MARKETING RESEARCH OF ATTITUDES TOWARDS GENETICALLY MODIFIED CROPS BY GEORGIAN FARMERS

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Abstract

Although, genetically modified (GM) crops have to be a broadly debated topic in different countries, there has been much less attention devoted to farmer 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, marketing research, Georgia.*

Classification JEL : *M310*

1. Introduction and context of the study

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.

From July 1, 2015, Georgian government enforced a new law according to which all products that contain genetically modified components must have proper labeling. The increased regulatory and labeling requirements of genetically modified organisms elevated extensive concerns about the production and marketing of GMO foods, which calls for a deeper understanding on the public's outlook toward GM products in Georgia.

The new regulation allows the government to verify whether imported food products are genetically modified and if they are, the products will be removed from the market. Although, new requirements are expected to benefit Georgian consumers, the Georgian farmers' opinion about GM foods and their features is still unclear.

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 farmers' attitudes and production intentions of genetically modified crops; 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 discusses related literature. Section 3 outlines main empirical strategy and estimation method. Section 4 reports and discusses the econometric results and main findings. Finally, Section 5 summarises and concludes.

2. Literature Review

Findings of academic literature on producer attitudes towards GM goods in various countries are mixed. Despite the fact that GM crops represent one of the most broadly practiced agricultural technology, the agriculture of GM products is still highly unacceptable for a wide range of 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 [1].

Farmers living in US stress on following benefits gained by adopting GM varieties: lower production costs [2] – [3]; less chemicals needed for plant protection, resulting in reduced pesticide input costs and increased yields [4] simple and efficient weed management system [5] - [6] – [7]; and growth in productivity in some cases, such as with herbicide-tolerant (Ht) corn and Ht soy [4] - [6].

Study by Carpenter and Gianessi revealed that farmers adopted herbicide-tolerant (HT) soybeans during 1990s as it provided simple and flexible weed management systems [5]. In a later study, Fernandez-Cornejo and McBride found that adoption of HT soybeans reduced chemical input costs and raised yields as a consequence of better pest control [4]. Fernandez-Cornejo and McBride also discovered that adoption of HT maize had a positive effect on net returns of the farm, while the adoption of Bt maize had an adverse influence. Furthermore, the two authors were not able to find any significant relationship between the adoption of HT soybeans and farm net returns. Consequently, the results suggest that such factors as easier management system and time savings could be the reasons for adoption of GM varieties by some farmers.

Darr & Chern concluded that reduced pesticide costs and reduced total production costs was the main determinant for adoption of GM soybeans by Ohio grain farmers [8]. Main benefits of Bt maize were reduced pesticide expenses, lower pesticide use, higher yields, and better insect control mechanism. Disadvantages related to Bt corn were: difficulty to market the crop and additional costs for acquisition of Monsanto's seed.

According to Pilcher et al around one-half of Illinois Bt maize producers believed that Bt corn had higher yields compared to non-Bt hybrids [6]. As with regards to economic returns, more than half of the Illinois Bt maize farmers believed in higher returns with Bt corn. Merrill, Goldberger, and Foltz state that a majority of Wisconsin producers received higher yields, higher costs, and higher profits with Bt maize, and reduced costs with HT maize compared to conventional corn species [7].

Fernandez-Cornejo, Margriet Caswell [9], concentrating on nation-wide adoption of HT soybeans in 1997, revealed positive correlation between the farm size and GM adoption rate. Darr and Chern [8], utilizing Tobit model to investigate adoption of GM varieties by Ohio producers, demonstrate that the relationship of income and farm size with Bt corn or GM soybean adoption is insignificant. Based on study by Alexander et al large Iowa farms tend to have higher adoption rate of GM maize and soybeans [10]. Employing logistic regression analysis to data pool gathered from South Dakota farms Van Scharrel and established positive correlation between total cropland acreage and adoption of HT soybeans [11]. Merrill et al revealed that large Wisconsin farms have a tendency to utilize more GM crops than small farms [7].

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. As it appears, an issue of higher productivity is vastly debated. Almeida, Massarani and Moreira, investigating producers attitude toward productivity and profitability of GM soy, came up with mixed results [12]. Some farmers conformed rises in yields after adoption of GM varieties. In addition, Almeida, Massarani and Moreira 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 Scharrel and Van Der Sluis claim that productivity of GM soy was higher in the beginning but fall thereafter [13].

As an academic literature show, in Argentina, the third biggest producer of GMO goods, GM crops were generally viewed positively during the first years of introduction of the technology [14]. 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. Nevertheless, few aligned GM crops with enlarged productivity [14].

