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How do we actually change the business as usual management of agricultural systems?

A methodology for building Climate-Smart Agriculture

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Abstract

Climate change fundamentally alters how we should manage agricultural systems for food security as clearly shown in the recently released IPCC Working Group II report on Food Security and Food Production Systems. Climate change is already threatening food systems and agricultural based livelihoods through a range of impact pathways, and these are likely to increase in the absence of adaptation. Agricultural growth is essential for increasing the availability and access to food, but historically such growth has resulted in significant increases in GHG emissions. The Climate-Smart Agriculture (CSA) approach was developed in 2010 in recognition of the need to address food security, agricultural development and climate change holistically. CSA was defined as an approach to developing the technical, policy and investment conditions to achieve sustainable agricultural development for food security under climate change. This approach is now being piloted in three countries based on a process developed for a country-driven CSA methodology. This involves the development of an evidence base, dialogue and policy harmonization, investment analyses and links to climate finance. This brief lays out the methodology and the variation in its implementation across varying circumstances in the three countries. Strengths and weaknesses of the methodology are presented, as well as indicators of early outcomes. The paper provides insights into what will actually be needed to support broader implementation of the CSA approach.

Keywords: Agriculture, climate change, food security, adaptation, mitigation

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1. Introduction

Recent estimates show that the world population will grow from the current 7.2 billion to 9.6 billion by 2050 with most of the increase occurring in South Asia and sub-Saharan Africa (UNDESA 2013). Given this projection and accounting for the changes in the composition and level of food consumption associated with growing household incomes, the Food and Agriculture Organization (FAO) of the United Nations estimates that feeding the world population will require a 60 percent increase in total agricultural production (Alexandratos and Bruinsma 2012).

Achieving food security, given these estimates and the fact that many of the resources needed for food security are already stretched, is hugely challenging. Climate change adds further challenges to this already worrisome scenario by reducing and/or threatening the productivity of the majority of existing food systems and harms the livelihoods of those already vulnerable to food insecurity (HLPE 2012). Reducing the direct and indirect GHG emissions from agriculture is also an essential part of the larger effort to slow the pace of climate change. To address these challenges, policies and programs designed to respond to climate change should be complementary to, not independent of, those needed for sustainable food security (HLPE 2012).

This brief will first introduce the components of Climate-Smart Agriculture (CSA) and then describe the approach for its implementation at the country level as developed and implemented by the Economics and Policy Innovations for Climate-Smart Agriculture (EPIC) Programme of work at the FAO.

2. What is Climate-Smart Agriculture?

Climate-Smart Agriculture is an approach to guide actions to transform and re-orient agricultural systems to effectively and sustainably support food security. “Agriculture” is taken to include crop and livestock production, as well as fisheries and forest management. CSA incorporates actions at various scales within the full range of farm plots, farming systems, landscapes, national and global.

The approach aims, within the context of national food security and development goals, to tackle three main objectives (FAO 2013):

- I. Sustainably improving food security by increasing agricultural productivity and incomes;
- II. Building resilience and adapting to climate change;
- III. Developing opportunities to reduce greenhouse gas emissions compared to expected trends, where possible.

The concept was first launched by FAO in 2010 in a background paper prepared for the Hague Conference on Agriculture, Food Security and Climate Change (FAO 2010). Since then, the approach has continued to evolve, including the conceptual framework, technical methods, policy approaches and examples of CSA applications (see FAO 2013).

3. What does the CSA approach involve?

The CSA approach is a relatively new concept which is gaining increasing attention while being under continuous development. The FAO, through the EPIC programme, has been working with three partner countries (Malawi, Vietnam and Zambia) on a project entitled “CSA: Capturing the Synergies between Mitigation, Adaptation and Food Security” funded by the European Commission since 2012. The project represents the first applied attempt at developing a CSA methodology and testing its application. The experience accumulated through the project shows that appropriate implementation of CSA actually depends on specific conditions, including:

- the role of agriculture in the national economy and its importance for poverty reduction as well as food supply,
- the nature, intensity and type of current and projected climate change impacts,
- the effectiveness of institutions, policy, and stakeholders at national and sub-national levels, and
- the specific production and marketing systems in place in a country.

