Methods and tools for adaptation appraisal in agriculture and assessing crop production

Outline

- Adaptation appraisal
  - Typologies of adaptation interventions
  - Appraisal methods
  - Costs and benefits of implementing CCA in agriculture
- Crop production
  - Methods and tools
  - Practices

National Adaptation Planning Process by UNFCCC

Start

Element A. Lay the groundwork and address gaps

- A.1 Initiating and launching of the NAP process
- A.2 Stocktaking: identifying available information on climate change impacts, vulnerability and adaptation and assessing gaps and needs of the enabling environment for the NAP process
- A.3 Addressing capacity gaps and weaknesses in the undertaking of the NAP process
- A.4 Literature review on national processes

Element B. Preparatory elements

- **B.1** Analyzing current climate and future climate change scenarios
- B.2 Assessing climate vulnerabilities and identifying adaptation options at the sector, subnational, national and other appropriate levels
- B.3 Reviewing and appraising adaptation options
- B.4. Compiling and communicating national adaptation plans
- B.5 Integrating climate change adaptation into national and subnational development and sectoral planning

Element C. Implementation strategies

- C1. Prioritizing climate change adaptation in national planning
- C.2 Developing a (long-term) national adaptation implementation strategy
- C3. Enhancing capacity for planning and implementing adaptation
- C.4 Promoting coordination and synergy at the regional level and with other multilateral environmental agreements

Element D. Reporting, Monitoring and Review

- D.1 Monitoring and NAP Process
- D.2 Reviewing the NAP process to assess progress, effectiveness and gaps
- D.3 Iteratively updating the national adaptation plans
- D. 4 Outreach on the NAP process and reporting on progress and effectiveness

Adaptation Interventions

Types	Examples
Immediate actions to address adaptation deficits beneficial to do now, reduces current climate risks, builds resilience, enables environment for adaptation	Pest management, Access to finance Soil and water conservation, DRR, improving climate services (forecast), Institutional strengthening
Early decisions with a long lifetime Early interventions that reduce future risks, builds resilience, increases robustness or allow flexibility, builds information and evidence	Climate risk screening, Upgradable infrastructure, Flexibility design, risk mapping, Siting/land-use plans to avoid future risks, Research and pilot
Early actions to address future long-term risks Early interventions for new challenges – where new decision time-scale involves decades, or option for information and early action to help future decisions	Iterative plans, early research and monitoring programs

Source: Watkiss, P. et al. (2015)

Examples of appraisal methods used in the adaptation context

- Cost-Benefit Analysis (CBA)
- Cost-Effectiveness Analysis (CEA)
- Multi-criteria analysis (MCA)
- Real Options Analysis (ROA)
- Robust Decision Making (RDM)
- Portfolio Analysis (PO)
- Iterative Risk Assessment (IRM)

Examples of appraisal methods used in the adaptation context

Tool	Published example applications
Cost-Benefit Analysis (CBA)	A South African case study examined the benefits and costs of avoiding climate change damages through structural and institutional options for increasing water supply in the Berg River Basin in the Western Cape Province (AIACC, 2006). In Germany, cost-benefit analysis was applied to assess 28 adaptation options (Tröltzsch et al., 2012).
Cost-Effectiveness Analysis (CEA)	Boyd, Wade and Walton (2006) undertook a detailed application of cost-effectiveness for water resource zones and the potential adaptation response to reduce household water deficits from future climate change in the UK. Tainio et al. (2013) investigated the cost-effectiveness of alternative conservation measures that could maintain the biodiversity of Finnish semi-natural grasslands under a changing climate.
Multi-criteria analysis (MCA)	Van Ierland et al. (2006) applied MCA to assess adaptation options for the Netherlands as part of the Routeplanner national study. This used a qualitative MCA, which included various adaptation criteria. A quantitative MCA was used in the Thames Estuary 2100 project (EA, 2009; EA, 2011) as part of a broader study looking at future coastal flood defenses for London. The MCA was used to include qualitative criteria (e.g. environment and heritage) alongside formal economic cost-benefit analysis.
Real Options Analysis (ROA)	Jeuland and Whittington (2013) applied real option analysis for a water resource planning case study (large water storage projects) in Ethiopia along the Blue Nile. Van der Pol et al. (2013) looked at optimal dike investments under uncertainty with learning about increasing water levels.
Robust Decision Making (RDM)	A comprehensive, formal application of RDM was undertaken by Lempert and Groves (2010) for Southern California's Riverside County Inland Empire Utilities Agency (IEUA). Dessai and Hulme (2007) present an example of the application for RDM to look at climate uncertainty for water supply management in the UK.
Portfolio Analysis (PO)	Crowe and Parker (2008) use portfolio analysis to investigate genetic material that could be used for the restoration or regeneration of forests under climate change futures. Hunt (2009) applied portfolio analysis to a case of local flood management in the United Kingdom, looking at portfolios of hard and soft options.
Iterative Risk Assessment (IRM)	The Thames Estuary 2100 project (EA, 2009; EA, 2011; Reeder and Ranger, 2011) developed a tidal flood-risk management adaptation plan for London using an iterative planning approach and adaptation pathways, with a detailed monitoring and evaluation strategy.

