Approaches to Assessment of Impacts and Vulnerability to Climate Change and Adaptation Options

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Outline

I. Two types of assessments to support climate change adaptation

II. Climate impact and vulnerability assessment – two vulnerability frameworks

III. Categorizing methodologies and methods under two vulnerability frameworks

IV. Overview: Designing climate impact and vulnerability assessment

V. Overview: Climate change adaptation options assessment

Examples
Two types of assessments to support climate change adaptation

1) Climate impact and vulnerability assessment – assessment of key changes in climate, climate change impact on different sectors, and vulnerability of livelihoods for strategic planning

[not to be confused with assessment of impact of adaptation interventions in project evaluation]

2) Climate change adaptation options assessment – assessment of different options’ effectiveness to achieve adaptation to identify best options
1) Examples of outputs from climate impact and vulnerability assessment

Examples of outputs from climate impact assessments of changing climate, climate impacts on agriculture and vulnerability

- Rainfall pattern, amount and area;
- Seasonality of climate (e.g. timing of monsoon, rainy and dry seasons);
- Water availability for rainfed and irrigated agriculture;
- Temperature (e.g. daytime maximum, night time minimum);
- Evapotranspiration;
- Frequency and intensity of extreme temperature events (cold spells, heat waves);
- Frequency, intensity, and duration of droughts and floods;
- Soil erosion and soil nutrient cycle;
- Snow cover;
- Pests and diseases impacted by climate;
- Changes in crop yields due to changes in climate (e.g. higher temperatures and reduced rainfall);
- Changes in market price of major commodities due to climatic factors, including climate-related disasters, such as droughts, floods and storms;
2) Examples of assessed benefits of climate change adaptation options

Examples of assessed benefits of CSA practices in contributing to climate change adaptation and mitigation, and food security

- Reduced soil erosion and improved nitrogen efficiency from minimum tillage, cover crops and improved rotations;
- Improved water availability from soil and water conservation activities;
- Improved crop yield with new varieties, a change in farm management (e.g. planting date change, fertilizer, irrigation water use) or short-term weather and climate forecasts;
- Improved livestock productivity through enhanced breeding and feeding practices;
- Balance among improved productivity, market prices, and farm income through fertilizer subsidy programmes;
- Improved economic resilience from income diversification; and
- Reduced GHG emissions or increased soil carbon sequestration through better management practices.
1) Climate impact and vulnerability assessment – two vulnerability frameworks

**Outcome vulnerability**
- Traditional concept in climate change work
- Top-down approach

**Context vulnerability**
- Emerging concept in climate change work
- Bottom-up approach
- Vulnerability of social-ecological systems is determined by multiple factors and processes
- Climate change is treated as one of the threats
Outcome vulnerability

- Climate change
- Exposure unit
- Potential impact

Source: adapted from O’Brien et al., 2007
Categorizing methodologies and methods under two vulnerability frameworks

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Source: Pearson and Langridge, 2008
Designing climate impact and vulnerability assessments

- Literature review
- Identification of stakeholders
- Assessment of information needs of stakeholders
- Evaluation of role and capacity of stakeholders
- Design of assessments, including agreement of adaptation objectives by stakeholders
What is your “adaptation” goal?

- There are different views on how to define “adaptation” to climate change (e.g. DRR and CCA links)
- What constitutes “successful adaptation” to climate change? (e.g. being to articulate contributions to resilience)
- Need to define adaptation goals with the wide participation of different stakeholders
Questions to ask when designing assessments

- What is the target sector?
- What is the temporal scale? The next few years to a hundred years?
- What is the spatial extent? National, subnational, local community or household?
- What is the spatial resolution? Meters, km, hundreds of km, individuals, households, community, farm or watershed?
- Simple or complex/more advanced tools?
“Categorization is not so clear-cut in reality”

Example 1:

FAO’s AMICAF Framework
AMICAF Framework: Addressing the Linkage Between Climate Change and Food Security

1. Impacts of Climate Change on Agriculture (Step 1)
2. Food Insecurity Vulnerability Analysis at household level (Step 2)
3. Livelihood Adaptation to Climate Change (Step 3)
4. Institutional Analysis and Awareness Raising (Step 4)

Global Guideline for Implementation in other countries (Global delivery)
Step 1 Impacts of climate change on agriculture

- MOSAICC – Modeling System for Agricultural Impacts of Climate Change
- Multiple impact models (Climate downscaling, Crops, Hydrology, Economy) in one package
- Software plus training
- Newly developed Partial Equilibrium Agricultural Market Model, named PAM (Provincial Agricultural Model), is used in addition to MOSAICC’s climate downscaling, crop and hydrology modules.
Step 1: Impacts of climate change on agriculture

MOSAICC has 4 components and uses several tools:

1. CLIMATE - facilitates the preparation of statistically downscaled climate data using an adaptation of a portal developed with the EU ENSEMBLES project.

