Climate and Agriculture – Key Challenges and Opportunities

Yahya Abawi, University of Southern Queensland, AUSTRALIA

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World Meteorological Organization

GFCS GLOBAL FRAMEWORK FOR CLIMATE SERVICES

Canada

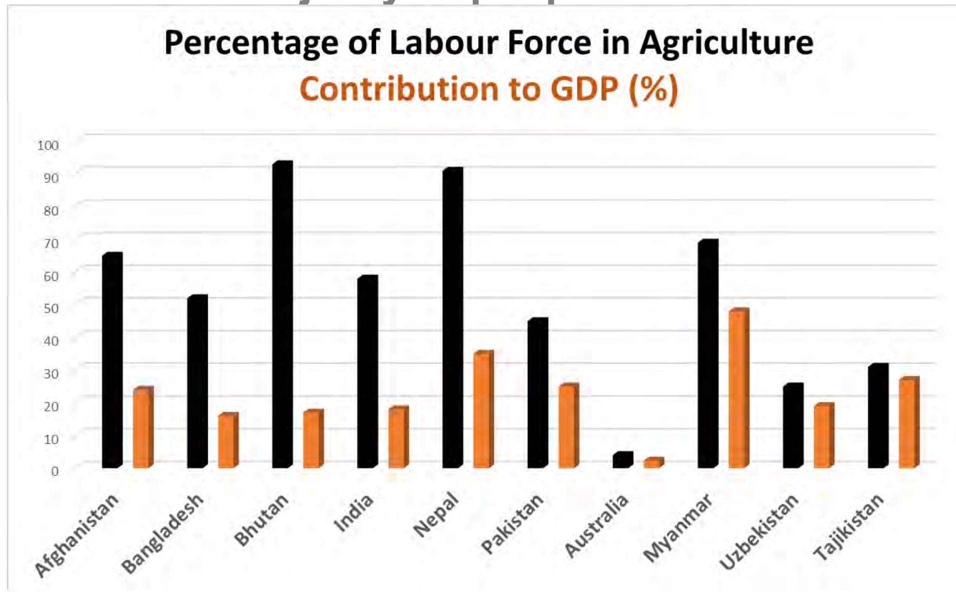
सत्यमेव जयते
Government of India

Overview of Presentation

- The role of Agriculture in Economic Development
- Challenges Facing the Agriculture Sector
- Opportunities for Improvement

Agriculture

Agriculture is the dominant sector of economy in most Asian countries providing income and livelihood to majority of people.



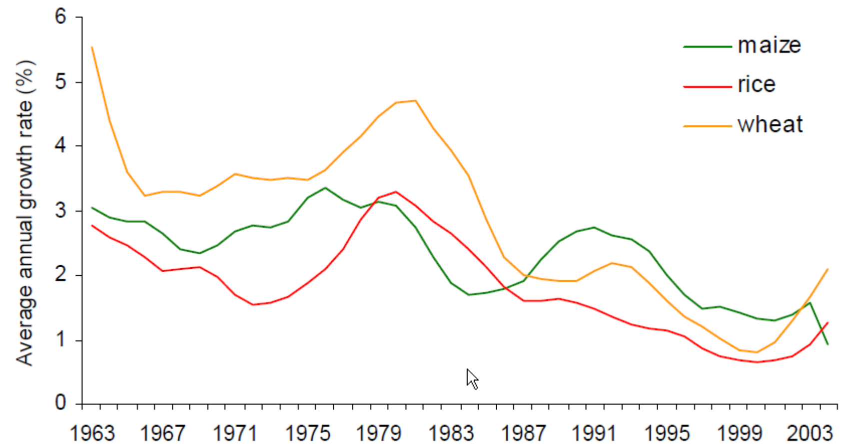
Every growing economy has agriculture as their base (Australia, America, Korea, Switzerland). Now this is occurring in developing countries, with agricultural growth rates greater than in OECD countries.

Small holder farmers in the developing world play an important part in this growth. Many are women.

Challenges facing agriculture

- Population growth
- Globalization
- Urbanization
- Water scarcity
- Declining yield
- Climate variability and Climate Change
- Modernization of agriculture has lagged behind industrialization in developing countries
- Transfer of land from the production of food to production of fuel
- Transfer of land to livestock (high protein food)
- Biosecurity issues affecting FTA

Growth rates of yields for major cereals are slowing for developing countries



Source: World Bank, World Development Report: Agriculture for Development, Washington, 2007 p 67.

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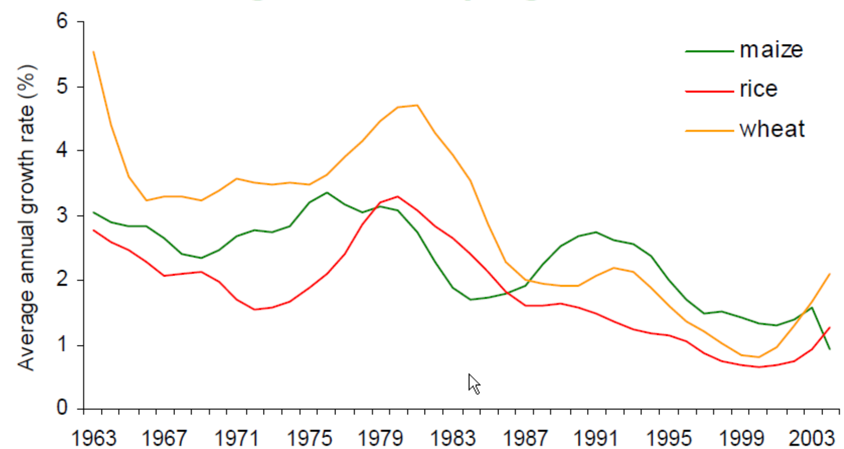

