

Research Article

Research of Risk Control of GM Technology in Food Products Based on Model of Risk Amplification Effect in China: Case of 2013 GM Cyber-controversy

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Abstract: The GM technology in food products in China takes the leading position around the world, but the technology is hotly disputed by general public. This study uses risk amplification effect model and take “2013 GM Cyber-Controversy” in China as an example. The authors analyze the process how the risk on GM technology in China expanded. Then points out the liability subject of the process and the consequence of the risk amplification. Finally, the paper provides some valuable suggestions on risk control of GM foods based on the results of the analysis.

Keywords: Case analysis, GM foods, GM technology, risk amplification, risk control

INTRODUCTION

Genetically modified foods (or GM foods) are foods produced from organisms that have had specific changes introduced into their DNA using the methods of genetic engineering. The foods' shape, nutritional quality, consumption quality are modified to suit personal needs so that they can be eat directly and use as raw material in food production. In the field of medical care, drugs, agricultural economy and life science, the technology has high value in use. However, the general public doubts the safety of it, because the use of transgenic technology in food industry cannot be proved either harmless or harmful. In China, the technology has been used to grow papayas, poplar trees, potatoes and peppers in some regions. The planting area is more than 3,600,000 ha that is the six largest in the world. The number of kinds of the GM plants in China are the second largest in the world just after America. Although the research and development on GM technology proceed in China, the foods are not accepted by the general public completely. Since the information about risk of the technology is wildly spread by social media, the public reject, refuse and even fear of GM foods. The “GM technology” is considered as derogatory words. Any technology or productions that relates to this technology are assumed to be harmful. Moreover, the daily foods are sometimes suspected of GM foods and people doubt about their safety. The unconfirmed risk about the GM foods negatively influenced the society and daily life of public. Therefore, the research on how the GM technology impacts both technology research field and social environment and how the risk of the technology are amplified to be social harm. The research will

contribute to control the risk of GM foods and maintain social stability and protect public life from the negative impact of the development of the technology. The research has important practical significance.

Based on the T equivalence theory, Bredahl *et al.* (1998) proved that public's attitude towards GM foods are largely impacted by the quality of the products, their experience in consumption and their own knowledge about food. According to the attitudes model, intention model and results of previous studies, Verdurme and Viaene (2003) chose fuzzy variables of “general attitude” to integrate various elements. Then construct the theoretical model to measure the public's purchasing intention on GM foods. Dreezens *et al.* (2005) empirical research indicated that the public's attitudes toward GM food and organic food have relationship with power values and common values.

So far, there is no complete system towards the theoretical study of GM technology in China. For the analysis of risk of GM technology in China, there is no unified research at present. According to the available literatures, several typical analysis are listed below. Tan (2006) took the public debate in foreign countries around the GM technology as an example and analyzed the reason that Chinese public joined the evaluation of the technology. Jiang (2010) used literature analysis and content analysis to do the empirical research on the transgenic technology reports in China's major newspapers in 2010. She considered that the reports reflected the positive attitude toward transgenic technology by the government of China. Some ethical issues were also existed in the technique area. Xiao-Yan (2012) used actor network theory and method to analyze the construction process and structure of the GM production commercializing network. The GM

products, experts, companies, supportive government, farmers, international management institutions and regulations are components of the commercialization of GM crops. The risk control of the commercialization relies on active participation of all elements. Guan (2012) proposed that the system of responsibilities, rights and obligations among government, the managers of transgenic crops and other stakeholders, has to be constructed in the management of GM crops and foods. The management mechanism has to manage both inside and outside completely and effectively. Zheng (2014) analyzed the debates on GM technology from post-normal science point of view. He stated that the debates were essentially the collision of two totally different scientific ideas. Using "expand the peer community" and "extension" concepts can promote the effective communication between professional community and the general public, in order to solve the problems in the development of transgenic technology.

PRINCIPLE AND METHODS

This study chooses risk amplification effect model to investigate the "2013 GM Cyber-Controversy". The analysis is mainly divided into two steps:

- Briefly introduce the event of "2013 GM Cyber-Controversy", in order to explain the negative influences result from the potential risk of GM food technology.
- Use risk amplification effect model to divide process of the issue into three stages, source of risk, the transmission and reinterpretation of risk information. Then explore the process how the social risk of GM technology amplified, in order to clarify the subject of the liability and determine the consequences of risk amplification.

