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**Modeling the impacts of adopting Bt cotton by African countries on world fiber and bioenergy crop markets**

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*Selected Poster prepared for presentation at the Agricultural & Applied Economics Association's 2013 AAEA & CAES Joint Annual Meeting, Washington, DC, August 4-6, 2013.*

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### Modeling the impacts of adopting Bt cotton by African countries on world fiber and bioenergy crop markets

#### Introduction

In recent decades, cotton production was primarily considered for the supply of fiber to the textile industry. However, with the emergence of a renewable energy sector, cottonseed oil might become an important feedstock for the biodiesel industry, which could result in an increasing demand for cottonseed in global commodity markets. This could possibly lead to:

- Opening an entirely new sector for the least developed cotton-producing countries of Africa, including the four major (C4) cotton-producing countries (Burkina Faso, Chad, Mali, and Benin).
- Potential opportunities for these C4 countries to increase their domestic farm-level income, generate rural employment, and also strengthen their foreign exchange through the production of cotton.

Even though the C4 countries together only contribute 5% of the world cotton production, with the absence of a domestic textile industry these countries are the second largest exporter of cotton after the United States. However, since 1980, the cotton productivity of the C4 countries has been stagnant, and even in decline after the 1990's. Therefore,

- C4 countries might pursue domestic policy reforms that would result in increasing productivity.
- As a way to increase productivity, C4 countries may want to encourage the use of proven technologies such as the adoption of genetically modified cotton.
- The adoption of genetically modified Bt (*Bacillus thuringiensis*) cotton by these countries would certainly keep them abreast with the rest of the world and help them remain competitive in the international market.

#### Objective

The research objective of this study is to determine the impact on both the world cotton and cottonseed market from the policy reform of adopting genetically modified Bt cotton, which would increase yields in the C4 African countries.

#### Data

Cotton production and consumption data used in the model are primarily obtained from USDA-FAS (Foreign Agricultural Service) Production, Supply, and Distribution (PS&D) data set. Macroeconomic data set are obtained from the International Monetary Fund (IMF) and IHS Global Insight, while commodity price data are obtained from USDA attaché reports, and other sources.

