

The Influence of Scientists, Agricultural Advisors, and Farmers on Innovative Agrobiotechnology

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Agrobiotechnology is one of the most innovative fields of science, and its achievements are widely used in knowledge-based bioeconomy (KBBE). At the same time, some products in several countries arouse public controversy; 75% of Poles are against using genetically modified organisms (GMOs) in food and feed production. It should be stressed that scientists involved in molecular research play a crucial role in technological progress, as well as farmers and agricultural advisors responsible for the information flow. In order to identify the determinants underlying the perception of GMOs, qualitative and quantitative studies were carried out in 2012 and 2013 in Poland. Results of this study revealed that scientists were rather optimistic about the use of genetic engineering in the economy, agricultural advisors were mostly against the use of GMOs in food and feed production, and farmers showed particular interest in the profitability and safety of specific GM products.

Key words: GMOs, information flow, public perception.

Introduction

The importance of a knowledge-based economy—and particularly the bioeconomy—was highlighted in 2010 in the Lisbon strategy, which identified the main objective of the European Union (EU) as “to become the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion” (European Parliament, 2010, p. 32). This concept was upheld in the strategy for Europe 2020 (Figure 1). The need to transform new ideas into innovative products—which, in turn, contribute to economic growth and job creation—has taken on greater significance in the context of economic recovery.

Biotechnology offers solutions to many challenges of the modern world, in the form of biopharmaceuticals, biomaterials, bioenergy, biofuels, and sustainable food and feed production. Therefore, this science is one of the foundations for an innovative bio-economy. However, the awareness of a need for innovative agrobiotechnology products has not been translated into specific actions within the European economy. The low level of commercialization of biotechnological inventions in the field of agrobiotechnology in most of the EU member countries increases the gap between the EU and the leaders of world production (such as the United States or Brazil; Masip et al., 2013). Although the EU was a key player in research and development of genetically modified plants until the 1990s, recently a large part of the private sector as well as academic research has moved its research to other regions due to anti-bio-

tech activists and unfriendly legislation (Romeis, Meissle, Brunner, Tschamper, & Winzeler, 2013; US Department of Agriculture, Foreign Agricultural Service, 2013). Poland is no exception; moreover, the Polish industry is involved in research funding on a very small scale, and the cooperation between academia and business is insufficient. An additional difficulty is the lack of legislative solutions to facilitate the promotion of the development of innovative technologies and public resistance against the use of GMOs in food and feed. In 2013, a national ban on GMO cultivation in Poland was imposed, and farmers who violate the ban will have to pay fines and destroy the crops at their own expense.

Public opinion polls on the acceptance of different sectors of biotechnology have been carried out repeatedly within the EU; these polls indicate the deepening aversion to the use of GMOs in the agri-food sector. On the other hand, there is still not enough data on opinions of people directly involved in agricultural biotechnology and on the flow of information between stakeholders. We should also ask the question whether—in the case of high-tech situations—the opinion of experts skilled in the art is equivalent to the views of laymen, especially given the fact that studies carried out in 2012 revealed that 66% of Poles did not know for what the acronym GMO stands, despite the fact that they had strong opinions on this matter (Nowicka & Kalinowski, 2012).

Better knowledge on the subject and a thorough understanding of the issue reduce the effect of manipulation. Understanding the molecular mechanism of



Figure 1. Key events for implementation of the concept of KBBE (Knowledge-Based BioEconomy) in the EU, based on European Commission, Bio-economy 2020 and Priority setting for research 2011.

