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Prospects for cultivation of genetically engineered food crops in China

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A B S T R A C T

Major food crops that contain genetically engineered (GE) traits cannot be legally grown in China, despite major investments in biotechnology research and despite government decisions that GE maize, soybeans, and canola are safe to import and eat. The paper uses a political economy model to analyze why GE maize and GE rice have not been commercialized in China and whether they are like to be commercialized soon. This model draws on recently completed studies of consumers' and business managers' attitudes towards the safety and the profitability of GE rice and GE maize and on new publications of the potential economic impact of these crops. Consumer opposition and the absence of competitive GE traits from Chinese companies were two major factors constraining commercialization of GE food in the past. This paper predicts that GE maize is, however, likely to be commercialized in the near future due to recent developments in GE technology, the Chinese economy, and Chinese politics.

1. Introduction[1]

China is moving from “Made in China” to “Innovated in China.” (Wei et al., 2017) in many sectors of the economy, but agriculture biotechnology has not made that shift. The Chinese government has invested more money in agricultural biotechnology research than any country, leading to the development many genetically engineered (GE) crops with a variety of different traits such as GE insect resistant cotton, rice and maize (corn) varieties, which can dramatically lower pesticide use and increase yields by limiting insect damage (Huang et al., 2005). GE maize and GE rice are ready for the market, but have not been approved for commercialization (Lin et al., 2016).

In addition to GE traits that were developed in China; international corporations, universities and governments have developed a substantial pipeline of GE traits (Parisi et al., 2016). Many of these traits could be used in China to improve the incomes and health of Chinese farmers and consumers. Seventeen GE maize traits, 12 GE soybean traits, and 12 GE canola traits have been approved by the Chinese government for importation as processing materials and subsequent consumption primarily in the form of meat by people (USDA, 2015). Despite the large number of options, the only foreign GE trait that Chinese farmers can legally plant is Monsanto's insect-resistant Bt cotton which was approved in 1997 and is now obsolete in the rest of the world.

With all these GE traits available and major investments by the Chinese government in biotechnology research, a puzzle remains: what is preventing farmers from planting and commercializing GE maize and GE rice. The major objective of this paper is to use a political economy model to understand why GE food crops such as Bt maize and Bt rice have not been commercialized in China and to assess whether GE food crops are likely to be commercialized soon? To analyze the past and present of biotechnology in China we use newly collected data on the perceived benefits and concerns of businessmen and consumers regarding GE crops as well as the results from new economic models of the benefits of GE crops to assess the role of key interest groups.

The paper is organized as follows. The next section discusses the Chinese biotechnology investments and policies before 2013 when the current government came into office. Section 3 uses a political economy model to assess the importance of interest groups in the biotechnology policy making process. Section 4 then uses this interest group model to assess the new policies since 2013, and Section 5 discusses recent changes in the possible economic benefits and power of key stakeholders. Section 6 summarizes the findings of the study and speculates about whether GE rice and maize are likely to be approved for

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cultivation in the near future.

2. Biotechnology policies before 2013

Three major goals of the Chinese government's biotechnology policy have been consistent since the 1980s: first, to increase the productivity of key crops and livestock so China can increase its food self-sufficiency and not be dependent on other countries for its basic food needs, and second, to build a Chinese agricultural biotechnology industry that can be a source of economic growth and compete globally. Social stability is the third goal of the government's biotechnology (and all other) policies.

To achieve the first and second biotechnology goals, the central and provincial governments invested extensively in agricultural biotechnology research. Agricultural biotechnology was an important component of three special research and development programs for key industries. The first focused on applied research in nine industries of which biotechnology was one. It was designated “863” because it started in March 1986. In March 1997 the “973” program for basic research started and continued through 2006. It was followed in 2006 by the National Science and Technology Key Programs, a much larger government program which focused on commercializing designated technologies. The agricultural biotechnology component is called the Special Program on New Transgenic Organism Breeding, which started in 2008 and is expected to end in 2020. The goal of this program is to commercialize Chinese GE varieties of five crops and three livestock species and is budgeted to cost US$3.8 billion (RMB 24 billion) over 12 years (Hu et al., 2012).

The Chinese central government also supported the development of the biotech industry by instituting regulations to assure the safety of GE food production and food products. In early 1993, the Chinese State Science and Technology Commission (SSTC) released the first set of biosafety regulations, called the “Safety Administration and Regulation on Genetic Engineering” (Chinese State Science and Technology Commission, 1993). The Ministry of Agriculture (MOA) issued the “Implementation Measures for Agricultural Biological Engineering” in 1996 (MOA, 1996). The first approvals of GE crops for commercialization took place in 1997. In 2001 the State Council decreed a new set of policy guidelines, the “Regulations on the Safety Administration of Agricultural Genetically Modified Organisms” (Huang and Wang, 2003). MOA also announced three new implementation regulations which covered biosafety management, imports and exports of GE foods and crops and mandatory labelling of GE food products, which took effect in March 2002 (Pray et al., 2006).