Source: ECONADAPT (2015)

Building resilience to CC in agriculture: the role of robust appraisal methods

- Robust approaches deliver adaptation goals by selecting projects that meet their purpose across a variety of plausible futures and thus particularly suited for deep uncertainty.
- Robust approaches do not assume a single climate change forecast but integrate a wide range of climate scenarios. Various mechanisms are used for this purpose, including identifying the least vulnerable strategy across scenarios.
- Robust Decision Making which can be applied to complex decisions with differentiated adaptation options and many stakeholders.

Estimating the costs of climate change adaptation in the agricultural sector

- Investment and financial flows
- Integrated Assessment Models (IAMs)
- Equilibrium models (CGE and PE)
- Vulnerability-based
- Ricardian
- Cost-benefit analysis

Estimating the costs of climate change adaptation in the agricultural sector

Approach	Scale	Likely end-user	Advantages	Disadvantages
Investment and financial flows	Global	International organizations; some national governments	Highlight the scale of investment needed; balance this against mitigation costs	Simplistic approach; unrealistic assumptions; exclude certain sectors; does not provide sectoral detail
Integrated Assessment Models (IAMs)	Global	International organizations; some national governments; academics	Useful for examining optimal policy mix between mitigation and adaptation; linked to climate science	Rudimentary representation of adaptation
Equilibrium models (CGE and PE)	Global and/or national	National; sectoral	Present economy-wide effects	Limitations representing climate impacts; less useful for refining adaptation costs and benefits
Vulnerability-based	National	National governments; adaptation funding bodies	Country-led; identifies the most urgent needs; pragmatic	Minimum assessment of adaptation costs
Ricardian	Local/ sectoral	National/local govt; academics	Useful for first-order estimates of the economic impacts of changing production systems	Do not provide any information about the costs or effectiveness of specific options, or constraints to implementation
Cost-benefit analysis	Local/ project	Local authority; individual business	Provide assessment of most efficient adaptations	Limited in ability to measure non-market factors; requires detailed data not always available

Source: Wreford and Renwick (2012)

Challenges and Possible Ways Forward

- Distributional effects of climate change
- Climate change is dynamic and changing over time
- Adaptation is a continual process, rather than an outcome
- Difficult to do cost-benefit analysis for soft adaptation measures, and uncertainty makes any form of CBA rather skewed.

