

SUMMARY AND CONCLUSIONS

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Climate variability is a reality that is affecting rural livelihoods in West Africa today and presenting a growing challenge in the region, as in many other parts of the African continent and elsewhere. Climate change will have far-reaching consequences for the poor and marginalized groups among which the majority depend on agriculture for their livelihoods and have a lower capacity to adapt. Weather-related crop failures, fishery collapses, and livestock deaths in addition to losses of property are already causing economic losses and undermining food security in West Africa. This situation is likely to become more desperate and to threaten the survival of the majority of poor farmers as global warming continues. Feeding the increasing populations in a subregion with one of the highest rates of population growth in the world requires radical transformation of a largely underdeveloped agriculture over the next four decades. A major challenge is increasing agricultural production among resource-poor farmers without exacerbating environmental problems and simultaneously coping with climate change.

There is apparently a growing awareness of the potential adverse effects of climate variability and change at the levels of both national governments and regional institutions. This has resulted in various initiatives, national and regional, aimed at addressing climate change issues. Other than Côte d'Ivoire, Ghana, and Nigeria, all West African countries involved in this study have submitted National Adaptation Programmes of Action (NAPAs) to the United Nations Framework Convention on Climate Change to identify priority activities for adaptation to climate change. Though useful in providing a framework for raising awareness among policymakers and guiding resource allocation for adaptation to climate change, the NAPAs would benefit immensely from studies like the present one in providing updated information on climate change, particularly in the agricultural sector.

The results of the individual country chapters clearly underscore the general concern for climate change in West Africa. The West African economies are especially vulnerable to climate change as a result of their heavy

dependence on rainfed agriculture. Despite the variation among models, there is a clear indication of changes in precipitation with either a reduction in the heavy-rainfall areas, particularly along the coast, or an increase in areas of the Sahel hitherto devoid of much rain. Côte d'Ivoire, Ghana, Guinea, Nigeria, and Togo, which are among the countries that receive the most rainfall, are shown to experience a reduction of at least 50–100 millimeters of rainfall per year, whereas Sahelian countries like Burkina Faso, Niger, and Senegal that receive little rainfall are shown to have substantial increases in rainfall (50–100 millimeters), with Niger predicted to receive as much as 200 millimeters by 2050.

Against the backdrop of the rainfall changes is an increase in temperature by an average of 2°C in all the countries, with at least one model showing a rise in temperature of up to 3.5°C in Liberia, Niger, and Sierra Leone. Certainly decreased precipitation and an increase in temperature will pose tremendous challenges to farming and related livelihoods. High temperatures above the ranges tolerated by crops will definitely affect the physiology of plants, including staple crops in the region, with consequences of decreased productivity that will affect food production. This situation could be compounded by genetic erosion due to the inability of plants to survive harsh conditions. Similarly, animal production, including livestock and fisheries, could be adversely affected. The climate projections for Africa presented in the Forth Assessment Report of the Intergovernmental Panel on Climate Change (Boko et al. 2007) include a likely average temperature increase of 1.5°–4°C in this century, which is higher than the global average (World Bank 2009). Acting now could help save the 10–15 percent of species that will otherwise likely be lost in an Africa that is 2°C warmer than in preindustrial days (Parry et al. 2007). This situation will demand actions on many fronts, including water conservation and the development of irrigation, conservation of biodiversity, and capacity building at various levels, all of which will require adequate resources and policy frameworks.

On the other hand, a drastic increase in rainfall in hitherto dry areas could pose serious challenges to adaptation and the conservation of biodiversity, at least in the short run. Increased humidity and flooding could threaten the existence of plants and animals adapted to dry conditions in the Sahel. The mosquitoes and tsetse flies that transmit the pathogens that cause malaria in human beings and sleeping sickness in cattle, respectively, abound in humid conditions. An increase in rainfall in the Sahel could pose a serious threat to the cattle industry, with a need to adjust the prevailing farming system. The

growing concern for rainfall variability is clearly expressed by virtually all the authors of the country chapters and reflected in their expression of the overwhelming need to provide support to national meteorological services and other climate information and service providers to make available relevant information that will adequately inform policymaking with a view to enhancing adaptation to climate change. This situation could open up opportunities for the private sector to play key roles in adaptation to climate change in the region, particularly in providing reliable climate information and disseminating such information as well as insurance for crops and animals.