The main thrust of CSA is enabling agriculture to support food security under climate change. In countries where agriculture is a dominant economic sector the main aim of CSA is to increase the productivity and incomes of the smallholder agricultural sector as a key strategy for reducing food insecurity and poverty. Adaptation is incorporated within the strategy of increasing productivity and incomes on the basis of site-specific climate change effects. Finally, identification and measurement of potential mitigation co-benefits may provide the opportunity to blend climate financing for adaptation and mitigation with existing financing to the sector for food security.

The CSA approach as applied at country level by FAO-EPIC consists of three main areas of activities: 1) building an evidence base; 2) building enabling technical, institutional and

policy frameworks; and 3) enhancing financing options. The specific activities in each of these categories are discussed below. One important premise, however, before moving into each for the three components is the important linkage and feedback loop that the FAO-EPIC has created between research and policy. The results of deep and well thought of analyses are often not used in making policy decisions, and in fact in many cases the relevant policy makers do not have access to those results. Likewise, many projects are developed and implemented without input from relevant policy-makers in properly formulating and posing research questions. FAO-EPIC approach addresses this shortcoming through facilitated dialogue between researchers and policy-makers as well as across various disciplines at both policy and research levels, e.g. environment and agriculture/food security, economics and ecology.

3.1 Building an evidence base

Given the importance of growth in the agricultural sector for food security and the major impacts climate change is already having on the effectiveness of agricultural growth strategies, the first step of the CSA approach is to develop an evidence base. The purpose of this step is to identify strategies for increasing productivity and agricultural incomes, as well as obtaining estimates of their potential mitigation co-benefits. The CSA evidence base takes the site-specific impacts of climate change at local levels into account. Essentially this involves developing a set of options to consider, as well as providing information on current and near term climate change impacts and the potential for best performing options combined with mitigation co-benefits.

a) Identifying potential options for increasing agricultural productivity and incomes. The development of the set of options to consider should be conducted through a participatory and country driven process, combining qualitative and quantitative approaches. A first step is country consultations involving key stakeholders to assess how robust existing agricultural development priorities and options for implementation are, given the impacts of climate change.

In the implementation of the FAO-EPIC project, a series of meetings with policy makers at the Ministries of Agriculture and of Environment as well as leading agricultural research institutions and universities were held to discuss the current agricultural policy priorities in the country and to identify a set of options for detailed analysis. Examples from the three countries included: sustainable land management, crop diversification, livestock production, and development of high value chains for coffee and tea. This list can also be expanded upon using information and inputs based on local and indigenous knowledge as well as science-based innovations in the country and externally.

In the case of the FAO-EPIC project, most of the practices identified are based on specific country agricultural development plans for food security. Stocktaking analysis of adopted and experimental options in the field were conducted through desk reviews, data and information collection by local consultants in collaboration with EPIC team to finalize the short list of selected options. Participatory workshops were organized to shortlist the potential CSA activities with specific attention to expected food security,

adaptation and mitigation outcomes. This forms the basis of further investigation on the three pillars of CSA to assist policy prioritization.

b) Identify historical & recent changes in relevant climate/weather variables at sub-national level as a first step in identifying the site-specific impacts of climate change on agriculture. There is an emerging economic literature on weather variables/shocks and their implications for a wide set of economic outcomes ranging from economic growth, to migration and agriculture (Dell et al. 2014). The earlier research on the topic mostly relied on cross sectional variation in outcomes and weather realizations (Gallup et al. 1999; Sachs 2001; Dell et al. 2009; Nordhaus 2006). Most of these studies show a negative relationship between hot climates and income per capita. Panel studies use the exogenous variation over time in weather variables to establish causal linkages between these variables and economic outcomes. These studies are becoming more common with the improving availability of time series data with high resolution. These studies establish a similarly negative relationship between economic growth/income and temperature in general, and rainfall in Sub Saharan Africa (Dell et al. 2012; Hsiang 2010; Barrios et al. 2010; Miguel et al. 2004; Bruckner and Ciccone 2011). In countries where agriculture dominates the economy, the main links between weather and incomes go through agriculture. Moreover, if a region is largely based on rainfed subsistence agriculture, this link also has food security implications.