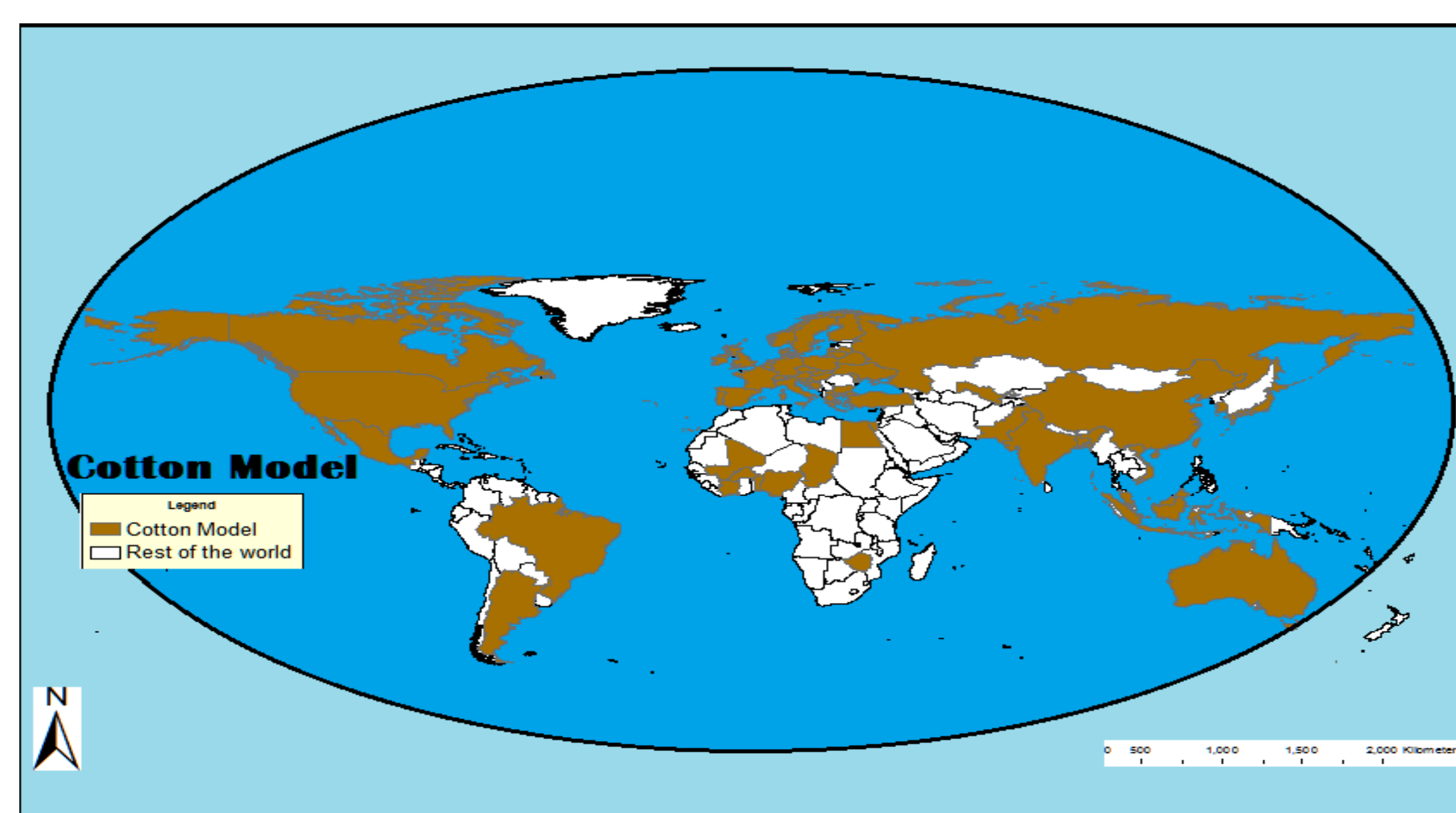


Figure 1. Cotton model by county coverage

#### Methods

- The Food and Agricultural Policy Research Institute (FAPRI/CARD) model for the world cotton market was used to give insight on the reforms in the C4 African countries' governmental policy, including the adoption of the new technology.
- The world cotton market is cleared within a broad modeling system of international agriculture. The cotton component is a multi-market partial equilibrium model, which includes the major world cotton producing and consuming countries (shown in Figure 1).
- The economic, biological, and technological relationships for the entire cotton production activities are captured through the model.
- FAPRI cotton model was extensively used for future projections, agricultural market outlook, and policy analysis.