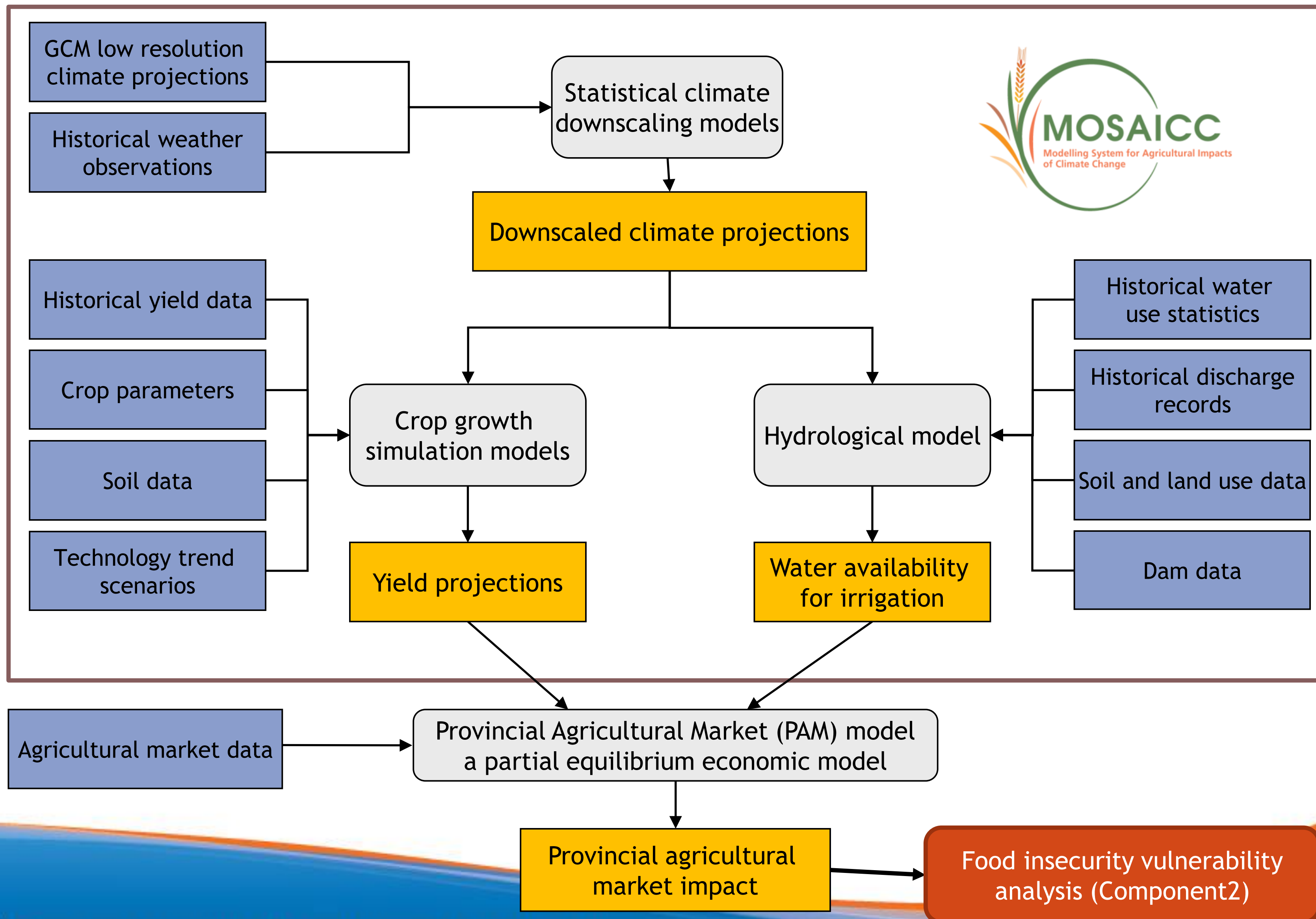
Methods and tools

CROP PRODUCTION

ASSESSMENT TOOLS

- MOSAICC
- SAFA
- Pictorial Evaluation Tool
- RISE

MOSAICC with Agricultural Market Model



AMICAF Analysis & Mapping of Impacts under Climate Change for Adaptation & Food Security

Addressing the Linkage Between Climate Change and Food Security

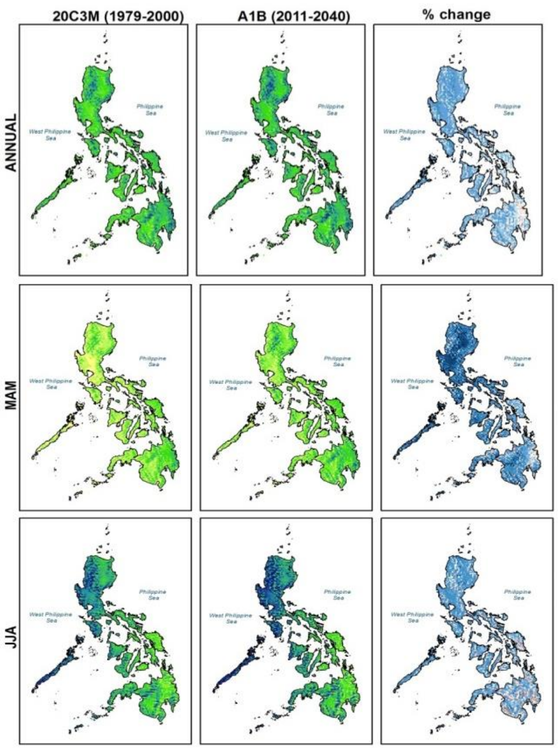
MINAGRI MINISTERIO DE AGRICULTURA Y RIEGO