11 years after the legal authorization of GM varieties in Argentina, a research led by Massarani et al,

demonstrated that, there was a substantial growth in social concerns resulting from significant expansion of this crop [15]. Despite the fact that GMO adoption was associated with additional economic benefits, bulk of the profits received by farmers originated from renting out their plots for commercial purposes and not from the crop itself. As a result, farmers became more dependent on other agents and lost their skills and identity as farmers Massarani et al [15].

Massarani et al applied a qualitative focus-group methodology to research small farmers' attitude toward GM crops. As the research illustrate, producers of GM crops have overall awareness about these new technologies, some of them providing proper definitions of GMOs and explaining main characteristics and types of benefits obtained. However, farmers with less involvement of GM crops mostly demonstrated low awareness, often being incapable to provide a suitable definition [15].

The GM discussion in the European Union countries has been constantly presented as being polarized into pro-GM and anti-GM. The surveys conducted by Gaskell et al in 1991, 1993, 1996, 1999 and in 2002, representing a sample of 16,500 respondents, revealed that a majority of Europeans do not support GM foods [16]. "These are judged not to be useful and to be risky for society. For GM crops, support is lukewarm, while they are judged to be moderately useful they are seen as almost as risky as GM foods" [16].

Areal et al tried to also study European Union (EU) farmers' attitudes towards adoption of genetically modified crops by applying cluster analysis [17]. The authors divided farmers into two groups; such approach allowed classification of farmers into prospective adopters or rejecters of genetically modified herbicide-tolerant (GMHT) crops. As the data revealed such economic factors as higher income and the drop of weed control costs are happened to be the most important reasons for the decision to adopt or reject GMHT crops. In addition, the study tests how implementation of various measures to ensure coexistence between GM and non-GM crops could impact farmers' attitudes towards GMHT crop adoption. Areal et al claim that the execution of a coexistence policy would have an adverse effect on farmers' attitudes on adoption and as a result may impede GMHT adoption in the EU [17].

Hall tried to identify farmer attitudes regardings genetically modified (GM) crops in Scotland using Q methodology. The study reveal three sorts of attitudes toward GM varieties: one prone to be positive towards the notion of GM and anticipating possible benefits, the second representing somehow uncertain viewpoint, cautious of the possible risks of the technology but likely to be reluctant adopters, and the third exhibiting a rather fatalistic attitude towards the issue of genetically engineered technologies. As the study revealed, farmers represent an important stakeholder group in the debate and are less profoundly pro- or anti-GM than other groups involved in the debate [18].

Han et al examined Chinas Bt cotton farmers' attitudes towards GM crops and the factors influencing these attitudes. Data was collected via interview surveys of farmer households. The authors utilized a discrete choice approach to address the hypothesis of interest. They generated two separate probit models to see the outcome of various indicators on the choices of the respondents. According to the article Bt cotton farmers tend to have a strongly positive attitude, since Bt cotton is a source of significant economic benefits [19].

Studies investigating the links between adoption of GM crops and farmer education and farmer age appeared to be inconsistent. Fernandez-Cornejo and McBride claims that adoption of Bt corn and HT corn was positively correlated with education, while same was not validated for HT soybeans [4]. Alexander et al states that more years of schooling were correlated with lower shares of GM soybeans adoption [10]; whereas Fernandez-Cornejo and McBride verified that better education positively influences on HT soybean adoption [4]. Darr and Chern established that farmers with an even minor college education have a tendency to adopt both Bt corn and GM soybeans [8]. The two authors also declared that older farmers were more likely to adopt Bt corn, however Van Scharrel showed that farmer age was adversely related to previous adoption practice of Bt corn [11].

As with regards to the links between farmer attributes and knowledge of agricultural biotechnology, Tegegne et al establish 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 [20].

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. For example, Apil et al found that the decision-making process related to purchasing the food products is impacted by the country from which the product originates [21]. Another study conducted by Todua et al reveals that Georgian consumers know very little about genetic engineering, however they still believe that consequences triggered by consumption of GM goods is negative [22]. 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.

3. Research Methodology

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 [23]. 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 was employed [24] (1):

$$n = \frac{t^2 \times \delta^2 \times N}{t^2 \times \delta^2 + \Delta^2 \times N} \qquad (1)$$

Where:

n is the stands for sample size;

t—value of the t-statistics for a given level of confidence. The study and 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 [25].

Margin of errors is set to be equal to 4%. This is a common precision level used in similar studies [26].

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 (table no. 1).

Table no. 1 Sample structure according to age and occupation

AGE	MEN							WOMEN						
	Government Agencies	Private sector	Own business	Farmer	other	Unemployed	TOTAL	Government Agencies	Private sector	Own business	Farmer	other	Unemployed	TOTAL
<20	-	-	-	-	-	1	1		1	-	-	-	1	2
20-24	8	10	-	3	2	20	43	4	4	1			13	22
25-54	44	20	7	51	11	72	205	56	8	4	14		41	123

55 >	27	11	5	53	1	68	165	10	3	3	11	2	21	50
TOTAL	-	-	-	-	-	-	414	-	-	-	-	-	-	197

Source: own elaboration.

