties • Expert exchange programme for promoting and scaling out stress-tolerant r varieties
Philippines	• Regional networking and collaboration for action research and development. (e.g. Asia Pacific Advanced Network (APAN) on climate change; CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS); SEARCA networks; GIZ CC programme, etc.) • Support for capacity building (degree and non-degree) on Climate Change Adaptation, Mitigation and Climate Resilience for next generation scientists • Better policy on germplasm exchange of STR varieties between ASEAN
Singapore	-
Thailand	• Technical support for capacity building (for researchers in rice research centres) on Climate Change Mitigation Adaptation and Climate Resilience • Select areas based on zoning policy for regional cooperation on the promotion a dissemination or scaling-out of stress-tolerant rice varieties
Vietnam	• Support for technical package research and exchange meetings • Support for capacity building • Sharing experiences, lessons on communication campaigns and pol mainstreaming activities.

2.2.3. Regional Cooperation

Table 13 summarises the challenges and areas for collaboration in Southeast Asian countries. Four areas for regional collaboration are common in most SEA countries, namely: a) financial support for development and deployment of new generation stress-tolerant rice varieties, b) capacity building, both degree and non-degree training, c) information dissemination, and d) technical expert exchange.

Table 13. Challenges and Areas for Regional Collaboration

Country	Challenges/Requirements being Faced	Areas for Regional Collaboration
Brunei Darussalam	-	-
Cambodia	• Few moderate submergence-tolerant rice varieties are recommended to wet season rice farmers. • But considering a big variation in the ecosystem, more breeding is strongly required in developing submergence and drought-tolerant varieties for wider adaptation.	• Financial and technical support for the development of submergence-tolerant varieties with a wider spectrum is needed.
Indonesia	• Increasing evidence of flood, drought and pest diseases investment • Development of multi-tolerant variety to overcome the multiple stresses due to climate change (Climate-ready rice) is needed, i.e. submergence-AG-drought-tolerant varieties, drought-heat-blast-tolerant varieties etc.	• Financial and facilities support for (a) development and deployment of multi- tolerant rice varieties; (b) agronomic study to have appropriate recommendation of new released variety for specific region. • Financial and technical support for demonstration plot of new abiotic stress variety in targeted areas

Country	Challenges/Requirements being Faced	Areas for Regional Collaboration
	• Supporting dissemination of stress-tolerant rice varieties for abiotic stress by encouraging farmers to be sovereign on seeds (i.e. demonstration plot, capacity building: community seed based, assistance for farmers on best management practices) • The limitation of labor, government has to encourage farmers on mechanization for rice cultivation especially outside java to improve productivity and save production cost	(especially outside java) • Capacity building (degree and non-degree training) for (a) young scientists (like phenotyping and genotyping ability, breeding technique, scholarship); (b) farmers & extension staff (like rice production, best stress-prone area: flood and drought-prone area; community seed based: seed production process); (c) extension staff of dissemination (how to prepare the dissemination package, public communication, video preparation etc.) management practices • Information dissemination and support for mechanization: transplanter, weeding, seed dibbler, drum seeder, tractor, harvester etc.) • Technical expert exchange, scientist exchange • Pre and Ex Ante study about socio-economic impact of the research collaboration results in selected or targeted area
Laos	• Few submergence-tolerant rice varieties are recommended to lowland rice farmers • With 3 ecosystems (upland, irrigated lowland and rainfed lowland) breeding suitable with ecosystem is needed • Support from national and private seed companies for development of submergence-, drought-tolerant varieties • HRD on climate change in Laos is not strong enough. • Uncertain and sudden weather events that make adaptation difficult	• Financial and technical support for the development of submergence and drought-tolerant varieties for lowland and upland areas • Capacity building (degree and non-degree training) • Information dissemination • Technical expert exchange
Malaysia	-	-
Myanmar	• Support from national and private seed institutions for further development of other popular and high-yielding varieties; • Wider adaptation and dissemination of stress-tolerant rice varieties for abiotic stress (i.e. submergence-tolerant, salinity-tolerant, drought-tolerant and heat tolerant) and biotic stress (pest and diseases-tolerant)	• Financial support for development and deployment of new generation stress-tolerant rice varieties; • Capacity building (degree and non-degree training) • Information dissemination • Technical expert exchange
Philippines	• Support from national and private seed institutions for further development of other popular and high-yielding varieties; • Wider adaptation and dissemination of stress-tolerant rice varieties for	• Financial support for development and deployment of new generation stress-tolerant rice varieties • Capacity building (degree and non-degree training) • Information dissemination

Country	Challenges/Requirements being Faced	Areas for Regional Collaboration
	abiotic stress (i.e submergence-tolerant, salinity- tolerant, drought-tolerant and heat tolerant) and biotic stress (pest and diseases-tolerant)	• Technical expert exchange
Singapore	• -	• -
Thailand	• Wider adaptation of stress-tolerant rice varieties for abiotic stress (i.e. submergence-tolerant, salinity-tolerant, drought-tolerant and heat-tolerant) and biotic stress (pest and diseases-tolerant) • Support from national and local organization for development of biotic and abiotic stress-tolerant rice variety for specific area	• Exchange of germplasm • Capacity building for researchers and farmers • Technical expert exchange
Vietnam	• Wider adaptation and dissemination of stress-tolerant rice varieties for abiotic stress (i.e submergence-tolerant, salinity- tolerant, drought-tolerant and heat-tolerant) and biotic stress (pest and diseases-tolerant)	• Financial support for development and deployment of new generation stress-tolerant rice varieties • Capacity building (degree and non-degree training) • Information dissemination • Technical expert exchange

2.2.4. Mechanism to Address Implementation

Building on established consortia and networks, strategic partnerships should be developed with NARES, local communities and stakeholders, and these will primarily include local and national organizations with existing programmes with rural communities. Participatory approaches should be embedded in the consortia and/or network activities, and these should begin with gaining a better understanding of livelihood strategies to form the basis for identifying and refining technology needs and opportunities. Building on participatory varietal selection at target sites, options should be widely evaluated with farmers. Validated options will be scaled-out through multi-channel approaches together with seed supplies, appropriate training, information and support.

The first step in delivering an upcoming variety to farmers is the production of genetically pure breeder seeds at the breeding station. It is crucial that this be done even before the variety is approved for release, so that, once released, adequate amounts of high-quality breeder seeds immediately become available on a large scale to immediately create impact. The Department of Agriculture and some Agricultural Universities have the mandate to also produce the next class of seeds—foundation seeds —for distribution to seed growers to develop the next class of seed — registered seeds. It is crucial to assure the availability of foundation seeds immediately upon varietal release.

Philippines, through the Bureau of Agricultural Research of the Department of Agriculture, can take the lead in the coordination and networking with partner SE Asian countries of the Good Practices for STR. IRRI being hosted in the Philippines, has existing rice RDE programmes under the DoA Food Security and Staple Food Program (FSSP), where development and deployment of new generation rice varieties for major rice growing ecosystems is one of the projects being supported by the Philippine government and IRRI. Through support from individual national government agencies, RD&E for STR should be given priority as one of the climate change adaptation strategies in their National Rice Sector Development Strategy.

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2.3 Agro Insurance using Weather Indices

2.3. Agro Insurance Using Weather Indices

Agriculture is of great importance for many countries, especially for developing countries. Johnston and Mellor (1961) stressed the importance of agriculture by proving that it is a source of (1) food, (2) foreign exchange, (3) labor, (4) savings for capital formation and (5) purchasing power to generate demand for manufacturers. The experience from Asia demonstrates that agriculture is the key to rapid development, economic stability and alleviation of poverty (Timmer 1993).

However, agriculture is more risky than any other economic sector. Farmers face multiple, often simultaneous, sources of risk including weather, market prices, diseases and more. In the context of CC impacts, it seems that they become more exposed to adverse impacts from weather and diseases.

In order to protect farmers from losses due to risks, different risk management schemes and tools have been introduced, of which insurance is an instrument that can work well in case of catastrophic risks that may lead to significant damage and losses and are widely recognized in agriculture today.

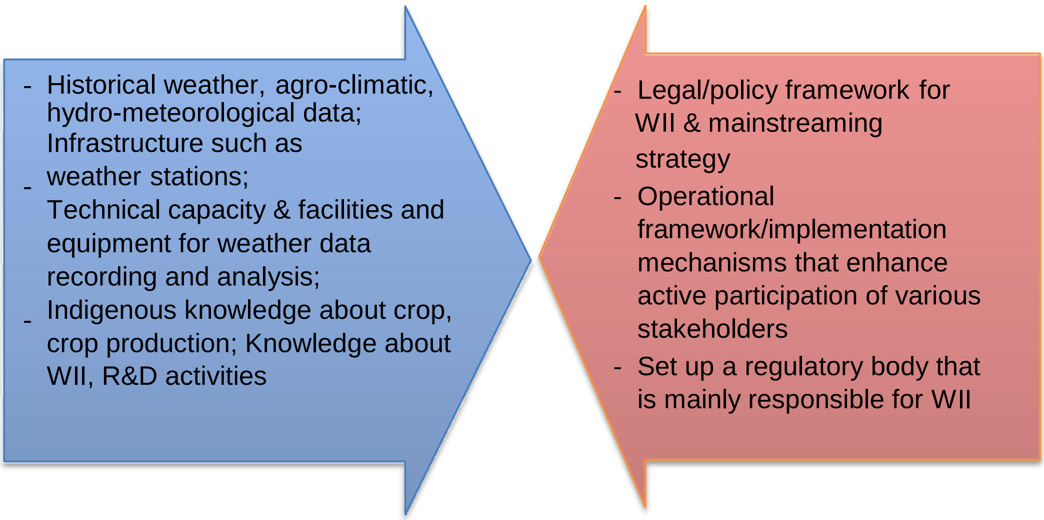
Crop insurance has been developed rapidly around the world and can be divided into two categories: traditional and index-based. Unlike the traditional crop insurance, which is based on actual crop losses and assessed by loss-adjusters on the ground, index insurance is based on the losses indicated by an index. The simplest type is the yield area index, where indemnities are due if the average area yield is lower than a guaranteed area yield. An outstanding feature of the yield area index is that it does not depend on individual farm losses, thus avoids the cost of loss assessment on field and asymmetric information problems. However, the disadvantage is that it can present basis risk: the possibility of incurring a loss and not getting an indemnity or getting an indemnity without having had a loss. Other types of index insurance are weather index insurance (WII), agro-meteorological index insurance and satellite imagery insurance.
Index insurance has become more and more popular because it significantly lowers transaction costs and allows insurance companies to sell to smallholder farmers. In addition to this, having insurance allows those farmers to apply for and receive bank loans and other types of credit previously unavailable to them (IFAD/29/09). In some developed countries, with the availability of satellite imagery, this insurance has been developed for pastures, given the complexity of loss assessment in this kind of agricultural production.