DEPARTMENT OF AGRICULTURE 1898

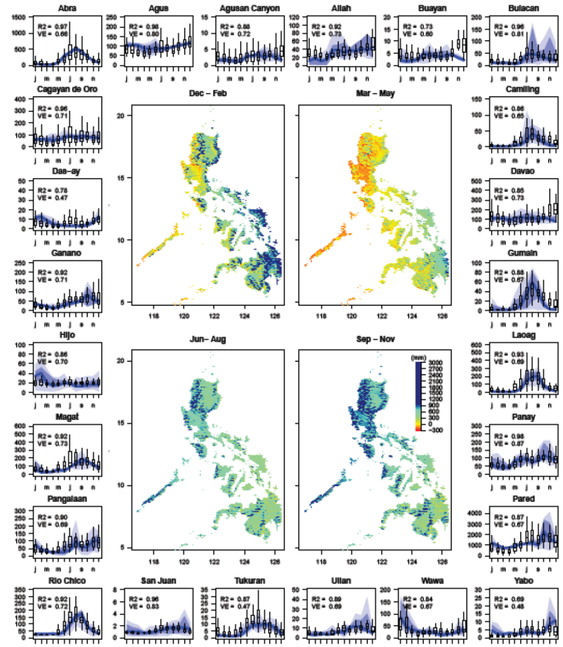
FAO FIAT PANIS

Climate Projections

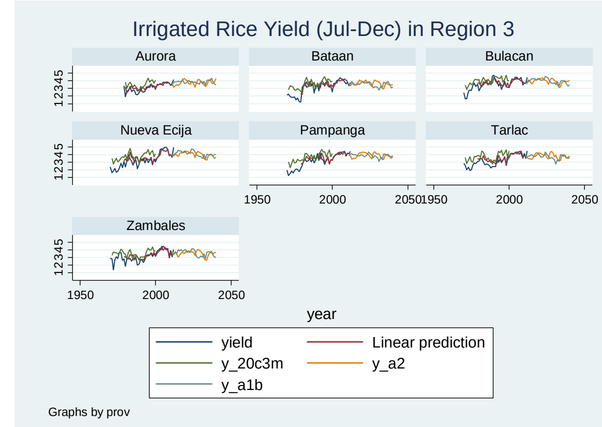
PROJECTED CHANGE & SEASONAL MEAN RAINFALL (MPEH5)



Hydrology:
Surface Water Availability for Agriculture under CC



Crops:
Rice and Corn Yields under CC



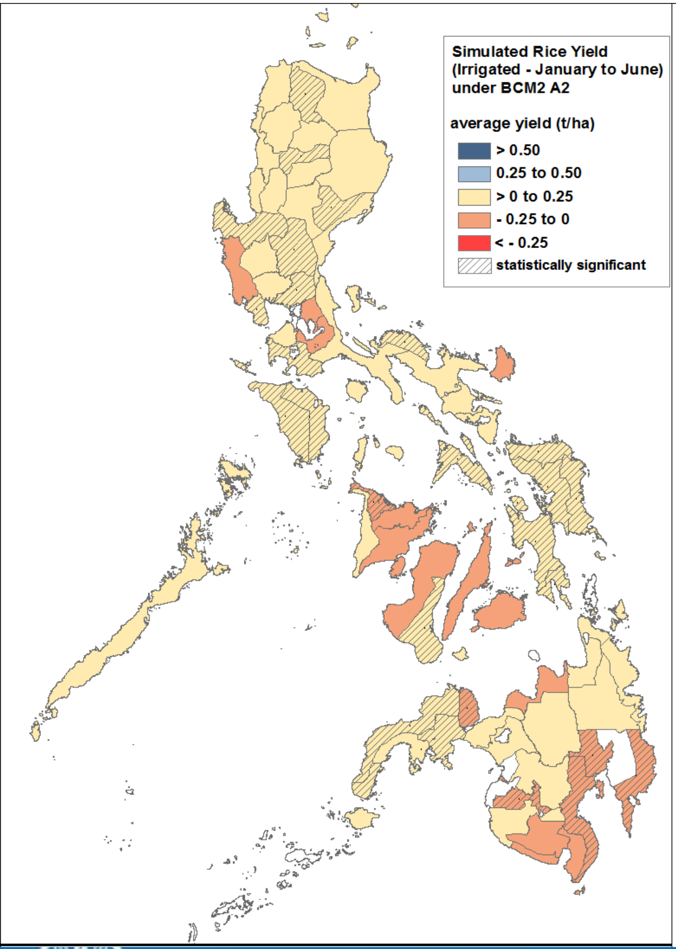
Household vulnerability analysis to food insecurity