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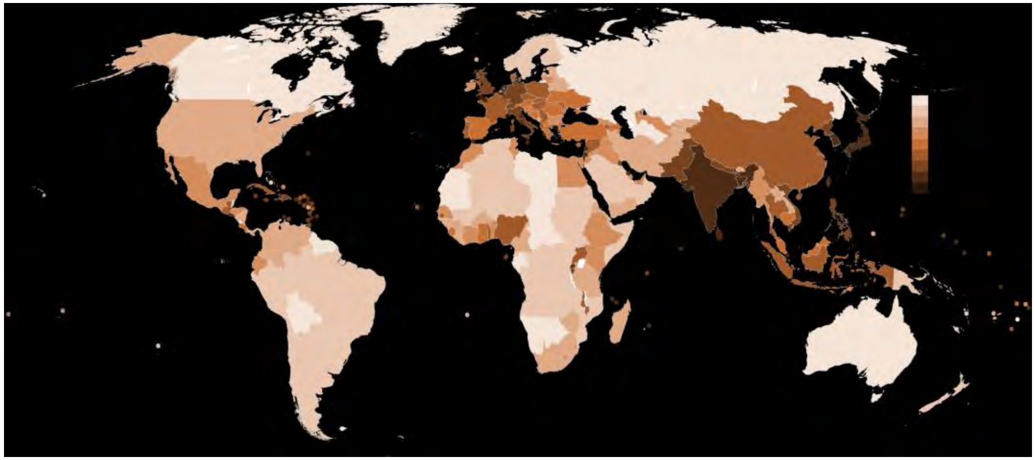
Population Growth



- The world population is estimated to reach 9 billion by 2050 (150 per minute)
- Most increase will be in Asia and Africa
- At present approximately 4.2 billion of the 7 billion people live in Asia
- By 2050, there are expected to be one billion more Asians and one billion more Africans (double the current population)
- Africa and Asia are also most vulnerable to climate risk
- This will have profound impact on food security

Achieving the Millennium Development Goals

Goal 1: Eradicate extreme poverty and hunger

Undernourishment around the world, 1990-2 to 2012-4

Number of undernourished and prevalence (%) of undernourishment

	1990-2 No.	1990-2 %	2014-6 No.	2014-6 %
World	1,010.60	18.6	794.6	10.9
Developed regions	20	<5	14.7	<5
Developing regions	990.7	23.3	779.9	12.9
Africa	181.7	27.6	232.5	20
Sub-Saharan Africa	175.7	33.2	220	23.2
Asia	741.9	23.6	511.7	12.1
Eastern Asia	295.4	23.2	145.1	9.6
South-Eastern Asia	137.5	30.6	60.5	9.6
Southern Asia	291.2	23.9	281.4	15.7
Latin America & Carib.	66.1	14.7	34.3	5.5
Oceana	1	15.7	1.4	14.2
Source: FAO The State of Food Insecurity in the World 2015 p. 8				

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Food security

" Reliable access to sufficient quantities of affordable, nutritious food to maintain healthy, active lives." – ***1996 World Food Summit***

Four main dimensions of food security are;

Availability – Supply of food as determined by production, stock level and net trade

Access - affected by income, expenditure, markets and prices

Utilisation – nutritional status of what we produce

Stability – Inadequate access to food on periodic basis

Availability and ***Stability*** are threatened by the impact of climate variability, climate extreme and climate change

How much food we need to produce ?

Global demand for food is expected to rise faster than population increase

Population is expected to increase by 30% by 2050 (9.3 billion people), but the average income per person will also rise by 120%.

There will be a change in diet from minimal calorie to high protein food.

The water foortprint of different food items

Food item	Unit	Average water Footprint (litres)
Beef	1 Kg	15,000
Pork	1 Kg	6,000
Chicken meat	1 Kg	4,300
Cheese	1 Kg	3,200
Sugar	1 Kg	1,500
Rice	1 Kg	2,500
Bread	1 Kg	1,600
Potatoes	1 Kg	250
Maize	1 Kg	900
Apple or Pear	1 Kg	700
Cabbage	1 Kg	250
Tomato	1 Kg	210
Chocolate	1 Kg	24000
Beer	1 glass of 250 ml	75
Wine	1 glass of 125 ml	120

