plant populations with ecological zones and agricultural practices.

Socioeconomics and policy research - Research is recommended on (i) policy processes and political factors influencing priorities and climate change adaptation;(ii) land use patterns ;(iii) land use regulations and mobility of pastoralists; (iv) costs and returns of adaptation options, quantity and value of fish stocks; (v) ex ante evaluation of adaptation options, effectiveness of climate change adaptation options, adoption rates and determinants of adoption; (vi) analysis of existing marketing structures to improve efficiency and determine how regional integration of markets and access to global markets will be important in responding to climate change; (vii) gender considerations in adaptation to climate change and variability; and (viii) effect of knowledge of climate change and variability on achievement of national development goals in poverty reduction, food security at national and regional levels.

Improving stakeholder involvement in research and policy on adaptation - Collaboration between stakeholders within West African countries should be strengthened through innovation platforms and participatory action research. Scientists should work together in regional projects on climate change and adaptation. The private business sector should be encouraged to participate in dialogues on climate change adaptation. Civil society, farmers' associations and journalists should be supported to link researchers with policymakers and be encouraged to participate with the other stakeholders in training and scenario building workshops.

Recommended Reading

CORAF/WECARD (2011) Agricultural Best Bets in West and Central Africa, Dakar, Senegal: West African Council for Agricultural Research and Development

ECOWAS (2005) The Regional Agricultural Policy, Abuja, Nigeria: Economic Community of West African States

ECOWAS (2008) Environmental Policy, Abuja, Nigeria: Economic Community of West African States

FAO (2008) Expert Meeting on Climate Change Adaptation and Mitigation, 5-7 March, Rome, Italy: Food and Agriculture Organization

FAO (2010) Climate Smart Agriculture: Policies, Practices and Financing for Food Security, Adaptation and Mitigation, Rome, Italy: Food and Agriculture Organization

FAO (2013) Climate Smart Agriculture Sourcebook, Rome, Italy: Food and Agriculture Organization

GEF (2012) Burkina Faso: Integrating Climate Resilience into Agricultural and Pastoral Production for Food Security in Vulnerable Rural Areas through the Farmers Field School Approach, Washington DC: The Global Environment Facility

IPCC (2007a) Climate Change 2007. Synthesis Report. Contribution of Working Group I, II, III to the 4th Assessment Report to the Intergovernmental Panel on Climate Change, Geneva, Switzerland: Intergovernmental Panel on Climate Change

IPCC (2007b) Climate Change 2007. Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the 4th Assessment Report to the Intergovernmental Panel on Climate Change, Geneva, Switzerland: Intergovernmental Panel on Climate Change

IUCN (2010) Building Climate Change Resilience for African Livestock in Sub-Saharan Africa, Nairobi, Kenya: International Union for Conservation of Nature, World Initiative for Sustainable Pastoralism

About AfricaInteract : AfricaInteract is a platform enabling research-to-policy dialogue for adaptation to climate change among a broad range of African stakeholders in sub-Saharan Africa. These include civil society, researchers, policy-makers, donors, and the private sector working on adaptation to climate change in the agriculture and health sectors as well as urban areas with water and gender as cross cutting issues. The overall objective of AfricaInteract is to develop a platform for the effective and efficient transfer of information to policy makers, with the ultimate aim of enhancing the resilience of vulnerable populations. AfricaInteract is funded by the International Development Research Centre (IDRC) and coordinated by the West and Central African Council for Agricultural Research and Development (CORAF/WECARD) under the auspices of the Forum for Agricultural Research in Africa (FARA). The regional focus of AfricaInteract is based on the Regional Economic Communities in the four sub regions of sub-Saharan Africa. Focal organizations coordinating regional activities are as follows: The Association for Strengthening Agricultural Research in East and Central Africa (ASARECA) – East Africa; Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN) – Southern Africa; Commission des Forets d'Afrique Centrale (COMIFAC) – Central Africa; and Energie-Environnement et Developpment (Enda) – West Africa.

AfricaInteract

Policybrief

Enabling research-to-policy

dialogue for adaptation to climate change in Africa

Research and Policies for Climate Change Adaptation in the West Africa Agriculture Sector

Context and Importance of Climate Change in West Africa Agriculture

The dominant farming systems in West Africa are smallholder rain fed annual and perennial crop farming, livestock rearing and fisheries. The livestock systems are agro-pastoral, pastoral and crop-livestock, while nomadic pastoralists and semi-nomadic pastoralists, also referred to as transhumance pastoralists, exist in the Sahelian ecologies.

Climate change has continued to threaten agricultural production and productivity in Africa, especially in West Africa. Increasing vulnerability of African countries to the impact of climate change makes Africa one of the most exposed regions in the world to climate change (Boko et al. 2007).