Recognizing the importance of these linkages and in order to exploit recent improvements in data availability, a novel set of variables to characterize local level weather variations and shocks in partner countries was created. Rainfall data from the Africa Rainfall Climatology version 2 (ARC2) of the National Oceanic and Atmospheric Administration's Climate Prediction Center (NOAA-CPC) since 1983-2012 are used to create rainfall related variables.² Temperature data since 1989 are obtained from the European Centre for Medium-Range Weather Forecasts (ECMWF).³

Close collaboration with local agricultural research institutions is required to identify the relevant variables to be created and analyzed, as they depend on the structure of agricultural production systems in each country. For example, while the onset date of the main rainy season (and farmers' access to this information) is a very important determinant of productivity and farmer decisions in Zambia and Malawi, the incidence of extreme rainfall events is more important in the case of the northern mountainous region in Vietnam. Both between- and within-year variability in these variables should

² ARC2 data are based on the latest estimation techniques on a daily basis and have a spatial resolution of 0.1 degrees (~10km). See http://www.cpc.ncep.noaa.gov/products/fews/AFR_CLIM/AMS_ARC2a.pdf for more information on ARC2 algorithms.

³ ECMWF data are surface temperature measurements at 10 day intervals (i.e. dekad). See <http://www.ecmwf.int/en/forecasts/datasets/era-interim-dataset-january-1979-present> for more information.

be analyzed at relevant levels (agro-ecological zone, district, village or commune) to make the connection to adaptation and food security.

c) Analyze the potential returns (in terms of productivity, food security or other resilience indicators) of different options under a range of climate conditions.

This analysis can be done through the use of simulation models or analysis of existing household data, where available. EPIC uses both of these approaches in partner countries. Where possible, nationally representative panel data from various sources are used to create a set of variables to analyze both the determinants of adoption and productivity/food security and other resilience impacts of potential CSA activities. In Malawi, the World Bank's Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA)⁴ are used, whereas in Zambia Rural Agricultural Livelihoods Surveys (RALS) from the Indaba Agricultural Policy Research Institute in collaboration with the Central Statistical Office are used to do the analyses. These data are then merged with the climate variables mentioned above to account for specific climatic/weather conditions at each level (village, commune or agro-ecological zone).

In the case of Vietnam, large-scale agricultural household data were not available, hence data collection was undertaken, which is a challenge (both time- and budget-wise) to the process of building an evidence base for CSA. In many applications detailed household data will not be available for this type of analysis, therefore it is important to build capacity for continuously generating the necessary data as well as undertaking the actual analysis to support the CSA approach.

The outcome variables of interest include productivity, the probability of yields falling below a minimum threshold level, total income, food security and vulnerability indicators. Productivity and its stability can be viewed as proxies for access, availability and stability dimensions of food security in smallholder subsistence agriculture.⁵ In other settings, analyses of market access and value chains are also required to link production to food security.

d) Assign a mitigation coefficient to different practices. Different agricultural activities can be associated to clearly varying impacts in terms of average GHG emissions or potentials for mitigation. The analysis under the EPIC programme identified baseline GHG emission levels under conventional cropping systems as well as average mitigation potentials for a set of targeted agricultural practices using mainly Tier 2

⁴ See World Bank LSMS-ISA web site for detailed information: <http://web.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTLSMS/EXTSURAGR/0,,menuPK:7420268~pagePK:64168427~piPK:64168435~theSitePK:7420261,00.html>

⁵ See <http://www.fao.org/docrep/013/al936e/al936e00.pdf> for dimensions of food security.

coefficients⁶. For this purpose mitigation coefficients were developed that are specific to sub-national agro-ecological conditions. Specifically systems of agricultural land management (e.g. tillage methods, cover crops, legume rotations, crop residue management), the role of agroforestry and livestock management were analyzed. The results of these analyses show a relative ranking of various cropland mitigation options, that can then be used in assessing the importance (or lack thereof) of mitigation potentials from these interventions to guide policy and financing decisions.