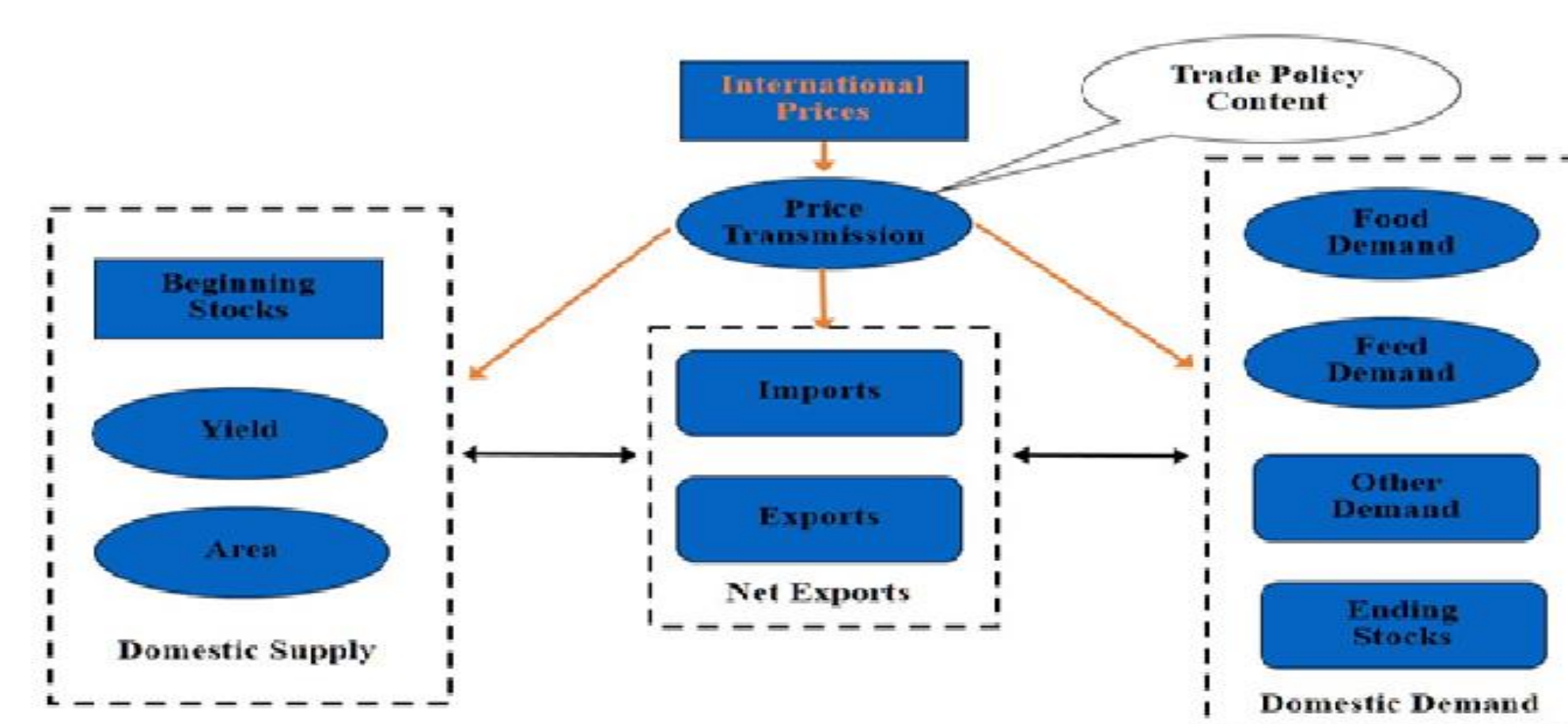


Figure 2. Schematic diagram of the global cotton market

The world cotton model is developed based on basic economic principles of demand and supply (shown in Figure 2). The model is solved for the market clearing price, taking into account the existing agricultural and trade policies of each cotton producing country. In the general structure of the model, the following identity is satisfied for each country/region and the world:

$$\text{Beginning Stock} + \text{Production} + \text{Imports} = \text{Ending Stock} + \text{Consumption} + \text{Exports}.$$

#### Results

The results show that with the adoption of Bt cotton in the C4 African countries, resulting in higher production in those countries projected in the year 2022:

- The world price of cotton would decrease by 0.54%. The rest of the countries would respond to the lower prices by decreasing production and increasing use, so exports decrease, and imports increase.



Figure 3. Percentage change in harvested area, production, consumption, and trade of cotton between the baseline and the scenario (5% increase in yield in C4 African countries) projected in 2022

If the adoption of Bt cotton by the C4 countries increased their cotton yield by 5%, then in the last year of projection, 2022:

- The average cotton production for the C4 countries would increase by 4.72%. Responding to the lower world price, the rest of the world (RoW) cotton production would decrease by around 6.27%.
- Given the slight increase in domestic cotton use, the average exports of C4 countries would increase by 4.64%, and the lower world price would decrease RoW exports by 9.35% in the last year of projection (2022).
- As expected, the cotton consumption for all countries would increase accordingly, and the harvest area would decrease (shown in Figure 3).

Results also showed that there would not be any significant change in US production, consumption, area harvested, and export with the increase in C4 countries cotton production. Even though the FAPRI/CARD modeling system was solved for all commodities, in the absence of any significant changes other commodities are not reported.

