Adaptation options for climate sensitive development

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Act fast, get it right and make it work

Food security can’t wait, neither can action on climate change
Rising average temperatures
Precipitation increases *very likely* in high latitudes.
Decreases *likely* in most subtropical land regions.
Sea-level rise
Vulnerability to sea level rise
Impacts of Salt water intrusion on Copra trees are already visible in Kiribati
Climate Change Impacts on Grain Yields

Percentage change in average crop yields. Effects of CO$_2$ are taken into account. Crops modelled are: wheat, maize and rice.

Parry et al. (2005)
Climate Change Impacts on crop, livestock and forest production: IPCC estimates

Increased (blue) or decreased (red):
- cereal crop productivity
- livestock productivity
- forestry production
Pressures on food supplies

- World population increased from 1.6 to 6 billion last century
- It is projected to rise to 9 billion by 2042
- Consumption per head will also increase (change from grain/vegetables to meat)
- Most good quality land is already in use
IMPACTS ON WATER RESOURCES

WATER QUALITY

CHANGES IN WATER SUPPLY

INCREASED COMPETITION FOR WATER
impacts

IMPACTS ON COASTAL AREAS

COSTS TO DEFEND COASTAL COMMUNITIES

EROSION OF BEACHES

INUNDATE COASTAL LANDS
The ecological stability of mangroves and coral reefs is threatened in PICs.
IMPACTS ON SPECIES AND NATURAL AREAS

LOSS OF HABITAT AND SPECIES

SHIFT IN ECOLOGICAL ZONES
<table>
<thead>
<tr>
<th>Global temperature change (relative to pre-industrial)</th>
<th>0°C</th>
<th>1°C</th>
<th>2°C</th>
<th>3°C</th>
<th>4°C</th>
<th>5°C</th>
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<td><strong>Food</strong></td>
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<td>Falling crop yields in many areas, particularly developing regions</td>
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<td>Possible rising yields in some high latitude regions</td>
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<td>Falling yields in many developed regions</td>
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<td><strong>Water</strong></td>
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<td>Small mountain glaciers disappear – water availability in many areas, including Mediterranean and Southern Africa</td>
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<td>Sea level rise threatens major cities</td>
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<td><strong>Ecosystems</strong></td>
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<td>Extensive Damage to Coral Reefs</td>
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<td>Rising number of species face extinction</td>
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<td><strong>Extreme Weather Events</strong></td>
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<td>Rising intensity of storms, forest fires, droughts, flooding and heat waves</td>
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<td><strong>Risk of Abrupt and Major Irreversible Changes</strong></td>
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<td>Increasing risk of dangerous feedbacks and abrupt, large-scale shifts in the climate system</td>
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Food security...

... exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

(World Food Summit 1996)

... is underpinned by Food Systems.
Negative impacts where food insecurity high

854 million people – one in seven of the world’s population lack access to sufficient food. In some countries, more than one third of the population suffer from hunger.

Prevalence of hunger in 2001-03

Source: FAO State of Food Insecurity 2006
Pressures on Agriculture

Socio-economic Trends
- Population Increase
- Changing Consumption Patterns
- Urbanization
- Economic Growth

Increased Demand
- Food
- Feed
- Fibre
- Energy
- Livelihood
- Ecosystem Services

Forestry  Agriculture  Fisheries

Sustainable Supply
- Soil
- Land Use
- Water
- Biodiversity

Environmental Challenges
- Climate Change
- Loss of Biodiversity
- Land Degradation
- Water Scarcity

Promoting Excellence in Agricultural Research for Development
Two Goals of Current Time

1. Achieving Food Security
   - 17.5 million by 2050
   - Food production has to increase 70% by 2050
   - Adaptation to Climate Change

2. Mitigation and Adaptation to Climate Change
   - Agriculture and Land use = 30% of emissions..
   - ..and needs to be part of the solution
A Paradigm shift is needed

Sustainably increases farm productivity and income

Strengthens resilience to climate change and variability

Reduces agriculture's contribution to climate change
- greenhouse gas emissions
- carbon storage on farmlands

Enhances the achievement of national food security and development goals

UNCCD
United Nations Framework Convention on Climate Change

World Food Summit

Rio+20 United Nations Conference on Sustainable Development

UNFCCC
United Nations Framework Convention on Climate Change

MDGs

Promoting Excellence in Agricultural Research for Development
Why Build Resilience?

- A key adaptation and mitigation strategy is to build the resilience of agroecological systems because these systems determine our capacity to produce food and clean water.