In the meantime it is worthy to note the important role being played by key continental and regional institutions with regard to climate change information. These include the Regional Centre for Agriculture, Hydrology, and Meteorology (AGRHYMET), a specialized institute of the Permanent Interstate Committee for Drought Control in the Sahel, composed of nine member states (Burkina Faso, Cape Verde, Chad, Gambia, Guinea-Bissau, Mali, Mauritania, Niger, and Senegal) and with headquarters in Niamey, Niger. AGRHYMET provides training and information in the areas of agroclimatology, hydrology, and crop protection. The African Centre of Meteorological Applications for Development, also based in Niger, contributes to strengthening the capacities of national meteorological services in climate monitoring and making predictions for short-range (daily or weekly), medium-range (10-day), long-range (monthly), and seasonal time-scales. The African Monsoon Multidisciplinary Analysis Network brings together more than 200 scientists who are stakeholders in African monsoon multidisciplinary analysis, which is aimed at improving understanding of the African monsoon and its influence on the physical, chemical, and biological environment regionally and globally. Strengthening the capacities of national meteorological services is imperative if reliable climate information is to be available to inform decisionmaking in the region.

The results of the study presented in this monograph clearly show that climate change will adversely affect the productivity of the major staples in the region, with relatively greater effects on sorghum and groundnuts, which are key crops in the Sahelian countries. Sorghum is the leading cereal crop in Burkina Faso and Nigeria and the second most important crop in Niger. These three countries cultivate more than 50 percent of the sorghum area in the region. It is interesting to note, however, that despite the adverse effects of climate change on the productivity of crops in the region, the production of all the crops is shown to increase in all countries, due mainly to improved

productivity rather than to an increase in the area under cultivation. It is worrying to note that the yields achieved by 2050 are still predicted to be far less than the current genetic potential of the respective crops, including land-races of such crops. A possible scenario is that the harsh climatic conditions will pose serious challenges to the attainment of the genetic potential of the crops. The importance of ensuring improved productivity under adverse climatic conditions is highlighted by all the country authors and reflected in the recommendations for increased support to research for the development of improved crop varieties that are resilient to the adverse effects of the weather in addition to appropriate management practices.

The challenges of climate change are also opening the avenue for serious consideration of the farming systems in the area with regard to crop diversification as well as crop–livestock integration to minimize the risk of crop failure or livestock deaths. This was specifically identified for Burkina Faso and Niger in the Sahel as well as for Togo, which stretches from the coast into the Sahel. Interestingly, the three countries share borders. The Niger chapter reports that the drought in 1969 led to an estimated loss of 30 percent of the cattle in Agadez and at least 13 percent in the rest of the country and that the catastrophic drought of 1974 killed almost all the livestock in the country. As recently as 2009, the Niger livestock sector was hit by a drought leading to the loss of thousands of cattle. Livestock production is also a key economic activity in both Burkina Faso and northern Togo. It is against this background that agricultural diversification is being promoted in these countries. Most of the country chapter authors advocate for crop diversification to reduce the risk of crop failure. In Nigeria cassava, which is relatively drought tolerant compared to a crop like rice or maize, is increasingly being grown in the hitherto cereal-dominated northern part of the country. On the other hand, the drastic reduction in precipitation predicted for some parts of the coastal countries like Nigeria, Benin, Togo, and Ghana could erode the advantage of growing tree crops like cocoa and coffee that require a longer rainy season and convince farmers of the need to grow drought-tolerant crops like sorghum and millet based on the reduced precipitation predicted for parts of this region by 2050.

Even though the scenarios show crop production increasing in all the countries, net exports generally decrease except in Nigeria, where net exports increase for all the crops considered in our study, including the two major staple foodcrops, sorghum and cassava. The decline in exports is related to both population and income growth. All countries have recorded improvements in under-five mortality and life expectancy due to increased

vaccinations against key diseases as well as improvements in per capita income. Unfortunately, the dismal level of family planning among the vast majority of the population in West Africa, particularly in rural areas, has resulted in a rapidly growing population that is not matched by the stagnant or slow increase in food production, which largely remains in the hands of smallholders who lack the vital inputs to deal with the growing challenges of the climate. Only in Nigeria and Burkina Faso does the total population based on the median variant not double by 2050. It is therefore very clear from the results of our study that population growth against the background of slow growth in crop productivity is a driver of negative net exports. The chapters on Benin, Côte d'Ivoire, Liberia, and Sierra Leone put specific emphasis on the need for appropriate action to slow population growth.