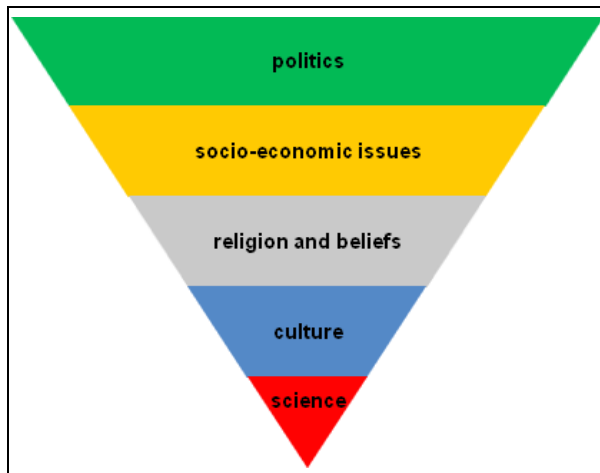


Figure 2. Effectiveness of manipulation depending on the impact on different social spheres.

transgenesis allows a critical evaluation and helps to undermine unfounded allegations formulated by well-organized anti-biotech activists. Discussion based on facts is more substantial than discourse based on personal views. What is more, by referring to scientific data we minimize efficiency of manipulation, whereas focusing on attitudes and personal views leaves much room for such influences (Figure 2).

Next to scientists—who are involved in molecular research—a crucial role for commercialization of innovations is the practitioner; in the case of agrobiotechnology, this role is filled by farmers. The direct contact of these two groups is only occasional, so the flow of information on new technologies is provided usually by agri-

cultural advisors, who are the intermediary link between the laboratories and the producers.

Methods

Given the importance of three groups—scientists, farmers, and agricultural advisors—for the further development of agricultural biotechnology, we carried out quantitative and qualitative studies in 2012 and 2013 in Poland (Figure 3).

The first step of our study was to choose the research method. Quantitative studies allow one to generalize results from a sample to the general population and to present gathered data in a numerical form, such as statistics or percentages. These studies present the answer to the question of how often the various opinions and facts occur in the sample, but the studies cannot provide insights into the setting of a problem. In the case of attitudes toward the use of transgenic organisms in agrobiotechnology, quantitative studies measure only the incidence of pro and contra views in a sample but do not explain the reasons of presented opinions. In order to gain a full understanding of underlying motivations, qualitative studies should be performed.

To provide better validity of research and reduce measurement error, we used triangulation. This technique involves the use of qualitative and quantitative methods or the application of two or more research methods (e.g., individual in-depth interviews and focus group interviews) in the study of one phenomenon. With this technique, we are able to validate data through verification from various tools.

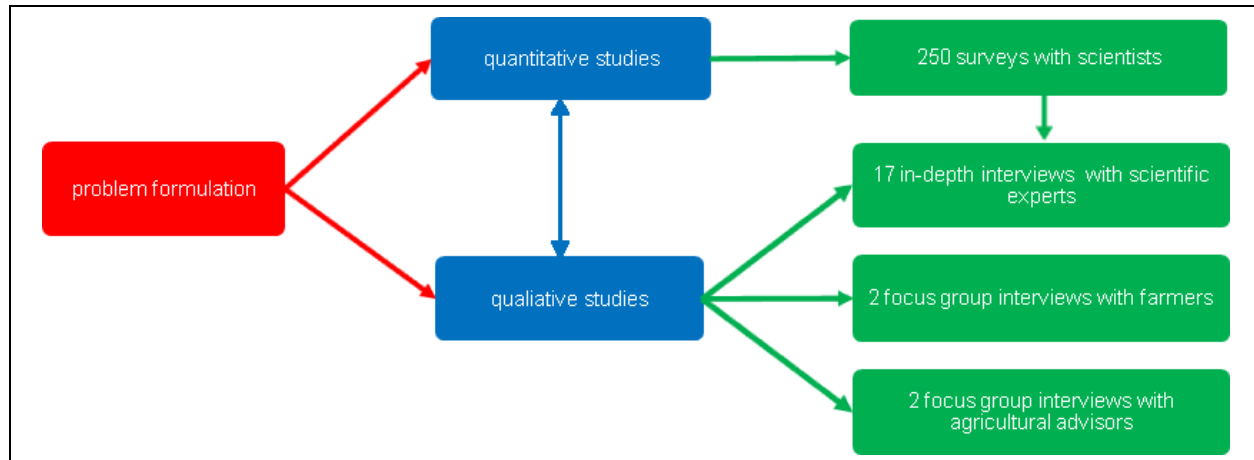


Figure 3. Stages of research on attitudes towards innovative agrobiotechnology.