Kilogram of grain used to produce 1 Kg of meat

Fish		2
Chicken		3
Pork		5.5
Beef		10

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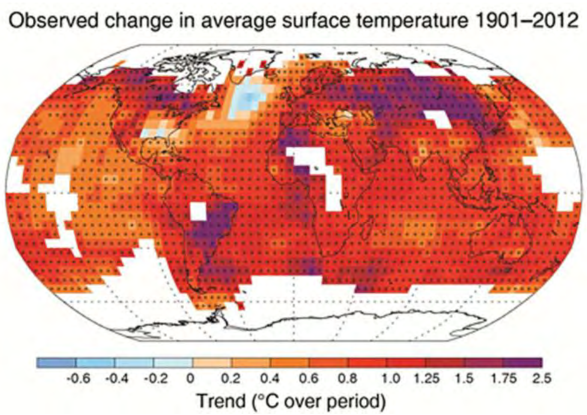
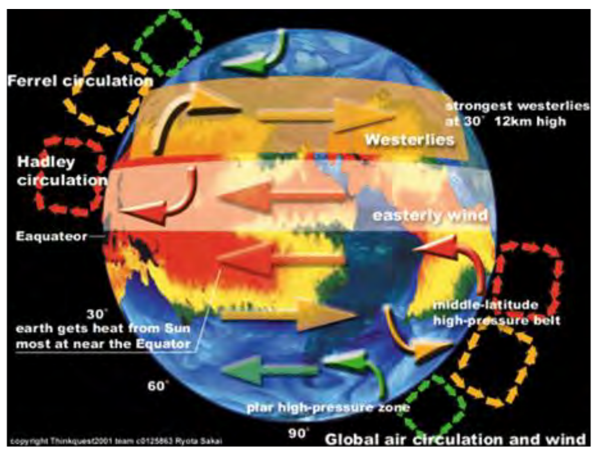
So at minimum we must increase food production by about 60% .

Impact of Climate Variability and Climate Change



Unprecedented long-term climatic changes are likely to occur from greenhouse warming that will also affect seasonal to interannual variability

Agriculture particularly rain-fed is most vulnerable from droughts, extreme events, monsoonal change, heat stress, pest and diseases



Impact of Climate on Rice Production

Rice feeds over half of the world population. About 65% of the world's rice is produced in Asia. One hectare of rice currently provides food for 27 people. By 2050 one hectare needs to support at least 43 people.

Co2 and Temperature – Higher Co2 typically increases biomass production but not necessarily yield. A one degree rise in minimum temperature typically reduces yield by 10%

Pest and Disease - Temperature increases will lead to changes in the composition and distribution of pests. A shorter winter will decrease the duration of hibernation and increase their activity.

Flooding- About 20 million hectares is at risk of being flooded, particularly in India and Bangladesh. –

Water Scarcity Water scarcity affects more than 23 million hectares of rain-fed rice production areas in South and Southeast Asia. In Africa, recurring drought affects nearly 80% of the potential 20 million hectares of rain-fed lowland rice.

Variability in the onset and duration of monsoon

Building Climate Resilient Systems

- Bringing Scientific outputs and user's needs together

To minimise the impacts of climate in the agriculture sector we need to develop strategies to cope with climate variability which are often culturally, regionally and sector specific.

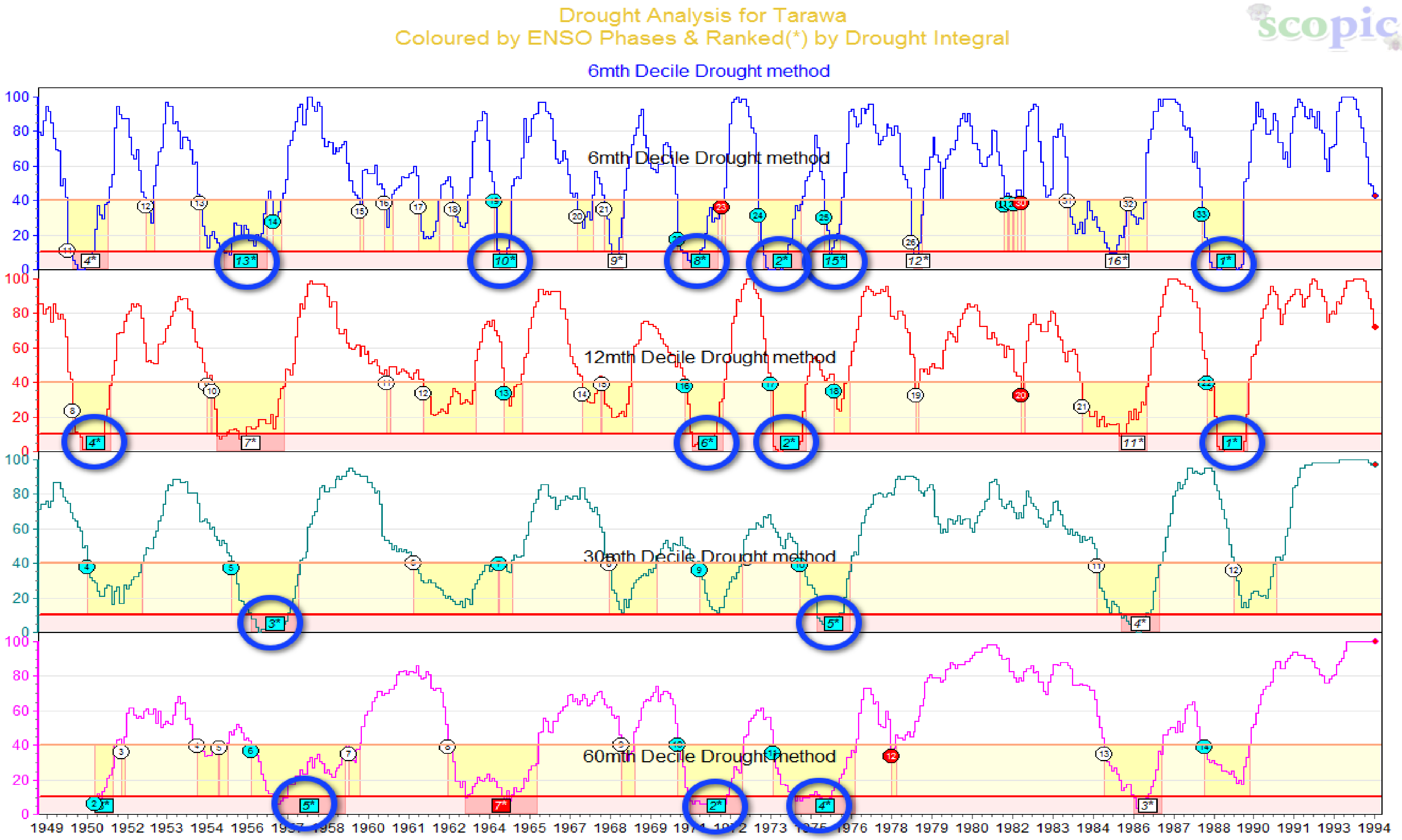
- Identify which regions and sectors would benefit from improved forecasts and from current forecast skill.
- Identify information needs of users of climate information (Surveys or structured discussions)
- Understand the system and its management: identify those decisions that could improve systems Performance; (fertilisation, irrigation, land management, pest management etc)
- Understand the impact of climate variability on different time scale: it is important to understand where in the system climate is an issue;
- Determine the opportunities for tactical and strategic decisions in response to the forecasts. Useful forecasts are those that meet recipients' need in term of timing, lead time , spatial and temporal resolutions

