



# Linking regional stakeholder scenarios and shared socioeconomic pathways: Quantified West African food and climate futures in a global context



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## ABSTRACT

The climate change research community's shared socioeconomic pathways (SSPs) are a set of alternative global development scenarios focused on mitigation of and adaptation to climate change. To use these scenarios as a global context that is relevant for policy guidance at regional and national levels, they have to be connected to an exploration of drivers and challenges informed by regional expertise.

In this paper, we present scenarios for West Africa developed by regional stakeholders and quantified using two global economic models, GLOBIOM and IMPACT, in interaction with stakeholder-generated narratives and scenario trends and SSP assumptions. We present this process as an example of linking comparable scenarios across levels to increase coherence with global contexts, while presenting insights about the future of agriculture and food security under a range of future drivers including climate change.

In these scenarios, strong economic development increases food security and agricultural development. The latter increases crop and livestock productivity leading to an expansion of agricultural area within the region while reducing the land expansion burden elsewhere. In the context of a global economy, West Africa remains a large consumer and producer of a selection of commodities. However, the growth in population coupled with rising incomes leads to increases in the region's imports. For West Africa, climate change is projected to have negative effects on both crop yields and grassland productivity, and a lack of investment may exacerbate these effects. Linking multi-stakeholder regional scenarios to the global SSPs ensures scenarios that are regionally appropriate and useful for policy development as evidenced in the case study, while allowing for a critical link to global contexts.

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## 1. Introduction

Climate change is a significant source of uncertainty for the food security, health and livelihood of the poor in many of the world's vulnerable regions, interacting with and compounding other

sources of uncertainty such as socioeconomic development, political stability and the effects of widespread ecosystem degradation (IPCC, 2014). Among the most vulnerable regions is West Africa, where 75% of the population of the fifteen countries that are members of the Economic Community of West African States (ECOWAS) live on less than \$2 a day and more than 35% of the regional GDP is derived from agricultural production (Hollinger and Staatz, 2015; World Bank, 2011). Though the region is home to currently less than 5% of the world's people, in the future it may be

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the fastest growing (Jiang and O'Neill, 2015; Kc and Lutz, 2014) and one of the most exposed to climate change due to its dependence on (rainfed) agriculture, and the estimated negative impacts of climate change (Leclère et al., 2014; Müller et al., 2011; Roudier et al., 2011). Those involved in government policy, private sector investments, civil society action and other strategic processes must consider the interacting uncertainties of development and climate change in an integrated fashion when planning for the future (Vermeulen et al., 2013).

Scenario-guided planning allows decision-makers to engage with uncertain futures and assess and improve the feasibility, flexibility and concreteness of their plans (Vervoort et al., 2014). The international climate change community is developing a set of global scenarios, consisting of various combinations of radiative forcing scenarios (Representative Concentration Pathways or RCPs) and socioeconomic and policy scenarios (Shared Socioeconomic Pathways; SSPs, and Shared Policy Assumptions; SPAs) that when combined can be used to examine the impacts of climate change. These scenarios also provide a global context and/or template for processes at lower geographical levels that seek to use scenarios to guide regional, national or sub-national planning (O'Neill et al., 2014). Conversely, there is scope for sub-global processes to complement the shared socioeconomic pathways (SSPs) with more regional contextualization of assumptions and results, even when using scenarios in the global setting. Regionally specific scenarios serve to assist policy makers in developing robust agriculture and climate adaptation strategies, while also providing the scientific community working at the regional, national, and sub-national level with multiple pathways for development that can be disaggregated or linked to adaptation assessments (Antle et al., 2015; Kihara et al., 2015; Valdivia et al., 2015).

The frameworks to develop the global SSPs have been thoroughly documented (O'Neill et al., 2014; Schweizer and O'Neill, 2013; van Ruijven et al., 2014; van Vuuren et al., 2014), linked to previous scenario assessments (van Vuuren and Carter, 2013), and recently integrated with climate change and quantified (Riahi et al., 2016). They are just beginning to be scrutinized through regional and national (Absar and Preston, 2015), and human impact (Hasegawa et al., 2015) lenses.