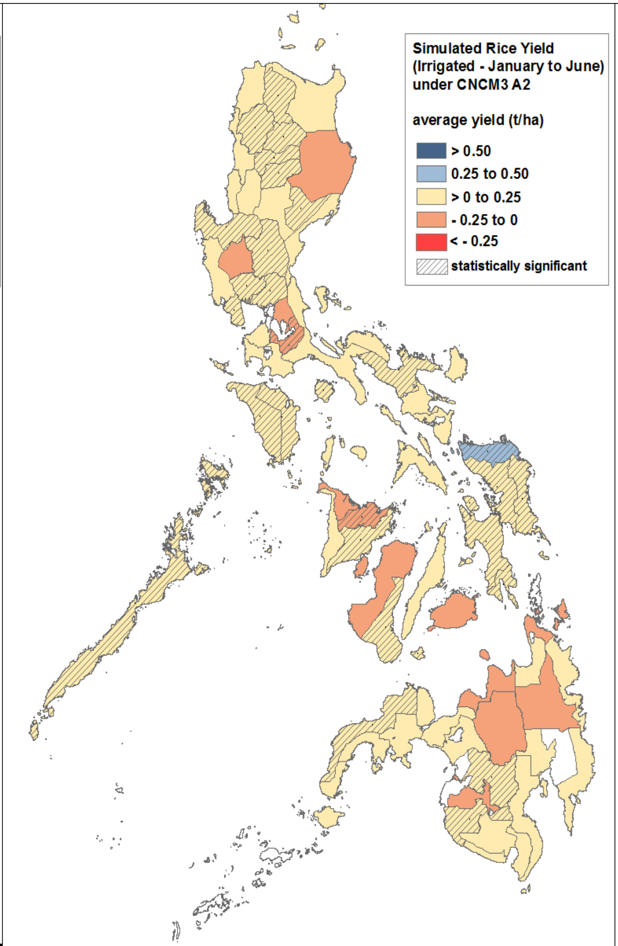
Economy:
Farmgate prices under CC

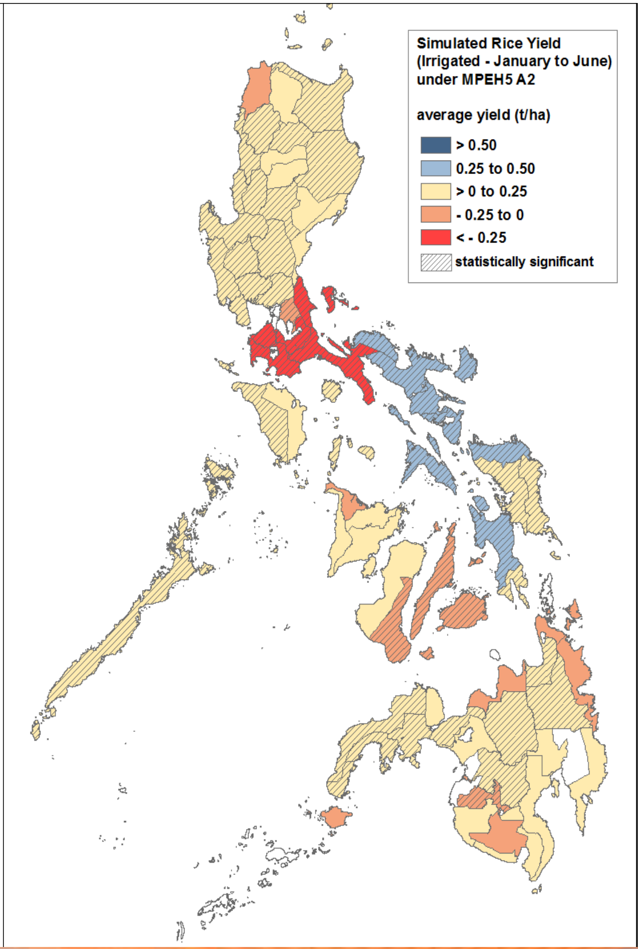
Global Circulation Models	Base (2010 for price)	PAM Model Projection (2011-2030)			
		A1B Scenario		A2 Scenario	
		2026-2030	2011-2030	2026-2030	2011-2030
BCM2					
Farmgate Price	14.870	30.199	**23.342**	29.573	**23.062**
CNCM3					
Farmgate Price	14.870	29.927	**23.484**	28.927	**23.068**
MPEH5					
Farmgate Price	14.870	29.430	**22.980**	29.594	**23.317**

AMICAF Analysis & Mapping of Impacts under Climate Change for Adaptation & Food Security

SIMULATED RICE YIELD (IRRIGATED)