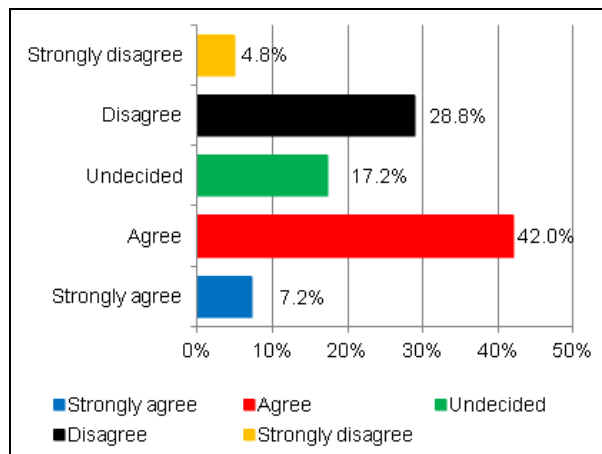


Figure 4. Opinion of the scientist about contribution of GM food/feed on the quality of food products on the market.

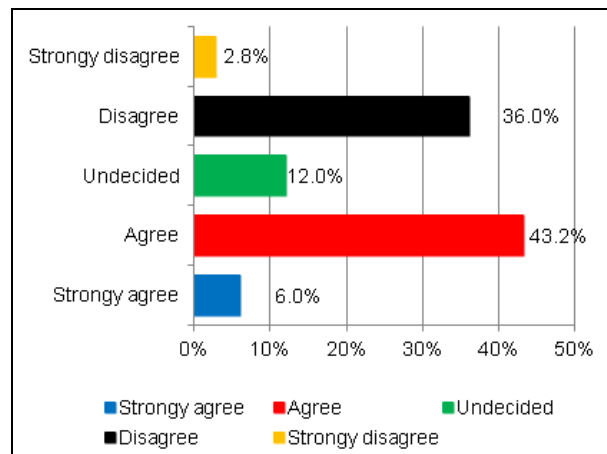


Figure 5. Opinion of the scientist about influence of GM food and feed on food prices available in the market.

The quantitative study included 250 questionnaires on attitudes toward various sectors of biotechnology and was carried out at 14 leading universities in nine cities in Poland. Respondents had at least a Ph.D. degree in life sciences. In this case, we decided to use purposive sampling in order to choose respondents with adequate knowledge of biotechnology. Therefore, it should be emphasized that this type of sampling does not ensure statistical representativeness but aims at typological representativeness and does not allow one to generalize results from a sample to the general population. The results of these studies provided descriptive characteristics of the respondents and stimulated qualitative research designed to explore some findings further.

The qualitative research included representatives of three groups.

- scientific experts, members of the Committee of Biotechnology, Polish Academy of Sciences, with at least a Ph.D. degree in biological sciences and conducting research using genetic engineering techniques
- agricultural advisors involved in the information flow on new agricultural technologies
- farmers, potential users of GM technology in the field of agri-food production

First, we carried out 17 in-depth interviews with scientific experts to explore reasons underlying attitudes toward innovative agrobiotechnology, in particular GMOs. The second step included two focus-group interviews with agricultural advisors who mediate information flow on new technologies in farming. Finally, we investigated the motivation of farmers to cultivate GM crops and use of GM feed.

Table 1. Advantages and disadvantages of the commercial use of GMOs.