Risk amplification effect model: Risk Amplification Effect Model was proposed by Kasperson *et al.* (1988). It is a risk analysis method comprehending several elements, such as social, psychological, institutional, cultural and economic factors. The method is mainly

used to study how the risk relevant events amplify public perception and the risk behaviors related. The model has following advantages:

- Contribute to describe the risk perception and reflect the process of risk amplification caused by non-technical factors.
- This method explains the fact that the serious negative effects result from low risk events in technical risk assessment system. The deficiency in current risk evaluation system, like risk identification and risk assessment, has been offset by the model.
- The interpretation of risk source identification and risk amplification process by the method has very important practical value in risk control.

Therefore, this study holds that Risk Amplification Effect Model has practical value in research of risk control of GM technology in food products in China.

THE THEORETICAL HYPOTHESIS OF RISK AMPLIFICATION EFFECT MODEL ANALYSIS

The Theoretical Hypothesis of Risk Amplification Effect Model is that the negative influence of risk phenomena will not be realized unless the information has been spread. Only if the impact of the risk phenomena, no matter positive or negative, recognized and spread by person, the phenomena will influence the stability of social system significantly. Without this kind of personal behavior, the influence of the phenomena is limited or even irrelevant.

The principle of risk amplification effect model analysis: The process of risk amplification can be divided into three stages, source of risk, the transmission and reinterpretation of risk information. The detail description is shown in Fig. 1.

The formation of risk sources: In this stage, the perceived risk phenomena are generated after the

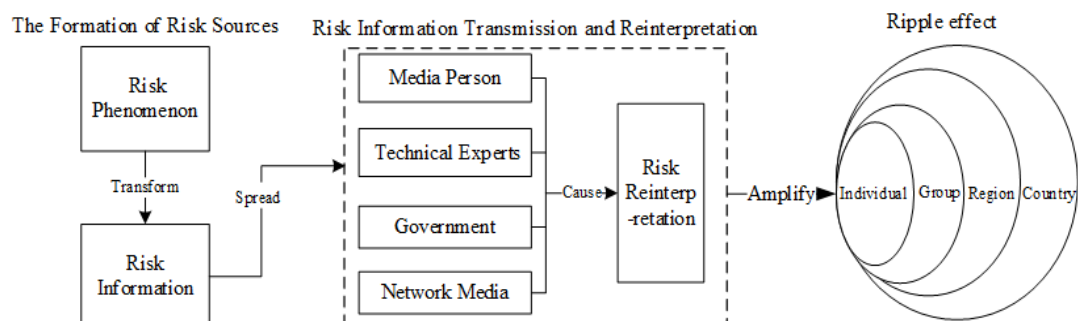


Fig. 1: The principle of risk amplification effect model analysis

spread of risk information. The information is carried by different signals, such as figure, character and symbol. The risk source is the combination of information carried by risk phenomena. In other words, as parts of risk source, risk information has been presented in various ways. The potential negative impact can be perceived by individuals when the risk source formed. However, the risk source is unreal at that time, because none material negative impact had happened. Moreover, if risk information had not been spread and kept in personal perception, it wouldn't cause material social influence in future as well. These are also the basic hypothesis of Risk Amplification Effect Model. The formation of risk source is important for the amplification of risk. Without risk information source, the risk phenomena cannot be aware by individuals. There isn't any source for the negative effect of risk as well.

The spread and reinterpretation of risk information: At this stage, risk information is spread and reinterpreted in risk amplification station. The risk sources are transformed by station depends on the probability of the happening of risk phenomena and the potential loss. It is a translation that can either increase or decrease the proportion of some information in risk phenomena. It will highlight some aspects of the phenomena or reinterpret recent symbol and figure, in order to trigger particular reaction from individual or social groups.

