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Impact of climate change on agricultural trade flows and food security in the Economic Community of West African States

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Disclaimer

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Contents

Abstract ..... **iii**
Acknowledgements ..... **iv**
1. Introduction **1**
2. Materials and methods **2**
2.1 Climate change and socioeconomic scenarios 3
2.2 Crop yield simulation 4
2.3 The bioeconomic profit maximization model 5
2.4 Trade module 5
3. Trade module parameterization **6**
3.1 Crop production levels 6
3.2 Crop demand 6
4. Model results and discussion **7**
4.1 Baseline scenario 7
4.2 Impact of climate change on paddy rice trade 8
4.3 Impact of climate change on the trade of cereals 10
4.4 Impact of climate change on the trade of vegetables, fruits and nuts 12
4.5 Impact of climate change on the trade in oil seeds 15
4.6 Sensitivity to the exterior common tariff 17
4.7 Implications for food security in the Economic Community of West African States 18
5. Conclusion **20**
Bibliography **21**

List of figures

Figure I Structure of the trade module 3
Figure II Marginal values of food imports per ton 19

List of tables

Table 1 Rice trade flow changes from baseline under RCP4.5 8
Table 2 Rice trade flow changes from baseline under RCP 8.5 9
Table 3 Cereal trade flow changes from baseline under RCP4.5 10
Table 4 Cereals trade flow changes from baseline under RCP8.5 11
Table 5 Vegetables, fruits and nuts trade flow changes from baseline under RCP4.5 12

Table 6 Vegetables, fruits and nuts trade flow changes from baseline under RCP8.5..... 14
Table 7 Oil seed trade flow changes from baseline under RCP4.5 15
Table 8 Oil seed trade flow changes from baseline under RCP4.5 16
Table 9 Trade cost differences for food imports from outside the ECOWAS region under climate change scenarios RCP4.5 and RCP8.5..... 17
Table 10 Sensitivity analyses for the exterior common tariff decreases under RCP8.5 18
Table 11 Changes from baseline in rice imports to the ECOWAS region under RCP4.5 and SSP1..... 18

Abstract

This paper presents a summary of a study conducted to investigate the impact of climate change on agricultural trade flows inside the Economic Community of West African States (ECOWAS) and between ECOWAS and non-ECOWAS countries. The study was conducted using a trade module of trade cost minimization within a bioeconomic optimization model for crop-land allocation. The results show that ECOWAS climate-influenced trade patterns will depend on prevailing socioeconomic conditions in the twenty-first century. No specific trade flow pattern is predicted, but specific countries are likely to become net food exporters in some years and net importers in others. In addition, several countries may become dependent on external trade to meet their domestic food requirements. The cost of importing food into ECOWAS countries will depend on the levels of common exterior tariffs. In that regard, the study shows that a 5 to 10 per cent reduction in common exterior tariffs could cut the overall cost of trade by approximately 3 to 7 per cent.

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1. Introduction

The impact of climate change on agriculture is expected to have a profound effect on the African continent if nothing is done to reduce greenhouse gas emissions and if no appropriate adaptation strategies are put in place (Intergovernmental Panel on Climate Change, 2014; Rosenzweig and Parry, 1994). There is now consensus that reductions in these emissions require global agreements between industrialized countries emitting large quantities of those gases. Regardless of whether agreements are concluded to reduce emissions to limit global temperature increases to less than 2^{o}C by 2100, adaption measures must be expediently formulated in order to reduce the impact of emissions on food security in countries located in the tropics. It goes without saying that African countries must also take the steps required to reduce emissions and must adopt appropriate mitigation strategies, including by promoting reforestation and investing in cleaner and renewable energies. Given that climate models predict that an increase in temperatures will be accompanied with uneven changes in precipitation levels around the world, however, some countries may experience more rainfall than others. Consequently, while some countries may experience good crop harvests, others may not. In such a scenario, food trade among countries may help to combat food insecurity. The present report focuses on the West Africa region as a case study and is intended to deepen understanding of the relationship among the region's climate, agricultural production, food trade and food security. In a previous study, it was established that countries located in the northern hemisphere will be only marginally affected by climate change in terms of their ability to produce agricultural food products (Rosenzweig and Parry, 1994), while agricultural food production in countries located in the southern hemisphere, especially in the tropics, will be much more seriously affected. Specific countries in that hemisphere may fare better than others, however. It is therefore possible that regional trade and food imports from the northern hemisphere will become critically important if countries in the southern hemisphere are to address the negative effects of climate change (Stephan and Schenker, 2008).