In Vietnam, index insurance, particularly WII, is quite new. It has been applied to rubber plantation in Vietnam with some successes. Rainfall index was used for coffee plantations for 2 years, then discontinued for some reasons, but brought valuable lessons for the next steps of WII application and expansion in coffee in particular and other crops.

Unlike Vietnam, WII has not been implemented in Indonesia, but feasibility studies come to the conclusion that there is a large potential for its development, despite several challenges which need addressing carefully.

2.3.1. Synthesis of Technical and Institutional Issues

Index insurance is a more recent and advanced measure to protect farmers against risks based on the realization of the index value according to a pre-agreed pay-out scale. Therefore, it relates to a number of technical requirements. There is also a series of institutional issues that seem to be more prominent than the technical ones. From the experience of WII in Vietnam, below are some technical and institutional issues that should be taken into account.



The foundation for the start of WII is the historical weather data sets for different geographical regions, because they will be used as inputs for designing proper insurance products in the next steps. Infrastructure for weather data collection, primarily weather stations, is also crucial to calculate indexes.

Technology, equipment/facilities in weather data recording and monitoring, together with desirable capacity of technical staff who use them in data collection and analysis, are other requirements for the success of WII.

In addition, knowledge about WII, R&D system and their activities in the field together with indigenous knowledge about crop and crop production are necessary for the development of WII.

With regard to institutional issues, it is essential to have a legal framework for WII to pave the way for the inauguration, then implementation of WII. At the national level, legal policy on WII may be in the form of a law on agro-insurance as in many countries. In order to ensure that policy is effectively implemented, a strategy to mainstream it at lower levels and an implementation mechanism are contributing factors. Both the mainstreaming strategy and the operational framework should be aimed at promoting the participation of different stakeholders, especially private entities and local official who work directly with farmers, and setting up a body that can regulate WII-related activities and enhance cooperation between the public and private sector.

2.3.2. Institutional and Technical Challenges

From the issues mentioned above, this part will highlight challenges that the scaling-up and scaling-out activities of good case studies face, from which areas for regional cooperation will be pointed out in the next part.

- Accessibility and credibility of historical weather, agro-climatic, hydro-meteorological data;
- Methodologies to calibrate historical data to apply to WII;
- Application of indigenous knowledge about crop, crop production to WII;
- Limited financial resources to invest in infrastructure/Low density of weather stations for data monitoring and collecting;
- Limited capacity of technical, R&D staff and unavailability of facilities and equipment for weather data recording and analysis;
- Limited information and materials about WII, WII implementation/case studies.

- Low commitment from central/local government to promote WII;
- Lack of incentives to promote active participation of stakeholders, especially private sector, R&D system, community officials;
- Lack of an effective regulatory body that facilitates the development of WII

Not only the availability of historical data but also the accessibility and credibility of weather data pose a challenge for WII. Taking Vietnam as an example, where data is recorded and monitored solely by the Ministry of Natural Resources and Environment (MONRE) instead of the Ministry of Agriculture and Rural Development (MARD). Therefore, it is not easy for institutions from MARD to access such data. Moreover, MONRE may record data for their own purposes by their own ways, which may not be suitable for WII purposes.

Methodologies to calibrate data are another problem. Using rainfall index insurance for coffee production in Vietnam to illustrate this case, thresholds, payout structures and face values varied greatly among production areas, reflecting the necessity of different data calibration methods to ensure that the robust design of insurance products is suitable to local conditions and equal for both farmers and agro-insurance companies. Underdevelopment of infrastructure, i.e. low density of weather stations, is a key constraint for the development of WII. For example, there are only six hydrological stations covering an area of 184,000ha in Daklak province, Central Highland region of Vietnam, where rainfall index insurance was applied for coffee. Therefore, farmers who live far from these stations usually claimed the rainfall index incorrectly, leading to their decreasing interest in climate index insurance. Furthermore, the backward technology used in these stations for climatic data monitoring and recording also contributes to the inaccuracy of the rainfall index provided. Limited capacity of meteorological and hydrological experts is a further barrier even if advanced technology was available for use.

Experiences from various countries that have been carrying out agro-insurance show that it is important to have strong commitment and support from the central and local government. Support is both technical and financial, particularly in terms of premium subsidies.

The regulatory body can be either a public or private institution whose main functions include:

1. regulating and monitoring the implementation of policy on agro-insurance;
2. facilitating the inter-linkages between public and private stakeholders, especially insurance companies; and
3. giving advice to modify, adjust the policy on agro-insurance if necessary

2.3.3. Regional Cooperation

The chart on the following page mentions many areas for regional cooperation in terms of either technical or financial support that can help to solve the above challenges.

Among many activities, raising awareness and capacity building are of great importance because they are the background for WII implementation. As mentioned before, climate index insurance remains a newer and less popular policy than the conventional one in many countries, including Vietnam and Indonesia, in terms of coverage area, crops and governmental support. This is firstly because the understanding and knowledge about WIBI is very limited, not only amongst farmers but also officials at both national and local levels. Moreover, it is a tailor-made product and highly related to technical issues; knowledge and information about WII should be delivered by different approaches for different regions applicable for different crops and targeted audience. The participatory approach is a highly recommended way to raise awareness of farmers and local officials to get involved in WII from the outset.

According to Indonesian researchers, the major focus should be on training farmers and local government officials, especially agricultural extension farmers, about WII. More importantly, local partners should be involved from the beginning, and the training material should be adjusted using feedback from all training courses to ensure that they suit and are adapted to the local context. Interactive exercises and instructional games are useful tools for capacity building that helps farmers understand the concept and benefits of index insurance and helps trainees get feedback from them.

- Regional e-forum/website to share
  - Historical weather, agro-climatic, hydro-meteorological data;
  - Information and material about WII.
- Regional workshops and field trips to share
  - Experiences on WII application
  - Lessons learnt from good examples/case studies on WII
- Capacity building activities include:
  - Training for technical staff on data analysis, calibration
  - Training for staff under agricultural extension system on crop production practices
  - Training for local staff on communication skills,participatory approach…
- South-south technical expert exchange to
  - Share experiences on application/modification of knowledge about crop, crop production to WII;
  - Carry out joint research on WII for particular crop such as rice for the whole region.
- Regional collaboration on fundraising activities to set up infrastructure (satellite..), improve facilities and equipment for WII for regional use

- South-South technical assistance to
  - Design legal framework suitable to local conditions
  - Design and pilot implementation of WII
  - Advise on setting up a regulatory body to work effectively on WII
- Regional workshop to share
  - Experiences disseminate information and knowledge about WWI
  - Effective approaches to raise awareness of stakeholders especially governments at different level
  - Succesful case studies that promote active participation of different stakeholders.

2.3.4. Mechanism to Address Implementation

Below is the draft 3-year timetable for promoting WII for crops through regional collaboration.