The risk amplification station can be divided into two types, individual and social amplification station. The individual amplification station includes normal social individuals, experts and scholars and officials. The social amplification station contains government departments, research institutions, media, non-profit organization and social groups and their members. In terms of personal amplification station, influenced by personal cultural background, professional knowledge and expectations, there are different ways in spread and reinterpretation of risk information. What is more, the largeness that the risk information can be amplified depends on the aspects of individuals' social status, reputation and the influence of their organization. To the contrary, the social amplification station's spread and reinterpretation of risk information impacts by the function and structure of the organization, culture and values. During this process, individual and individual, group and individual, group and group communicate with each other. The public's perception of risk information differentiate violently during this stage. The different perception of risk information results in the process of spread and reinterpretation that contributes to the debate on the evaluation of risk phenomena. Therefore, the public holds different point of view on the same phenomena.

The primary reason for the realistic social harm concentrate from potential risk of information is the

existence of the social amplification station. Meanwhile, under the support of existing transmission technics, the individual amplification station play an important role in risk amplification gradually.

Ripple effect: At this stage, the amplified risk information will influence different areas in different levels. The spread of risk information is like stones thrown into the water, which spread to other social field less related to the risk phenomena and result in some unexpected negative impacts. Then the stability of the society system will become unstable.

EXAMPLE AND RESULTS ANALYSIS

Example selection: The case, "2013 GM Cyber-Controversy", is chose in this study as an example, because of the following two reasons. On one hand, the rapid development of China's internet industry, especially the construction of mobile internet and wildly use of mobile internet products, like Weibo and WeChat, provides the environment for the fast spread of social opinion. As the latest form of social public opinion transmission, internet controversy offers platform for presentation and communication of information from different areas. The research about the risk amplification of GM technology in food products benefit from the argument. On the other hand, before "2013 GM Cyber-Controversy", other than GM scientists, social experts and some non-profit organization, the general public were not interested in taking part in the argument. However, the situation changed after the issue. Topic about GM food and GM technology was concerned by general public. In 2014, a large number of events happened in China, such as a lawsuit about an unlabeled GM product, a GM food tasting held by proponents of GM technology and the sale of GM foods in Gansu province. These issues gave rise to the worry about the safety of both GM technology and GM foods by general public. According to the reasons above, it is practicable and essential to choose "2013 GM Cyber-Controversy" as an example to analyze the expansion of the risk of GM technology in food products in China.

Case introduction: China's online debate about GM technology started in September 2013. Media persons, science writers, technical experts, biological scientists and food supervision and management departments, local government and the ministry of agriculture joined in the argument. In the debate, the public not only was the observers, but also participated in the debate through internet. The process of the debate is shown as follows:

- On September 7th, Fang Zhouzi, one of China's science writers, claim that it was better to eat GM foods everyday than normal ones. Then Cui

Yongyuan, a famous host worked in China Centre Television, doubted the scientificity of Fang's announcement. Next, Fang criticized Cui on his understanding of science. It is the start of "2013 GM Cyber-Controversy". After that, GM technology and GM foods were concerned by Chinese netizens, when the topics, like "Blacklists of GM food in China" and "Production and imports of GM food approved by the state government", widely spread online. The public became worried about the GM technology and GM foods at that time.

- On September 16th, the official Weibo account of China's People's Daily published a report about "How to identify GM products", which briefly introduced current GM foods in China and the mistakes in the way to identify GM foods. The report also answered some questions netizens concerned. The next day, China's agriculture ministry officials and experts answered these questions online as well.
- On October 7th, Cui Yongyuan published the periodic conclusion about his research in Japan about GM foods. He found that Japanese know little about GM foods and there wasn't any GM food in their market.
- On October 17th, an article issued on the official website of Department of Agriculture, which pointed out that the word eating GM foods would cause sterilization and cancer is rumor. There is no need to do human trial for GM foods.
- On October 25th, transgenic crops planting were officially banned by documents from government in Zhangye, Gansu Province. Zhangye became the first city where modify crops planting was banned by the authority.
- On October 28th, a debate held on the website of Chinese People's Daily. Gu Xiulin, a professor from Southwestern University of Finance and Economics, insisted that GM technology would cause inconceivable harmfulness to organisms. Zheng Fengtian, a professor from Renmin University of China, opposed to commercialize the planting of GM crops or treat GM crops as main food source, since the safety of the technology was undefined. Nonetheless, Ling Yongjun from Huazhong Agricultural University did not agree with the experts above. In his opinion, compared with the rice in the market, the GM rice with insect resistant characteristic was safer. He also took himself as an example. After eating GM foods for fourteen years, there is not any adverse impact yet.
- On November 9th, an interview with Huang Dafang, who is a member of China national agricultural GM organisms' safety committee, was published on website of Beijing News. Huang Dafang claimed that there was no relationship

