# 中国转基因作物面临的问题

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**摘　要**　转基因(GM)作物已在世界各地广泛种植,并且对粮食安全和环境可持续发展做出了巨大贡献。中国是种植转基因作物的主要国家之一,但最近放缓了推进的步伐。在过去的 20 年里,中国政府对转基因生物一直持积极态度,对农业生物技术研究提供了大量的扶持政策,然而,公众舆论对人类健康、经济效益和环境的过度担忧,逐渐表现出反对转基因生物的倾向。转基因推广应用的问题主要体现在以下几个方面:科学家与公众之间缺少沟通、不同管理部门对转基因生物缺乏有效的监管、对采用先进技术态度模糊、媒体的多变和不实报道,以及全球反转组织的干扰。本文讨论了这些问题及可能的解决方案。

**关键词**　转基因作物; 中国; 科学交流

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自 1996 年首次商业化种植以来,转基因作物的种植面积逐年递增。2013 年,27 个国家的转基因作物种植面积超过 1.75 亿 $hm^2$,是 1996 年 170 万 $hm^2$ 的 100 多倍(http://www.isaaa.org/)。美国仍然以 7 010 万 $hm^2$ 的种植面积领先全球,其转基因品种的采用率达 90%(http://www.isaaa.org/)。转基因作物的广泛种植和应用,在提高产量的同时减少了农药使用和 $CO_2$ 排放并保护生物多样性,对可持续的粮食安全和环境安全做出了巨大贡献。

预计到 2020 年,中国的人口数量将达到 14.5 亿,其粮食需求持续增加,并面临着城市化、工业化、耕地面积减少和农业劳动力流向城市的严峻形势[1]。毋庸置疑,中国渴求发展包括基因技术在内的新兴技术来支持其现代化建设。2013 年,中国转基因作物种植面积达到了 420 万 $hm^2$,其中棉花占了大部分,此外还包括木瓜、杨树、番茄和甜椒(http://www.isaaa.org/)。从 20 世纪 90 年代就开始商业化种植的转基因抗虫棉是第一个在中国应用的生物技术农作物产品,它使中国农民在农药方面的支出减少了 20%,并减少了 80% 的农药使用[2-3]。如今种植的棉花中 70% 以上都是转基因抗虫棉,每年消费的大豆中的 80%(2012 年达到 5 838万 t)都是从美国、巴西和阿根廷进口(http://data.stats.gov.cn),而其中绝大部分都是转基因的。

在过去的 20 年里,为了保证粮食的自足生产,中国政府对转基因生物一直持积极的态度,并对利用农业生物技术进行转基因品种研发提供了最大的政策扶持。2009 年中国政府启动了 12 个国家科技重大项目,其中包括转基因生物新品种培育重大专项。通过对农业和植物生物技术研发的持续资助,全国已经构建起一个包括大学、中国科学院、中国农业科学院以及地方农业研究所在内的综合研究网络。此外,中国还针对转基因作物建立了相关的法律和法规,对市场中的转基因产品制定了非常严格的标识系统[4]。

十多年前,中国人对待转基因作物的态度虽然说不上热情但也算是正面的接受,至少对于少施农药、增加纤维产量和节省劳动力的转基因抗虫棉是如此。尽管一些科学调查表明,随机调查的大部分人群仍然支持农业生物技术,但现在的公众舆论却表现出了反对转基因的态度。另一方面,尽管没有明确的证据表明某些人对转基因的强烈抵制改变了

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决策者对待转基因的态度，但公众舆论还是会影响政策的倾向性。2009年中国颁发了2个转基因水稻品种和1个转基因玉米品种的转基因安全证书，使中国有可能成为世界上首个在主粮作物中使用转基因技术的国家[5]。然而，在批准商业化种植之前，上述安全证书已经在2014年8月17日到期。公众对于转基因作物的舆论可能还是影响了决策。

除了担心转基因品种影响人类健康以外，反对者认为转基因水稻和玉米的种植会威胁中国的小农户，而给大型转基因种子公司带来巨大利益。对转基因品种的担忧还涉及到它与常规作物的混杂或者杂交，以及西方跨国公司对包括转基因技术在内的知识产权的掌控。在作物杂交方面，反对者担心农田中大量种植未批准的转基因作物可能把性状转移到传统作物上或者与之混合。