Benefits	Risks
<ul style="list-style-type: none"> • lower use of chemical pesticides and herbicides • resistance to pathogens and abiotic stress of GM crops • production of innovative biopharmaceuticals • redevelopment of brown field sites • biofuels production • decline in overall production costs 	<ul style="list-style-type: none"> • monopolistic practices • license fees • modifying exclusively main crops • the overall risk of any innovation

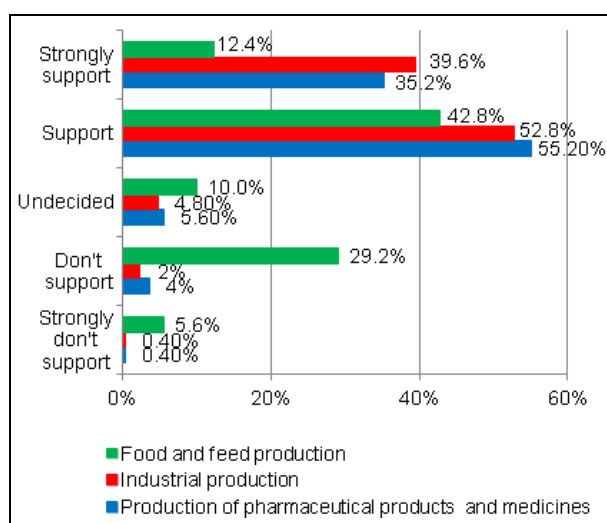


Figure 6. Scientists' support for the use of GMOs in different sectors of economy.

Results

According to the opinion of scientists—who were respondents in the quantitative studies—agrobiotechnology is the second (after medical biotechnology) sector of biotechnology growing most rapidly in Poland. Almost two-thirds of scientists felt that Polish production does not meet the demand for biotechnology products on the domestic market. More than 60% of respondents stated that the EU supports the development of biotechnology in Poland. As for agrobiotechnology, every second respondent believed that GM food and feed may improve the quality of products available on the market (Figure 4). Furthermore, approximately 50% of scientists stated that GM technology will reduce the price of food (Figure 5).

When asked specifically about the use of GMOs in different sectors of the economy, scientists expressed a high level of acceptance. Almost all of the respondents supported the use of transgenic organisms in industrial production of enzymes, biomaterial, and bioenergy (93%) and in the production of pharmaceutical products and medicine (90%). Scientists were less supportive of the use of GMOs in food and feed production—in this case, almost 55% was pro biotechnology (Figure 6). As

was mentioned earlier, these quantitative data cannot provide insights into the setting of a problem and explain reasons underlying the reduced support.

To uncover prevalent trends in opinions of scientists about transgenic organisms and to investigate the motivation underlying different levels of acceptance of the use of GMOs in the economy, we conducted 17 in-depth individual interviews with scientific experts.

Studies have shown that the scientific community is very open to widespread use of GMOs, but the acceptance depends on the level of knowledge about genetic engineering. As scientists stated, they are rarely against GM technology, and in most cases their skepticism stems from non-scientific reasons, such as economical concerns, common beliefs, cultural determinants, and prejudices. The respondents emphasized the “very poor education in schools” and well-organized anti-biotech actions performed by non-governmental organizations (NGOs). In their opinion, media tend to present GM products as unhealthy, unnatural, and of lower value. Scientific experts frequently and spontaneously pointed out the advantages of different genetic modifications, emphasizing that the evaluation should not be addressed to technology in general, but based on a case-by-case study. However, they could identify some general pros and cons of commercial use of GM technology (Table 1).

Scientists stressed that no technology is 100% safe but indicated the existence of hundreds of scientific publications supporting the safety of commercial use of GMOs. Furthermore, very restrictive rules concerning introduction of a new product to the market are a guarantee of a safety for consumers. Respondents stated that the biggest obstacles to the development of GM technology in Poland are public opposition and strict regulations. According to scientists, the official position of the Polish Government states that Poland should be a GMO-free zone, which disputes the validity of research with potential application.

Agricultural advisors were much more skeptical and expressed the belief that no reliable data on the safety of GMOs exists. Respondents clearly articulated distrust of

public institutions and science, suggesting that “scientists are financed by multinational companies” and that “science is not and never had been objective.” Genetic engineering techniques have raised many doubts, according to respondents, as contrary to the laws of nature. However, respondents positively assessed the medical use of GM technology.