There is compelling evidence that the adaptation of agricultural systems to mitigate the effects of climate change will require changes to current agricultural practices, including the use of innovative, heat-resistant seeds and the planting of agricultural crops that can withstand heat waves and droughts. Other recommended changes include increasing investment in dams and water reservoirs, with a view to improving irrigation. Indeed, significant investment will be needed to ensure the success of both stream-fed and groundwater irrigation schemes. Currently, most West African countries have inadequate resources for such investment because their Governments already face multiple social and economic challenges, including the need to invest in their health and education systems and in basic infrastructure. Even if investment is made to reduce the current burden on water supplies, the effectiveness of funded projects will still depend on the availability of adequate water resources. In that regard, several West African countries, including Benin, Ghana and Togo, recently experienced electricity shortages, resulting in several days of blackouts. This was due in part to the fact that the water levels in the Akosombo and Nangbeto dams had dropped significantly because of reduced rainfall. Food trade may therefore become a critical means to address food shortages in regions that have a water deficit due to irregular rainfall. Dynamic climate-induced comparative advantages that could arise from climate change, in which specific countries temporarily become net exporters of agricultural products, could be exploited in order to resolve food insecurity in West Africa (Food and Agriculture Organization of the United Nations, 2015). There are several reasons why trade in agricultural commodities could help countries and communities to adapt to and mitigate the effects of climate change (Stephan and Schenker, 2008). First, trade could act as a veritable insurance policy against the risk of climate change. Accordingly, trade would be the means by which food availability is maintained in regions affected by reduced agricultural

productivity. Second, free trade flows could help to spread the costs of climate adaptation measures among stakeholders: free trade would allow regions that are net exporters of food to shoulder some of the increased cost of food that are borne by regions facing food deficits. This, however, once again raises questions relating to food accessibility that were raised in a previous study (Julia and Duchin, 2007), namely, that, although food can be imported, the majority of a country's inhabitants might not be able to afford it. This could lead to food insecurity if a country's inhabitants have insufficient purchasing power to buy food. This study therefore contains an examination of how food trade could help to reduce food insecurity in West Africa. Specifically, this paper is intended to: (a) differentiate between countries that are net suppliers of food from those that have food deficit in various scenarios, while identifying the most cost-effective ways to move food from excess supply countries to excess demand countries; (b) measure the impact of trade and agricultural policies on trade flows within the Economic Community of West African States (ECOWAS); and (c) evaluate the implications of trade flows on food security. To achieve these objectives, several questions must be addressed, including: (a) how effectively could food be moved from excess supply countries to excess demand countries? (b) what are the implications of food trade on the costs relating to climate change adaptation? and (c) what are the food security implications of the observed trade flows? In order to prospectively answer those questions, a bioeconomic optimization model for 14 West African countries was developed. These countries included Benin, Burkina Faso, Côte d'Ivoire, the Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, the Niger, Nigeria, Senegal, Sierra Leone and Togo. The model was calibrated for observed land use as of 2004, was simulated up to 2100 and included drivers such as crops yields and prices within a few climate and socioeconomic scenarios. A trade module minimizing trade costs was then developed in order to identify excess supply versus excess demand countries, with a view to developing cost-effective mechanisms to move food from excess supply countries to excess demand countries.

This paper is presented as follows: the first section elaborates on the methodological approaches used in the study, while the following section explains the model parameterization, scenario development and the model simulation results. It concludes with policy recommendations formulated on the basis of those results.

2. Materials and methods

The study used a bioeconomic optimization model based on a representative risk-neutral profit maximizer assumption. Within this model, a food trade module was developed. The food trade module was built as a transport model, intended to optimally transfer food from excess