

ABSTRACT

Genetically modified (GM) rice has been developed to confer agronomic benefits such as tolerance to herbicides, drought, flood, and salinity, and resistance to insects, as well as health benefits such as improved vitamin content. Yet regulatory, policy and market barriers including perceptions of consumer and producer unwillingness to purchase and grow GM rice have prevented commercialization.

This study is designed to help understand the barriers and controversies of GM rice acceptance in the selected Latin American countries and identify the factors that affect the willingness of consumers to purchase and producers to grow GM rice.

Double bounded dichotomous choice (DBDC) contingent valuation (CV) and multinomial logistic maximum likelihood models are estimated to measure consumer willingness to pay (WTP) for resource stress and enhanced nutritional GM rice events. Stochastic payment card (SPC) approach is used to estimate rice producers' willingness to adopt (WTA) GM rice.

The results point to a positive view of GM rice by consumers in both Colombia and Honduras as represented by WTP higher than the reference price for regular rice.

Producers in Colombia require lower agronomic and nutritional incentives to switch from inbred to GM rice varieties than Honduran producers.

INTRODUCTION

GM technology has been adopted worldwide except for food grain crops, rice and wheat. It has generated sizable economic benefits to the adopters, many in the developing world¹.

Despite the benefits associated with this technology, to date no GM food crop, including rice, have been commercialized at a large scale².

Despite the barriers to commercialization, research and development of GM rice continues, focusing on agronomic and nutritional improvements to stabilize production and improve the well being of consumers.

Colombia is one of the few countries that has approved the commercialization of LibertyLink® rice for human consumption, but no approval for production has been even presented to the regulatory authorities. Honduras has no GM rice event approved either for human consumption or commercial production.

The objective of this study is to analyze the willingness to adopt GM rice in Latin America. Colombia and Honduras are selected for detailed analysis of consumer and producer attitudes toward GM rice through the estimation of consumer WTP and producer WTA.



Colombia



Honduras

METHODOLOGY

Consumer surveys in each country, included random selection of 200 consumers. Selected locations were in Bogota, Colombia, and San Pedro Sula, Honduras, for a total of 400 consumers. WTP of consumers were estimated using the DBDC CV method.

Science-based information treatments were applied, including:

1. neutral, no information provided
2. environmental GM, information about *Bt* rice
3. nutritional GM, information about Golden rice
4. stacked environmental plus nutritional GM)

Ordering effects (benefits first vs. risks first) were tested. The DBDC questionnaire had 5 different GM rice starting prices. Socio-demographic questions were also included.

Consumer data were analyzed following the procedure by Lopez-Feldman³.

Producer surveys included 200 rice producers in USOCOELLO and USOSALDAÑA, Tolima Colombia and 103 Honduran rice producers from Guangelola, Jesus de Otoro, and Cuyamel regions. WTA was estimated using SPC CV methods following Whittington and Wang⁴. Three GM potential trait gains were framed as SPC questions—likelihood by rice farmers to produce GM rice compared to inbred rice given 0% - 20% improvements in yield, cost of production reduction and nutritional benefit.

RESULTS

Consumer results. The vast majority of respondents (84% in Colombia and 90% in Honduras) had no knowledge about GM rice prior to the survey. Most are female, with an income distribution skewed to the right. Colombian respondents have higher education and spend less in food than Honduran respondents. The WTP for GM rice across the full sample was estimated at C\$ 2,790/Kg in Colombia and L 12.2/Lb. in Honduras. Based on the WTP estimates and the reference price of non-GM rice, the findings suggest consumers in Colombia and Honduras are willing to pay a premium of 11.6% and 52.2% for GM rice, respectively. The high premium Honduran consumers are willing to pay for GM rice is striking.