- Building ecosystem resilience will enhance the capacity of these systems to withstand shocks and rebuild after damage.
Outcomes of Improved Resilience

Examples of improved resilience outcomes in the agriculture sector include:
increased adaptation of crops and livestock to climate stress, enhanced access and utilization of technology and information, increased income generation, increased use of resource-conserving technologies, open and transparent trade regimes, and improved risk sharing.
Factors affecting crop production in changing climate

Yield

- Temperature & CO₂
- Soil Water
- Soil
- Length of growing season
- Weeds
- Pests & Diseases
Key components of new and innovative adaptation measures to climate change

- changes in **agricultural practices** to improve soil fertility and enhance carbon sequestration;
- changes in **agricultural water management** for more efficient water use;
- **agricultural diversification** toward enhanced climate resilience;
- **agricultural science and technology development**, agricultural advisory services, and information systems; and
- **risk management and crop insurance**.
How to build Resilience?

- The adoption of resource-conserving technologies—such as rainwater harvesting; conservation tillage; and integrated crop, water, and pest management—will form the backbone of actions to sustain and enhance agroecological systems.

- Promote research for development and the adoption of new drought- and heat-resistant crop varieties, strengthen water-use productivity and performance, and promote synergies between adaptation and mitigation.

- Support knowledge, coordination, collaboration, information exchange, and institutional responsiveness will be the backbone for building technical skills needed to prepare, plan, and respond to unpredictable contingencies.
Early Maturing Sweet Potato
Conservation Agriculture

- Minimum tillage
- Mulching
- Multi-cropping and rotation
- Water harvesting and optimisation
Strategy for Adaptation to CC impacts

Dissemination of CC-coping strategies

- Drought tolerant crop varieties
- Simple irrigation methods
- Seed storage
- Food drying, processing & storage
- Fire control
- Frost control
Changes in Agricultural Practices

Key changes in farm management practices include:

- Application of new technologies and changes in input use including organic and low external-input agriculture.
- Application of new land-management techniques, such as zero till.
- Changes in crop and livestock varieties.
- Changes in planting dates.
- Introduction of water-use efficiency techniques (drip, sprinkler, wet and dry).
- Effective use of pest-, disease-, and weed-management systems through application of integrated pest and pathogen management techniques and development and use of crop varieties resistant to pests and diseases.
- Crop diversification with legumes (atmospheric N; improve OM and low GHG emissions) and green manure (soil structure).
How to enhance Farmer’s ability to Resilience?

- Enhancing farmers’ ability to respond to climate variability and climate change will require significant improvements in developing and disseminating agricultural technologies targeted at the major evolving biotic and abiotic stresses generated by climate change.

- Innovative responses to climate change needed for agricultural adaptation are

- Improved crop varieties have the potential to be more drought-tolerant and enable both an increase in nutrient- and water-use efficiency as well as a decrease in pesticide use.
Agricultural Advisory Services & Information Systems

- Effective dissemination of modern technologies is essential for success in agriculture.
- Successful action in agricultural adaptation requires better and clearer information combined with investment and advisory services to disseminate the information to users.
- Improved information systems allow for more informed decisions, heightened awareness to change crops and adopt practices to enhance management sustainability.
- As a basis for adaptation planning Pacific countries alongside their international partners, will need to conduct comprehensive climate change monitoring and forecasting.
- Collection of systematic meteorological data and the development of stronger human capacity in climate change analysis and research is needed.
- Until this capacity is developed, the international research community will remain critical to these efforts.
What is needed?

Linking Existing Information Centres to Resource Centres in Remote Areas

R & D Institutions

Finance and Rural Communities

Resource Centre

Farming and Rural Communities
and... Real-time data

Benefits:
- Real-time data enables visual monitoring of weather conditions as it occurs
- Farm safety
- Tracking of lightning and storm activity increases capability to react quickly to address pertinent issues e.g. fires, power outages
Forecasts or predictions

Target – Agricultural and other economic sectors

Benefits:

- Forecasts provided ahead of time to enable careful planning of resources around severe weather events.
- Instrumentation with cameras enable visuals with key parameters to be viewed in key locations supporting quick decision making.
- This product can assist farmers to put their safety measures such as ventilation when the heat value exceed certain threshold.
Traditional Forecasting Process

- Schedule Driven
- Product Oriented
- Labor Intensive

National Centers
Model Guidance

Field Offices
Type Text Products

National Centers
Generate Graphical Products

U.S. Drought Monitor
Excessive Heat Products
Threats Assessments

Snow likely above 2500 feet. Snow accumulation by late afternoon 1 to 2 inches above 2500 feet. Colder with highs 35 to 40. Southeast wind 5 to 10 MPH shifting to the southwesterly.