- e) **Assess the near term projections of climate change.** This could be done through the use of down-scaled global climate models (GCM) to assess near term climate change predictions at each locality. GCM can be combined with crop models to assess the projected impacts on crop production. The point of this exercise is to check whether recent past information that is used in the statistical analyses explained above is actually a good guide to what we can expect in the near future in terms of climate and crop production patterns. EPIC uses the projections from existing GCMs at local scale to assess the potential impacts of climate change on local climate indicators that are important for crop production, productivity and its stability over time.
- f) **Score CSA options** by agro-ecological zone and production system using cost-benefit analyses of various options that have demonstrated adaptation and food security benefits, as well as associated mitigation potential. The CSA options with this complete set of information can then be used to identify interventions taking into account the local needs for/urgency of food security and adaptation. EPIC has conducted medium-scale survey data collection in each partner country to obtain detailed information on the costs and benefits of the CSA options on the ground (to complement the existing data sources). This information, combined with the evidence base detailed above provides a tool to prioritize and target agricultural policies.

3.2 Building enabling institutional and policy frameworks

The existence of a robust evidence base is necessary but not sufficient for effective agricultural and food security policy implementation. Enabling institutions (e.g. financial institutions, land tenure, customary law, community-based organizations, insurance, information provision) and policy frameworks (i.e. national agricultural development plans, provisional and local extensions to national plans) are essential in making use of the evidence base created as part of the CSA approach. The following are the steps for building such an enabling environment.

⁶ Tier 1 level of precision refers to equations and default parameter values provided by mostly global or regional databases, as most notably from the guidelines for National Greenhouse Gas Inventories (IPCC 2006). Tier 2 and 3 are each providing higher location and practice specificity, while likewise being more demanding in terms of complexity and data requirements. See IPCC (2006), V4, Ch.1.9 for definitions.

- a) **Assess major barriers to adoption of priority CSA options.** Develop a database on local institutions and their impact on agricultural production choices. This may be done through qualitative as well as quantitative methods – e.g. through local level dialogue/workshops or analysis of adoption patterns. The role of risk management is key to consider here, since it has major impacts on adoption and climate change is increasing its importance. EPIC uses the nationally representative household data sets mentioned above to analyze barriers and drivers of adoption, and collects its own data on the relevant local institutions that play a crucial role in production decisions. The results of these analyses are then discussed with stakeholders in the countries – with farmers as well as policy-makers.
- b) **Estimate the potential role and magnitude of local institutions for overcoming barriers** to adoption identified above. This may require simulation models as well as dialogue at local and national level with civil society partners, private sector and government.
- c) **Analyze the value chain of CSA's outputs** to ensure increased yield translates into increased income for farmers (i.e. reduce transaction costs, increase gross-margins). The result of this analysis would be part of the removal of barriers and strengthening of institutional frameworks.
- d) **Engage in dialogue with local communities**, presenting information on recent and projected near future climate change as well as potential options to develop implementation plans.
- e) **Develop capacity** to adopt and undertake CSA implementation. To this purpose it is important to engage in enhancing countries' capacity at different levels, from agricultural frontline staff to agricultural research institutes and universities. To this purpose EPIC supports the training of students and researchers to undertake studies related to climate change and agriculture, as well as extension agents, who will diffuse knowledge to farmers.
- f) **Develop strategies** combining the results from the evidence base and the institutional analyses on barriers to adoption.
- g) **Support policy coordination, through dialogue and analysis.** For example, analysis of synergies, gaps, overlaps and contradictions of existing or planned agricultural and climate change policies could be used as a basis for dialogue between policy makers in these respective areas. EPIC experience shows that policy dialogues between ministries of agriculture and environment are a very effective way of identifying and minimizing the contradictions and inconsistencies between national agricultural and climate change plans. This exercise supports the **development of recommendations for changes** in existing policy instruments or institutional arrangements (e.g. is there need for joint agriculture and climate change committee), taking into account their respective cycles.
- h) **Build necessary linkages to global policy processes.** EPIC recognizes the lack of prominence of agriculture in global policy dialogues on climate change in spite of the fact that agriculture can play an important role in the mitigation of and adaptation to