2. HYDROLOGY - estimates water resources under future climate conditions and uses STREAM, a grid-based precipitation run-off model, to simulate the discharge rate in large catchment areas.
Step 1: Impacts of climate change on agriculture

3. CROPS - simulates crop yields under future climate change and technological progress scenarios. It uses WABAL (crop specific water balance model), the industrial version of FAO’s AgroMetShell.

4. ECONOMY - makes use of a Provincial Agricultural Market (PAM) Model to evaluate the economic impacts of future crop yields and water resources projections.
CCI - User Functions

The FAO-MOSAICC User Interface is designed around a few concepts:
A. Data Type
B. Module
C. User Function

Several Data Types are defined, but basically we can trace them back to some general types:

- Grid / Raster data
- Polygon-related Data
- Point-related Data

Those general data types define the different methods the modules work with them and then the concept of "Work Mode" has been define.

One of the aims of FAO-MOSAICC is to create a proper user interface for each module, trying to generalize them in order to limit the number of interfaces to develop and maintain. The modules can easily be classified and the concept of "Module Type" has been define. Some functions can be used in different modes, such as "Calibration" and "Simulation": the concept of "Function Mode" has been defined to handle those modes.

The concept of "User Function" combines the different ideas reported above and extends them to some functionalities of the system that don't require to run an external module. More precisely, the User Function provides a general method to provide the parameters to a module and allows to specify the following information:

- the work mode, i.e. main type of data the module will work on
- the function mode, i.e. the way a module works with the data
- the module parameters, that depend on the work and the function modes
MOSAICC with Agricultural Market Model

- IPCC GCM
  - Low resolution projections
- Historical weather records
- Historical yield records
- Crop parameters
- Soil data
- Technology trend scenarios
- Climate projections downscaling
- Downscaled Climate projections
- Crop growth Simulation
- Yield projections
- Provincial Agricultural Model (PAM)
- Step2 (Food Insecurity Vulnerability Analysis)
- Hydrological Model
- Water availability for irrigation
- Historical water use statistics
- Historical discharge records
- Soil and Land use data
- Dam data
Step 1 Impacts of climate change on agriculture

Downscaling products

Downscaling of reanalysis for 1979-2010. Reproduces daily historical weather variation at the local level. For use in the calibration of crop/hydrology models.

Downscaling of (free-running) GCM for the twentieth century (20C3M) for 1971-2000. For use with the calibrated model to establish current baseline.

Downscaling of GCM for future periods 2011-2050 (up to end of 21st century possible). For use by the calibrated model as input to make projections.
Sample of Rainfall Projection Results for 3 models for January-June (2011-2040) under A1B Scenario

BCM2 model

CNCM3 model

ECHMA5 model
Step 2 Food Insecurity
Vulnerability Analysis

Vulnerability as a function of household characteristics, exposure to climate change risks and extreme weather shocks

Vulnerability: the probability a household to become food insecure in the near future (a household’s probability to fall or stay below a food-security threshold)

Inputs:
- Household survey data
- Climate/Weather data at community-district-regional level
Step 2 Food Insecurity Vulnerability Analysis

Model:

Direct impact of climate shocks to farm productivity (and caloric intake?) and then to food insecurity

Outputs:

- Channels of transmission of shocks to food insecurity are identified
- Profile of vulnerable population groups (e.g. chronically vs. temporarily food insecure)
- Exploring the relative efficiency of different policy tools in reducing vulnerability
Climate change: enters the model through the impacts that temperature and precipitation changes (from Step 1) have on income (value of land productivity) and food consumption (expenditure); and caloric intake
Current work on Vulnerability Analysis to food insecurity

- Data gathering (from NSO, CBMS, FNRI) for the FAO econometrics model using national household datasets (using **income expenditures** from FIES-NSO, **calorie intake** from FNRI) for national analysis

- Variety of socio-economic data at smaller administrative units (5 provinces using CBMS dataset) and with Step 3 pilot provinces (Cam Sur and Surigao Norte) for community-level (municipal/barangay) VA using CBMS dataset
Step 3 Livelihood Adaptation to Climate Change

- Community–based adaptation using current vulnerabilities (and later making best use of information from Steps 1 and 2)

- Identification, validation, field-testing, and evaluation of good adaptation practices at the local context through participatory processes and capacity development under the framework of Farmer Field Schools

- In the Philippines, field-testing sites are Camarines Sur, Luzon Island and Surigao del Norte, Mindanao Island with drought, flooding and saline intrusion used as the backdrop for testing -- Siargao Island upcoming
Example 2: Enhanced CCA Capacity of Communities in Contiguous Fragile Ecosystems
The project aimed to:

(1) develop inter-sectoral, rights-based, and gender-friendly adaptation approaches, including “no regret” options, in contiguous mountain/forest-lowland agriculture ecosystems and

(2) test innovative adaptation measures/technologies for agriculture, water/watershed management including biodiversity conservation.
The demonstration sites were located in the low, middle, and high elevation areas of Benguet and Ifugao representing agriculture and forest ecosystems.

