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Georgian Farmers' Attitudes Towards Genetically Modified Crops

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Although, genetically engineered products (GM) have to be a broadly debated topic in different countries, there has been much less attention devoted to farmers' attitudes towards GM crops. This paper attempts to research farmers' insights on GM crops in Georgia through February-March 2014. An in-depth survey of 611 farmers revealed that respondents lack sufficient knowledge about genetic engineering. They tend to have a negative attitude towards GM crops and are strongly against of import and adoption of GM seeds. An empirical examination based on analysis of variance and Pearson's correlation coefficient verified that both education and age were significant determinants of awareness of farmers about genetically engineered crops, while income used to have no significant influence on the farmers' decision to adopt GM crops. In addition, relationship between awareness about genetic engineering and farmers' decision to adopt GM crops has to be insignificant, as well.

Keywords: genetically modified crops, farmers, attitudes, empirical research, awareness, Georgia

Introduction

Fast changes and developments in modern science and technology caused growing availability of GM products. Although, an active usage of genetic engineering and genetically modified organisms (GMO) could derive significant benefits to the society, sufficiently nourishing a rising number of people, attitude of the broad masses of society toward these technologies is still highly disputed.

Although, various studies demonstrate that many people are willing to accept GM foods, yet relatively few people know much about their features. It is still puzzling to understand what factors shape farmers' attitudes toward taking risks raised from planting GMO's, awareness about genetic engineering and GM labeling, and what basic socio-demographic determinants influence their decision to plant varieties of GM crops. Thus, there is a solid demand for systemic research on the producers' acceptance of GMOs. It is essential to both identify causal indicators and empirically test the model of the acceptance of GMO engineering.

The objective of the research is two-fold: first to study the significance of various socio-demographic factors that may influence Georgian farmers' attitudes and production intentions of genetically modified crops;

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second, grounding on empirical findings, formulate recommendations to come up with relevant GM goods regulations to better match the needs of Georgian farmers.

The paper is organised as follows. Section 2 reviews related literature. Section 3 outlines main empirical strategy and estimation method. Section 4 discusses the econometric results and main findings. Finally, Section 5 summarises and concludes.

Literature Review

Findings of academic literature on producer attitudes towards GM goods in various countries are mixed. Despite the fact that genetically modified (GM) crops represent one of the most broadly practiced agricultural technologies the agriculture of GM products is still highly unacceptable for many countries. Even in the largest GMO producer countries opinions with regards to GMOs are conflictual and contentious.

Majority of researches conducted in the United States—the largest grower of GMOs in the world—demonstrate a high level of tolerance of American farmers towards GMOs. However, it should be emphasized that most of the studies are quantitative in nature and are conducted as closed questionnaires; furthermore, they fail to address the differences between small- and large-scale producers.

Farmers living in US stress on following benefits gained by adopting GM varieties: lower production costs (Darr & Chern, 2002; Van Der Sluis & Van Scharrel, 2004; Chimmiri, Tudor, & Spaulding, 2006); less chemicals needed for plant protection, resulting in reduced pesticide input costs and increased yields (Fernandez-Cornejo & McBride, 2002; Darr & Chern, 2002; Van Der Sluis & Van Scharrel, 2004) simple and efficient weed management system (Carpenter & Gianessi, 1999; Pilcher et al., 2002; Van Der Sluis & Van Scharrel, 2004; Merrill, Goldberger, & Foltz, 2005; Chimmiri et al., 2006); and growth in productivity in some cases, such as with herbicide-tolerant (Ht) corn and Ht soy (Pilcher et al., 2002; Fernandez-Cornejo & McBride, 2002).