To achieve the research objective, the questionnaire was designed to identify:

— Farmers awareness about GM crops;

— Farmers interest and willingness to plant GM crops;

— Attitude of farmers as consumers toward GM products;

— Farmers attitude and adoption decision on genetically modified crops according to their socio-demographic characteristics.

4. Research Results

Farmer Awareness about Genetically Modified Crops

As the results of survey revealed the majority of farmers do not have a basic knowledge about genetically modified 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 and renounced to answer the question about them. 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. 3% 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 sixteen percent 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, thirty-eight percent considers 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.

Farmers Interest and Willingness to Plant GM Crops

The research also tries to learn what was the interest level of Georgian farmers towards GM technologies. Results showed that sixty-four percent of total respondents were interested in this technology and furthermore 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 with regards to the demand for genetic modified seeds it was found out that seventy-five percent preferred to continue working with the natural seeds the way they used to. The other twenty-five percent were interested in working with GM seeds, but only because of the interest in modern technology-development.

As with the willingness to adopt GM seeds, the results were very similar to the ones on demand mentioned above. 78 % 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.

With reference to the aforementioned results, only 1 % agrees and is willing to harvest GM crops in their farms. Eight percent of respondents agree to work with hybrid products, while the absolute majority of respondents ninety-one percent are strongly against GM seeds and are willing to work only with natural seeds.

It was also important to understand the views/perceptions of farmers towards import of GM seeds. Sixty percent of respondents think that there is no need to import GM seeds in Georgia. Respondents agree that quantity of natural seeds in Georgia is sufficient enough to keep farming going in the country. On the other hand, 16 % believe that GM seeds should be imported in Georgia to some extent, while twenty-four percent do not have enough data to answer the question.

Attitude of farmers as consumers toward GM products

It is important to understand the interests of farmers not only as suppliers but also as consumers. According to the results of the research, the majority (88 %) of farmers base their purchasing decisions of quality of the product and only eight percent on price. Study also revealed that for the remaining of the ample (4 %) other factors, such as design, visual features, country of origin, etc. were important during the purchasing decisions.

Since, the labeling genetically engineered products is actual in Georgia it was also important to understand the level of interest towards data available on the labels. The study showed that seventy-eight percent of respondents read/interested in data available on the packaging. 11 % does not read the information available on packaging/label of the product, while 11 % does not trust the data on the labels and are not interested in reading them.

According to eighty-one percent of survey-participants, the government should control the import and adoption of genetically engineered crops through legislation, and conduct necessary inspections and checks in order to ensure proper labeling of such products in the market.

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 with regards to 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 of farmers 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 variable.

At first, the study investigates whether education level has any influence on the awareness/knowledge of farmers on genetic engineering (table no. 2). 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 no. 2 Impact of education on genetic engineering awareness of farmers

Estimated Marginal Mean					
Dependent Variable: *Awareness*					
	Sum of Squares	df	Mean Square	F	p
Education	7,345	3	1,469	8,480	.000
Error	104,805	607	0,173		

P<0.05 means that the differences between the groups studied are statistically significant.
Source: own elaboration.

One Way ANOVA F-Test was used to check if age differences have any impact on farmers' awareness about genetic engineering (table no. 3). The results suggest that age plays an important role in awareness of farmers (F=3.668, p=0.12). Younger and middle age farmers are relatively more informed about GMOs.

Table no. 3 Impact of age on genetic engineering awareness

Estimated Marginal Means					
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		

P<0.05 means that the differences between the groups studied are statistically significant.
Source: own elaboration.

In order to test the third hypothesis researchers employed both ANOVA and the Pearson Correlation Coefficient (table no. 4). 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 no. 4 Impact of income on adoption of GM crops by farmers

Estimated Marginal Means					
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		

P<0.05 means that the differences between the groups studied are statistically significant.
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 (table no. 5). Based on F-statistics (F=1.89, p=0.17) the null hypothesis cannot be reject, thus GMO awareness-adoption relationship could not be confirmed.

Table no. 5 Impact of awareness about genetic engineering on adoption of GM crops by farmers

Estimated Marginal Means					
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		

P<0.05 means that the differences between the groups studied are statistically significant.
Source: own elaboration.

5. Conclusions

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 in Ajara region 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 Ajarian 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. In addition, findings suggest that farmers expect the government to take care of both imports and local production regulations of genetically modified organisms, paying particular attention to labeling issues.

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 decisions 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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