No.	Activities	Output	Year 1	Year 2	Year 3
1	Crop adoption	A shortlist of crops selected for WII			
2	Practice/insurance products adoption	A shortlist of practices selected (rainfall or wind, fog, storm,…index)			
3	Identification of lead country	Selection of the lead country			
4	Identification of participating AMS	A list of participating AMS			
5	Stakeholder identification in lead country	Stakeholder mapping with clearly assigned tasks and duties			
6	Pilot model design and implementation	Lessons learnt for multiplication of pilot model			

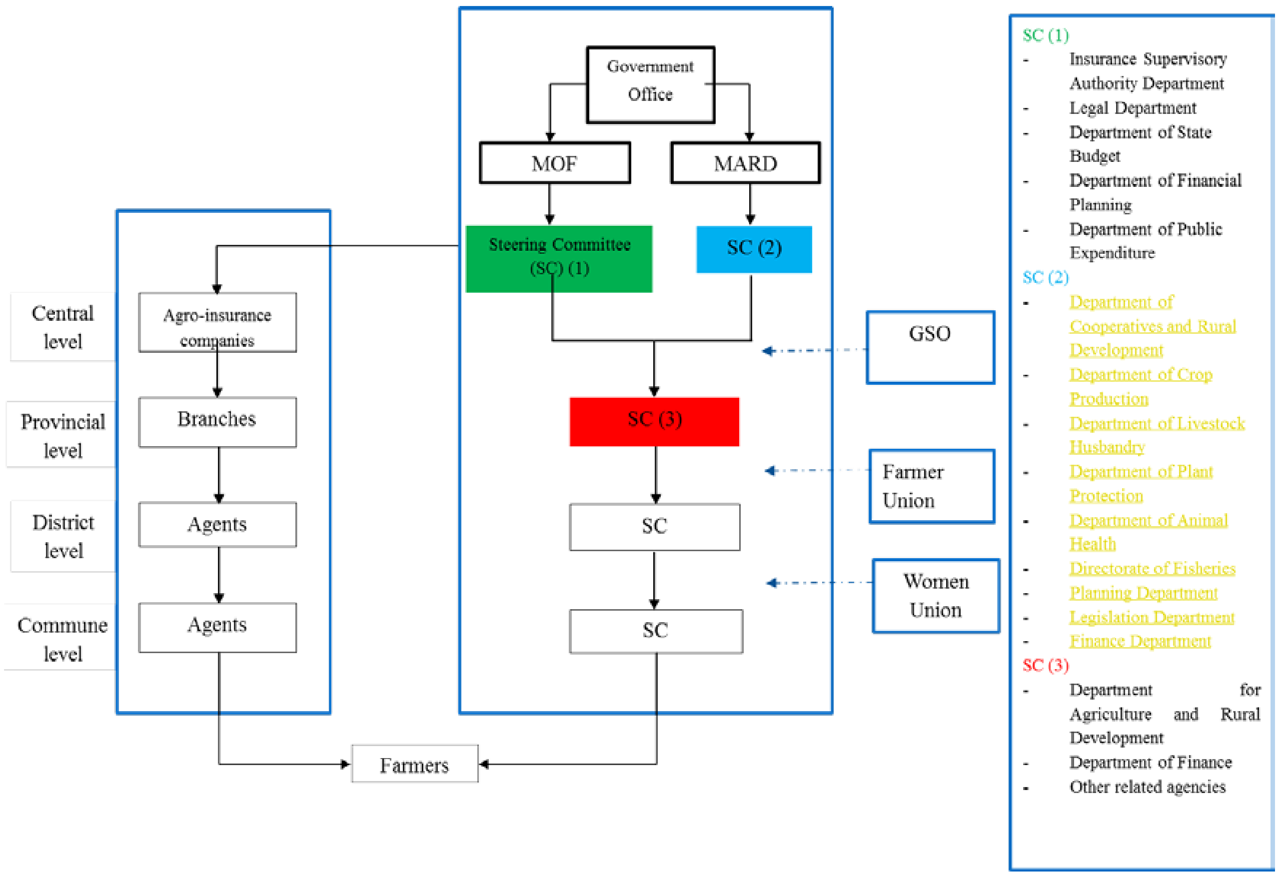
For crop selection, as rice is widely cultivated and the main staple crop in the region, rice should receive the highest attention.

Different ecological regions, different crops, different crop seasons may be subject to different types of risks, thus it is necessary to take into account all local conditions to select the most appropriate insurance practice. For example, rainfall index is suitable for dry paddy season, but storm index should be used for rainy season.

With regard to stakeholder identification, below is an example of stakeholder mapping for pilot agro-insurance in Vietnam

Mapping lets us know the number of stakeholders at different levels of the model, and their inter-linkages. More importantly, it helps policymakers monitor the implementation process or make adjustments if necessary.

Pilot model design and implementation is a challenging step, because it requires technical, financial and institutional resources. Technical assistance is needed to design a WII that is suitable to local context. As mentioned before, effective approaches to raise awareness – especially of governments at different levels – and to promote active participation of different stakeholders are highly important to ensure the success of the pilot model.



Notes:

Commanding

Supporting

2.4 Alternate Wetting And Drying

2.4. Alternate Wetting and Drying

Alternate Wetting and Drying (AWD) is a rice cultivation practice involving the alternate flooding and draining of rice fields during the production cycle. The practice represents a viable climate change adaptation (CCA) technology for rice-producing countries in Southeast Asia that offers mitigation co-benefits. AWD offers considerable savings in water use during the rice-growing season without reducing crop yield (Lampayan et al., 2015). The traditional practice of growing rice in continuously flooded fields consumes a disproportional amount of water compared to other crops. It has been estimated that irrigated rice uses 40% of the world's irrigation water while only covering 30% of irrigated cropland (Dawe, 2005). Appropriate use of AWD technology can reduce water used in cultivating rice by up to 38% (Lampayan et al., 2015). As droughts are projected to increase in many areas of Southeast Asia as a result of climate change (USAID, 2013), the ability to grow rice using less water enhances the resilience of rice farmers in this region, while also contributing to food security for a growing population.

Another factor that contributes to AWD's significance as a CSA practice is its capacity for reducing greenhouse gas (GHG) emissions, specifically methane, relative to traditional lowland rice cultivation. The combination of continuously flooded soils and the organic-rich rice paddy environment provides ideal conditions for anaerobic bacteria to decompose organic matter, thereby producing methane as a by-product. According to the World Resources Institute, "global rice production emits 500 million tons of GHG (carbon dioxide equivalent) per year, or at least 10% of total agricultural emissions". In Southeast Asia, the relative contribution of rice production to GHG emissions from the agricultural sector is closer to 50% (Adhya et al., 2014).

Proper implementation of AWD requires farmers to drain rice fields to the extent that soils become oxygenated, while still maintaining sufficient soil moisture to support optimum plant growth. The partial draining, however, is enough to inhibit the methane-producing bacteria that require anaerobic soils for their decomposition processes. IPCC (2006) assumes an average methane reduction of 48% using AWD compared to the traditional, continuous flooding practice. In some scenarios, emissions reduction using AWD has been as high as 90% (Linquist, 2014).

The general protocol for implementing AWD is as follows. Transplanting of rice seedlings occurs at the beginning of the crop cycle in flooded fields. Fields remain flooded for two weeks to inhibit weed production during the early growth stage of the rice plants. After two weeks, field drainage is initiated and allowed to continue until the water level drops to 15 cm below the soil surface. Draining to this threshold is considered "safe", as studies have shown the rice plants can still access sufficient water in the soil to support their optimum growth. The number of days it takes to drain the fields to this level varies depending on contextual circumstances, such as terrain and soil characteristics. The farmer can monitor and measure the subsurface water level, using a simple tool such as a field water tube. Once the threshold water depth of 15 cm is reached, the fields are flooded again to a surface depth of 5 cm, after which the drainage cycle is initiated again; with the exception of a week before and following the flowering period, when rice plants are most sensitive to water stress and fields are therefore continuously flooded (Richards and Sander, 2014).Currently, AWD pilots have been run in various countries in Southeast Asia, including the Philippines, Vietnam, Bangladesh, Thailand, and Myanmar. Review of the economic benefit to farmers that have participated in trials indicates a positive impact, with net returns increasing from 9 to 38% relative to continuously flooded traditional practice; this benefit is more pronounced for downstream farmers, where, historically, water supply has been unreliable (Lampayan et al., 2015).

2.4.1. Synthesis of Technical Issues

The technical feasibility of implementing AWD for a given farmer or irrigation district is dependent on a number of factors. First, the practice requires access to a reliable irrigation supply; and the irrigation infrastructure and management must allow for careful control of the water inputs and drainage schedule of the rice fields. Second, the fields must have the capacity to drain sufficiently. Certain areas, such as within major river deltas of the region, may not be able to achieve this due to high groundwater levels that will likely become higher with sea level rise. Also, fields may not be able to drain properly during certain periods of the rainy season. Finally, farmers must be open to the change in practice from traditional methods, and their willingness to change must be supported by local government and irrigation management.

While it is fairly established in the literature that practising AWD results in water savings at the field level, changes in water use and availability at higher spatial scales deserves additional research. Reducing irrigation for upstream users has demonstrated more reliable water supply for downstream farmers under certain irrigation and landscape contexts (Siopongco et al., 2013; Lampayan et al., 2015). However, under alternative scenarios, it is quite probable that reductions in upstream water inputs may limit recharge of groundwater and therefore result in reduced water availability for downstream users. Additional research to understand the water budget at a higher scale than the field level is warranted (Lampayan et al., 2015).

The effects of AWD on ecosystem services provided by traditional flooded rice landscapes should also be explored further (Lampayan et al., 2015). While research has focused on the effects on nutrient cycling related to GHG emissions, understanding biogeochemical cycles in a wider context is important due to the significant changes to hydrology and soil redox potential that result from shifting to AWD cultivation. Additional changes to ecosystem services related to habitat value and, as mentioned above, groundwater recharge should be evaluated.

As with water savings, estimated GHG emissions reductions have been calculated largely at the field level. However, with the potentially significant water savings that can be attained through AWD, farmers may find that they can convert additional land into rice production in areas that are now limited by the availability of water. This secondary effect has been observed in the Philippines in some of the pilot project areas (Siopongco et al., 2013). While there may be significant economic and food security benefits associated with this additional land conversion, determining the net reductions in GHG emissions should perhaps be done at the watershed or irrigation district level to capture any significant changes in land use.

2.4.2. Institutional and Technical Challenges

To achieve regional scaling of AWD, stakeholders must be aware of both the opportunities and challenges that will affect successful dissemination and mainstreaming of the practice. The following enablers and constraints were taken largely from Lampayan et al. (2015).