EASTON
PTCLDY CLOUDY PTCLDY PTCLDY SUNNY PTCLDY
60/52 63/54 65/47 55/40 55/37 50/33
POP 20 POP 20 POP 20 POP 20 POP 10 POP 10
New Forecasting Process

- Interactive
- Collaborative
- Information Oriented

National Centers
Model Guidance

Grids

Field Offices
Data and Science Focus

Collaborate

Local Digital Forecast Database

NWS Automated Products
- Text
- Graphic
- Digital
- Voice

National Digital Forecast Database

User-Generated Products
- Voice
- Graphic

National Centers
Model Guidance

Interoperable

Collaborative

Information Oriented
TODAY...RAIN LIKELY. SNOW LIKELY ABOVE 2500 FEET. SNOW ACCUMULATION BY LATE AFTERNOON 1 TO 2 INCHES ABOVE 2500 FEET. COLDER WITH HIGHS 35 TO 40. SOUTHEAST WIND 5 TO 10 MPH SHIFTING TO THE SOUTHWEST EARLY THIS AFTERNOON. CHANCE OF PRECIPITATION 70%
National Digital Forecast Database Gives Customers What They Want

- More weather data
- Higher resolution forecasts
- Visual displays of probability
- User-defined products create business opportunities

The public, emergency managers and city planners use Internet graphic products for detailed forecasts.

Commercial weather companies & emergency managers use grids to generate tailored products.

Radio stations & public read text forecasts.

Different Products for Different Customers

TODAY...RAIN LIKELY. SNOW LIKELY ABOVE 2500 FEET. SNOW ACCUMULATION BY LATE AFTERNOON 1 TO 2 INCHES ABOVE 2500 FEET. COLDER WITH HIGHS 35 TO 40. SOUTHEAST WIND 5 TO 10 MPH SHIFTING TO THE SOUTHWEST EARLY THIS AFTERNOON. CHANCE OF PRECIPITATION 70%.
The Path to NOAA’s Seamless Suite of NWS Products and Forecast Services

IBM Supercomputer at Gaithersburg, MD Computer Center

Central Guidance → Local Offices

Observe → Process

Respond & Feedback

e.g., National Association of State Energy Officials, Emergency Managers

Distribute
While you can go almost a month without food...
your body can’t survive one week without water.
According to the U.N., a child dies from a water-related disease every 15 seconds.
1/3 of the world’s population live in basins that have to deal with water scarcity.
MOST HUNGRY AND POOR PEOPLE LIVE WHERE WATER CHALLENGES POSE A CONSTRAINT TO FOOD PRODUCTION

840 million malnourished people remaining

Will there be enough water to grow enough food, reduce poverty and support ecosystems?

No, unless ....

We change the way we think and act on water issues.
WHAT OF THE FUTURE?
Per capita meat demand (kg/cap/yr)

- USA
- China
- World
- India

Data vs projections

Meat consumption kg/cap/yr

1961 2003 2050
Food demand doubles over the next 50 years because of diet and population growth

Water Needs (ET) will double – without water productivity gains

Climate Change

Mitigation is about gases.
Adaptation is about water.
Consider a range of agricultural water management options:

- **Purely rainfed**
  - Field conservation practices
  - Water harvesting
- **Supplemental irrigation**
  - Groundwater irrigation
  - Surface water irrigation
- **Fully irrigated**
  - Drainage

Fish, Livestock, Crops, Ecosystem Services
Increase Water Productivity

• Physical Water Productivity – more crop per drop
  – To reduce future water needs
  – For food production increases

• Economic Water Productivity – more value per drop
  – For more income, growth
  – Integrated, multiple use systems
Adapt yesterday’s irrigation to tomorrow’s needs

1. To reduce rural poverty
2. To improve performance of systems
3. To keep up with changing food demand
4. To adapt to changes – water scarcity, competition, climate change, energy
5. To increase multiple benefits and ecosystem services, while reducing negative impacts
Get water to poor people, use it better

Around 70% of the world’s under-nourished live in rural areas where non-agricultural livelihood options are limited.

Improve and Safeguard Water Access

Access to Technologies
Manage Externalities

Deal with negative impacts of water development

- Ecosystem degradation
- Negative health impacts
- Inequitable benefits
- Loss of biodiversity
Address Drivers of Change

Our policies and actions on:
- Agriculture
- Trade
- Response to climate change
- Diets
- Energy/biofuels

have a profound impact on water resources.

Photos from Diet for a Small Planet
Key messages 1: Practices

- Climate-smart practices exist
- Ecosystem approach at landscape level is crucial
- Investments are needed in
  - filling data and knowledge gaps
  - R&D of technologies, methodologies
  - conservation and production of varieties and breeds
Key messages 2: Policies

- Smallholders need institutional and financial support for the transition
- Strengthened institutions for dissemination and coordination
- Consistency between agriculture, food security and climate change policies
Key messages 3: Finance

- Available financing, current and projected, are substantially insufficient.
- Combining finance (public/private, climate change/food security) improves options.
- Fast-track financing must take sector-specific considerations into account.
Two Goals

1. Achieving Food Security

2. Avoiding Dangerous impacts of Climate Change

We must reach both.
EM TASOL