In Brazil, the second largest GMO producer country, farmers exhibit high level of expertise in genetically engineered crops, demonstrating sophisticated and empirical understanding of these products. However, an issue of higher productivity is vastly debated. Céleres (2010) and Massarani, Polino, Cortassa, Fazio, and Vara (2013), investigating producers attitude toward productivity and profitability of GM soy, came up with mixed results. Some farmers conformed rises in yields after adoption of GM varieties. In addition, Céleres (2010) and Massarani et al. (2013) illustrate that some farmers received higher profits at the end of the harvest, while other farmers failed to get higher profits as a result of the royalties paid to Monsanto. Van Der Sluis and Van Scharrel (2004) claim that productivity of GM soy was higher in the beginning but fell thereafter.

As an academic literature shows, in Argentina, the third biggest producer of GMO goods, GM crops were generally viewed positively during the first years of introduction of the technology (Vara, 2005). According to Argentine farmers GM crops are associated better weed control management system, a saving in pesticides expenditures, and easier and time-efficient crop management.

Studies investigating the links between adoption of GM crops and farmer education and farmer age appeared to be inconsistent. Fernandez-Cornejo and McBride (2002) claim that adoption of Bt corn and HT corn was positively correlated with education, while same was not validated for HT soybeans. Alexander et al. (2003) state that more years of schooling were correlated with lower shares of GM soybeans adoption; whereas Fernandez-Cornejo and McBride (2002) verified that better education positively influences on HT soybean adoption. Darr and Chern (2002) established that farmers with an even minor college education have a tendency to adopt both Bt corn and GM soybeans. The two authors also declared that older farmers were more

likely to adopt Bt corn, however Van Scharrel (2003) showed that farmer age was adversely related to previous adoption practice of Bt corn.

As regards to the links between farmer attributes and knowledge of agricultural biotechnology, Tegegne et al (2003) established that age, education, and farm size were significant determinants of self-reported knowledge for a sample of small farmers in Tennessee. Farmers being younger, more educated, and with broader operations tend to have greater self-reported knowledge in genetic engineering.

The main goal of all the aforementioned researches was to verify farmers' awareness, behavior and attitudes towards genetic engineering. As it stands, studies provide mixed results on the attitudes of producers towards adoption of GM crops. Although empirical literature advocates that higher yields are the most common motive for GM adoption, qualitative evidence verifies that the potential of GM crops to raise incomes per acre of land is not the only concern of modern farmers.

There is limited number of articles published on Georgians attitudes towards GM engineering. Apil, Kaynak, and Todua (2008) found that the decision-making process related to purchasing the food products is impacted by the country from which the product originates. Study conducted by Todua, Gogitidze, and Phutkaradze (2015) reveals that Georgian consumers know very little about genetic engineering, however they still believe that consequence triggered by consumption of GM goods is negative. Furthermore, as an empirical investigation based on analysis of variance and Pearson's correlation coefficient validated education, income and social class are significant determinants of genetic engineering awareness among consumers, whereas age used to be irrelevant factor.

As it stands, all these studies concentrate on general consumer behavior in Georgia, while omitting the opinion of farmers as potential producers of GM crops. It is important to value practical knowledge and experiences of farmers. For this reason it is necessary to conduct an in-depth research, investigating the links between farmer attitudes and GM agriculture in Georgia.

Research Methods

In order to survey sample size to be an accurate representative of the total number of Georgian farmers the study employed stratified selection approach. This method assumes division of the entire population sample into a number of homogenous layers (strata), subsequently sampling a prearranged number of units from each stratum, proportionally to its size (Malhotra, 1999). The stratified sampling technique ensures various clusters of population to be represented in the sample in the right proportion.

In order to define the right survey sample size formula developed by Belyaevsky, Kulagina, and Korotkov (1995) was employed:

$$n = \frac{t^2 \times \delta^2 \times N}{t^2 \times \delta^2 + \Delta^2 \times N}$$

where:

n—stands for sample size;

t—value of the t-statistics for a given level of confidence. The study follows the broadly accepted norms in the contemporary economic literature and defines a confidence level to be 95% with an infinite number of degrees of freedom (df);

δ^2—measure of variance of the control variable in the population. In other words it is a precision level, or the maximum permissible amount of random error;

N—population size.