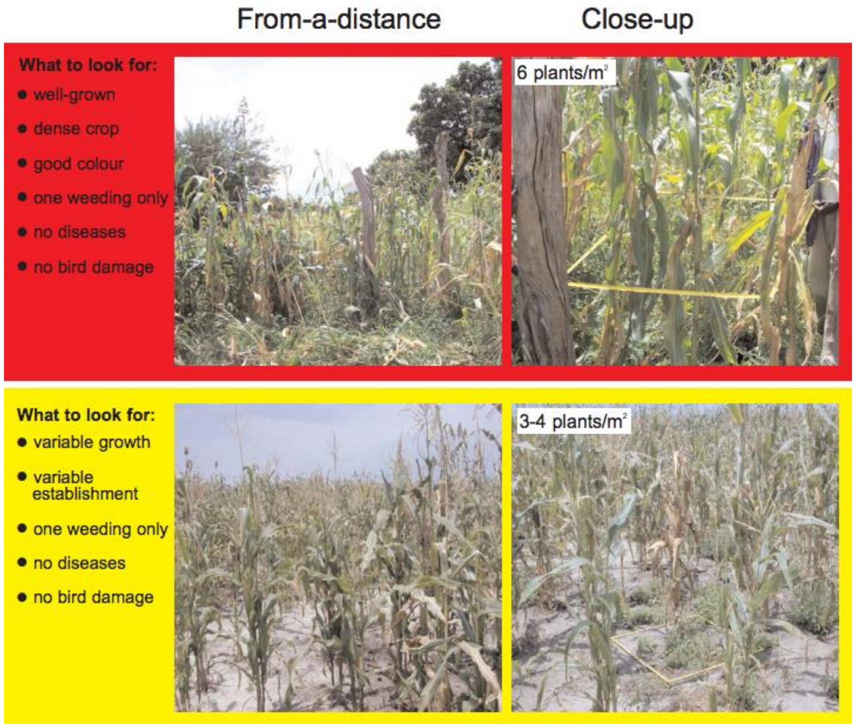




Sustainability Assessment of Food and Agriculture systems (SAFA)

- Assesses the impact of food and agriculture operations on the environment and people
- An app and an online tool are available support the implementation of SAFA Guidelines, specifically at the supply chain assessment level.
- http://www.fao.org/nr/sustainability/sustainability-assessments-safa/

Pictorial Evaluation Tool

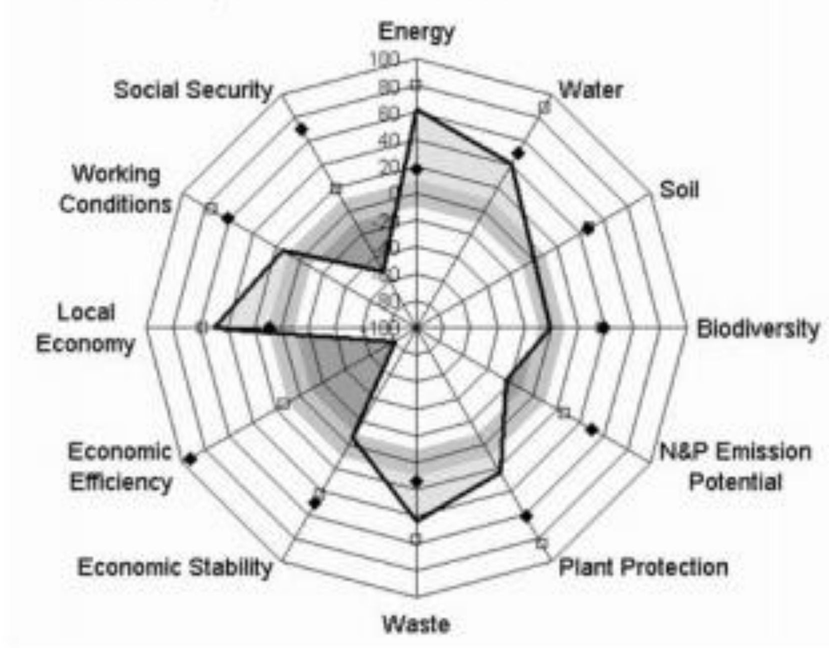


- Shows you how to use pictures to estimate the amount of crop in fields at harvest time. A guide book contains photographs of different crops.
- Utilizes pictures in the guide book with the crop in a field to provide guidance on how much crop may be harvested from that field.
- http://www.agritechtalk.org/PETmanualandmethodology.html

Response-Inducing Sustainability Evaluation (RISE)

- A computer-supported method developed at Bern University of Applied Sciences, which facilitates a holistic assessment of agricultural operations.

Figure 1. Summary polygon with mean indicator degrees of sustainability of 202 Armenian farms.



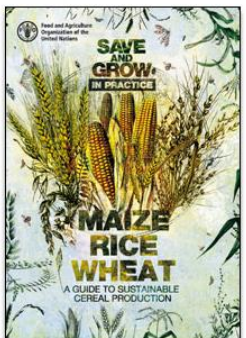
Source: HAFL

PRACTICES

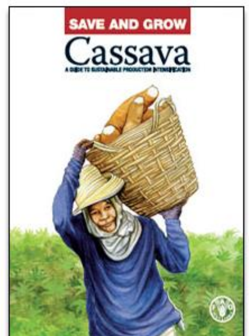
- Save and Grow
- Conservation Agriculture (CA)
- System of Rice Intensification (SRI)
- Alternate Wetting and Drying (AWD)

Save and Grow

Save and Grow (FAO, 2011). With the publication of *Save and Grow*, FAO proposed a new paradigm of intensive crop production, one that is both highly productive and environmentally sustainable.