Media were the main source of knowledge about transgenic organisms for agricultural advisors. Based on this information, respondents referred repeatedly to alleged adverse effects of GMO consumption, such as allergies, infertility, and civilization diseases. At the same time they had great difficulty in identifying any benefit to the consumer, stressing that the only beneficiaries of GM technology are multinational corporations. One of the crucial aspects turned out to be the freedom of choice for consumers and the need for labeling of GM products, which—in the opinion of advisors—is not currently enforced.

Respondents stated that they did not talk with farmers about GM technology, as no such a need was expressed. Moreover, currently most advisors do not feel competent enough to provide any information on this subject, which was attributed rather to the lack of reliable scientific data than to poor understanding of the topic. An excellent summary of attitudes toward GM technology may be the opinion expressed by one of the respondents: “as employees of the state administration, we are committed to the implementation of government policy, which, in the case of GMOs is not in conflict with our personal views.”

Farmers selected for this study were large-scale agricultural producers and turned out to be much more open to new technologies than advisors: “GM has been around for a long time; we have been consuming GM products for a while, not having a clue.” Agricultural producers stressed the role of a generalized social anxiety to any new technology; at the same time they found that it is impossible to predict all the effects of the introduction of GM products to the market. Respondents were concerned about conflict between the media and scientists on the safety of GMOs; in their opinion, there is no authority that could settle the dispute. Once again the group stressed distrust of public institutions and science. On the one hand, farmers articulated the need for information directly from the experts; on the other hand, they assessed scientists as unreliable due to the private funding of research. This situation seems to be a source of frustration and a deterrent to learning more about GMOs. According to respondents, the only reliable peo-

ple who could provide useful information were farmers growing GM crops.

Agricultural producers supported the use of transgenic organisms in the medical and pharmaceutical sectors and were quite positive about genetic engineering in general. Farmers were particularly interested in GM plants resistant to insect pests, which could reduce crop losses and improve their quality. But the higher cost of seeds might significantly reduce the economic benefits of growing these plants. Farmers did not agree with the policy of the Polish Government, which allowed the import of GM products but banned the domestic production. They clearly stated that currently there is no alternative to GM soybean meal used for animal feed, and a ban on its use would be an economic disaster.

Interestingly, the farmers were in favor of organizing a national debate about GMOs that should include all stakeholders. Currently, farmers felt that their interests are not as important as demands of well-organized environmental organizations. They would be willing to cultivate transgenic plants, provided consumer interest and clear legislation.

Conclusions

In Poland, scientists, producers, and potential consumers remain conflicted about the use of agricultural biotechnology. Acceptance varies greatly among practitioners and researchers involved in molecular studies. Conducting quantitative and qualitative research among groups directly involved or interested in the progress of agrobiotechnology helped to uncover prevalent trends in their opinions and provided insight into the reasons for underlying differences in views on commercial use of genetically engineered products. The key findings from this study are as follows.

- Lack of a coherent message given by scientific community concerning safety of GM products leaves room for manipulation.
- The greatest obstacle to effective communication of scientists with the public and changing the image of GM products is distrust of institutions and scientists.
- Lack of effective information flow from researchers to potential users of new technologies may increase the fear of innovation, which in turn inhibits further development and commercialization of scientific discoveries.
- Scientists—who have direct access to scientific data—present mostly positive attitudes toward GM technology and GMOs. Therefore it can be assumed

that in-depth knowledge of genetic engineering increases the level of acceptance for its products (GMOs).

- Agricultural advisors do not have enough knowledge about transgenic organisms to be able to accurately report on the pros and cons of specific GM products available on the market.
- Farmers are more open to innovation, assuming that profits result from the commercial use of GMOs in agricultural production.

Although every innovation has specific pros and cons, a generalized fear of novelty is always present in society. Thus, if the competent bodies do not take action to inform the public, a room for manipulation arises. Identifying specific reasons underlying social anxiety toward innovative agrobiotechnology may allow the planning of effective communication with society and minimize the unjustified fears and concerns.

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