It is possible to utilize findings from previous researches to derive the variance of the control variable in a population of interest, but, as it stands, no consistent historical data are available on the portion of the Georgian farmers who produce or agree to produce GM crops. Therefore, it is recommended to accept the highest conceivable variation that would occur if there were an equal split between pro-GMO (50%) and anti-GMO (50%) adoption (Golubkov, 1998).

Margin of errors is set to be equal to 4%. This is a common precision level used in similar study (Iadov, 1995).

According to the State Statistics Department of Georgia there are 762 thousand beneficiary farmers in Georgia based on the preliminary data for the 2014 census. Based on the formula the minimum net survey sample size is calculated to be equal:

$$N = \frac{1.96^2 \times 50^2 \times 762000}{1.96^2 \times 50^2 \times 4^2 \times 762000} = 600$$

The survey was carried out in Georgia from February to March, 2014. Six hundred and eleven farmers (414 men and 197 women) were in-depth interviewed. The face-to-face interaction research methodology of data-collection was applied.

Research Results

As the results of survey revealed the majority of farmers do not have a basic knowledge about GM goods. Twenty-four percent of respondents have absolutely no idea about genetic engineering and GM products, while only half of the remaining can provide basic definition and explain main characteristics of GM technologies.

Fifty-three percent of farmers were inexpert to list the positive characteristics of GM products. Almost a third of participants (27%) emphasized on durability and resistance to various diseases to be the main benefit of GM products. Thirteen percent believe that GM crops are featured with better quality. Three percent underlined the idea that GM crops were absolutely healthy for adoption and 4% consider genetic engineering and GM products as means to promote biodiversity.

Less than half of respondents stated that the usage of genetically modified products could damage the environment and harm human health. Forty-three percent of survey-participants agree that GM goods are dangerous for human health, while 16% believe that GMOs are less likely to damage well-being of a person. Only 10% of total respondents stated that GM products do not pose any kind of threat to a human health. On the other hand, 31% of farmers left question unanswered due to the lack of actual data available regarding genetically modified crops.

According to the responses on the influence of gene modified seeds on the environment, 38% consider that such seeds will definitely have a negative impact on the environment, on the contrary to 9% of farmers, who agree that GM seeds will not have any negative effects on the environment. Nineteen percent of respondents think that GM seeds are less likely to have any bad impact on the environment, while 33% rejected to answer the question due to the lack of data available to them about the impact of GM seeds on the environment.

The research also tries to learn the interest of Georgian farmers towards GM technologies. Results showed that 64% of total respondents were interested in this technology and were willing to get more information about it. On the other hand, the rest 36% were less interested in this technology at this stage.

As regards to the demand for genetic modified seeds it was found out that 75% preferred to continue working with the natural seeds the way they used to. The other 25% were interested in working with GM seeds, but only because of the interest in modern technology-development.

With the willingness to adopt GM seeds, the results were very similar to the ones on demand mentioned above. Seventy-eight percent of participants were strongly against the usage of GM seeds on their property. On the other hand, the 22% were tolerant towards GM seeds and were willing to experiment with the product given the chance.

Factors Influencing Awareness and Adoption of GM Crops

Based on the survey results numerous hypotheses that define relationship between the degree of awareness about genetic engineering and the tendency of Georgian farmers to adopt GM varieties were established:

H1: Education positively impacts awareness of farmers on genetic engineering;

H2: Age influences awareness of farmers about genetic engineering;

H3: Income is an important factor for adoption of GM crops by farmers;

H4: Awareness about genetic engineering influences the decision to adopt GM varieties.

The hypotheses were tested using the SPSS (Statistical Package for the Social Sciences) statistical software. Analysis of variance was conducted and the Pearson correlation coefficient was calculated in order to verify the hypothesis of interest. The research used One and Two Way ANOVA *F*-Tests to understand if there is an interaction between the independent variables and the dependent variables.