Beyond population growth, net rural–urban migration, particularly by youth, is identified by most of the country authors as a challenge in meeting the consequences of climate change, such as high unemployment rates, overcrowding, and inadequate social services, which are also leading to armed robberies and increased strikes, all of which are part of a recipe for civil unrest that can undermine political stability. This trend has been driven by low agricultural productivity coupled with the lack of improved socioeconomic conditions in the rural areas. Climate change is bound to worsen this situation, especially the adverse effects on agricultural productivity. As reported in the Senegal chapter, the severe drought in the late 1960s and early 1970s contributed significantly to the migration of the rural population to urban areas, particularly youth in search of jobs. The majority of the country authors specifically recommend actions related to rural development, including the construction of roads and market infrastructure as well as the provision of inputs for farmers, as indicated in the case of Burkina Faso.

It should also be noted that in addition to the direct effects of climate on crop productivity, heavy rains could pose a serious challenge to the condition of roads, particularly the unpaved feeder roads vital for the transport of inputs to farming areas and produce to market. This is likely to be a problem especially in the humid forest regions of countries along the coast. Several of the country authors, particularly in the cases of Liberia and Sierra Leone, indicated that some of the roads are impassable during the peak of the rainy season. The increasing rainfall for some of the Sahelian countries (Burkina Faso, Niger, and Senegal) shown by the results of our study could pose similar problems for these countries, particularly in view of the fact that roads and other structures in this region have not been built to withstand rainfall conditions.

A growing phenomenon in all the countries covered by our study is the decreasing proportion of the agricultural sector in total gross domestic product. Invariably this has mainly been due to the diversification of the economies of these countries. Nevertheless, this situation reveals the inefficiency of the agricultural sector, because the sector still employs the majority of the workforce in each of these countries. There is therefore a need to make the necessary changes to improve agricultural productivity with special attention given to climate change, which has been clearly identified as a critical force driving low agricultural productivity in the region.

In view of the foregoing, we make the following suggestions for consideration by the regional economic body the Economic Community of West African States (ECOWAS) as well as relevant regional organizations that have a stake in the development of the region, particularly with regard to agricultural development related to climate change adaptation in the region.

- AGRHYMET, which is responsible for weather monitoring in the Sahelian countries, should be supported in extending its activities to the remaining countries in the West African region to ensure reliable weather data collection for the region.
- There is a need for targeted research on climate change related to agriculture. The strategic framework of CORAF/WECARD (Conseil Ouest et Centre Africain pour la Recherche et le Developpement Agricoles / Western and Central African Council for Agricultural Research and Development) for climate change research needs support for both promotion and implementation.
- The many rivers in the region (such as the Niger, Senegal, and Volta Rivers) have a tremendous potential for irrigation. Most of the major rivers run through several countries that have an increasing need to develop dams for electricity and irrigation. There is definitely a need for the effective coordination of such dams along the rivers to ensure maximum benefit and avoid conflict in their exploitation.
- There is a growing awareness of the need for conservation of natural resources, particularly forests, and the development of parks. Many such designated areas are adjacent to neighboring countries, which necessitates collaboration between or among countries sharing such common borders and goals. An example is the Gola Peace Park between Sierra Leone and Liberia.

- ECOWAS should pursue efforts in economic integration, particularly the adoption of a common currency and harmonization of the multiple trade policies of member states to encourage trade within the region. Effective implementation of the ECOWAS Agricultural Policy will be a step in the right direction.
- The international road network in the region should be improved to facilitate the movement of goods and people throughout the region.

In the wake of the growing awareness of climate change, it is imperative that there be developments in climate science as well as the biophysical sciences related to agriculture, particularly innovations that will contribute to realistic adaptation to climate change. It is a reality that basic science is not a prerogative of countries in the West African region. However, there is room for collaboration between research institutions in the national agricultural research systems and advanced institutions in the north. Certainly such collaboration can be fostered bilaterally, but an effort should be made to advance regional initiatives. This calls for proactive strides by ECOWAS and synergy between the CGIAR centers in the region, particularly the Climate Change, Agriculture, and Food Security Research Program of the CGIAR and the International Food Policy Research Institute, to collaborate with CORAF/WECARD, which has been designated by ECOWAS and the Forum for Agricultural Research in Africa to coordinate agricultural research in the region with a view to promoting the effective implementation of innovative food and agricultural research programs, satisfying the requirements of the citizens of member countries, promoting economic development, and reducing poverty.

