



AN INTRODUCTION TO THE ARCC ADAPTATION IN THE SAHEL SERIES

INTRODUCTION

The six reports gathered under the ARCC Sahel Studies Series¹ address diverse yet related topics. For the series, instead of conducting detailed assessments, ARCC developed unique approaches and tools for evaluating how climate change may impact the performance of crops and agricultural practices. The series also includes two documents demonstrating specific steps in these approaches: an agronomic review of the environmental and climatic requirements of crops important in the Sahel, and a manual describing farm-level adaptive practices. The final two documents described below present the climatic and environmental parameters of pests and diseases that afflict selected crops and livestock species important to the region's economy. Together these documents serve as a resource for decision makers working to reduce climate change vulnerability in the rain-fed agricultural zones of the Sahel. Beyond piloting new approaches, these documents help frame future studies by highlighting methodological challenges that need to be addressed and identifying questions for further research.

A PHENOLOGICAL SCREENING APPROACH TO EVALUATING CROP VULNERABILITY

Each stage in the lifecycle of a crop has different temperature and moisture requirements. Climate change will present clear challenges to Sahelian farmers if it pushes temperatures and rainfall amounts and patterns outside of these thresholds. "An Approach to Conducting Phenological Screening of the Impact of Climate Change in the West African Sahel," describes a method for evaluating how changes in climate may alter the frequency with which these thresholds are breached and how this may affect crop production. The approach, designed to be conducted at the geographic scale of the Sahel, pays particular attention to changes in intra-seasonal rainfall, a key element in understanding how new climates may impact agriculture.

¹ "An Approach to Conducting Phenological Screening of the Impact of Climate Change in the West African Sahel," Simpson, B.M., 2014a, USAID; "Agricultural Adaptation to Climate Change in the Sahel: An Approach to Evaluating the Performance of Agricultural Practices," Simpson, B.M., 2014b, USAID; "Agronomic Profiles of Fifteen Crops Important in the Sahel," del Rio, A., & Simpson, B.M., 2014a, USAID; "Agricultural Adaptation to Climate Change in the Sahel: Profiles of Agricultural Management Practices," Ray, M., and Simpson, B.M., 2014, USAID; "Agricultural Adaptation To Climate Change in the Sahel: Expected Impacts on Pests and Diseases Afflicting Selected Crops," del Rio, A., & Simpson, B.M., 2014b, USAID; "Agricultural Adaptation to Climate Change in the Sahel: Expected Impacts on Pests and Diseases Afflicting Livestock," Younan, M., & Simpson, B.M., 2014, USAID.

To implement the approach, the parameters of the analysis must be defined, spatially and temporally resolved weather data must be selected and analyzed, and phenotypic profiles must be developed for each crop under consideration. The screening process itself consists of an analysis of the climate data to identify trends in the frequency at which the predetermined thresholds are breached. The results of such an analysis would describe the dominant threats facing the crops studied, such as temperature spikes, dry spells, or intense rainfall events. These results would aid decision making about investments in adaptation and could be used to develop guidance on crop selection. The screening results could also be used to alert policy makers to potential losses or gains in revenues from major cash crops and help indicate when long-term research into new, more tolerant varieties is necessary.

IMPLEMENTING THE PHENOLOGICAL SCREENING APPROACH

“Agronomic Profiles of Fifteen Crops Important in the Sahel” concerns one step in the phenological screening approach. The profiles, based on existing research literature supplemented by interviews with experts, detail the range of conditions that support the development of the selected crops. Each profile describes the geographic distribution and importance of the crop, the life cycle of the crop, and known rainfall and temperature requirements at different stages of development. The profiles also identify growth thresholds related to soil conditions, water availability, and temperature, and discuss the crop’s potential adaptability to changes in climate.

While the ARCC agronomic profiles may serve as a useful reference tool to assess climate based threats to crops, the study also reflects the limitations of the literature used to produce it. As a result, the profiles are restricted to descriptions of general crop types cultivated in the Sahel; they do not describe the characteristics of specific varieties. Further, descriptions of temperature, rainfall, and soil requirements are not precise and do not take into account the complex interactions between these and other variables as this information is not covered in the research literature and, in many cases, is not yet fully understood.

APPROACHES TO EVALUATING ADAPTIVE AGRICULTURAL PRACTICES

Changing field level farm management practices constitutes one approach available to farmers to reduce the negative impacts of changes in climate on the productivity of their crops. Governments, donors, research institutions, and other organizations that seek to help farmers in the Sahel develop and adopt such practices will need an approach to evaluate how future climate change will affect the performance of these practices. At a minimum, practices will need to be screened for their potential technical, financial, and social benefits.

“Agricultural Adaptation to Climate Change in the Sahel: An Approach to Evaluating the Performance of Agricultural Practices” provides a review existing approaches to evaluating farm level management practices, and describes a three stage process to selecting among these approaches and applying them to conduct evaluations in the context of climate change. The first consists of defining the future climate conditions to which agricultural practices will need to adapt. This is followed by the development of an “adaptation profile” for each practice to be assessed. The final stage includes the evaluation to determine changes in the effectiveness of the selected practices under the defined future climate conditions. Similar to the analysis of crop productivity, the paper calls for ways to ensure that this type of technical analysis look beyond simple inter-annual variations in rainfall and also consider increased variations in intra-annual rainfall.