Building Climate Resilient Systems (…continued)

- Bringing Scientific outputs and user's needs together

- Adoption of technology is best achieved through evaluation of tactical or strategic decision options (economic, environmental), including measures of uncertainty and downside risks.
- Modelling and development of Decision Support Systems offers the best potential for evaluating the performance of a system and the utility of Seasonal Climate Forecasts.
- Examples in agriculture include, drought management, cropping decisions, planting, harvesting, pest and disease management, transportation… to name a few.

Drought Monitoring and Forecasting



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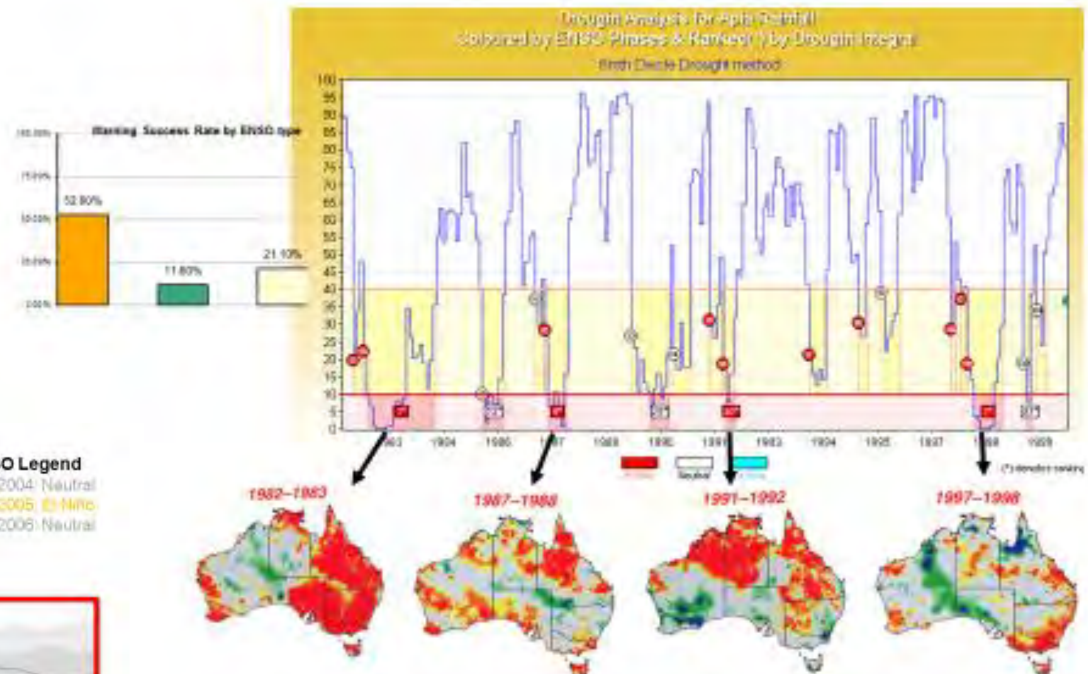
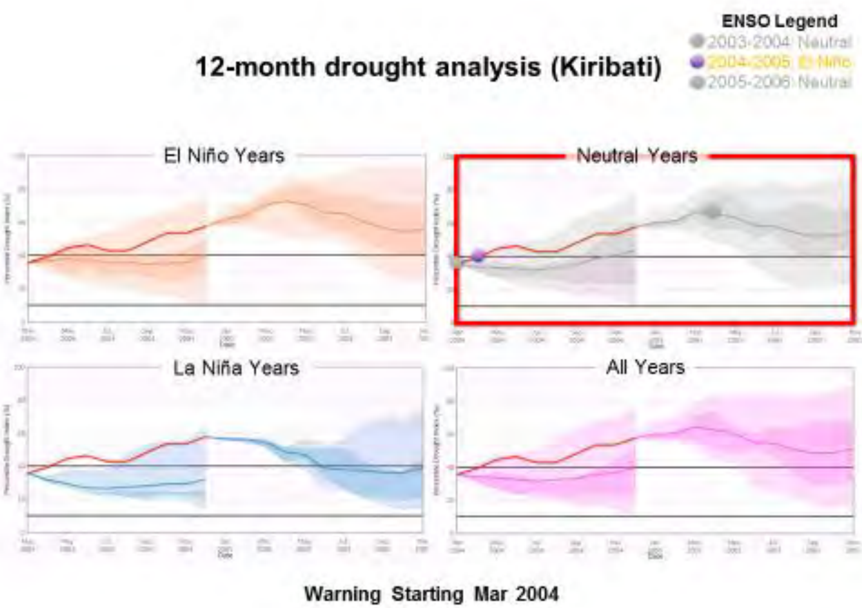
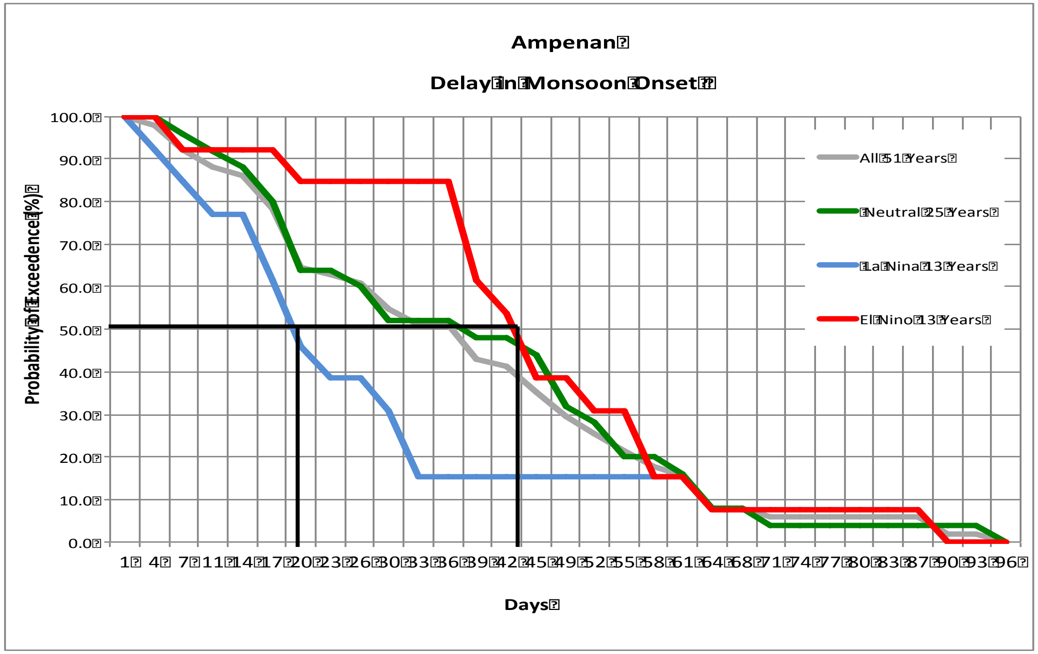




