

Analysis of Evolutionary Trends in International GMO Labeling Regimes and Implications for China: A Postprint

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Abstract

GMO labeling is intimately linked to consumers' right to know and right to choose, and has thus become one of the most highly scrutinized GMO policies. Since the establishment of the first GMO labeling system in 1997, more than 70 countries and regions worldwide have implemented distinctive GMO product labeling management regimes. Since 2015, under the influence of multiple factors including GMO industry development policies, public acceptance, agricultural product trade demands, and national political positions, countries such as the United States, South Korea, Russia, Ukraine, and Japan have successively adjusted their GMO labeling policies or revised implementation details, demonstrating characteristics such as strong advocacy for mandatory labeling, expanded labeling scope, more explicit labeling methods, and more standardized negative labeling. Through analyzing international GMO labeling systems and their evolution trends, this paper proposes management recommendations for China's GMO labeling regarding the expansion of labeling scope, establishment of labeling exemption thresholds, and standardization of negative labeling.

Full Text

Analysis of Recent Trends in International Labeling Policies for Genetically Modified Products and Implications for China

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Abstract

The labeling of genetically modified (GM) products is closely related to consumers' right to know and right to choose, making it one of the most closely watched GM policies. Since the first GM labeling policy was promulgated in 1997, more than 70 countries and regions have implemented distinctive labeling management systems for GM products. Since 2015, influenced by multiple factors including GM industry development policies, public acceptance, agricultural trade demands, and national political positions, the United States, South Korea, Russia, Ukraine, and Japan have successively adjusted their GM labeling policies or revised implementation details. These changes are characterized by increasing calls for mandatory labeling, expanded labeling scope, more explicit labeling methods, and more standardized requirements for negative labeling (non-GMO labeling). Through analysis of international labeling policies and their evolution trends, this paper proposes recommendations for China regarding the expansion of labeling scope, establishment of labeling exemption thresholds, and standardization of negative labeling.

Keywords: Labeling; Genetically Modified (GM); Mandatory; Labeling Scope; Public Acceptance

Following the large-scale commercial cultivation of GM crops in 1996, the European Union issued the Novel Food Regulation (258/97) in 1997, becoming the first to implement mandatory labeling management for GM products. Subsequently, particularly between 1997 and 2004, more than 20 countries and regions including Australia, New Zealand, the United States, Canada, Japan, Russia, South Korea, Brazil, and China rapidly established GM product labeling management systems, forming the construction period for GM labeling institutions. Currently, over 70 countries and regions have successively implemented GM product labeling management, with policies remaining basically stable for more than a decade [1,2]. Since 2015, public attention to GM products has continued to rise, agricultural trade markets have become increasingly diversified, and countries such as the United States, South Korea, Russia, Ukraine, and Japan have begun adjusting their labeling policies or revising implementation details, entering a new period of GM labeling policy adjustment.

1. Main Types of International GM Labeling Management During the System Construction Period

National GM labeling systems can be categorized into four types based on whether they are mandatory, whether they establish thresholds, and whether they maintain labeling catalogs: voluntary labeling, mandatory qualitative directory-based labeling, mandatory quantitative directory-based labeling, and mandatory quantitative comprehensive labeling.

1.1 Voluntary Labeling Management

Countries and regions including Canada, Argentina, the Philippines, and Hong Kong, China adopt voluntary labeling systems where the government does not mandate requirements and producers voluntarily choose whether to label GM ingredients in their products. However, labeling is required when GM products exhibit significant changes in nutritional value (quality improvement), allergenicity, or other characteristics compared to their conventional counterparts [3]. The United States also maintained a voluntary labeling system before 2016.

1.2 Mandatory Qualitative Directory-Based Labeling Management

China is the only country that adopts mandatory qualitative directory-based labeling, requiring labeling for all agricultural GM organisms or products made from such organisms listed in the labeling directory. Currently, five categories of crops including soybeans, corn, cotton, and tomatoes with 17 product types are subject to labeling .

1.3 Mandatory Quantitative Directory-Based Labeling Management

Countries such as Japan and Thailand implement mandatory directory-based labeling systems that require GM labeling for products in the labeling directory when their GM content exceeds a certain threshold. For example, Japan stipulates that labeling is required when GM organism content in the main raw materials of 33 product types reaches 5%, defining main raw materials as those ranking among the top three in content and accounting for more than 5% of the raw material weight . Before 2017, South Korea also implemented a directory-based mandatory labeling system, requiring labeling when GM organism content exceeded 3% among the top five ingredients in 27 product types .