Save and Grow in practice: maize, rice, wheat (FAO, 2016). This new book looks at the application of "Save and Grow" practices and technologies to the production of the world's key food security crops, with examples from Africa, Asia and Latin America.



Save and Grow: Cassava (FAO, 2013). This guide shows how "Save and Grow" can help cassava growers avoid the risks of intensification while contributing to national economic development.

- A policymaker's guide to the sustainable intensification of smallholder crop production
- Provides policy guidance on improving farming systems, soil health, crop varieties, water management, plant protection and legal and institutional frameworks.
- http://www.fao.org/ag/save-and-grow

Conservation Agriculture

- A set of soil management practices that minimize the disruption of the soil's structure, composition and natural biodiversity through the application of the three principles: minimal soil disturbance, permanent soil cover and crop rotations.
- Has proven potential to improve crop yields, while improving the long-term environmental and financial sustainability of farming.
- http://www.fao.org/ag/ca/

System of Rice Intensification

- An agro-ecological methodology for increasing the productivity of irrigated rice by changing the management of plants, soil, water and nutrients.
- Four main, interacting, principles:
  - Early, quick and healthy plant establishment
  - Reduced plant density
  - Improved soil conditions through enrichment with organic matter
  - Reduced and controlled water application
- Based on these principles, farmers can adapt recommended SRI practices to respond to their agroecological and socioeconomic conditions.
- http://sri.cals.cornell.edu/

Alternative Wetting and Drying

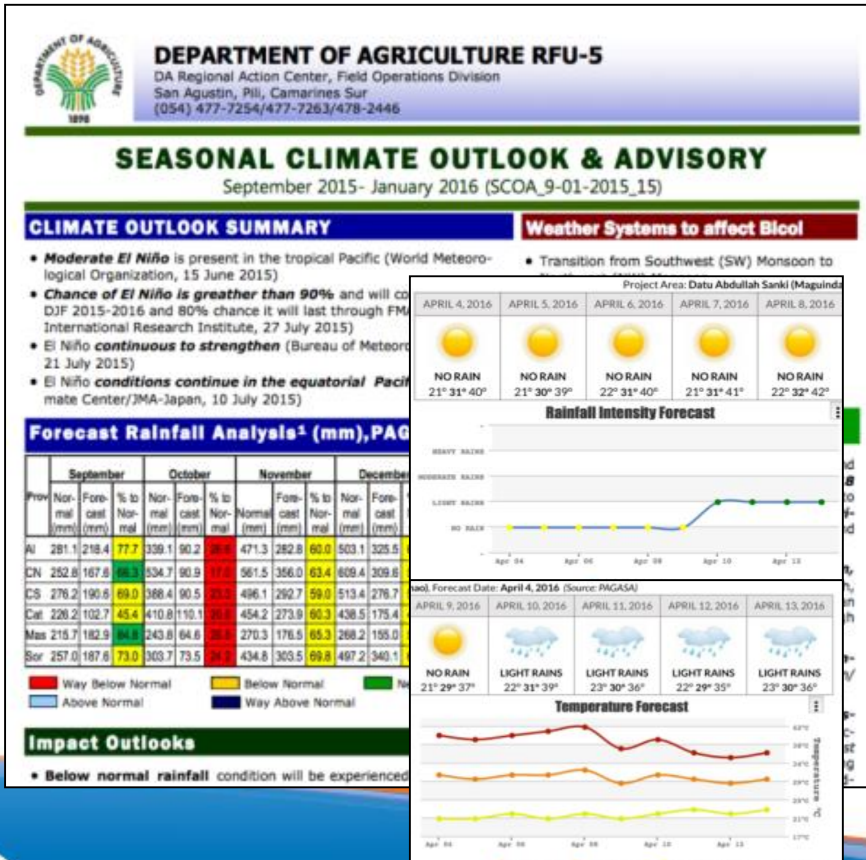
- A water-saving technology that lowland (paddy) rice farmers can apply to reduce their water use in irrigated fields. In AWD, irrigation water is applied to flood the field a certain number of days after the disappearance of ponded water. Hence, the field is alternately flooded and non-flooded. The number of days of non-flooded soil in AWD between irrigations can vary from 1 day to more than 10 days.