虽然科学家在转基因技术和转基因作物及食品方面作了很多科普宣传，对一些质疑也进行了解释，但这还远远不够。相对于科学数据的解读和事实，人们总有更多的问题。因此，必须在更大范围内开展生物安全研究，尽管这些研究无利可图，但对于获得民众对转基因作物的支持是至关重要的。健康相关的研究更应受到关注，并且主流转基因科学家要积极地参与这些健康方面的研究。转基因生物的安全性和对环境（生态）的影响应该放在更重要的位置，而不是新品种培育的附带研究。这需要更多的经费来监控转基因生物对环境造成的影响。从长远来看，农业生物技术研究应着重于造福广大消费者。研究应展示转基因作物的安全性和不可替代性的优势。

此外，中国社会整体的信息传播体系不利于转基因技术或相关问题的建设性对话或互动。虽然中国科学家在政府资金的大力支持下，从植物的基础研究到转基因作物育种上取得了巨大的成就，但大多数研究机构以科研为主，缺乏公关能力，导致其处理公众疑虑及反转组织和个体的言论的能力不足。研究机构很少设立一个实际的科学交流和传播部门，也没有足够的资金或者鼓励措施去支持科学家做科普宣传。科学界对转基因相关事件的迟缓回应也造成了媒体的不客观报道。与西方国家相比，中国科学界习惯于宣传科研成果，但在知识科普方面还欠缺经验。科学家在反驳反转人士言论的时候，往往要求拿出能够证明转基因作物低风险的确凿证据。转基因作物和传统作物在食用安全性和环境安全性方面等同的说法可能是真的，但还不够有说服力。

另一个重要的问题是政策的完整性和不同部门之间的协调性。转基因生物监管体系建设虽然已经取得了很大的进展，但仍需加强。对食品安全、生物安全、科学竞争力和经济独立等不同的诉求或关注导致了规章制度的不连贯性。目前，转基因品种的田间试验审批过程非常缓慢，而批准进口新的转基因产品则需要数年的时间。企业研发能力不足并且缺乏将农业和植物生物技术研究成果商业化的动力。相对欠缺的监管导致对农业生物技术公司的专利授权许可非常繁琐。政府应对突发事件，如最近转基因水稻种子泄露的问题，也是反应迟缓且杂乱无章。

新闻媒体对于转基因生物的报道花样百出，让人难以判断其态度是反对还是支持。媒体对于转基因问题的报道，不管是正面还是负面的，都没有产生建设性的影响。人民日报和光明日报等官方媒体对于转基因问题的报道大多是以负责的态度赞扬科学成果并且避免造成混乱和谣言。科学媒体在肯定转基因生物有效的同时，通常以更加平衡的语气报道其对健康和生态方面的潜在挑战。然而，一些自由媒体和城市小报热衷报道转基因的负面新闻（而不关注转基因生物本身）。专业的媒体人士通常都没有科研背景，缺少处理科学问题的能力，大多数都不能辨别主流的科学结论与一些引起误导的说法。

全球化对中国农业生物技术的发展是一把双刃剑。它在酝酿和促进转基因生物争论中发挥着关键作用，而经济和商业上的原因使这场争论愈演愈烈。在引进先进技术和资金的同时，也带来了“反转”。全球化带来了国际化的“反转”阵营，正如2014年北京食品安全与农业可持续发展论坛及其北京宣言的一样，他们希望中国成为“反转”的中心。

如同其他大多数高科技领域，经济上的考虑依然是中国决策者支持农业生物技术的基本动力。一些“反转”组织和个人沉浸于进口转基因大豆对本地大豆是“灾难性”的论断并大肆传播这些言论。这些言论具有强大的影响并战胜了中国应该研发自己的转基因大豆的主张。而当支持转基因技术的专家提出发展中国自主的农业生物技术方案时，有些人，尽管大多数不是“反转”积极分子，却强调要保护国内农业处于非转基因的状态。农业贸易保护主义者极具轰动和煽情的“反转”演讲几乎遮挡了转基因支持

者勾画的美好未来。

基于以上对中国转基因生物技术所面临问题的分析，需要提出多层次的可行的解决方案以应对当前转基因生物面临的困境。在中国，努力推进转基因技术时，交流应该被视为重中之重和不可或缺的重要组成部分。科学家应该与公众和媒体进行更加积极和有计划的互动，认真倾听公众的声音和提出的问题，不应认为后者是科学文盲而忽视其担忧。科学家还应该更加频繁地与其他领域的专家接触。有关转基因生物的问题是基于科学的问题，但又超出了科学的范畴。在中国，与转基因生物相关的机构应当是透明、廉洁和有公信力的，无论何时，只要科学家能够影响决策者，他们就应该说出来并说服后者提高领域内的监管能力。

最后，与传统的单向信息交流相比，强调公民与科学家平等对话的公众科学传播模式是一个正确方向。也许在中国完全采用这种模式的时机尚不成熟，但至少应当尝试让广大群众参与讨论类似转基因技术等有争议的话题。