<u>Enablers for Scaling-up and Dissemination of AWD in Region</u>

- Solid in-country pilot programmes to demonstrate to country-specific stakeholders that AWD is effective and doesn't reduce yields
- Good farmer training opportunities
- Engagement with partners in local government, private sector, and non-governmental organizations (NGOs) who can facilitate promotion and training of AWD
- Adoption into national policy, which can have the secondary effect of mobilizing funds

for dissemination of practice

- Widespread media representation
- Well-organized farmer cooperatives to facilitate training and support mechanisms
- Central management of irrigation systems

Constraints for Scaling-up and Dissemination of AWD in the Region

- Well water management system is strongly required for applying AWD
- Fixed, area-based water fees (vs. volumetric-based fees) inhibits incentives for farmers to make changes
- Private pump owners may be unwilling to negotiate on payment structure (i.e. change from fixed rate to cost-based on actual usage)
- Unevenness of fields, which limits ability to control water management throughout the crop production area
- Older irrigation systems or unreliable systems, which may not be set up for controlling water at the level required for AWD; also farmers must have confidence that they can re-flood fields once drained.

2.4.3. Regional Cooperation

There are several areas for regional cooperation to help address the aforementioned institutional and technical challenges and advance the scaling-up and scaling-out of AWD throughout Southeast Asian countries with irrigated rice production systems. While the viability of implementing full-scale AWD may be compromised by the annual rainy season common to this region, variations on the CSA practice can still significantly mitigate GHG emissions and conserve water (Adhya et al., 2014).
ater shortages and the degradation of water quality, projected to worsen with climate change (USAID, 2013), will be exacerbated by poor water resource management for production of rice and other crops.

Some challenges and areas for regional cooperation for climate adaptive rice cultivation and improved water management, through practices such as AWD, are listed below. The primary areas for regional cooperation include:

2.4.3.1. Strengthening regional centres and information networks to support climate change adaptation assessments, mitigation and adaptation, such as regional research network programmes or a regional platform to enhance cross-sectoral knowledge sharing and cooperation among Ministries of Agriculture, other relevant ministries and the scientific community (SEARCA, 2015);

2.4.3.2. Strengthening South-South collaboration through capacity building and exchange of information, experts and technology, such as dynamic integrated crop management (ICM) systems like *PalayCheck* in the Philippines, as proper design and coordination within the local context is key to successful implementation of the technology (SEARCA, 2015);

2.4.3.3. A coordinated, comprehensive assessment of the various water management strategies across the region, irrigation water use for rice production, how to incentivize efficient use of water, and what the cost-effectiveness is of implementing technologies such as AWD in major rice growing areas (Adhya et al., 2014);

2.4.3.4. A comparative analysis of irrigation payment schemes and alternate pricing arrangements to facilitate implementation of AWD;

2.4.3.5. Financial and technical support for a systematic series of pilot projects to demonstrate how to employ water management systems and technology, such as AWD, to maximize direct benefits for farmers (Adhya et al., 2014); and

2.4.3.6. Education and awareness-raising about AWD and other alternative water-management strategies among relevant national-level ministries, research institutions and aid agencies involved in climate change adaptation initiatives in the region.

Areas for regional collaboration include research into the roles of women in rice cultivation and gender impact assessments of adaptation and mitigation strategies (SEARCA, 2015). This research will inform the creation of mechanisms to guarantee women's involvement in developing and implementing adaptation and mitigation strategies and financing and the development of principles and procedures to protect and encourage women's access to national adaptation programmes and projects.

2.4.4. Mechanisms to Address Implementation

There are many consortia and networks to facilitate regional cooperation for the scaling-up and scaling-out of AWD to ASEAN Member States with irrigated rice production.

The International Rice Research Institute (IRRI) is currently collaborating with national partners to identify opportunities for scaling-up AWD in Vietnam through the Agriculture Initiative of the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC). In Southeast Asia, the Paddy Rice Production component of the CCAC Agriculture Initiative is led by IRRI with support from the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). It aims to expand the practice of alternate wetting and drying (AWD) on a large scale to facilitate both more stable food supply and reduced methane emissions. Current activities include identifying priority areas where AWD can be implemented and establishing national working groups to pinpoint incentives, technical support mechanisms and enabling conditions to overcome barriers that farmers face using the new practices. A global information platform will be set up to offer a database for country- and region-specific information and best practices related to AWD.

The Policy Information and Response Platform on Climate Change and Rice in ASEAN and its Member Countries (PIRCCA) is another IRRI-led CCAFS-supported project that is investigating which activities, projects, information-sharing platforms and networks are successful at influencing national decision-makers to establish policy environments and institutional mechanisms to facilitate large-scale adoption of technologies and agricultural management practices that enhance resilience to short-term climate variability and long-term climate change. Through PIRCCA, IRRI scientists contributed to the documentation of case studies by the ASEAN Technical Working on Agricultural Research and Development (ATWGARD) project on Promotion of Climate Resilience in Rice and Other Crops. The Involvement of IRRI in the ASEAN Climate Resilient Network established by ATWGARD offers a potentially useful mechanism to enhance knowledge sharing between the research and policy communities.

A third IRRI initiative that supports large-scale implementation of AWD is the project "Assessing incentives for scaling-up mitigation at different stakeholder levels: 'No-regret' mitigation strategies in rice production" funded by CCAFS. This project focuses on agronomic and economic benefits of AWD, such as better root development, less lodging and lower field inputs. Activities that aim to generate robust data on beneficial side effects of AWD will be implemented in close collaboration with farmers and extension services. The policy networks created through the PIRCCA and CCAC initiatives will be used to elevate the outputs of the 'no-regret' project.

Several ASEAN initiatives and frameworks provide the basis for establishing regional networks and platforms for knowledge-sharing and cooperation at a government-to-government level, including the ASEAN Climate Change Initiative; the ASEAN Integrated Food Security Framework; and the ASEAN Multi-Sectoral Framework on Climate Change (AFCC).

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2.5 Cropping Calendar For Rice and Maize

2.5. Cropping Calendar for Rice and Maize

Agricultural crops continue to be at risk in a changing climate due to their dependence on climatic variables, such as rainfall, temperature, and solar radiation. In Southeast Asia, rice and maize are the two major crops that are commonly used for food consumption, animal feed and livelihood activities. These crops are vulnerable to climate change as temperature increases and rainfall events vary widely, affecting crop growth and development, resulting in reduced yields. Strong winds, floods and droughts also have adverse impacts, since they destroy the land area for crop production and also damage the crops.

Evidence of climate change is often observed in rising temperature, shifts in rainfall patterns and distribution, and occurrences of extreme climatic events, such as more intense rainfall and strong typhoons. Climate change scenarios indicate that in most areas in the Philippines, the wet season is expected to become wetter and the dry season drier (PAGASA, 2011; Comiso et al., 2014; Lansigan, 2015). The shifts in distribution of rainfall have altered the cropping period or planting calendar especially in rainfed production areas. Thus, synchronizing the planting calendar with the occurrence of precipitation is a climate-change adaptation measure in crop production. Shifting the planting calendar in line with the onset of rainfall can also help reduce irrigation water requirement and improve crop yields (Amarasingha et al., 2014). There are a number of approaches in determining the optimal cropping calendar or best planting date. These approaches may be grouped according to procedures based on (1) analysis of precipitation data in an area; (2) analysis of crop yield probabilities; and (3) combined analysis of rainfall data and crop yields.

2.5.1. Synthesis of Technical Issues and Challenges

One approach that is being used to develop planting calendars under a changing climate is the use of crop simulation models (CSMs) that estimate crop yields from weather and soil data, cultivars, planting date and crop management with the help of user-friendly computer software (Graves, et al., 2002). Some examples of crop simulation models used are the Decision Support System for Agrotechnology Transfer (DSSAT) CERES-Rice and CERES-Maize models, CropSys and ORYZA of IRRI. Moreover, CSMs can be used with the seasonal climate forecasts to assess the impacts of climate variability on crop yields as well as to determine the best planting date for a given seasonal climate outlook.

Approaches in Determining Planting Calendar

A. <u>Based on Rainfall Probabilities</u>

One popular approach to determine the optimal planting date is by calculating the probability of exceeding the water loss due to evapotranspiration, ET, i.e. soil surface evaporation and crop transpiration. The particular day (or week of the month of the year, and/or season) is determined to start planting/transplanting a crop when the water requirement at every growth stage of the crop is likely to be satisfied. That is, the water requirement is met during the vegetative/development stage, the flowering/reproductive stage and the maturity/dry harvest stage (Lansigan, 2010). The optimal planting date is determined as the period when the estimated water requirement for each development stage of crop growth is most likely to be satisfied. This is the period during which there is maximum probability of meeting the crop water requirements via evapotranspiration. Considering the weather variables, crop characteristics, and management and environmental aspects for a certain crop production area, measures of crop evapotranspiration rates are needed to estimate the water loss during the different crop growth stages.

The FAO Penman-Monteith method has been widely used and recommended as the standard method for the computation of the reference evapotranspiration. The method overcomes the shortcomings of the previous FAO Penman method and provides values that are more consistent with actual crop water use data worldwide. Furthermore, recommendations have been developed using the FAO Penman-Monteith method with limited climatic data, thereby largely eliminating the need for any other reference evapotranspiration methods and creating a consistent and transparent basis for a globally valid standard for crop water requirement calculations (Allen et al., 2006).