Flows of major rivers would fall, in a situation of increasing demand for irrigation water and population growth. By 2100, farm sector losses the West Africa ,due to climate change and variability could reduce regional GDP by 2 to 4 percent (Namara et al. 2011).Climate change may entrain deforestation as more lands are brought under cultivation. Mangrove forests in coastal areas may be damaged and breeding grounds for fisheries threatened. Rise in sea level, frequent storms and floods would degrade marine fisheries resources; fish would die because of high temperatures and low oxygen concentration of waters. Projected climate change, population and market changes acting together cause major declines in fish stocks in West Africa, if adaptation measures are not undertaken (Warren et al. 2006, cited in IPCC 2007; Allison et al. 2005; ECF/PIK 2004). Using used models, Lam et al. (2012) estimated that total landings of 14 West African countries will drop by about 8 percent and 26 percent from 2000-2050 for a low and high greenhouse gas emission scenario respectively. In addition, the study indicated that the Exclusive Economic Zones (EEZs) of Ghana, Côte d'Ivoire, Liberia, Togo, Nigeria and Sierra Leone will experience over 50 percent reductions in landings under a high emission scenario.

Rise in sea levels will leads to flow of salty water into agricultural lands and cause degradation. Apart from crop yields, impacts of climate change have been assessed in terms of crop revenues and length of growing periods. Kurukulasuriya and Mendelsohn (2008) calculated baseline values of cropland and revenues and estimates

of impacts of climate change on them. . Reductions in crop revenue in West Africa were between US$9.2bn (-17 percent) and US$17.4bn (-32 percent) for the Parallel Climate model (PCM) and the Canadian Climate Centre model (CCC) respectively by 2100.

The effect of climate change on livestock production is generally expressed through changes in feed resources, which could influence feeding options, grazing management, prices of stover and grain, and overall livestock productivity. Climate change would impact on vector borne diseases. Predictions of climate and population changes in tsetse fly density indicate that tsetse populations and animal trypanosomiasis will decrease in the semi arid and subhumid zones of West Africa. In addition to vector borne diseases, helminth infections of small ruminants will be influenced by changes in temperatures and humidity.

Regional policies related to Climate Change Adaptation in West Africa

NEPAD's Comprehensive Africa Agriculture Development Programme (CAADP), lists the 'vagaries of climate and consequent risks' as one of six challenges to achieving productive agriculture (AU 2010). The ECOWAS Regional Agricultural Policy for West Africa (ECOWAP) and the Offensive for Food Production and Against Hunger (ECOWAS 2005) constitute the framework of reference for the principles and objectives assigned to the agricultural sector and to guide interventions in agricultural development in West Africa. ECOWAP recognises that deterioration of climate characterised by reduced rainfall and high temperatures and flooding, is an important challenge for West Africa's agriculture to increase productivity while protecting the natural resources base and boosting production systems resilient to climate change.

In 2010, ECOWAS adopted a Regional Action Program to Reduce Vulnerability to Climate Change in West Africa (ECOWAS 2009a; 2009b). It was agreed, at the International Conference on Reduction of Vulnerability to Climate Change of Natural, Economic and Social Systems in West Africa of 2007 held in Burkina Faso and at the 2008 Ministerial Meeting on Climate Change of in Benin, to develop and implement a programme of action to reduce vulnerability of West Africa to climate change. CILSS, the Economic Commission for Africa (ECA) and ACMAD were mandated to develop the programme. The goal of the ECOWAS programme is to develop regional mechanism, identify stakeholders, and strengthen capacity to provide support to governments and communities to adapt to climate change. The low income developing countries in West Africa developed NAPAs under the guidance of UNFCCC while Nigeria, Ghana and Côte d'Ivoire developed national adaptation documents separately. Gender was strongly emphasized in the development of NAPAs.

National policies in Nigeria, Ghana and Senegal, are more robust for technological practices than policies for non-technical risk management. . International trade is expected to play a critical role in climate change adaptation but there is poor understanding of how all these will contribute to climate change adaptation. . One major weakness in West African countries is that climate change and adaptation do not feature in National Agricultural Development Policies and Strategies.

In West Africa, major policy gaps in climate adaptation include (i) strengthening climate communication and information networks to improve timely delivery of weather information; mainstreaming gender into all climate adaptation policies and strategies; and weak institutional capacity to generate and utilise adaptation technologies.(ii) protection of pastoral resources such as wetlands(ii) protection of dry season reserves and livestock corridors from encroachment by crop farmers, investors and national parks;(iii) integration of Sahelian and coastal zone livestock markets; and (iv) transboundary control of water resources; and management of marine fisheries resources in the shared Atlantic Ocean.

Key research findings to be considered for informed decision making in climate change adaptation in West Africa

Crop farming

Improved Varieties Tolerant to Climate Change Stresses - Plant breeders at AfricaRice, the Africa Rice Centre, have identified, rice breeding materials, including the indigenous African rice Oryzae glaberrima, with several traits that contribute to drought tolerance. Molecular markers are used to tag genes that contribute to drought tolerance to speed up development of drought tolerant lines. Gene pools of wild or weedy rice species O. barthii and O. longistamata are also being exploited (Manneh et al. 2007). In West Africa, the International Maize and Wheat Improvement Center (CIMMYT) and the International Institute of Tropical Agriculture (IITA) have released several new maize hybrids and open pollinated maize varieties which are drought tolerant and produce 20-50 percent higher yields than other maize varieties under drought conditions (CGIAR 2010; CIMMYT 2008).