Abawi and White (2014)

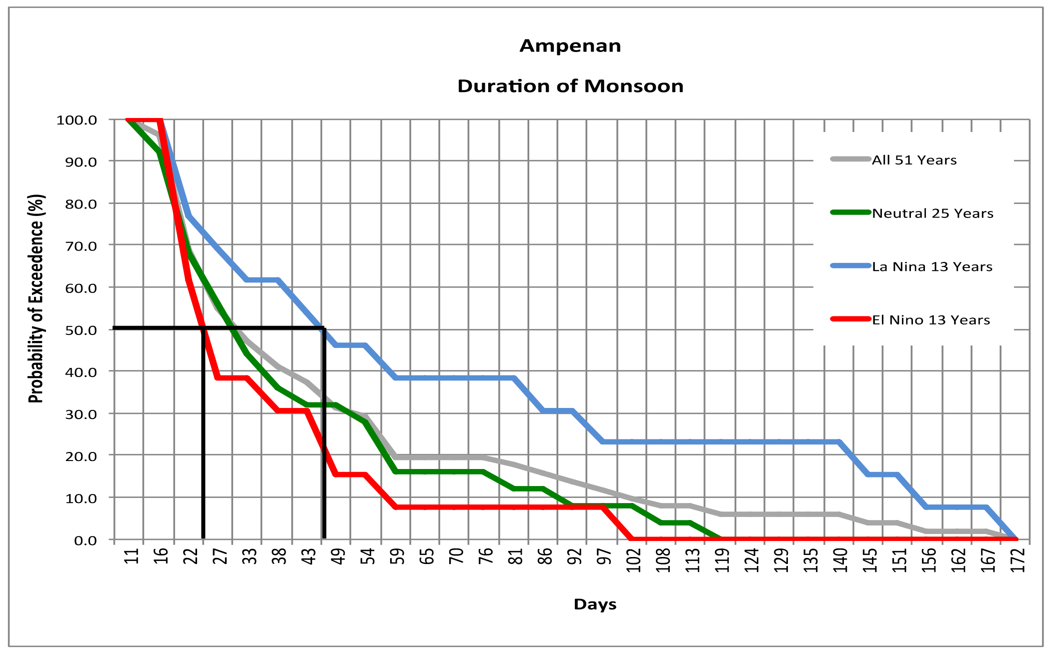
ENSO impact in SE-Asia



Later Onset of Monsoon

One month delay in monsoon onset resulted in average loss of 1 million tons of rice in central and East Java (Naylor et al. (2007

Shorter Monsoon Duration



Queensland **the Smart State**

Seasonal Climate Forecasting for Better Irrigation System Management in Lombok

Using seasonal climate forecasts (SCF) to improve the management of water resources and irrigation systems in Lombok for more secure crop production.