Methodology

a. Crop evapotranspiration. Crop water requirement or evaporative demand based on ET is calculated as:

$$ET_C = K_C \cdot ET_O$$

where:
ET_C crop evapotranspiration (mm/day)
K_C crop coefficient (dimensionless)
ET_O reference crop evapotranspiration (mm/day)

b. Probability of exceeding crop evapotranspiration

$$P[CR_i > ET_{ci}] = 1 - P[CR_i < ET_{ci}]$$

$$= 1 - \frac{k}{n+1}$$

$$= \frac{m}{n+1}$$

where:
CR_i Cumulative rainfall of the ith unit;
n total number of observations;
k number of historical cumulative amount of rainfall lesser than the water requirements; and
m number of historical cumulative amount of rainfall exceed the water requirements

Examples of some results in the Philippines

Table 14 indicates the optimal planting dates for selected locations in different seasons in the Philippines using the rainfall probability approach. One limitation of this approach or procedure is the dependence on the availability of adequate historical weather data for a particular location.

Table 14. Planting dates for selected locations in different seasons in the Philippines using cumulative rainfall approach

IR 64 Variety					
Average		Dry		Wet	
30	23 Jul	36	3 Sep	39	24 Sep
35	27 Aug	35	27 Aug	38	17 Sep
36	3 Sept	37	10 Sep	36	3 Sep
31	30 Jul	34	27 Aug	37	10 Sep
34	20 Aug			40	1 Oct
29	16 Jul			35	27 Aug

PSB Rc 14 Variety					
Average		Dry		Wet	
30	23 Jul	36	3 Sep	39	24 Sep
35	27 Aug	35	27 Aug	38	17 Sep
36	3 Sept	37	10 Sep	36	3 Sep
31	30 Jul	34	27 Aug	37	10 Sep
34	20 Aug			40	1 Oct
29	16 Jul			35	27 Aug

PSB Rc 192

Average		Dry		Wet	
31	30 Jul	38	17 Sep	39	24 Sep
35	27 Aug	37	10 Sep	37	10 Sep
36	3 Sep	35	27 Aug	36	3 Sep
30	23Jul	36	3 Sep	38	17 Sep
37	10 Sep			41	8 Oct
33	13 Aug			40	1 Oct

Best Planting Date Based on Evapotranspiration Demand (from FAO, 2000)

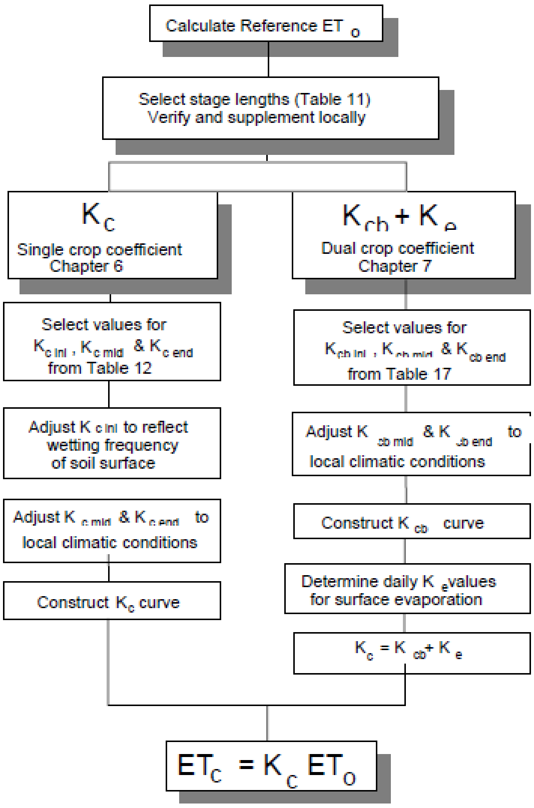

Figure 2. General procedure for calculating ET_c

Table 15. Data/Information needed to compute the crop evapotranspiration, ET_c

Parameter to be computed	Data/ information needed
1. Reference Evapotranspiration, ET_0, mm/day	• Daily temperature, °C (minimum, maximum) • Relative humidity, % (minimum, maximum) • Daily solar radiation (average mean) • Wind speed, m/sec: Height (where the equipment is located) above ground surface, in meters • Coordinates of site location, radians or decimal degrees • Actual duration of sunshine, n
2. Length of every crop stage, in days	• Determine the length (in days) of every growth stage of maize and rice • Verify at the local set-up
3. Crop Coefficient, K_c	• Crop type (albedo, crop height, aerodynamic properties, leaf and stomata properties, stages of maturing properties) • Climate • Soil evaporation (fraction of the soil that is both exposed and wetted) • Crop development stage (Initial, crop development,

Parameter to be computed	Data/ information needed
	mid-season and late season stage)

B. Planting Date Based on Yield Probabilities

The approach based on yield probabilities is aided by the use of a process-based crop simulation model in determining the best planting date. Using a crop simulation model, crop yields based on multiple years of weather data can be simulated. Using the multiple values of simulated yields for the same planting date, the probability that a certain yield level will be exceeded can be estimated.

There are at least two cases for obtaining multiple yield values for a given planting date. One is by using available historical weather data as inputs to the crop simulation model. In this case, the yield for the same planting date for different years would be simulated (e.g. yield for January 1, 1979, 1980, 1981, and so on) resulting in multiple yield values for a single date. Another case is by using a weather data generator to replicate a single-year data to have multiple "years" of data behaving like the original available dataset. Then, yields for the same planting date could be simulated using multiple generated years of weather data. After obtaining multiple yields for a single date, yield probabilities could be computed.

Some Examples and Results

Table 16 shows the simulated yield values (in kgs./ha.) for rice in Isabela province in the Philippines for two different planting dates, July 5 and July 26. The crop simulation model used historical weather data from 1991 to 2013 for a total of 23 years. Table 17 shows the ranked yields for the two planting dates with corresponding yield probabilities using the yield probability approach. Figure 3 is the plot of yield versus probability.

It can be clearly shown that planting rice on July 5 in Isabela province would result in higher yield levels compared to planting on July 26. Based on Table 16, 87.5% of the time, 2,647 kg would be attained or even exceeded when crop is planted on July 5 versus 2,534 kg./ha when crop is planted on July 26. Based on these results, the recommended planting date is July 5 rather than July 26.

Table 16. Simulated yields (kg/ha) for rice for two different planting dates, Isabela location.

Year	5-Jul	26-Jul
1991	2671	2669
1992	2864	2577
1993	2647	2655
1994	2787	2690
1995	2635	2456
1996	2733	2549
1997	2890	2546
1998	3113	2868
1999	3449	3222
2000	2986	2832
2001	2820	2701
2002	2848	2708

Year	5-Jul	26-Jul
2003	2692	2635
2004	2878	2751
2005	2641	2534
2006	2732	2568
2007	2822	2727
2008	2837	2589
2009	2676	2537
2010	2749	2733
2011	2725	2573
2012	2690	2565
2013	2869	2498

Table 17. Ranked simulated yield of rice with corresponding probabilities, Isabela Province.

Rank	5 Jul	26 Jul	Probability
1	3449	3222	0.0417
2	3113	2868	0.0833
3	2986	2832	0.125
4	2890	2751	0.1667
5	2878	2733	0.2083
6	2869	2727	0.25
7	2864	2708	0.2917
8	2848	2701	0.3333
9	2837	2690	0.375
10	2822	2669	0.4167
11	2820	2655	0.4583
12	2787	2635	0.5

Rank	5 Jul	26 Jul	Probability
13	2749	2589	0.5417
14	2733	2577	0.5833
15	2732	2573	0.625
16	2725	2568	0.6667
17	2692	2565	0.7083
18	2690	2549	0.75
19	2676	2546	0.7917
20	2671	2537	0.8333
21	2647	2534	0.875
22	2641	2498	0.9167
23	2635	2456	0.9583

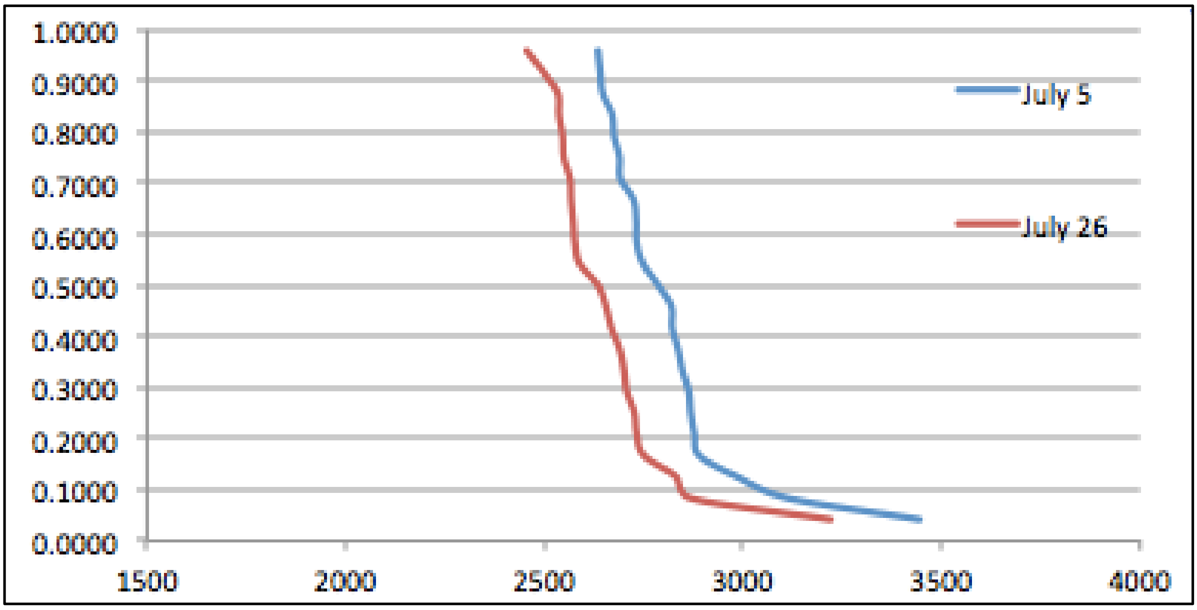

Figure 3. Simulated yield values for rice for two planting dates, Isabela, Philippines.