A field tube in flooded field

Photo: IRRI

ICT in Agriculture

Climate Infosys



DEPARTMENT OF AGRICULTURE RFU-5
DA Regional Action Center, Field Operations Division
San Agustin, Pili, Camarines Sur
(054) 477-7254/477-7263/478-2446

SEASONAL CLIMATE OUTLOOK & ADVISORY
September 2015- January 2016 (SCOA_9-01-2015_15)

CLIMATE OUTLOOK SUMMARY

- **Moderate El Niño** is present in the tropical Pacific (World Meteorological Organization, 15 June 2015)
- **Chance of El Niño is greather than 90%** and will co... DJF 2015-2016 and 80% chance it will last through FM... International Research Institute, 27 July 2015)
- El Niño **continuous to strengthen** (Bureau of Meteor... 21 July 2015)
- El Niño **conditions continue in the equatorial Pacif**... mate Center/JMA-Japan, 10 July 2015)

Weather Systems to affect Bicol

- Transition from Southwest (SW) Monsoon to

Forecast Rainfall Analysis¹ (mm),PAG

Prov	September			October			November			December	
	Normal (mm)	Forecast (mm)	% to Normal	Normal (mm)	Forecast (mm)	% to Normal	Normal (mm)	Forecast (mm)	% to Normal	Normal (mm)	Forecast (mm)
Al	281.1	218.4	77.7	339.1	90.2	[illegible]	471.3	282.8	60.0	503.1	325.5
CN	252.8	167.6	[illegible]	534.7	90.9	[illegible]	561.5	356.0	63.4	609.4	309.6
CS	276.2	190.6	69.0	388.4	90.5	[illegible]	496.1	292.7	59.0	513.4	276.7
Cat	226.2	102.7	45.4	410.8	110.1	[illegible]	454.2	273.9	60.3	438.5	175.4
Mas	215.7	182.9	[illegible]	243.8	64.6	[illegible]	270.3	176.5	65.3	268.2	155.0
Sor	257.0	187.6	73.0	303.7	73.5	[illegible]	434.8	303.5	69.8	497.2	340.1

Way Below Normal · Below Normal · Above Normal · Way Above Normal

Impact Outlooks

- **Below normal rainfall** condition will be experienced

Project Area: Datu Abdullah Sanki (Maguinda

APRIL 4, 2016	APRIL 5, 2016	APRIL 6, 2016	APRIL 7, 2016	APRIL 8, 2016
NO RAIN 21° 31° 40°	NO RAIN 21° 30° 39°	NO RAIN 22° 31° 40°	NO RAIN 21° 31° 41°	NO RAIN 22° 32° 42°

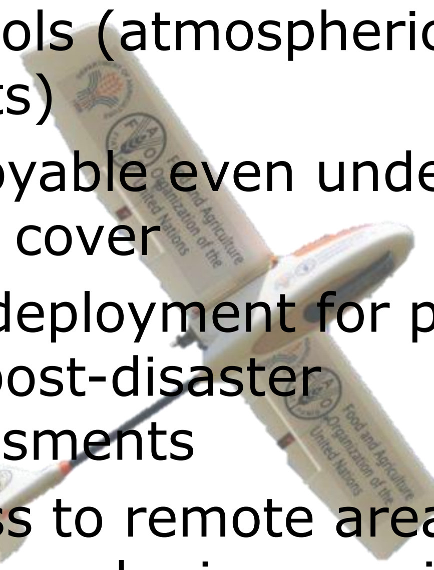
Rainfall Intensity Forecast

Forecast Date: April 4, 2016 (Source: PAGASA)

APRIL 9, 2016	APRIL 10, 2016	APRIL 11, 2016	APRIL 12, 2016	APRIL 13, 2016
NO RAIN 21° 29° 37°	LIGHT RAINS 22° 31° 39°	LIGHT RAINS 23° 30° 36°	LIGHT RAINS 22° 29° 35°	LIGHT RAINS 23° 30° 36°

Temperature Forecast

Drone Mapping



- Minimizes errors arising from water vapor and aerosols (atmospheric effects)
- Deployable even under cloud cover
- Fast deployment for pre- and post-disaster assessments
- Access to remote areas that may be inaccessible after disasters.

DATA AND INFORMATION PORTALS

Climate Impact on Agriculture

- Contains methodologies, tools for a better understanding and analysis of the effect of the variability of weather and climate on agriculture as well as data and maps.
- http://www.fao.org/nr/climpag/

Global Agro-Ecological Zones

- Provides interactive and dynamic web application to report on the current state and trends of agricultural production and crop suitability
- www.fao.org/nr/GAEZ

Technologies and practices for small agricultural producers

- A platform where you can find practical information – agricultural technologies and practices – to help small producers in the field
- http://teca.fao.org/

Thank you!

Contributions to the presentation by

www.fao.org/climate-change