The specific aims of the project are to:

* develop decision support systems and tools for optimising choice of crop, crop-area and irrigation water allocation
* use simulation modelling and scenario analysis to illustrate the benefits of SCF in irrigation water allocation and cropping decisions
* promote SCF-based planning amongst irrigators, government officials and community leaders
* build local capacity in the development and operational use of decision support systems.

A joint project between...

- Queensland Government
- University of Mataram
- Badan Meteorologi & Geofisika
- Balai Pengkajian Teknologi Pertanian
- Dinas Pertanian
- Kimpraswil, NTB

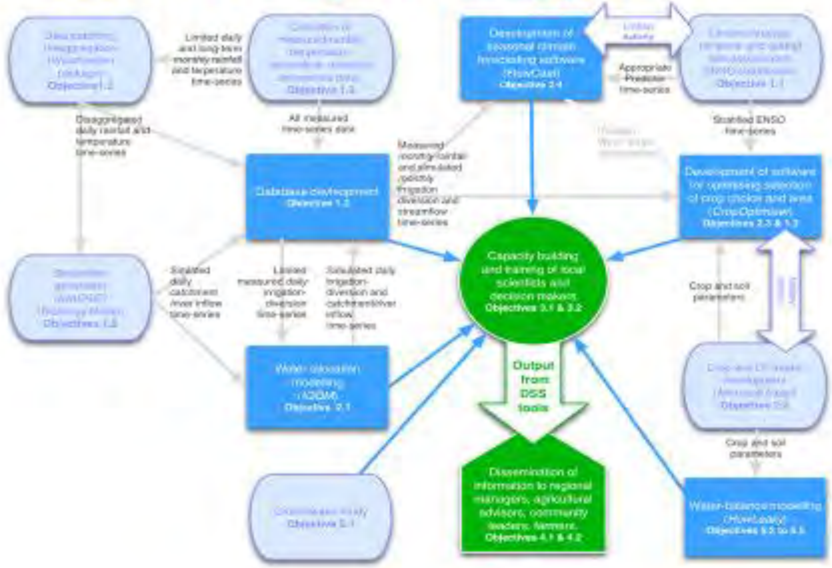
Crops such as rice, vegetables, legumes, corn, chillies and tobacco are grown in the southern regions of Lombok. However, crop productivity is often erratic due to high climate variability associated with the El Niño Southern Oscillation (ENSO) phenomenon. Tactical adjustment of crops and water allocation using ENSO-based seasonal climate forecasts (SCF) can help to improve yields in favourable seasons and reduce the risk of crop loss in dry years.

Contact:
Dr Yahya Abawi, Principal Scientist
Climate Change Centre of Excellence
Environmental Protection Agency
Telephone +61 7 4688 1123
yahya.abawi@climatechange.qld.gov.au

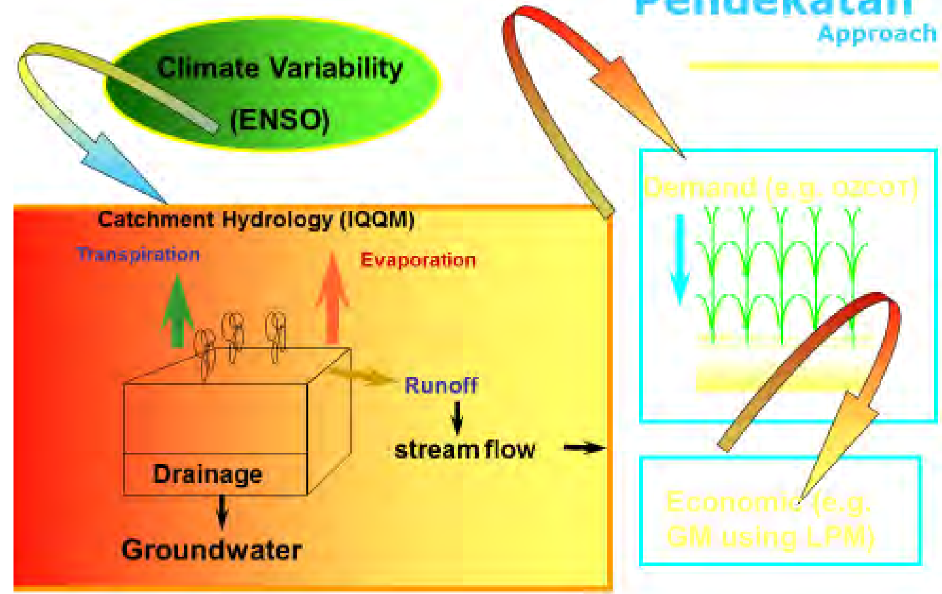
Australian Government
Australian Centre for International Agricultural Research

Queensland Government
Climate Change Centre of Excellence

Lombok "Systems Approach"