To be adopted, practices need to not only generate the technical adaptation outcomes required; they should also have a neutral or positive financial effect for the farmer, and they should be desirable and within the farmer’s capacity to manage. Further, adaptability to climate change will not be the only — or even the most important — determining factor in decisions about investments in various farming practices. Many other factors need to be considered, including international trade, domestic policies,

large-scale infrastructure investments, the functioning of research and extension services, and local social structures. The author outlines the broad range of factors — beyond technical performance — that influence farmers as they develop or select adaptive practices. These factors need to be evaluated to accurately inform decisions regarding long-term investments in the promotion of specific adaptive practices.

IMPLEMENTING THE APPROACH TO EVALUATING ADAPTIVE PRACTICES

As one step in the technical evaluation of adaptive agricultural practices, “Agricultural Adaptation to Climate Change in the Sahel: Profiles of Agricultural Management Practices” provides background on many of the practices that farmers in the Sahel use to adapt to seasonal variations in temperature and rainfall. Four types of strategies are presented: moisture retention, supplemental water supply, soil fertility enhancement, and temperature and wind abatement. The document provides an overview of each practice, its technical specifications, the context in which it functions best, and the practice’s limitations and weaknesses. Similar to the report on crop agronomic profiles, the content of the available literature limits the detail to which each practice can be presented. The document nevertheless provides a basis for the technical specifications to be used in an evaluation of the impact of climate change on the performance of many of the adaptive practices employed by farmers in the Sahel. It also serves as a broader reference guide to these practices.²

CLIMATE CHANGE IMPACTS ON PESTS AND DISEASES

In addition to affecting the growing cycles of crops and the effectiveness of field management practices, climate change will also impact the prevalence of some pests and diseases that afflict crops and livestock. Two ARCC reports draw on the research literature to document the likely impacts on endemic pests and diseases in the Sahel under two broadly defined climate scenarios.

Crops. Peer-reviewed scholarly journals report on about 100 diseases and pests that affect important crops in the Sahel. Using two simplified scenarios for future climate conditions — hot and wet, and hot and dry — it is possible to make straightforward projections of the possible effects of changes in climate on the risk factors for those pests and diseases. However, changes unrelated to climate will also affect the risk factors for pests and diseases. Farmers will adapt new techniques for managing pests and diseases and will likely adopt varieties and crops with different resistance to certain pests and diseases. Expansion into other types of land may also affect risks.

The report titled “Agricultural Adaptation to Climate Change in the Sahel: Expected Impacts on Pests and Diseases Afflicting Selected Crops” catalogs the current prevalence and impact of crop pests and diseases. For each crop, it describes the damage caused (by phenological stage where possible), the mode of transmission, the overall impact of the pest or disease, and the environmental conditions that affect the spread of the disease or pest. While these are often climatic conditions, other factors, such as soil moisture, shade, wind, or other vectors, also have effects. Where possible, the effects of intra-annual events on pests or diseases are noted.

Livestock. Peer-reviewed scholarly journals report on about 50 diseases and pests that affect important livestock species in the Sahel. Again, by using the two simplified scenarios for future climate conditions — hot and wet, and hot and dry — it is possible to make straightforward projections of the

² ARCC also implemented two other steps in the approach to evaluating adaptive practices described in Simpson (2014b). The results are presented in two studies found in the ARCC Climate Change in Mali Series: “Climate Change in Mali: Organizational Survey and Focus Groups on Adaptive Practices,” LaLumia, C., et al., 2014, USAID; and “Mali Agricultural Adaptive Practices Impact Modeling Assessment,” Folle, S., & Mulla, D.J., 2014, USAID.

possible effects of changes in climate on the risk factors for those pests and diseases. However, changes unrelated to climate will also affect the risks of pests and diseases. Farmers and pastoralists will adapt new techniques for managing diseases and will likely adopt livestock breeds with different levels of resistance to certain pests and diseases. Farmers may also move their livestock into new and different types of land, which may also affect risks.

The report titled “Agricultural Adaptation to Climate Change in the Sahel: Expected Impacts on Pests and Diseases Afflicting Livestock” catalogs the current prevalence and impact of livestock pests and diseases. For each species, it provides a general description of vector-borne, environmentally transmitted, and animal-to-animal transmitted diseases. The document provides information about the relationships between climate, livestock management, land use, and pathogen transmission. It also offers possible mitigation strategies.

IMPLICATIONS FOR RESEARCH ON EVALUATING THE IMPACT OF CLIMATE CHANGE IN THE SAHEL

Taken together, these studies and tools serve to illustrate a number of high level lessons reinforced by the larger body of ARCC work. Strengthening climate change adaptation in the agricultural zones of the West African Sahel will require a broad perspective, one which takes into account the complex interrelationships of development issues that impact, and serve as the context for, farmers as they make decisions regarding climate change adaptation. The six studies of the ARCC Sahel series provide useful and actionable information and tools to this end and are important for developing strategies to help farmers and livestock holders to adapt to the effects of climate change.

These studies also contribute insights into the design and use of methods to evaluate the potential impacts of climate change on the region’s agricultural and livestock systems. They highlight the fact that the efficient and effective implementation of these methods will require significant advances in the collection, analysis, and distribution of relevant information, especially — but not exclusively — climate information. The studies make clear the limits of available information on climate, plant processes, agricultural practices, and the potential impacts of pests and diseases. Available literature provides only a basic description of the technical specifications of field level adaptive practices employed by farmers, and published research does not enable the development detailed phenological profiles of all the varieties of crops grown in the Sahel. Few studies have been conducted on the potential impact of climate change on the incidence of agriculturally relevant pests and diseases in the Sahel. Beyond their findings, the studies of the ARCC Sahel series demonstrate the types of research that need to be conducted and scope of information that needs to be collected to advance our understanding of some of the potential impacts of climate change on agricultural systems in the Sahel.