The German government is supporting the West African scientific community that deals with the impact of climate change by establishing a Science Service Center on Climate and Adapted Land Use (WASCAL) linked with the scientific community in Germany. Its initial geographic target area is the Guinea Savanna agroecological zone in the riparian countries of the Volta River Basin (Benin, Burkina Faso, Côte d'Ivoire, Ghana, Mali, and Togo). The initiative involves the construction of a Competence Center in Ouagadougou to be shared with the Volta Basin Authority. This Competence Center will assist partner countries to collect panel data on climate, hydrology, land use, biodiversity, demography, and economic development. In addition, WASCAL will formulate a research program to be jointly implemented by a German and regional research consortium. The Core Research Program will target the

advancement of knowledge on the impact of climate change on West African land resources through the promotion of resilience through adapted land use to ensure sustainable development.

Also, as part of WASCAL a series of graduate schools are being sponsored in the participating countries to address the deficit in human resources in the region in areas dealing with the impact of climate change in West Africa. In this regard, a Masters Research Program in Climate Change and Adapted Land Use is being hosted by the Federal University of Technology, Minna (FUT Minna), Niger State, Nigeria, while the Kwame Nkrumah University of Science and Technology, Kumasi Ghana, is focusing on capacity building at the PhD level. The postgraduate program ultimately aims at strengthening the research, educational, and policy capacity and competency of West African countries to deal with issues of climate change through adapted land use on a scientific basis in partnership with German institutions. It is expected that upon graduation these postgraduate fellows will be competent for engagement by universities, research institutes, and public services.

The resilience of resource-poor farmers to the effects of climate change in West Africa will be supported by the availability of reliable climate information that will guide farmers' management of scarce resources. Improved modeling could guide farmers' decisionmaking as well as policy formulation. Developing and making available crop varieties with a wide range of adaptations to moisture and temperature could ensure the preservation of a valuable gene pool in a changing climate situation. Every effort should be made to capitalize on indigenous knowledge across the region to provide adequate information on relevant entry points for research and development. There will be a need for the harmonization of efforts and procedures to reflect the regional perspective.

The actions to be taken over the next 10 years and beyond will be especially critical. New initiatives are needed—ones that integrate and apply the best and most promising approaches, tools, and technologies. The involvement of farmers, policymakers, researchers, the private sector, and civil society in the research process is vital. Successful mitigation of climate change and adaptation to it will entail changes in individual behavior, technology, institutions, agricultural systems, and socioeconomic systems. These changes cannot be achieved without improving interactions among scientists and decisionmakers at all levels of society.

It is critical that the all-inclusive IAR4D (Integrated Agricultural Research for Development), a multistakeholder and multiinstitutional participatory process that puts the farmer or entrepreneur at the center of the process, be adopted

to achieve the common goals of adaptation to climate change and sustainable food production. In this novel approach, which is characterized by systemic facilitation and mutual learning among all actors, value-chain and innovation approaches are employed. In it the development of innovation platforms where mutual learning occurs among all stakeholders (including producers, processors, researchers, policymakers, and others) is essential. In the meantime it is absolutely critical that an appropriate forum that facilitates interactions among key stakeholders be established to adequately and appropriately inform policymakers in developing policies aimed at enhancing adaptation to climate change in Africa. To fill this gap, CORAF/WECARD, through AfricaInteract, a project funded by the International Development Research Centre, aims to establish an effective platform that will provide the much-needed forum for dialogue among key stakeholders in research and development, among them policymakers. This initiative is expected to stimulate the formation and development of meaningful partnerships in the quest to improve livelihoods in the face of the growing climate change challenges on the continent.

Finally, it is worth noting that the actions of individual countries will have consequences for neighboring countries with regard to climate. It is therefore in the interest of all countries to collaborate as much as possible in meeting the challenges of climate change, improving livelihoods in a way that will ensure the realization of economic development and improved welfare goals, and attaining the Millennium Development Goals.

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