Adjustment of Planting Date and Cropping Systems - Mathematical modelling of daily maximum and minimum temperatures for selecting the best planting date resulted in minimising the total irrigation water requirements for maize in conditions of of water shortage and competing uses.

Agroforestry - Research on climate change in agro forestry systems in West Africa has focused attention on carbon sequestration potential and effect on soil fertility. Thus carbon sequestration by traditional agricultural parklands in Senegal was estimated at only 0.4t/ha/yr with a potential of 20t/ha in 50 years. This finding led to the conclusion that in the West African Sahel, agroforestry is valuable for climate change adaptation than for mitigation (Torquebiau 2013).

Crop Residue Management : Smallholder farmers in West Africa usually dispose of crop residues by burning, thereby releasing CO2 into the atmosphere. Numerous reviews (for example Schlecht et al. 2006; Bationo and Buerkert 2001; Bationo et al. 1996) pointed out the benefits of crop residue restitution to soil organic matter content, water holding capacity and agricultural productivity. . The practice is therefore considered climate smart.

Biotechnology - Genetically modified organisms (GMOs) constitute a technological option for adaptation to climate change through improved effectiveness of insect pest management (Howden et al. 2007). ECOWAS,WAEMU and CILLS are harmonising regional biosafety regulations (Knight and Sylla 2011) while Burkina Faso, Mali, Ghana and Nigeria have enacted legislation allowing field trials of GM products. Burkina Faso is at the front in West Africa in the application of biotechnology for improving crop productivity and addressing issues of climate change adaptation.

Genetic Improvement and Tolerance to Stress : Genetic improvement of livestockis an important technological option for adaptation to climate change and other stresses.

Research involving combination of genomic-based is being used in an International Livestock Research Institute (ILRI) project in Senegal (ILRI 2012). The West African Dwarf sheep is robust and has strong sexual vigour that enables it to withstand the stress of climate, disease and irregular feeding and has different coat colours. Fadare et al. (2012) studied in Nigeria the effect of coat colour on heat stress, using physiologic indicators and blood parameters and showed that selection of white coloured sheep to control heat stress is desirable.

Reducing Post Harvest Losses : In Sierra Leone in the hot humid coastal zone, research (Government of Sierra Leone 2004) has shown crop losses of 20 percent for rice and 40-50 percent for fruits and vegetables. Recovery rate is 40-50 percent of oil from palm bunches and 40 percent for green coffee beans. . Technology is available to substantially reduce these losses, for example rapid drying after harvest to moisture content of 14 percent or less, use of mechanical rice and coffee hullers and oil palm mills.

Aquaculture : Studies on the breeding of Tilapia (Eknath et. 2007) and the stocking density of Tilapia and the African catfish in Côte d'Ivoire (Coulibaly et al. 2007; Ouattara et al. 2003) suggested that aquaculture fish improvement and management can serve as adaptation strategies to climate change and variability. WorldFish has developed an improved variety (Akosombo) of the Nile Tilapia that grows 30 percent faster than non-improved varieties and is now boosting productivity in West Africa (Spore 2013a). WorldFish is also working with partners in SSA to refine integrated aquaculture-agriculture technologies and cycling of nutrients on farms; this work has relevance to West Africa and is climate smart.

Weather Forecasting and Early Warning Systems : Modelling studies have provided better understanding of the use of weather forecasts to smallholders. Seasonal forecasts improved farmers' productivity in bad years and farmers benefited from improved incomes. . The IDRC/DFID programme showed through PAR how weather forecasting, taking into account indigenous knowledge can be successfully used to strengthen farmers' adaptive capacity to climate change (CCAA 2012).

Policy Options for consideration in the West Africa Agriculture Sector

Tackling climate change in the context of multi-sector challenges A collaborative research approach, involving coordination of interdisciplinary research in crops, livestock, fisheries and forestry sectors, is recommended. Good governance, decentralisation and participation of citizens in decision-making that creates the environment for social cohesion, rapid agricultural growth rates and GDP growth are essential for efficient climate change adaptation.

Risk management dealing with stocks, weather forecasting and insurance

Risk management should involve feasibility studies of buffer stocks, , improvement in the quality of meteorological data collection and weather forecasting tools and techniques as well as early warning systems to reflect the needs of farmers. Innovative insurance schemes should be established for smallholder crop farmers, livestock keepers and fisherfolk.

Technical research on crops, livestock and fisheries

Research themes and topics to be conducted include: (i) crop and animal improvement for yield and tolerance to biotic and abiotic stresses; (ii) effects of climate change on incidence of crop and animal pests and diseases; (iii) fine tuning conservation agriculture to biophysical and socioeconomic conditions for high smallholder uptake;(iv) livestock conservation of genetic diversity through gene banks;(v) pasture improvement based on controlled grazing, mobility, improving efficiency of agricultural water use in the crops and livestock sectors;`(vi) reclamation of land degraded by salty water; (vii) screening and matching agroforestry species and