C. <u>Planting Date Based on Cumulative Rainfall Approach</u>

Yoshida (1981) at the International Rice Research Institute (IRRI) concluded that rice has a water requirement of 180--300mm a month to produce a reasonably good crop. Thus, the best planting date for rice in a rainfed production area is when 200 mm of rainwater has been accumulated from the next 30 days from the driest day the year. For maize, experts suggest a threshold value of 100 mm of rainfall accumulated for 20 consecutive days must be satisfied. Considering this water requirement, the cumulative rainfall approach aimed to determine the planting dates for rice and maize under rainfed conditions that satisfy the amount of water needed to start planting or transplanting.

Schematically illustrated below (Figure 4) is the flowchart for getting the planting date of rice and maize using the cumulative rainfall approach.

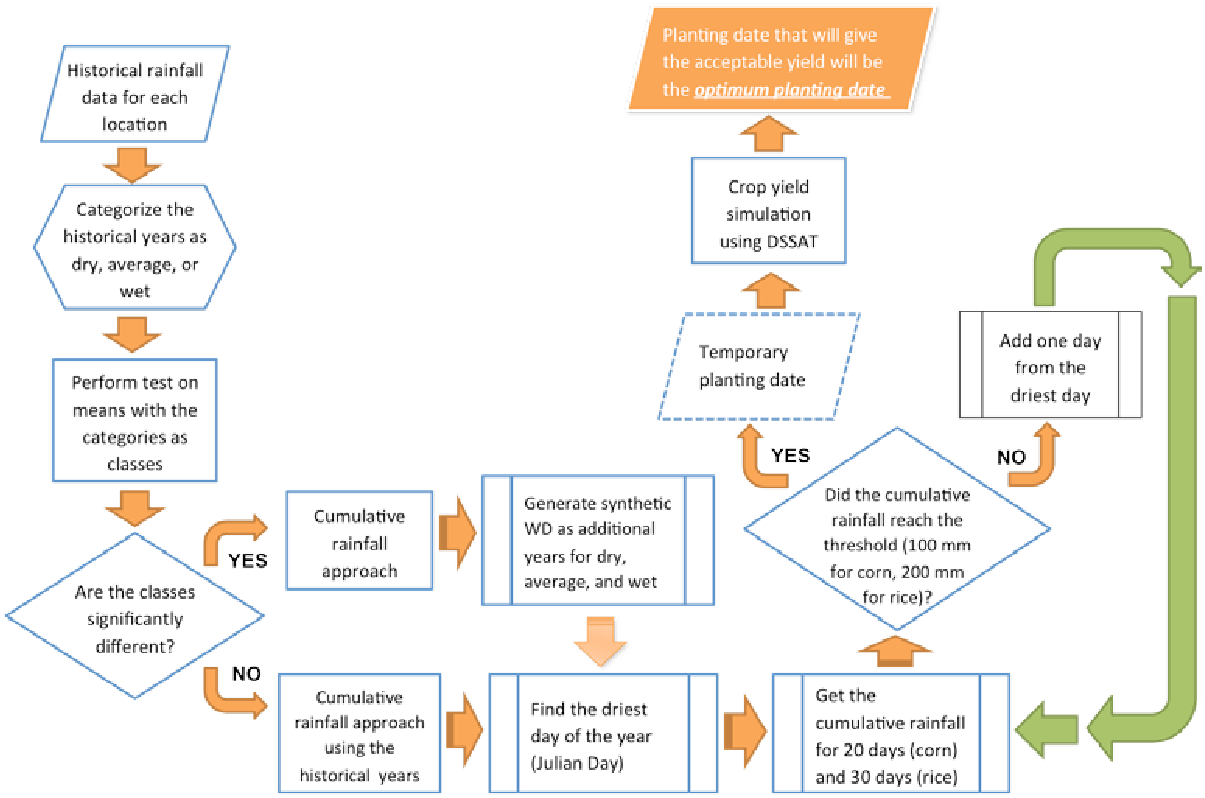

Figure 4. Schematic of the method to determine the planting date for rice and maize based on the cumulative rainfall approach.

Illustrated Examples and Some Results

Table 18 shows the recommended planting dates determined by the cumulative rainfall approach. The years were classified into ‘dry year’, ‘average year’ and ‘wet year’, based on the ONI values for each year. Analysis of variance was also conducted among the year categories, and results show that the year categories are significantly different. Simulated crop yields that are likely to occur with 80% probability of exceedance are graphed in Figures 5, 6 and 7 for ‘dry year’, ‘average year’, and ‘wet year’, respectively.

Table 18. Planting dates for rice and corn in different location sites determined using cumulative rainfall approach for selected rice and corn growing areas in the Philippines.

Location	Dry Year		Average Year		Wet Year	
	Rice	Corn	Rice	Corn	Rice	Corn
Calapan, Or. Mindoro	19-May	28-Apr	11-May	25-Apr	20-May	18-Apr
La Granja, Negros Occ.	23-May	16-May	16-May	18-Apr	14-May	13-Apr
Iloilo City, Iloilo	11-Jun	25-May	8-Jun	22-May	16-May	6-May
Echague, Isabela	23-Jun	17-May	27-May	11-May	1-Jun	2-May
Munoz, Nueva Ecija	19-Jun	27-May	4-Jun	18-May	26-May	14-May
Malaybalay, Bukidnon	30-May	20-May	21-May	10-May	26-May	11-May

Location	Dry Year		Average Year		Wet Year	
	Rice	Corn	Rice	Corn	Rice	Corn
Mactan, Cebu	7-Jul	12-Jun	23-Jun	4-Jun	3-Jul	10-Jun
Davao City, Davao del Sur	1-Jun	15-May	16-Jun	14-May	5-Jun	4-May
Legazpi City, albay	28-Jun	16-Jun	21-Jun	10-Jun	6-Jul	15-Jun
Lumbia, Misamis Oriental	18-Jun	29-May	17-Jun	25-May	21-Jun	1-Jun
Los Baños, Laguna	27-Jun	2-Jun	18-May	11-Jun	22-May	22-Jun

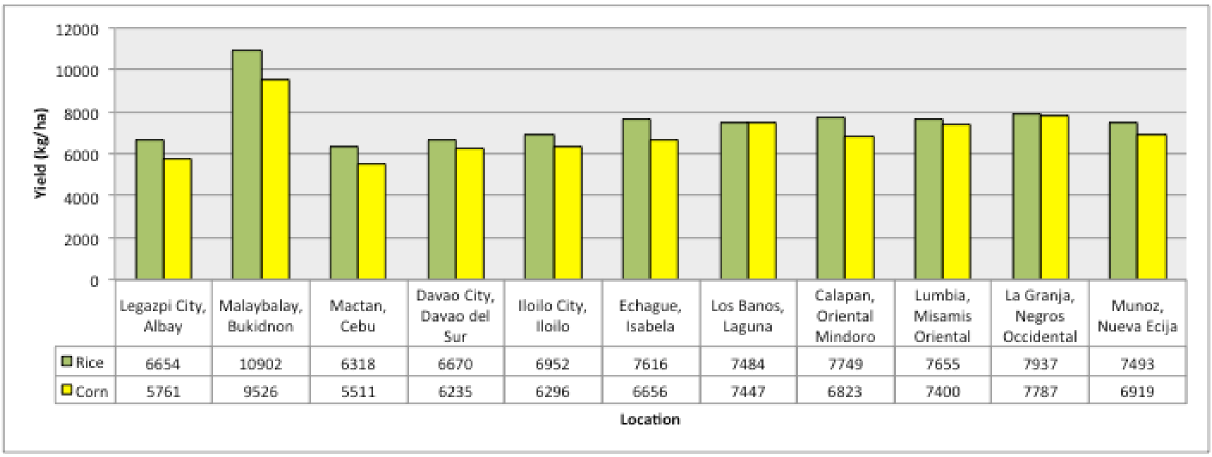

Figure 5. Simulated rice and corn yields (kg/ha) for different sites in the Philippines during a dry year that on average has at least 80% probability of exceedance.