Based on the extraction rate, the estimated changes in biodiesel production form cottonseed oil in C4 countries in the 2022:

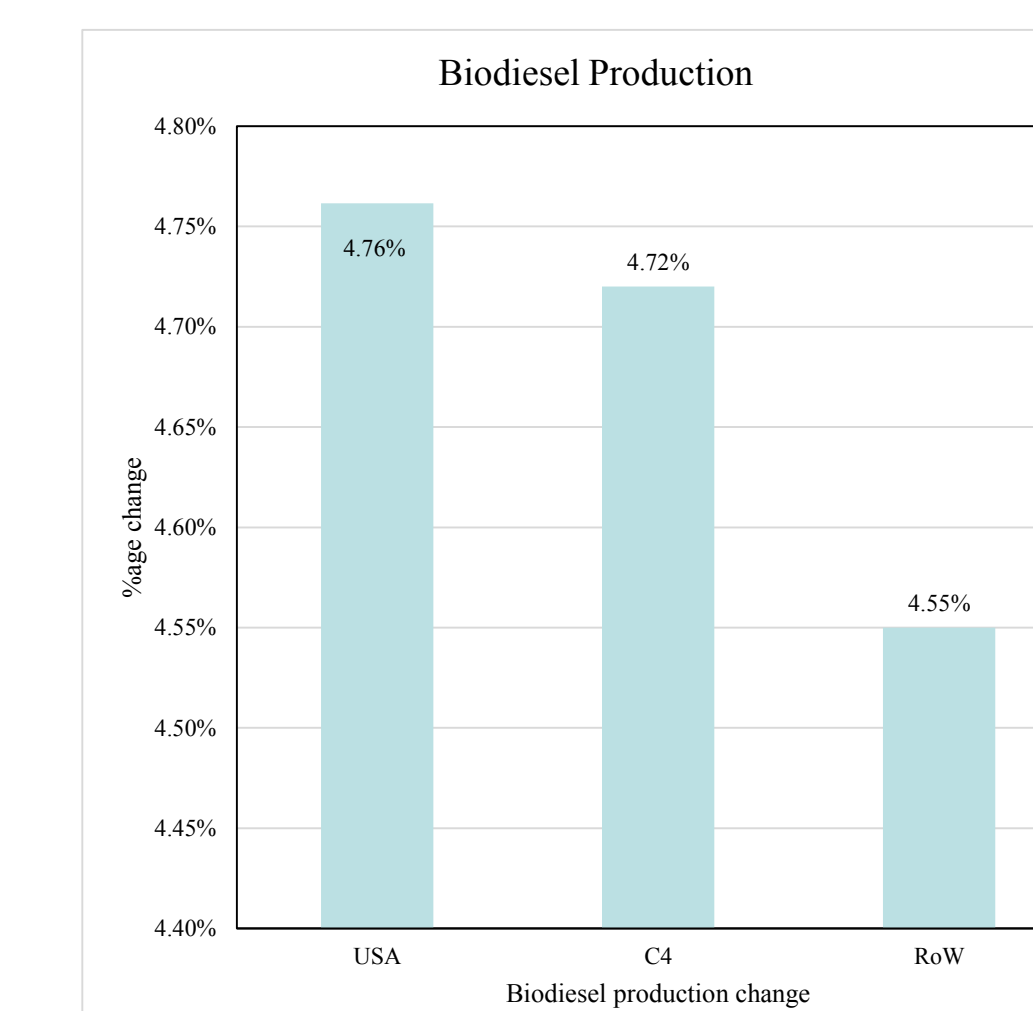


Figure 4. Percentage change in biodiesel production

- Biodiesel production would increase by 4.72%.
- US and RoW biodiesel production derived from cottonseed oil would increase by 4.76% and 4.55% respectively (shown in figure 4).

#### Conclusion

Results shows that one of the implications of the policy reform of adopting Bt cotton production by the C4 African countries, is an increase in their domestic cotton production by around 4.72%, which may increase farm income and strengthen foreign exchange in the cotton sector for those countries, and might contribute in the reduction of poverty.

Also, additional availability of bioenergy feedstock derived from cottonseed oil can be either used for biodiesel to extend local energy supply or to be exported to areas in which the demand for biofuels is large, such as the US and EU.

In the future, a more complex integrated model would be developed and solved for internally forecasting for the cottonseed price under the broad framework of the FAPRI/CARD biofuel modeling system.

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#### Acknowledgements

We would like to acknowledge the supporting staff members of FARPI/CARD, Iowa State University, USA for their technical assistance and editorial help.