climate change. To increase the prominence of agriculture, EPIC supports the partner countries' representation of agriculture at the global climate change and food security policy dialogues, including UNFCCC, WTO, GEF and GCF.

3.3 Enhancing financing options

One of the key components of a successful CSA implementation is finance. As a consequence of the lack of prominence in global climate change dialogue mentioned above, financing for CSA has been lagging behind the concept itself. Only recently the landscape of CSA finance is changing and creating more opportunities, such as the Green Climate Fund (GCF), the Climate-Smart Agriculture financing in the GEF-6 Program of the Global Environmental Facility (GEF) and the growth of climate and green bond financing to mention a few.

- a) **Develop investment proposals.** The evidence base generated through the activities above provides a rich basis for dialogue at country level to prioritize investment options. Consultations with key stakeholders –including government ministries, private sector and civil society provide a basis for prioritizing as well as building partnerships and implementation strategies – as well as strong country ownership. Investment proposals intended for specific financing sources can then be developed based on cost estimates associated with the household budgets related to the different practices, as well the assumptions on uptake/scaling rates together with the cost estimates associated with the institutional analysis.
- b) **Develop methodology for assessing, measuring and reporting adaptation and mitigation benefits.** The benefits that these investments are planned to provide need to be measured and reported using a sound methodology. This methodology should also be linked to the development of National Agricultural Plans (NAP) and past efforts on National Adaptation Programmes of Action (NAPA) as well as Nationally Appropriate Mitigation Actions (NAMA) where relevant, while at the same time paying attention to the requirements of financing agencies particularly GEF and GCF.
- c) **Dialogue with financing sources on the proposal development and accounting for benefits is crucial** in the design of successful proposals. EPIC is working closely with in-country focal points and international representatives of financing and implementing agencies to ensure coordination and financing.
- d) **Funded investment proposals** initiate in the field. The final step is to start implementation of CSA interventions based on the robust evidence base and enabling institutional/policy frameworks developed as detailed above.

4. Conclusions

CSA is a new approach to agricultural development planning for food security under the realities of climate change. The approach to implementation does not have a prescriptive blue-print as it depends on the case-specific food security challenges and agro-ecological and institutional environments. This brief has outlined the approach of FAO-EPIC CSA project developed in conjunction with country partners in the first pilot CSA policy support project. The approach is grounded on a robust evidence base, institutional inclusiveness and country ownership.

Explicit recognition of the potential for tradeoffs between the multiple objectives of CSA and a focus on building mechanisms to capture and enhance synergies between them is a fundamental aspect of the CSA approach. Continuous dialogue with global financing sources and other implementing agencies to facilitate CSA at a larger scale complements this approach to ensure sufficient investments in agriculture that capture the synergies and minimize the potential tradeoffs between national food security, adaptation and mitigation goals.



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Economics and Policy Innovations for Climate-Smart Agriculture (EPIC)

EPIC is a programme hosted by the Agricultural Development Economics Division (ESA) of the Food and Agriculture Organization of the United Nations (FAO). It supports countries in their transition to Climate-Smart Agriculture through sound socio-economic research and policy analysis on the interactions between agriculture, climate change and food security.

This paper has not been peer reviewed and has been produced to stimulate exchange of ideas and critical debate. It synthesizes EPIC's ongoing research on the synergies and tradeoffs among adaptation, mitigation and food security and the initial findings on the impacts, effects, costs and benefits as well as incentives and barriers to the adoption of climate-smart agricultural practices.



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