In this paper, we present a process in which a set of stakeholder-generated, regional scenarios for West Africa was linked quantitatively to the SSPs by using the regional stakeholder scenarios to critically examine and adapt SSP assumptions made for the region. This way, a set of scenarios was created that focuses principally on regional challenges but has been made coherent with the SSPs (Zurek and Henrichs, 2007), allowing for a global situating of the scenarios. The resulting set of scenarios was designed to be used for planning by policy makers (in the widest sense, including private sector and civil society groups) at national and regional levels and have been used for this purpose in a number of planning processes, among which are national policy guidance processes in Burkina Faso and Ghana. The process was led by the CGIAR Program on Climate Change, Agriculture and Food Security (CCAFS).

We present this process as 1) an example of using global models to quantify regional scenarios to balance the need for regional perspectives with the need for connections to global futures; and 2) to more specifically examine the implications for agriculture and food security in West Africa under future climate and socioeconomic uncertainty.

In this paper we will first describe our participatory scenario development methodology, including how the scenarios were linked across levels and quantified. Then we will present the resulting regional scenarios: the socioeconomic drivers of change and the quantitative modeling results, highlighting the link to the SSPs by their narratives, scenario drivers, and challenges to

adaptation. Finally, we will discuss the benefits and drawbacks of our approach of linking regional and global scenarios and compare it to alternative approaches. A note on terminology: following Cash et al. (2006) we use 'level' rather than 'scale' to describe levels such as 'regional' and 'global'.

## 2. Methodology

### 2.1. Main process objectives and design choices

Scenarios are hypothetical futures expressed through narratives, numbers or other means (visual, interactive), to explore different directions of change (van Notten, 2006; Vervoort et al., 2010). The CCAFS West Africa scenarios provide globally contextualized meso-level futures for policy guidance at regional, national and sub-national levels across West Africa. A number of policy guidance processes were co-developed between the project researchers and policy makers, and designed to directly examine a given policy or plan in the context of multiple scenarios, leading to an assessment and an improvement of the plan's robustness in the face of future uncertainty, based on new insights coming from the examination of the plan through each different future scenario (Vervoort et al., 2014).

This strong focus on regional and national policy guidance has consequences for how the regional scenarios and global SSPs should be linked. To ensure policy relevance, drivers considered to be the most important at the regional level should frame the scenarios, and policy makers should be involved in the identification of these drivers and the development of the scenarios (Wilkinson and Eidinow, 2008). Multi-level scenario processes can exhibit different degrees of integration of scenarios across levels, though they are often conceived through a top-down process (Biggs et al., 2007; Kok et al., 2007, 2006a, 2006b; Shaw et al., 2009; Kok et al. In Review). Zurek and Henrichs (2007) describe the different possible degrees of linkage between scenarios organized at different geographic levels, from 'equivalent' (the scenarios are the same at different levels) to 'independent' (unconnected scenarios). We start with regional scenarios that Zurek and Henrichs would categorize as 'comparable' to the global SSPs – in that they have a similar scope of concern, but the framing drivers and assumptions of the scenarios are not connected. This comparable regional set of scenarios was then quantified to provide inputs for global modeling, in a process that mapped the regional scenarios to the global SSPs in terms of quantitative drivers. We will argue that this process moved the regional scenarios toward being 'coherent' with the global SSPs – meaning that the regional scenarios and the global SSPs map to each other in terms of content and assumptions. Having two different, comparable starting points for the scenarios at each level means that the regional scenarios provide an independent, regionally grounded perspective from which the regional assumptions for the SSPs can be examined and adapted. At the same time, moving the scenarios from comparable toward coherent through the quantification process means that the scenarios can be situated in global SSP contexts – which is essential to understanding the development of West Africa's future in the face of global drivers of change.

### 2.2. Scenario development and framework

The CCAFS scenarios process in West Africa started by examining, with regional stakeholders, the impacts of future climate and socioeconomic drivers on food security, environment and rural livelihoods. Scenarios were developed over three separate workshops. Regional stakeholders took ownership of the process by offering information on the relevant drivers of change as they related to agriculture, food security and climate

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