1.4 Mandatory Quantitative Comprehensive Labeling Management

The European Union, Brazil, and other countries and regions implement mandatory quantitative comprehensive labeling without establishing directories, requiring labeling for any product detected to contain GM components exceeding a specified threshold. The EU requires labeling for all GM products containing or made from GM organisms when GM organism content exceeds 0.9% . Brazil requires labeling for products with GM content exceeding 1% .

2. International GM Labeling Policy Adjustment Trends

Since 2015, several representative countries in agricultural GM safety management, including the United States, Japan, South Korea, and Russia, have begun adjusting their GM labeling management policies. Overall, the coverage and information disclosure of GM labeling have further expanded, while management of negative labeling has become more standardized.

2.1 High Demand for Mandatory Labeling

The United States has long been a 标志性 country implementing voluntary labeling management. The FDA's 1992 "Policy on Foods Derived from New Plant Varieties" and 2001 "Guidance for Industry: Voluntary Labeling Indicating Whether Foods Have or Have Not Been Developed Using Bioengineering" established a voluntary labeling system, yet domestic demands for mandatory GM labeling have continued to emerge. Since 2002, Oregon, California, and Washington have attempted to enact mandatory GM food labeling through state legislation, but all failed [4]. In 2013, Connecticut enacted the GM Food Labeling Act, and in 2014, Maine enacted the Act to Protect Maine Food Consumers' Right to Know about Genetically Engineered Foods and Seed Stock, both requiring mandatory labeling but never implemented. Vermont enacted regulations related to labeling of foods produced from genetic engineering in 2014 and implemented mandatory labeling for GM foods starting July 1, 2016 [5]. To avoid a patchwork of state regulations and inconsistencies between some states and federal law, the United States passed the National Bioengineered Food Disclosure Standard in July 2016, mandating a unified federal mandatory labeling system that allows GM labeling through text, symbols, or QR codes, with smaller companies permitted to provide information via telephone numbers or websites. On May 4, 2018, the USDA published implementation draft guidelines for the National Bioengineered Food Disclosure Standard, providing more detailed provisions and management recommendations regarding the definition and scope of bioengineered foods, labeling methods, and bioengineered food lists. The draft also proposed three candidate threshold exemption schemes for public comment: exemption when a food component contains bioengineered ingredients at less than 5%; exemption when a food component contains bioengineered ingredients at less than 0.9%; and exemption when the total amount of bioengineered ingredients in one or more components does not exceed 5% of the final product. The comment period for this draft ended on July 3, 2018, with the United States maintaining voluntary labeling management until the standard's formal implementation.

2.3 More Explicit Labeling Methods

Some countries that have already implemented mandatory labeling have further clarified labeling methods and specifications. In May 2016, Russia, Kazakhstan, and other Eurasian Economic Union members notified modifications to the "Food Labeling" provisions in the Customs Union Technical Regulations (TR TS 022/2011), stipulating that in EAEU member markets, GM product labels should appear next to the unified circulation mark with symbols in the same format and size, such as " ". South Korea's new labeling system increased font size from 10 to 12 points and specified detailed labeling requirements for GM agricultural products, vegetables, foods, and products containing or potentially containing GM ingredients, with formulations such as "GM soybean," "bean sprouts made from GM soybeans," "contains GM soybeans," and "may contain

GM soybeans.”

2.2 Expanded Labeling Scope

South Korea is a typical country implementing directory-based mandatory labeling. In April 2016, South Korea’s Ministry of Food and Drug Safety announced the revision of GM food labeling standards . The new labeling system expanded the scope from 27 foods and food additives where GM content exceeded 3% among the top five ingredients to all foods or food additives containing GM DNA or GM proteins (excluding processing aids, diluents, excipients, and stabilizers). However, two situations are exempt from labeling: (1) agricultural products with unintentional GM mixing below 3% and foods or food additives manufactured or processed from such products, provided that “isolation circulation certificates” or government certificates proving effective separation of GM and non-GM products and unintentional mixing are submitted; and (2) foods or food additives from which GM components (including foreign DNA or proteins) cannot be detected, including cooking oils, sugars, soybean paste, starch, and alcoholic beverages. The new GM labeling standards were fully implemented in February 2017. In May 2018, South Korea proposed further amendments to GM food labeling standards, allowing test reports from designated testing institutions as supporting documentation for exemption labeling in addition to “isolation circulation certificates” or government certificates .