At first, the study investigates whether education level has any influence on the awareness/knowledge of farmers on genetic engineering. Findings indicate that coefficient of education is significant at 5% level, meaning education to be significant determinant of farmers' awareness about genetic engineering and GM crops ($F = 8.480$, $p = 0.000$). Based on results it can be claimed that H1 is supported, thus it indicates that the farmer has more information on GMO if one is more education.

Table 1

Impact of Education on Genetic Engineering Awareness of Farmers

	Dependent variable: *Awareness*				
	Sum of squares	df	Mean square	*F*	*p*
Education	7.345	3	1.469	8.480	0.000
Error	104.805	607	0.173		

Source: own elaboration.

One Way ANOVA *F*-Test was used to check if age differences have any impact on farmers' awareness about genetic engineering. The results suggest that age plays an important role in awareness of farmers ($F = 3.668$, $p = 0.012$). Younger and middle age farmers are relatively more informed about GMOs.

Table 2

Impact of Age on Genetic Engineering Awareness

	Dependent variable: *Awareness*				
	Sum of squares	df	Mean square	*F*	*p*
Age	1.997	3	0.666	3.668	0.012
Error	110.153	607	0.181		

Source: own elaboration.

In order to test the third hypothesis researchers employed both ANOVA and the Pearson Correlation Coefficient. The ANOVA test illustrates that income is not an important factor in the decision-making process with regards to adoption of genetically modified crops by farmers. *F*-test = 0.653 (p = 0.625) is not significant at 5% level, meaning income of farmers does not have any influence on the GMO adoption rate.

Table 3

Impact of Income on Adoption of GM Crops by Farmers

	Dependent variable: *Adoption of GM crops*				
	Sum of squares	df	Mean square	*F*	*p*
Income	0.323	3	0.81	0.653	0.625
Error	57.96	607	0.124		

Source: own elaboration.

Analysis of the relationship between awareness about genetic engineering and the decision of farmers to adopt GM crops revealed that the relationship is not significant at 5% level. Based on *F*-statistics (F = 1.890, p = 0.170) the null hypothesis cannot be rejected, thus GMO awareness-adoption relationship could not be confirmed.

Table 4

Impact of Awareness About Genetic Engineering on Adoption of GM Crops

	Dependent Variable: *Adoption of GM crops*				
	Sum of squares	df	Mean square	*F*	*p*
Income	0.327	3	0.327	1.890	0.170
Error	105.401	607	0.173		

Source: own elaboration.

Conclusion

This research analyzed the determinants of awareness and acceptance of genetically engineered crops by Georgian farmers. The researchers empirically investigated the survey data collected from 611 farmers to test general attitudes of Georgian farmers towards GM crops and identify which socio-demographic factors influence farmers' decision to adopt genetically modified crops at their farms.

The study results indicate that Georgian farmers are relatively "uninformed" about genetically engineered products, but they are keen to get more information about it. In general, there is a negative attitude towards GM crops. Absolute majorities (91%) of farmers are strongly against GM seeds, claiming that the quantity of natural seeds in Georgia is sufficient enough to keep farming going in the country. However, such approach is the outcome of farmers' determination and socio-cultural practice to produce natural goods rather the lack of knowledge.

Based on empirical analysis it was found out that both education level and age are significant determinants of awareness of farmers about genetically engineered crops. More educated and younger farmer are the ones who are more knowledgeable about GMOs. On the other hand, the results suggest that income does not have any significant influence on the farmers' decision to adopt GM crops. The study also found that awareness about genetic engineering is not a significant factor in the decision-making process of farmers to adopt GM crops.

The current low level of knowledge and awareness of Georgian farmers suggests they need more information about genetically engineered crops and that governmental policies should respond to their interest. Farmers should be more actively involved in the policy related debates, since their decision about whether or not to cultivate GM crops is crucial to the future of the technology and Georgia's agriculture development.

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