between GM foods and the semen quality decrease of Chinese university students. The result of carcinogenic GM corn test by Gilles-Eric Seralini from France turned out to be wrong. Moreover, most citizens have had GM foods before.

- From December 8th to 18th, Cui Yongyuan visited several places in the United States to investigate the understanding of GM foods by American. He found that they know little about the technology. Also, the scientists cannot draw the conclusion on the safety of GM food. The procedure of research was filmed into documentary. The film broadcasted on main video websites in China, like Baidu, Sohu and PhoenixNet. It caused social public debate.
- On December 26th, food and drug administration in Gansu province issued a notice on its website, read that, "since March 1st, shop would sell GM foods".

The process analysis of risk amplification:

The formation of risk information source: The risk phenomena turn out to be risk information in two ways, personal experience and professional information broker. The analysis of the approaches is as follows:

- According to the process of "2013 GM Cyber-Controversy", several typical risk phenomena and individual perceived risk information existed in the issue.

As Table 1 presented, since individuals judge risk information by their own knowledge, experience and education background, risk information perceived by individuals has significant difference to what risk phenomena offered. Along with the continuation of the issue, the intense of controversy and the increasing depth of debate. The public doubts the safety of GM foods.

- Network media and technical expert are both professional information brokers. Their opinions influence the public perception of risk phenomena and the form of risk information source.

According to Table 2, as an information transmission platform, the information on network media do not have significant bias on value. Since the technical experts are more rational than general public, experts' and public's feeling of the risk is totally different. The experts measure the safety of GM technology, while general public links potential risk of GM technology to the safety of GM foods. Therefore, the responses to the information by experts and individuals are totally different. The experts treat GM technology as a controllable risk whose harm can be controlled by further investigation. On the contrary, the

Table 1: Typical risk phenomena in “2013 GM cyber-controversy”

Risk phenomena	Risk information contained in risk phenomena	Risk information perceived by individuals
The debate on GM foods between science writer and host. The reports of “Blacklists of GM food in China” and “Production and imports of GM food approved by the state government” were posted online.	The support and against views of the safety of GM technology in food products. Disastrous consequences may result from the application of a new technology in daily life.	Since the safety of GM foods is doubted by social media, there is risk existed. GM foods were sold in supermarket without any notice to customers.
Research of GM foods in Japan by the TV host and proved that there was no GM food sold in Japan.	The GM foods are not sold well in foreign countries.	The citizens in developed countries do not eat GM foods, so the foods are unsafe and inedible.
Transgenic crops were not allow to be planted by official document in Zhangye, Gansu Province. The TV host directed a documentary to present his investigation about the safety of GM foods. He doubted the safety of GM foods, because it was not widely accepted by American society.	Protect the market of traditional crops from GM crops. The difference between advertise and current condition of GM foods.	GM crops are banned by Chinese government, so the GM foods are unsafe. The inconsistent between the domestic promotion and the result of investigation proved the unsafely of GM foods.

Table 2: The difference in perception of the risk of GM technology in food products among network media, technical expert and general public

Network media	Technical expert	General public
The source of risk of GM foods.	How safety that GM technology applied in food field.	Who is producing and selling GM foods?
The harmfulness of GM technology in food products.	The probability of the happening of hazardous event caused by GM foods.	Are GM foods poisonous?
GM food technology's impact on the environment	How to measure the impact to environment by GM crops.	Will eating GM foods impact offspring and environment?
The consequence of using GM technology	Will eating GM foods cause negative effects to human health?	Are GM foods eatable?
The potential hazards of GM technology	What are side effects of GM foods?	Will eating GM foods cause death?