Government policies also encouraged GE development and commercialization by local firms. Government scientists were encouraged to develop, patent and then license GE technology to local firms. The Special Program described above subsidized biotechnology research and commercialization by local firms. In addition, these firms were protected from foreign competition by regulations that kept out foreign biotechnology. The biosafety regulatory system allowed the importation of foreign GE maize, soybeans and canola for processing and consumption but not for sale as seeds for food production in China. Regulations on Foreign Direct Investment (FDI) protected Chinese biotechnology firms by prohibiting research on biotechnology or commercialization GE traits by foreign firms in China. It was hoped that these regulations would allow local firms to develop their own GE traits or commercialize GE traits that were developed by government research academies and universities.

The result of these policies is that Bt cotton traits from CAAS and Monsanto that were releasere the only traits of a major field crop that Chinese farmers are allowed to grow. No new GE traits for cotton cultivation have been approved since 1997, and no new GE technology for major feed and food crop cultivation have been commercialized. Consumers and livestock producers have benefitted from GE crops that are produced elsewhere. Most vegetable oil consumed in China is made from imported GE soybeans. Livestock are fed imported GE soy meal and GE maize

This set of agricultural biotechnology policies kept most economic interest groups inside and outside China happy except for some biotechnology scientists and some big foreign and local biotechnology firms. Consumer remained largely in the dark with respect to any changes in their food system. Interestingly, prior to 2010, most consumers did not know they were eating oil made from GE soybeans. Studies that examined consumers’ purchasing behavior found that Chinese consumers did not require a price discount to purchase the labeled GE oil (Lin et al., 2005). Farmers in the US and South America were happy because they could export more soybeans and maize to China. Local seed and biotechnology firms were protected from competition with the foreign biotechnology giants. The largest Chinese group that lost money from this situation was the small maize and soybean farmers, who could not increase their profits by growing more productive GE crops, but their losses were masked by government subsidies on inputs and high support prices for their crops.

In 2009 after the world food price crisis of 2007 and 2008, the government approved insect resistant rice (hereafter Bt rice) and high phytase maize (HPM) as safe for consumption and production in China. The Bt rice was developed by Huazhong Agricultural University around 2000 and produced by small local seed companies and HPM was developed by CAAS and Origin Agritech Ltd, and Origin was licensed to commercialize it.[2] The government did not announce China's achievements of being the first country in the world to develop and approve GE rice or that the Bt rice could greatly reduce pesticide use making rice safer for consumers to eat and better for the environment. It also did not publicize Chinese scientists’ achievement of the first GE maize that was a better animal feed and could improve the environmental impacts of livestock production. Instead the MOA quietly approved these technologies and listed their approval in an official document.

Chinese consumers did not find out about government approval of GE rice and HPM maize until Greenpeace discovered and publicized it on the web in China and globally in 2010 (Greenpeace, 2010). This allowed the opponents of GE crops to accuse the Chinese government of secretly approving a new type of rice that was risky for human health and for the environment. A conservative component of the Communist Party started using stories from Greenpeace and other global opponents of GE foods to criticize the government's decision and indirectly criticize the mainstream of the Communist Party. Some components of the Army said that GE food was a Western plot to weaken the Chinese people. Some Generals said they would not allow their troops to eat GE food and publicly opposed GE food (Yap, 2013). The soybean industry from northern China, which had been pushed into decline by imported GE soybeans, claimed in newspapers that the regions of China that ate soy oil from GE soybeans had higher levels of cancer than regions that still used Chinese non-GE soy oil (What's on Xiamen, 2013).

At the same time, there was the breakdown of public trust in the ability of the government to ensure the safety of food. Chinese consumers were outraged about the deaths and sicknesses of children from contaminated milk in 2008. That crisis was followed by a regular stream of newspaper reports on food safety problems. The opponents of GE food were able to link food contamination and GE food in consumers’ minds which contributed to the firestorm of urban consumer opposition to GE rice in social media starting in 2010 (Huang and Peng, 2015).

The firestorm of media attacks against GE rice in 2010 through 2012 came at a sensitive time for the government because a new government was to be chosen and put in place in late 2013. The combination of opposition in social media and uncertainty about the position of the new government on GE meant that most scientists and bureaucrats did

[2] It is considered a Chinese firm even though it is listed on the NASDAQ stock exchange because all of the founders were Chinese, and its corporate headquarters are in Beijing.