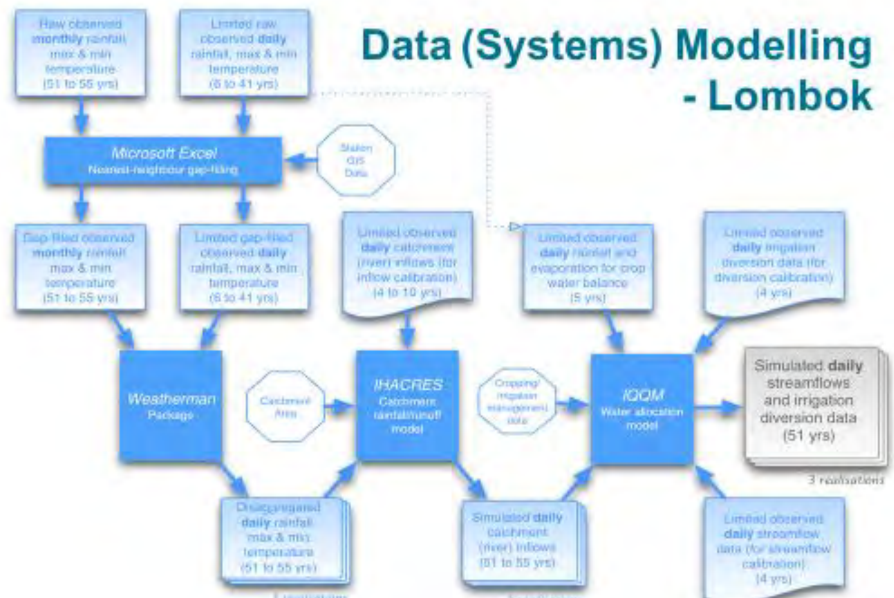
Pendekatan
Approach



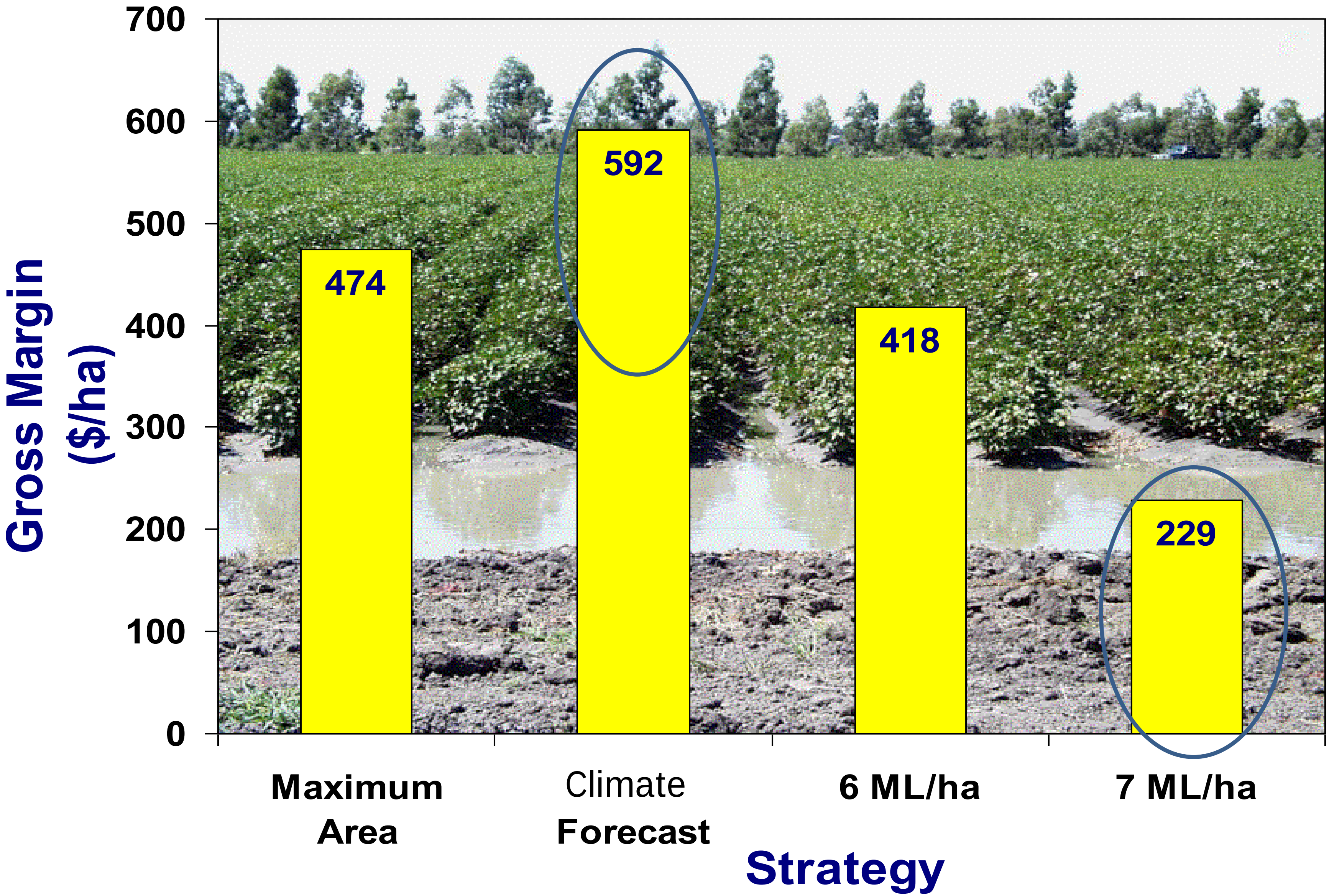
Southern Lombok Irrigation System

IQQM Node Layout with Calibration Quality Indicators and CropOptimiser SubArea/Node Associations