Table 3: The spread and reinterpretation of risk information by risk amplification station

	Individual amplification station	
	Media amplification station	Experts amplification station
Propagation properties	Spread by individuals and groups	Spread by individuals
Mode of risk information transmission	Present opinions through social network and discuss with the persons who have different points	Answer typical technical questions through personal homepages and press conferences
Risk information reinterpretation	Since the increasing intense of the debate on GM foods, the interpretation of risk information result in the insecurity about the technology by general public.	The experts' independence is doubted because they are both technology researchers and business interest getters.
	Social amplification station	
	Government amplification station	Network media amplification station
Propagation properties	Spread by groups and transmission platform	Spread by transmission platform
Mode of risk information transmission	Publish official documents through official websites and pass on to related government departments and organizations	Provide platform for communication
Risk information reinterpretation	Documents holding totally different opinions on GM foods were published by different government departments, which increase the sense of distrust by general public.	The report by network media increased the spreading speed of risk information and the conflictions between people holding different opinions.

public holds the opposite view that there is no need to do any research on GM technology, because it is proved to be harmful to human health. Two conflict views on the development of GM technology contribute to the formation of risk information.

The spread and reinterpretation of risk information:

After the formation of risk information source, the risk information amplified by different kinds of risk amplification stations. It results in amplification effects of risk information source. The weight of some part of the risk information from risk information source increased in the process, which make some characteristics of risk phenomena obvious. Then, other

participants in society reinterpret these traits. Risk amplification station can be classified into two categories, individual amplification and social amplification station. Based on the process of “2013 GM Cyber-Controversy”, individual amplification station can be divided into media amplification station and technical experts’ amplification station and social amplification station can be divided into government amplification station and network media amplification station.

According to Table 3, since media amplification station has two attributes, individual and group dissemination, it is easy to form some opinion supporting groups. When opinion conflicts occurred

among media persons, their opinion supporting groups also have the same confliction. This situation increases the spread speed of risk information. It is technical experts' responsibility to explain the safety and reliability of the GM foods. However, since the independence of expert's suggestions were doubted, the general public do not believe what experts said. In addition, governments become amplification stations is because different government departments published different ideas. The Ministry of Agriculture in China supports research and promotes GM technology through press conference, the network media and their official websites. On the other hand, GM crops are banned from planting to selling in Gansu Province by government decree. The public support what government of Gansu Province did to protect consumers from unsafety food and doubted what central government did to promote research on GM technology. The network media held some debate and transgenic technical expert interview which provide environment for the transmission of information about GM technology. Plenty of reports lead to intensive concern by general public about health threaten and ecological environmental damage resulting from the technology. The reports strengthened the reinterpretation of risk information generated from GM foods by the public.

Ripple effect: Fierce social response takes place at the stage of ripple effect. Dominate behaviors outburst at this stage, which produced wider impacts than it ought to be. What is more, it may influence some other social subsystems which unrelated to the risk phenomena. On the basis of influence of risk phenomena on social system, ripple effect can be divided into individual influence, group influence, regional influence and social influence.

Individual influence: Individual risk perception and recognition is impact by not only some internal factors, such as life experience, knowledge, values and cultural beliefs, but also some external elements, like public opinion propaganda, policy guidance and social identity. During the case "2013 GM Cyber-Controversy", the technical experts' attitude is the determining factor of individual's risk perception of GM technology. When the experts pointed out the risk of technology, the general public will feel the unknown risk. Most individuals having vague notions about principles and functions of GM technology. In other words, even the experts publish the principles and functions of the technology, few of the public can fully understand the knowledge and judge the safety of technology by themselves. In addition, for experts presenting their ideas with arrogance attitude, the idea is hard to be accepted by the general public. No wonder, the public will doubt the safety of GM foods.

Group influence: Two groups of stakeholders involved in GM technology in food products, consumer groups and transgenic technology business community. Consumers are the direct risk takers and what the food they choose directly influence the development of GM technology in food products. The community contains experts, biotechnology companies and seeds companies which engaged in research and development of transgenic technology and foods. The promotion of commercializing the GM crops brings huge economic benefit to the group. After "2013 GM Cyber-Controversy", the doubt from the public of GM foods would block the market expansion of the GM foods, then the economic income of the community would also be impacted. Hence, the group tries to remove the obstacles of the GM technology through several information dissemination channels. This kind of behavior also results in the questioning by public about the safety of GM technology.