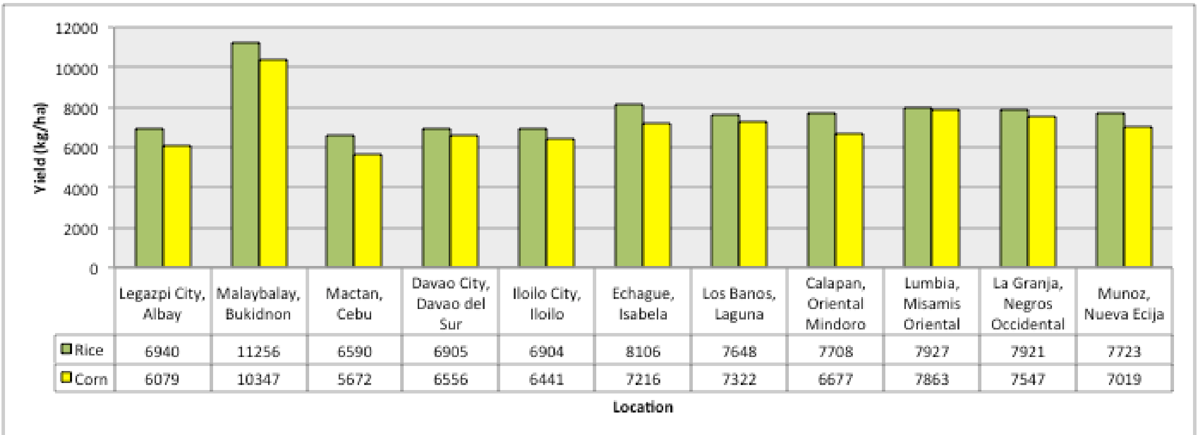

Figure 6. Simulated rice and corn yields (kg/ha) for different sites in the Philippines during a dry year that on average has at least 80% probability of exceedance.

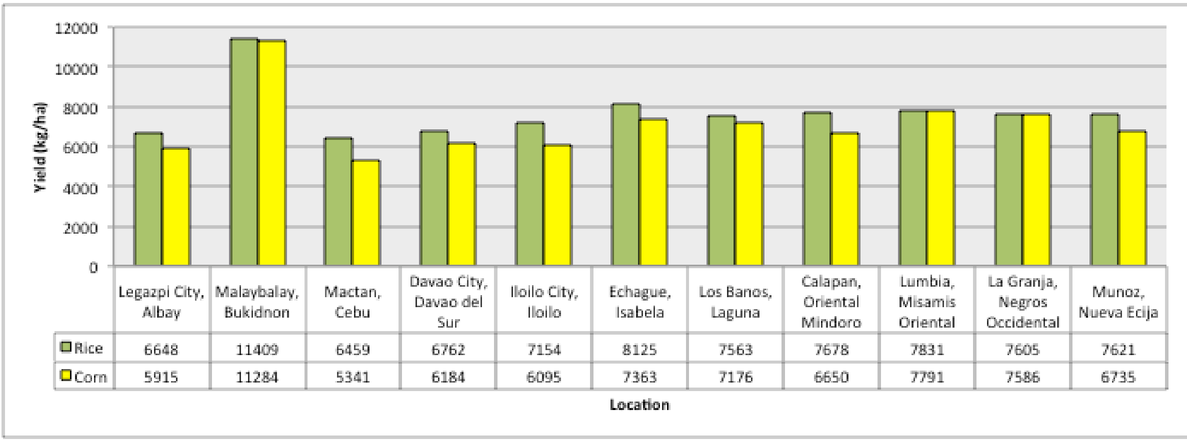

Figure 7. Simulated rice and corn (kg/ha) for different sites in the Philippines during a dry year that on average has at least 80% probability of exceedance.

2.5.2. Regional Cooperation

Regional climate change cooperation has massive impacts especially on crops like rice and maize. Extreme climatic events such as flooding and droughts as well as rainfall variability are important concerns in crop production. The cropping period, especially in rainfed crop production areas, is synchronized with the rainfall pattern in a bid to achieve reasonable yields. Thanks to advances in science and technology, new tools and approaches to adapt to a changing climate as well as to improve crop yields have been developed. One adaptation strategy in crop production is to adjust the planting calendar of the crops. A number of approaches in adjusting the planting calendar or in determining the best planting date under a changing climate and climate variability have been presented. These approaches are based on estimated water requirements for the different stages of crop growth, on rainfall distribution and patterns, and on probabilities of crop yields. The applicability of each of these approaches must consider the availability of data and information, such as weather data, soil data, and crop management data, as well as crop characteristics, such as water requirements, growing period and tolerance to environmental stresses.

While the methods or approaches to determine the best planting date should be simple easily understood, they must have a sound theoretical or scientific basis to be accepted and used. The results of applying these methods and procedures should be simplified as much as possible to be easily understood by end-users including farmers, agricultural technicians and suppliers, among others. These recommendations should be reliable and disseminated on time to be useful.

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ANNEXES

ANNEXES

Annex 1: ASEAN-CRN Terms of Reference

ASEAN Climate Resilience Network

Under the auspices of the

ASEAN Technical Working Group on Agricultural Research and Development

Terms of Reference

May 20, 2015

Rationale

1. The Royal Thai Government initiated a project on *Production System Approach for Sustainable Productivity and Enhanced Resilience to Climate Change* in rice and other crops at the 8th Meeting of the ASEAN Technical Working Group on Agricultural Research and Development (ATWGARD) in Singapore, 2013. The ASEAN Climate Resilience Network (herewith to be referred to as **ASEAN-CRN**) was established as an outcome of this above-mentioned project as a platform to address the issues of climate change in agriculture.

2. Relevant ASEAN frameworks include the ASEAN Multisectoral Framework on Climate Change: Agriculture, Fisheries and Forestry towards Food Security (AFCC) of which ATWGARD is a member. Furthermore, the ASEAN-CRN activities should be implemented in broader consultation with other ASEAN bodies, namely ASEAN Sectoral Working Group on Crops (ASWGC), ASEAN Working Group on Climate Change (AWGCC) and in alignment with the Vision and Strategic Plan for ASEAN Cooperation in Food, Agriculture and Forestry (2016-2025) (FAF).

3. The Terms of Reference for the ASEAN-CRN are elaborated below to ensure the effectiveness in achieving its objectives and efficient working of the ASEAN-CRN, and shall be reviewed accordingly for their relevance.

Objectives

4. The objectives of the ASEAN-CRN are:

   i. To promote a common understanding on climate change and the agriculture sector amongst ASEAN Member States (AMS) and facilitate mutual learning;

ii. To promote resiliency of agriculture within the region, through the scaling-up and scaling-out of identified good practices and policies at the AMS level that address climate-related threats and opportunities (climate-smart agriculture practices[37]) to agriculture;

iii. To identify common concerns and capacity needs and propose regional support strategies and instruments to address these in a coherent manner; and

iv. To support ASEAN decision-making and implementation processes by providing input based on policy-oriented research in the field of climate change and agriculture.

With the aim of

5. Ensuring that AMS are in a better position to adapt their agricultural sector to climate change and optimize its mitigation potential.

Scope of Tasks

6. The ASEAN-CRN strives to achieve these objectives by providing a platform to:

i. Assess climate change impacts on selected agricultural production systems (and the contribution to climate change of those systems);

ii. Strengthen areas of regional cooperation to facilitate knowledge exchange and mutual learning;

iii. Promote a conducive environment for scaling-up climate-smart practices throughout the region;

iv. Respond to emerging issues on agriculture and climate change raised by AMS and relevant ASEAN bodies, and from regional and international processes that are relevant to AMS;

v. Provide evidence-based policy recommendations, protocols and guidelines on the promotion of CSA practices for the relevant ASEAN bodies and decision makers

vi. Enhance policy formulation and implementation to further strengthen the promotion of climate-smart agriculture in AMS, taking into account the different agronomic and climatic conditions and levels of socio-economic development in AMS;

vii. Mobilize resources and build partnerships to develop and coordinate collaborative initiatives relevant to AMS in order to ensure sustainable financing, enhance synergies and avoid duplication of efforts;

viii. Learn about funding opportunities for scaling up and scaling out climate-smart practices, and support AMS in the formulation of proposals targeting

[37] http://www.fao.org/climate-smart-agriculture/en/

investments;

ix. Involve relevant stakeholders, such as the private sector, academia and the research community to enhance climate change and agriculture policy processes in ASEAN as well as scaling-up and scaling out of climate smart practices;

x. Create and support a regional pool of expertise/experts in ASEAN to undertake policy analysis and research on climate change and agriculture issues from the perspective of AMS;

xi. Develop and implement the agreed upon a *Work Plan* for regional cooperation on scaling-up climate smart practices: through the *Regional Guidelines on Scaling-up CSA Practices; and*

xii. Review the Regional and Technical Guidelines and corresponding ASEAN-CRN Work Plan and adjust accordingly on an annual basis, or when deemed necessary.

Chairperson

7. The Chairperson of the ASEAN-CRN for the initial years (3 years) is the lead country of the proposed initiative, namely Thailand. Thereafter, upon agreement by the members of the ASEAN-CRN, a Chairperson amongst the founding members (see 11) will be appointed on rotational basis (duration to be determined).

8. The Chairperson of the ASEAN-CRN, with the support of the CRN Secretariat, shall make preparation for the meeting as well as coordinate the implementation of the Operational Plan.

9. The Chairperson of the ASEAN-CRN shall represent the ASEAN-CRN at the ASEAN Technical Working Group on Agricultural Research and Development (ATWGARD) as well as other relevant working groups, such as ASWGC and ASWGCC, and report its activities to the SOM-AMAF.

Members

10. The ASEAN-CRN will be composed of nominated members from the ATWGARD who will act as permanent representatives of ASEAN member states. They constitute the core members of the ASEAN-CRN. Their task is to coordinate and facilitate national contributions to the ASEAN-CRN at the country level.