We found no significant differences in WTP among information treatments or ordering effect in Colombia or Honduras. Furthermore, we found no socio-demographic variable with significant explanatory power to explain variation in WTP in Colombia. In Honduras, there is evidence of a negative relationship between educational level and WTP: respondents with primary education or less have a WTP of USD 1.6/Kg, falling to USD 1.4/Kg for those with a high school degree, USD 1.3/Kg for those with a college degree, and USD 1.2/Kg for respondents with graduate degrees. Furthermore, for the gender variable, women have a significant marginal positive impact on WTP of USD 1.1/Kg.

Table 1. Frequency of selected socio-demographic variables and estimated WTP by country

Country	Female	Income Class			Education				Share Food Expenditure			Average WTP USD/Kg	GM Rice Premium
		Low	Medium	High	<= Primary	High School	College	>= Master	<= 15%	15% - 25%	>= 25%		
Colombia	66%	49%	40%	11%	4%	42%	46%	8%	27%	33%	40%	1.41	11.6%
Honduras	78%	60%	32%	8%	28%	35%	35%	2%	8%	20%	72%	1.35	52.9%

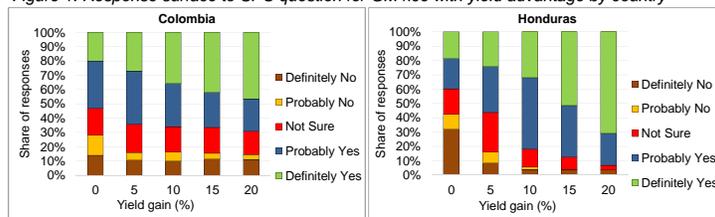
Producer results. Similar to consumers, most rice producers (81% in Colombia and 82% in Honduras) had no previous knowledge about GM rice. Roughly 90% of the respondents in Colombia and Honduras were male with an average age of 50 years and 46 years, respectively. The average farm size is significantly higher in Colombia (56 has) than Honduras (16 has).

The results suggest that Colombian producers are more willing to adopt GM rice than Honduran producers. Everything else constant, Colombian producers require a mean yield gain (of GM versus inbred varieties) of 1.8% to switch to GM rice, while Honduran producers require a 5.6%.

Also, Colombian farmers need a 1.3% decrease in production cost while Honduran farmers need a 5.7% decrease to opt for GM rice.

The nutritional benefits needed for producers to switch to bio fortified GM rice is estimated at 2.6% and 5.9% in Colombia and Honduras, respectively.

Figure 1. Response surface to SPC question for GM rice with yield advantage by country



DISCUSSION

The results of this study point to an aggregate favorable view of GM rice by consumers in both countries, represented by willingness to pay estimates higher than the reference price for regular rice. The price premium estimated for Honduras is strikingly large. No significant effect was found for information treatments, ordering effects, prior knowledge, and socio-demographic variables, except for gender and educational level in Honduras.

Everything else equal, producers require economic and nutritional benefits to switch from inbred to GM rice varieties. The results suggest Colombian farmers have a lower yield, cost, and nutritional benefit threshold to switch than Honduran farmers.

Further analysis will focus on estimation of factors to explain rice producers WTA. The findings of this study can certainly help GM private and public stakeholders design appropriate GM rice policy strategies.

REFERENCES

- 1 Brookes, G., and P. Barfoot (2014). Economic impact of GM crops. The global income and production effects 1996-2012. *GM Crops & Food: Biotechnology in Agriculture and the Food Chain*, 5:1, 1–11.
- 2 Demont, M., and A.J. Stein (2013). Global value of GM rice: a review of expected agronomic and consumer benefits. *New Biotechnology*, 30(5):426-36
- 3 Lopez-Feldman, A. (2012). Introduction to contingent valuation using Stata. MPRA Paper No. 41018.
- 4 Whittington, D, and H. Wang (2005). Measuring individuals' valuation distributions using a stochastic payment card approach. *Ecological Economics*, 55(2): 143-154

¹Research Scientist and ²Distinguished Professor, Dept of Agricultural Economics and Agribusiness University of Arkansas Fayetteville, AR 72701