2.4 Standardization of Negative Labeling

The United States and South Korea have strengthened regulations on negative labeling (“non-GMO” labeling) while adjusting GM labeling management. U.S. regulations stipulate that a food cannot be deemed “non-bioengineered” or “non-GMO” or carry similar claims simply because it is exempt from labeling under the National Bioengineered Food Disclosure Standard. The standard emphasizes that bioengineered foods should not be considered safer or less safe than non-bioengineered foods solely because they employ bioengineering technology. South Korea prohibits negative labeling for products without commercially available GM counterparts—for example, since no GM sunflower seeds have been approved for the market, “non-GM sunflower seeds” cannot be labeled. For products with commercially available GM counterparts where the raw material is the highest ingredient or exceeds 50% of the product, “non-GM” or “GM-free” labeling is permitted, but no unintentional mixing of any GM components is allowed. For instance, if corn is the primary raw material of a product or accounts for more than 50% of ingredients and contains no GM components, it can be labeled “non-GM.” Japan also intends to revise its current “non-GM” regulations, with the Consumer Affairs Agency holding multiple seminars and releasing a draft review report on March 28, 2018, discussing the change from allowing “non-GM” labeling for products with unintentional GM mixing of 5% to requiring a zero threshold for GM content .

3. Analysis of Factors Influencing GM Labeling System Formulation

Labeling policies reflect the comprehensive interplay of national biotechnology development, agricultural conditions, and trade policies, involving multiple factors such as development level, public perception, political needs, and food security.

3.1 GM Industry Development Level

The economic benefits brought by the GM industry constitute the dominant factor in formulating labeling policies. The United States and Argentina are major GM crop planting and exporting countries. In 2016, the adoption rates of GM corn, soybeans, and canola in the United States reached 92%, 94%, and 90%, respectively. Preliminary statistics show that in 2016, exports of corn products, soybeans, canola, and related oil products totaled approximately US\$35 billion, accounting for over 20% of U.S. agricultural exports [6]. Moreover, U.S. GM technology has consistently maintained an international leading position. A relaxed management environment helps secure the commanding heights of biotechnology, which is why the United States maintained a voluntary labeling system before 2016. Meanwhile, the National Bioengineered Food Disclosure Standard provides relatively flexible and lenient labeling requirements, allowing text, symbols, or QR codes, with small food manufacturers permitted to label via telephone numbers or websites. Argentina was one of the earliest countries to cultivate GM crops internationally, with corn products, soybeans, and soybean oil exports totaling approximately US\$11.5 billion in 2016, accounting for over 30% of its agricultural exports [6], and it also implements voluntary labeling for GM products. Russia's GM crop research and development has progressed relatively slowly, with Russian scientists conducting some experimental research on GM crops but not yet reaching field trial stages. In 2016, Russia banned the cultivation of GM plants and breeding of GM animals within its territory but allowed the import of GM crops, having previously never cultivated or bred GM organisms domestically. Meanwhile, Russia's domestic soybean and corn production and exports have continued to grow in recent years. Consequently, Russia implements relatively strict mandatory labeling, requiring labeling for foods containing more than 0.9% GM organisms, and in 2016 notified modifications to GM labeling format requirements.

3.2 Public Acceptance

Like other product labels, GM labeling essentially serves to protect consumers' right to know and right to choose. GM labeling is unrelated to safety, as scientific research and trials have demonstrated that GM products that have passed safety assessments and obtained safety certificates are safe [7]. However, public awareness and acceptance of GM products inevitably become important factors influencing labeling management systems, playing an increasingly significant role. The transition from voluntary to mandatory labeling in the United States

fully reflects the important impact of consumer advocacy on labeling systems. U.S. public opinion polls have shown that even during the FDA's voluntary labeling policy phase, over 90% of citizens supported mandatory labeling of GM foods, with various movements promoting mandatory labeling legislation emerging continuously and some states enacting mandatory labeling regulations [8]. The primary purpose of the U.S. National Bioengineered Food Disclosure Standard was to unify GM food labeling methods and avoid a situation where states acted independently and some states opposed federal regulations. One of South Korea's motivations for expanding GM labeling scope was also to respond to public concerns and protect consumers' right to know and choose.

3.3 Food Demand

GM agricultural products currently occupy an important proportion in international agricultural trade, and food demand is one of the priority constraints for GM product-importing countries when formulating policies. Taking Japan as an example, in 2016 Japan imported 3.13 million tons of soybeans and 15.34 million tons of corn. When formulating GM labeling systems, it is necessary to balance public acceptance and consumption concerns with the need to import and use GM products to ensure national food security. Therefore, although Japan has established a mandatory labeling system, it both limits the types of products subject to labeling and sets a relatively high labeling threshold. South Korea previously adopted similar management policies, and after transitioning to a comprehensive labeling system, it still exempted labeling requirements for oils, soy sauce, and sugars.