11. Membership is also open to relevant and willing ASEAN Working and Experts' Groups, such as ASWGC and ASWGCC.

12. ASEAN-CRN Members should be actively involved in agriculture and climate change research and development activities.

13. ASEAN-CRN Members should attend or have suitable representatives in attending ASEAN-CRN Meetings.

Partners

14. ASEAN-CRN Partners are individuals, organizations and relevant ASEAN bodies, which the ASEAN-CRN Members have invited to contribute to the aim of the ASEAN-CRN. These can include development agencies, research institutes, academia, private sector, civil society organisations as well as eminent regional experts. Consistency in the representation from partners is highly encouraged.

15. Partner representatives are invited to attend ASEAN-CRN meetings, as needed.

Working Modalities

16. The Chairing Country of the ASEAN-CRN provides a secretarial function with the support from GAP-CC (committed until the end of 2017) and in coordination with the ASEAN Secretariat (ASEC), herewith referred to as the ASEAN-CRN Secretariat.

17. The ASEAN-CRN Secretariat and ASEAN-CRN Chairperson, shall play a facilitating role for the ASEAN-CRN, as well as provide interface and manage communication between ATWGARD, other relevant sectoral bodies, and the ASEAN-CRN.

18. The ASEAN Secretariat shall play a facilitating role to ensure ownership by AMAF. It contributes to formal communication within ASEAN organs.

19. The ASEAN-CRN shall, if deemed necessary, establish appropriate sub-working groups to address specific technical cooperation on the individual CSA practices laid out in the *Regional Guidelines for Scaling-up CSA Practices,* with representation of relevant selected AMS.

20. Until the end of 2017, the ASEAN-CRN and its activities will be supported by Lead Country (namely the Department of Agriculture, Thailand) and Development Partners (namely Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) through GAP-CC). During this period the effectiveness and added value of the ASEAN-CRN will be reviewed. Based on the review and depending on the continued demand for the ASEAN-CRN, sustainable funding sources (for example through pooled funding from AMS contributions, private sector investments and development partner support) will be developed.

21. Research, especially policy-oriented research, policy analysis and pilots conducted by ASEAN-CRN shall be incorporated into a work plan.

22. The ASEAN-CRN will be guided by the ASEAN-CRN *Work Plan*, which is based on the *Regional Guidelines for Scaling-up CSA Practices.*

23. Official communication should be through the Chairperson of the ASEAN-CRN and core members, to be facilitated by the CRN Secretariat.

Network Meetings

24. The ASEAN-CRN, will convene its meeting, depending on the availability of resources, at least once a year or as called by the Chairperson as and when necessary, preferably back to back with ATWGARD meetings.

Duration

25. This TOR will take effect at the date of endorsement by the ATWGARD meeting.

26. The ASEAN-CRN should be in overall support of the FAF and will plan its activities annually. Near to the end of the GAP-CC support in 2017, the ASEAN-CRN may review its functions and relevance and assess new sources for sustainable funding.

Annex 2: ASEAN-CRN Action Plan 2015—2017

Supported by

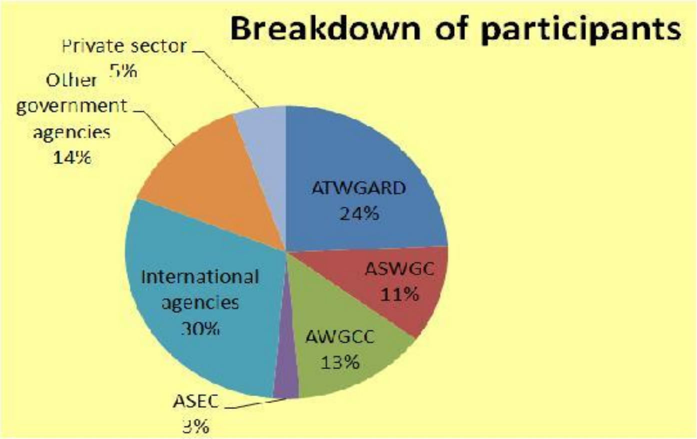
SUMMARY

First ASEAN Climate Resilience Network (ASEAN-CRN) Planning Meeting

14-16 December 2015 | Nusa Dua, Bali, Indonesia

BACKGROUND

The **ASEAN Climate Resilience Network (ASEAN-CRN)** is established to ensure that ASEAN Member States (AMS) are in a better position to adapt their agricultural sector to climate change and optimize its mitigation potential. The first major activity of the ASEAN-CRN was to facilitate a coordinated regional study across AMS in early 2014. Based on the findings in the study, the ASEAN Regional Guidelines for Promoting CSA Practices (Regional Guidelines) have been developed and endorsed in the 37th Meeting of the ASEAN Ministers of Agriculture and Forestry in September 2015. The ASEAN-CRN constitutes a dialogue platform amongst AMS as well as other stakeholder groups for implementing the Regional Guidelines. Since the first official ASEAN-CRN meeting in May 2015, the network members have exchanged knowledge on Climate Smart Agriculture (CSA) practices as well as relevant processes of the United Nations Framework Convention on Climate Change (UNFCCC) and based on that further shaped the agenda of the ASEAN-CRN.



As a follow-up activity, the ASEAN-CRN 1st Planning Meeting has been conducted on December 14–16, 2015 in Bali, Indonesia. Selected members from the ASEAN Technical Working Group on Agricultural Research and Development (ATWGARD), the ASEAN Sectoral Working Group on Crops (ASWGC), and the ASEAN Working Group on Climate Change (AWGCC), as well as national and international research organizations, related government agencies, and development partners convened together to assess the progress of the implementation of the ASEAN-CRN Regional Guidelines for Promoting CSA Practices, concretize the strategies of the ASEAN-CRN in achieving in its objectives, and develop its 2016-2017 Work Plan.

KEY RESULTS

VISION OF THE ASEAN-CRN

"ASEAN-CRN is a capable and valued multi-stakeholder collaboration network for a sustainable, competitive, climate resilient agriculture in the ASEAN community."

OBJECTIVES
of the ASEAN-CRN

1. Promote a common understanding on climate change and the agriculture sector amongst AMS and facilitate mutual learning;
2. Promote resiliency of agriculture within the region, through the scaling-up and scaling out of identified good practices and policies at AMS level, which address climate related threats and opportunities to agriculture;
3. Identify common concerns and capacity needs, and propose regional support strategies and instruments to address these in a coherent manner; and,
4. Support ASEAN decision-making and implementation processes by providing inputs based on policy-oriented research results in the field of climate change and agriculture.

FIVE WORK AREAS
to advance the scaling-up of CSA Practices

Knowledge Management

Project Support for scaling-up CSA Practices

Funding

Capacity Building

Joint Policy Statement and Protocol

FIELDS OF REGIONAL COOPERATION

Field of Cooperation	ASEAN Member States						
	CA	LA	ID	MM	PH	TH	VN
1. Model Farming	**√**	√					√
2. Crop Management	√	√	**√**	√	√	√	√
3. STVs seed production	√	√	√	√	**√**	√	√
4. Appropriate CSA – Technology Package	√	√			√	**√**	
5. Post-harvest Handling		√	**√**		√		**√**
6. Crop Insurance	√	√	√		√		**√**
7. Climate Information Service (CIS) and Early warning		√	√	**√**	√	√	√
8. Pest Surveillance		√		√	**√**	√	√

√	=	Lead country in a field of cooperation
√	=	Participating countries

Cross cutting tasks were also identified, such as incorporation of gender in planning and analysis, policy formulation, monitoring of Intended Nationally Determined Contributions (INDCs), and utilization of appropriate communication tools, which will all be supported by the Forest and Climate Change Project (FOR-CC) under the ASEAN-German Programme on Response to Climate Change (GAP-CC)/GIZ.

WAY AHEAD FOR THE ASEAN-CRN

Several ideas and activities came out from the discussions and inputs from the participants during the lively and enthusiastic planning meeting. Some of the key activities that the ASEAN-CRN will be conducting in the coming months include the following:

- Field Visit of Lao Delegates to Thai Maize Seed Village *(January 2016)*
- Submission to UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) 44 on issues related to agriculture *(March 2016)*
- Knowledge exchange on Crop Insurance *(to be announced)*
- Development of funding proposals to gain support for planned projects and activities *(to be announced)*

Annex 3: Exchange of Good Practices

AMS	Priority List of Identified Good Practices		
	Rice	Maize	Cassava
Brunei	Cropping calendar, AWD, stress- tolerant varieties	Maize (special type, for consumption)	
Cambodia	Stress-tolerant varieties, crop diversification/model farming, best crop management practices		Healthy planting materials, contour inter-cropping
Indonesia	Dynamic cropping calendar, new varieties, crop insurance based on weather climate index	Dynamic cropping calendar, new varieties, crop insurance based on weather climate index	
Laos	Crop diversification, postharvest technologies, Thai smallholder seed production	Crop diversification, postharvest technologies, Thai smallholder seed production, stress-tolerant varieties, cropping calendar	
Malaysia	Crop calendar, drought tolerant, water use efficiency		Planting materials, good agricultural practice (GAP), postharvest
Myanmar	Climate-resilient varieties, AWD, Site-Specific Nutrient Management (SSNM), proper postharvest technology	SSNM, Sustainable Maize Production in Sloping Areas (SCOPSA), Quality Protein Maize (QPM)	
Philippines	Climate-ready varieties, crop diversification, cropping calendar, rice shrimp farming	Stress-tolerant varieties, SSNM, SCOPSA	
Thailand	Cropping calendar, stress-tolerant varieties, RIICE technologies	Breeding and production of stress-tolerant varieties	
Vietnam	Rice shrimp farming, crop insurance, AWD	Stress-tolerant and high-quality varieties, optimal row spacing and density, SSNM	