Benguet is a representative site for vegetable-based agriculture.

Ifugao is a representative for rice-based agriculture.

Benguet is a representative site for vegetable-based agriculture. Ifugao is a representative for rice-based agriculture.
Example 3:

FAO’s Regional Rice model under Climate Change
FAO’s Regional Rice model Under Climate Change

Future climate change Impacts (BCM2, CNCM3 and ECHAM5; A1B and A2 scenario)

AMICAF (Existing)
MOSAICC (Existing)
Regional Rice Markets (Newly develop)
Downscaled Climate Projection Model
Crop Yield Projection model
Hydrological Model
Provincial Agricultural Market Model (PAM)
Provincial agricultural markets (79 provinces and 2 Cities)

World Agricultural commodities (except for rice), Livestock market projection (From AGLINK-COSIMO) (Existing)

Climate change impacts on rice yield in Thailand (RAP/ UC Berkley)
Rice yield projection (sub-national level)

The Phillipines Market (Sub-national level)
Thailand (Sub-national level)
International Rice Price (Market Equilibrium Price)
Other Asean countries (Lao PDR, Indonesia, Malaysia, Vietnam, Cambodia and Myanmar) (National level)
China, Japan, Korea, USA, EU27, India and other world (National level)
2) Climate change adaptation options assessment

- Builds on climate impact and vulnerability assessment
- Assessment examines the extent to which different adaptation measures may achieve the adaptation objective
- The result of assessment helps practitioners identify effective adaptation options
Example 1:

Two approaches for climate change adaptation options field-testing and assessments

i) Participatory Action Research

ii) Climate-Smart Farmer Field Schools

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AMICAF Framework: Addressing the Linkage Between Climate Change and Food Security

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- Global Guideline for Implementation in other countries (Global delivery)
Participatory Action Research

Local working groups
- Technical training and advice
- Monitoring and evaluation
- Lesson learning
- Knowledge Management

Enhanced Climate Change Adaptation Capacity of Communities in Contiguous Fragile Ecosystems in the Cordilleras
Considerations for launching community-based adaptation and disaster reduction processes

1. Develop viable adaptation options
2. Collate local, introduced and improved adaptation options
3. Synthesize into potentially suitable adaptation options for location specific conditions
4. Scientific validation of adaptation options
5. Local prioritization/selection of adaptation options for field testing
6. Field-testing; Monitoring and evaluation;

Vulnerability Assessment
- with consideration to both climate-related risks and hazards

Seasonal Assessment

Stakeholder involvement at every step/stage

Local working groups
ii) **Climate-Smart Farmer Field Schools**
Climate-Smart FFS Integration Framework

**Climate Field School**  
(Dumangas/Irosin Model by RWAN and PAGASA)

- Climate, Pest and Crop Growth and Development
- Cropping Systems and Climate – Related Risks
- Observation of Weather and Climate Parameters
- Weather and Climate Information Products and Sources (Temperature, Rainfall, Evaporation Rate, Humidity)
- Forecast Generation, Climate Forecast Interpretation, Translation and Communication
- Incorporating Climate Forecast in Decision Making

**Farmer Field School**  
(PalayCheck by PhilRice and ATI)

- Use high quality seeds of a recommended variety.
- No high and low soil spots after final leveling.
- Practiced synchronous planting after a fallow period.
- Sufficient nutrients from tillering to early panicle initiation and flowering stages.
- Avoided excessive water or drought stress that could affect the growth and yield of the crop.
- No significant yield loss due to pests.
- Cut and threshed the crop at the right time.

- Topics and information on Climate/Weather outlooks, forecast, farm advisory, parameters etc... are discussed every meeting in addition to key check systems;
- Documented good practice options/adaptation strategies are introduced to participants for adoption/ testing;
- Focused on increasing farm productivity, reducing losses from climate related risks/hazards and minimizing food insecurity.
Activities and materials developed under the Climate-Smart FFS

- A Facilitator’s Guide for AEWs in the conduct of CS-FFS is being finalized
- A set of flipcharts on climate information, CCA/DRR and examples of good practice options is developed for AEWs doing CSFFS
- Seasonal Climate Outlook and Advisory Bulletin is prepared at start of season
- Conduct of CCA options field-testing
Example 2:

FAO’s AMICAF and RRI Policy Simulations under Climate Change
Step1; Regional econometric simulation of Rice under climate change in the Asian region

Step2; Conduct policy simulation to alleviate climate risks of rice production systems and rice markets

Final Goal; Policy Recommendation to alleviate risks of rice production systems and rice markets (include price volatility)

FAO NRC, FAO Philippines and partners

FAO RAP and NRC
Building RRMCC

Detect Policy variables (Regional level)

Policy Simulation (Regional level)

Technical Report

Detect Policy variables (The Philippines, National level)

Policy Simulation (The Philippines, National level)

Technical Report (Mid-term and Final)

Policy Recommendation to alleviate risks of rice production systems and rice markets

AMICAF (Step4)
Thank you for your attention

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