Data (Systems) Modelling - Lombok

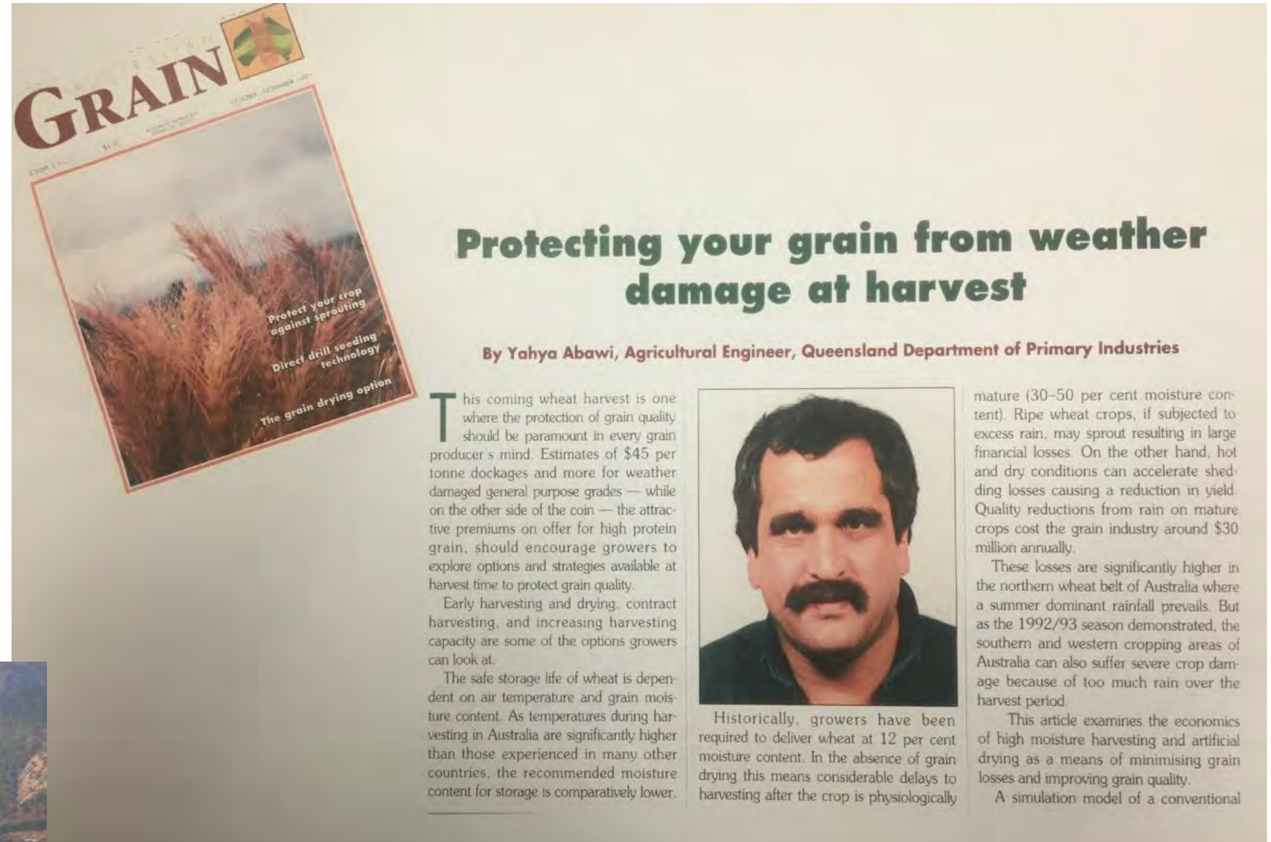


Value in demonstrating economic pay-offs in applying seasonal climate information to irrigation decisions (Abawi, 2004).



Harvest Management

Abawi GY An Operations Research Model of Wheat Harvest Management in North-Eastern Australia. Department of Civil Engineering, University of Queensland. St Lucia 1994.



Protecting your grain from weather damage at harvest

By Yahya Abawi, Agricultural Engineer, Queensland Department of Primary Industries

This coming wheat harvest is one where the protection of grain quality should be paramount in every grain producer's mind. Estimates of $45 per tonne dockages and more for weather damaged general purpose grades — while on the other side of the coin — the attractive premiums on offer for high protein grain, should encourage growers to explore options and strategies available at harvest time to protect grain quality.

Early harvesting and drying, contract harvesting, and increasing harvesting capacity are some of the options growers can look at.

The safe storage life of wheat is dependent on air temperature and grain moisture content. As temperatures during harvesting in Australia are significantly higher than those experienced in many other countries, the recommended moisture content for storage is comparatively lower.

Historically, growers have been required to deliver wheat at 12 per cent moisture content. In the absence of grain drying this means considerable delays to harvesting after the crop is physiologically mature (30–50 per cent moisture content). Ripe wheat crops, if subjected to excess rain, may sprout resulting in large financial losses. On the other hand, hot and dry conditions can accelerate shedding losses causing a reduction in yield. Quality reductions from rain on mature crops cost the grain industry around $30 million annually.

These losses are significantly higher in the northern wheat belt of Australia where a summer dominant rainfall prevails. But as the 1992/93 season demonstrated, the southern and western cropping areas of Australia can also suffer severe crop damage because of too much rain over the harvest period.

This article examines the economics of high moisture harvesting and artificial drying as a means of minimising grain losses and improving grain quality.

A simulation model of a conventional

In 2013 cyclone Phailin caused massive losses to rice crops in Paro when it hit the region in October when most farmers had harvested their crop and left it in the field to dry.

Thank You