

### ABSTRACT

Genetically modified (GM) rice has been developed to confer pest resistance, herbicide tolerance and health benefits, yet regulatory, policy and market barriers prevent commercialization of GM rice. This study assesses factors that prevent commercialization of GM rice. It is a large-scale project to assess constraints through several research activities:

1. Qualitative policy analysis of the regulatory landscape for GM rice in the following countries: Bangladesh, China, India, Japan, Colombia, Honduras, Tanzania, the European Union, and the United States.
2. Statistical analyses of producer and consumer willingness to pay and willingness to adopt GM rice in China, Bangladesh, Tanzania, Ghana, Colombia, and Honduras. We examine in particular GM events associated with pest tolerance and micro-nutrient fortification.
3. Global impact of GM rice adoption in selected countries. We focus on major rice importers who are more concerned about domestic self-sufficiency than international approval of GM rice that would constrain export trade.

The results show similarities and differences across countries with respect to regulatory environment, consumer and producer preferences and global impacts.

### INTRODUCTION

Meeting world food needs is a fundamental challenge as global population is expected to increase to more than 9 billion by 2050. Can GM crops help to feed the world? The John Templeton Foundation's investment in big questions along with the L.C. Carter Endowment and the University of Arkansas Division of Agriculture funded this research to "Identify and Analyze the Barriers to the Acceptance and Use of GM Rice".

Rice is one of the major crops that feed the world (accounting for 19% of global food calories, UN FAOSTAT). Yet it is one of the major crops whose GM events are yet to be accepted and used to feed the world's population. This study has examined barriers to acceptance and use of GM rice at the global level and at the country level. Descriptive and analytical policy analysis of government treatment of GM rice was conducted in the major producing/consuming and major exporting/importing countries. Particular attention has been given to a set of developing countries in Asia, Africa and Latin America to obtain a more diverse and deeper understanding of constraints towards GM rice in these countries.

More detailed results of this project are presented in other posters at the 2014 International Rice Congress.<sup>1,2,3,4,5</sup>

### METHODOLOGY

**Qualitative policy analyses were conducted using a common outline for all countries:**

- A. Overview of the food and agricultural economy of the country
- B. Overview of the political agricultural economy and food policy environment of the country
- C. History and development of current biotechnology and GM policy
- D. Identification of the political, legal, regulatory and socio-economic barriers to the acceptance and use of GM rice
- E. Critical assessment/conclusions of barriers to the acceptance and use of GM rice.

**Contingent valuation (CV) studies of consumer willingness to pay (WTP) and producer willingness to adopt (WTA).** Double bounded dichotomous choice (DBDC) questionnaires are used to estimate consumer WTP for resource stress and enhanced nutritional GM rice events. Stochastic payment card (SPC) approach is used to estimate rice producers' WTA GM rice.

**Global impact analysis** The Arkansas Global Rice Model (AGRM) and the RICEFLOW model are used to provide stochastic and dynamic analyses of the global impact of alternative adoption, diffusion and acceptance of *Bt* rice by Bangladesh, China, Indonesia, Nigeria, and the Philippines.

### RESULTS

Detailed and updated research results are posted on the project website at <http://gmrice.uark.edu/index.html> Drafts of the country policy landscape chapters reflect the diversity of rice in the national food economies of the selected countries. Stark differences in the regulatory environment exist across countries and pose major constraints and challenges to the harmonization and commercialization of GM rice in the global economy.

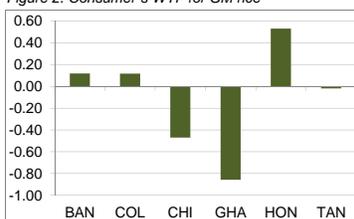
Figure 1. Geographical scope of the project



As a major food staple in many countries, the consumer WTP studies reflect large differences in the average premium or discount needed to accept GM rice (Figure 2). Consumers in Honduras were willing to pay the highest premium of 53% above the price of their regular conventional rice. Consumers in Ghana however required an average price discount to purchase GM rice relative to conventional rice of 86%. Further analysis of country and multi-country relationships between WTP and socio-demographic variables is ongoing.

However, we found that science-based information treatments of alternative traits—*Bt* rice, Golden rice, stacked traits—generate little difference in the WTP estimates, regardless of country. We also found that the order effect of providing consumers information on benefits and risks of GM rice traits did not affect WTP estimates.

Figure 2. Consumer's WTP for GM rice

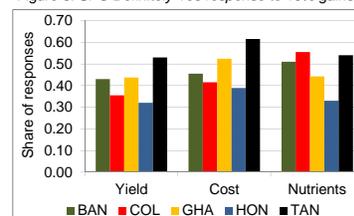


Results on producer acceptance of GM rice show that incremental improvements in yield advantage, reduction in cost of production, and improvement in health benefits are positively related. Differences across countries vary in magnitude and by trait. Figure 3 shows survey responses for farmers in five countries: Bangladesh, Colombia, Ghana, Honduras, and Tanzania. We depict a probabilistic adoption response rate of 'definitely yes' for a 10% improvement in GM yield relative to inbred, reduced cost of production and improved nutrient health benefit. the farmers

Over 50% of farmers surveyed in Tanzania are willing to adopt GM rice for a 10% improvement in any of the three traits.

In general, if farmers perceive relatively marginal yield improvements, or reduction in costs of production, or health benefits through bio-fortification, these are sufficient incentives to adopt GM rice in their production systems. Further analysis will explore the relationship in variation in WTA with farm and socio-demographic characteristics of farmers surveyed.

Figure 3. SPC Definitely Yes response to 10% gains



The global impact of *Bt* rice adoption by selected rice importing countries is found to have important impacts on total rice trade, prices, and factor markets. While these studies are hypothetical, they are based on results from research trials that have established the potential impact of GM rice on yield improvements, and reductions in pesticide application, labor and land.

### DISCUSSION

The analyses conducted by this project provide a cross-sectional assessment of the constraints and challenges facing governments, consumers, producers, bio-science companies, and international organization and foundations who are concerned about the future of food availability, food quality, environmental sustainability and the global rice economy. The research on this important topic must and will continue. Genetic improvements in a wide range of traits are necessary for one of the world's most basic staple foods. Acceptance and commercialization of GM rice has benefits and risks. However, it is important to better understand the constraints and potential of GM rice in helping to meet future food demand, to help sustain the environment and to meet the health challenges of a very large population who heavily depend on rice as a basic food staple.

### REFERENCES

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<sup>1</sup>Dept. Agr. Econ. and Agribus, Univ. of Arkansas, Fayetteville, AR USA; <sup>2</sup>Bangladesh Agricultural Univ., Mymensingh, Bangladesh; <sup>3</sup>Mzumbe Univ., Morogoro, Tanzania; <sup>4</sup>China Agr. Univ., Beijing, China; <sup>5</sup>Univ. of Gent, Belgium; <sup>6</sup>Kyushu Univ., Fukuoka, Japan.