3.4 Political Reasons

Due to the convergence of political, military, and economic interests, some countries choose to adopt labeling systems similar to their allies. For example, as a U.S. ally, the Philippines adopts a voluntary labeling system similar to that previously used by the United States. The EU-Ukraine Association Agreement took effect in 2017, and to align Ukrainian legislation with Europe, Ukraine formulated relevant labeling regulations in the same year in accordance with European Parliament and Council Regulations No. 2001/18 and No. 1830/2003, requiring products with GM organism content reaching 0.9% or more to indicate "this product contains GM organisms" and specify the type on outer packaging, enabling consumers to make informed choices. Previously, Ukraine required labeling for all GM foods containing more than 0.1% GM organisms in whole or in components.

4. Implications and Recommendations

The Ministry of Agriculture's 2002 "Administrative Measures for the Labeling of Agricultural Genetically Modified Organisms" established mandatory labeling requirements for agricultural GMOs and published the first labeling catalog, in-

cluding 17 products such as soybean seeds, soybeans, soybean flour, soybean oil, soybean meal; corn seeds, corn, corn oil, corn flour; rapeseed seeds, rapeseed, rapeseed oil, rapeseed meal; cotton seeds; tomato seeds, fresh tomatoes, and tomato paste. Since 2002, labeling of relevant GM products such as edible oils and cotton seeds has been effectively implemented. However, challenges remain, including public perception that the first labeling catalog coverage is insufficient, relatively chaotic negative labeling in the market, and extremely strict qualitative labeling policies. In light of international GM policy adjustment trends and considering China's GM industry development status and public acceptance, the following recommendations are proposed for GM product labeling management in China.

4.1 Develop a GMO Food Labeling Catalog

The 2015 “Food Safety Law of the People’s Republic of China” first stipulated that “the production and operation of GM foods shall be prominently labeled according to regulations,” but specific implementation details remain unclear. Currently, there is strong public demand to expand the GM product labeling catalog to include foods such as tofu and soy milk. On the other hand, some products listed in the agricultural GMO labeling catalog, such as GM tomatoes, have no commercial cultivation domestically or internationally and have effectively exited the market. It is recommended to accelerate the formulation of a GM food labeling catalog that expands labeling scope based on current GM crop production, cultivation, and import situations, incorporating major processed foods using soybeans, corn, rapeseed, and papaya as raw materials such as tofu and soy milk. However, foods that are difficult to label should be included in labeling exemption categories according to international practice, including meals sold in restaurants and service industries, and unpackaged bulk foods sold in farmers’ markets. Simultaneously, it is recommended to revise the agricultural GMO labeling catalog by removing commercially non-cultivated GM tomato products to avoid consumer misunderstanding.

4.2 Establish Labeling Exemption Thresholds to Avoid Over-Labeling

China adopts qualitative labeling for GM products, effectively setting the threshold at zero. However, unintentional mixing of GM components may occur during production, harvesting, processing, and transportation of agricultural products, foods, and feeds. From the perspective of protecting consumers’ right to know and choose, if products with 0.01% unintentional GM mixing are labeled identically to those containing 5% or 10% GM components, the indicative significance of labeling will diminish, actually impairing consumers’ right to choose. Among countries currently implementing mandatory GM labeling, all have established GM labeling thresholds such as Brazil’s 1%, or thresholds allowing unintentional mixing of GM organisms such as South Korea’s 3%. It is recommended to draw on the experience of South Korea, the United States, and other countries by maintaining China’s current regulation that all products in the labeling cata-

log containing GM organisms or composed of GM organisms must be labeled, while exempting from labeling agricultural products or foods processed from such products that contain GM components below a certain threshold. Based on current public acceptance of GM products in China, the threshold could be set at 1%, a relatively low value internationally. This labeling system helps maintain regulatory continuity, respects public acceptance, allows currently labeled oil products to continue being labeled, and avoids over-labeling of products with only trace amounts of unintentionally mixed GM organisms. Additionally, according to general international practice, unintentionally mixed GM components must be from GM varieties already approved in the country.

4.3 Standardize Negative Labeling Management to Prevent Misleading

In recent years, some businesses have exploited consumer psychology by using “non-GM” as a sales pitch for product promotion, resulting in numerous negative GM labels in the market. In particular, some businesses have applied negative labeling to crops such as peanuts for which no GM varieties exist worldwide. These labels are clearly misleading to consumers and affect public perception of GM product safety. It is recommended to learn from South Korea, the United States, and other countries by legally stipulating that negative labeling can only be applied to products with commercially available GM counterparts and must not mislead or imply that non-GM products are superior to GM products. Products bearing negative labeling must provide supporting documentation proving that both raw materials and final products are free of GM components. Products without commercially available GM counterparts should be prohibited from negative labeling, thereby creating a fair competitive environment for GM and non-GM products.

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