Regional influence: "2013 GM Cyber-Controversy" mainly influences the regional economy development in agriculture. For example, in Hubei province, a journalist from "news probe" in CCTV bought five kinds of rice randomly in a supermarket in Wuhan. Then, three of them were found contain transgenic ingredients. The investigation showed that the seeds were got out from Huazhong Agricultural University on purpose. Although local government strictly punished this kind of behavior, the illegal traffic and wildy planting of GM rice got out of control. Therefore, the local consumers worried about the food safety.

National influence: According to "Central First Document" over the years, the central government advocated the breeding of new varieties of GM crops and tried to industrialize GM foods. However, in 2015, the "Central First Document" indicate that the GM technology have to be researched and popularized scientifically and managed safely. The document showed the governments' attitude toward GM technology, which is "positive research, careful promotion and strict management". After "2013 GM Cyber-Controversy", macro policy of the nation was strongly influenced by the amplification of risk information. Several laws, regulations and other normative documents have been published to guide and constraint the development of GM technology in food products, in order to reduce the public's scare of the technology and maintain the stability of the social system.

RESULTS

After "2013 GM Cyber-Controversy", the risk information that there were risk existed in the GM c "stigmatized". "Stigmatized" refers to technology

which regarded to be high risk by the general public because of the report about accident related and potential risk. Because the debate in “2013 GM Cyber-Controversy” magnified the technology’s potential harm and negative effect, the public treated it as a completely harmful technology. After being “Stigmatized”, the products related with GM technology will be rejected by the general public instinctively, no matter what use value and real effect of the technology has. Hence, government departments and relevant experts in China have to let the public know the truth of the development of GM technology and release the negative effect of “Stigmatized” phenomenon.

CONCLUSION

Through the analysis of “2013 GM Cyber-Controversy” and the process of risk amplification of the GM technology in food products, the conclusion drawn as follows:

Expand the opinion expression and communication between different subjects in order to control the risk of GM technology in food products: When the risk information transfers to risk information source, the technical experts can predict the probability and loss of the risk cautiously. Yet, there are significant difference in the identification of risk between the general public and the experts. In most times, the general public cognizes risk relying on their own social relationship. The risk of technology enlarged because the experts always treat the general public as outsiders to technology and had not taken them into consideration. As a result, the risk controller has to expand the opinion expression and communication between different subjects so that every subject is able to present his or her own opinions and the probability of risk amplification decrease.

Use risk amplification station to reduce the spread and misunderstanding of risk information in order to control the risk of GM technology in food products: The media amplification station spread information widely and speedily. The risk controller need to introduce the development status and the process of technological progress of GM technology to media persons. Then the information will be translated into common expressions what even general public can easily understand. Moreover, instead of arrogance and interest-oriented standpoint, the technical experts have to add credits to their announcement. In addition, it is better for government to execute coherent policies so as to avoid the risk amplification result from the suspicion by general public. Finally, network media need to build ways for opinion expression and communication between different subjects.

Control the spread region of the ripple effect in order to reduce the probability of the substantial social harm: In order to reduce the antipathy towards GM technology by the general public, the transparency of research on GM foods should be enhanced in individual risk control. After receiving the information, the general public will assess GM foods rationally. During the development and research of GM technology, technology, products and staff should be scientifically managed in case of the occurrence of negative events. The research and development of GM technology shall be restraint by government departments. If the research breaks the law, the person in charge must be accountability in order to eliminate the ripple effect from risk amplification.

Adaptive debugging has to be done by risk controller in order to prevent the GM technology in food products from “Stigmatized”: The form of active adaptive debugging is divided to popularization of science, active discussion and information presentation by authority. The popularization of science can remove the information asymmetry between experts and public and answer the questions from general public about GM foods. The conflict from debate of GM technology can be relieved by active discussion. The general public will also treat the technology with sense. The information presented by government departments can clarify the fact of the debatable risk phenomena and information; Public fears will be reduced after the verification from authorities.

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