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# Issues confronting GMO crops in China


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**Abstract** Genetically modified (GM) crops have been widely planted worldwide and contribute greatly to food security and environment sustainability. Although China is one of the major countries planting GM crops, recent progress is slow. In the past 20 years, Chinese government has maintained a positive attitude towards the GM organisms and provided the most supportive policies on agricultural biotechnology researches, however, public opinions have becoming perceivably against GMOs with presumptive concerns on human health, economic benefits and environment. Poor communications between scientists and the public, weak GMO governance among different departments, hesitation to advanced technology, variable and non-evidence based voices from media, as well as global anti-GMO organizations, are among the important aspects in this conflict. Possible solutions to solve the conflict are discussed.



**Key words** GM crops; China; scientific communication



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**Abstract** Genetically modified (GM) crops have been widely planted worldwide and contribute greatly to food security and environment sustainability. Although China is one of the major countries planting GM crops, recent progress is slow. In the past 20 years, Chinese government has maintained a positive attitude towards the GM organisms and provided the most supportive policies on agricultural biotechnology researches, however, public opinions have becoming perceivably against GMOs with presumptive concerns on human health, economic benefits and environment. Poor communications between scientists and the public, weak GMO governance among different departments, hesitation to advanced technology, variable and non-evidence based voices from media, as well as global anti-GMO organizations, are among the important aspects in this conflict. Possible solutions to solve the conflict are discussed.
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Since first commercialization in 1996, the genetically modified (GM) crops have increased every single year, by more than 100-fold from 1.7 million hectares in 1996 to over 175 million hectares distributed in 27 countries in 2013 (http://www.isaaa.org/). Of these, the US continued to be the leading country with 70.1 million hectares, with an average 90% adoption across all crops (http://www.isaaa.org/). Such worldwide planting and application of GM crops have contributed greatly to sustainable food security and the environmental harmony through increasing crop production while reducing pesticides application and $CO_2$ emission, as well as conserving biodiversity.

China's population is set to top 1.45 billion by 2020, and the country needs to a continuous increase grain production, a daunting task in the face of urbanization, industrialization, farmland reduction and the efflux of rural workers to cities[1]. Without doubt that China is eager to developing new technologies to support its modernization, which include gene technology. In 2013 China grew 4.2 million hectares of GM crops, among which cotton takes the majority, in addition to papaya, poplar, tomato and sweet pepper (http://www.isaaa.org/). The transgenic Bt cotton is the first biotechnology product of agriculture applied in China and started to be planted commercially since 1990s, which saved Chinese farmers 28% of pesticide cost and 80% of toxic pesticides[2-3]. Today, more than 70% of its cultivated cotton plants are genetically modified, and up to 80% (58.38 million tons in 2012) of soybeans are imported from such countries as the United States, Brazil and Argentina (http://data.stats.gov.cn), most of which are also genetically modified.

In the past 20 years, Chinese government has maintained a positive attitude towards the GM organisms and provides the most supportive R&D policies on agricultural biotechnologies to develop home-grown GM varieties in order to maintain self-sufficiency in food. In 2009 the Chinese government launched the genetically modified crop seeding scheme, one of the 12 mega S&T programs in China's civil sector. After continuously funding regular research in agricultural and plant biotechnologies, a comprehensive research network has been set up nationwide, covering universities, institutes of the Chinese Academy of Sciences (CAS) and of the Chinese Academy of Agricultural Sciences (CAAS), and some local public agricultural research institutes. Furthermore, China has also established laws and regulations for GM crops, and developed a very strict labeling system for GMO products in the market[4].

More than 10 years ago, Chinese people were generally positive, if not enthusiastic, to accept GM crops, at least the transgenic Bt cotton, which

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showed a great benefit on reducing pesticide usage, improving fiber yield and saving labor force. However, public opinions are now perceivably against GMOs, although several scientific surveys still showed that most randomly sampled people support agricultural biotechnology. On the other hand, despite that there is no clear evidence that the strong and highlighted public resistance to GMO has changed policymakers' attitude to GMO, but the public attitudes influence policy priority. In 2009 China granted safety certificates for two GM varieties of rice and one of maize. This raised expectations that it might become the first country in the world to use GM technology in the production of a main staple[5]. However, these safety certificates are expired without renew on August 17, 2014, before further approvals of commercial growing. Public opinions about GM crops likely played a key role in this decision or non-decision.

Apart from the precautionary concerns over the impact of GM varieties on human health, opponents argue that transgenic rice and maize represent a threat to small-holding farmers in China and that most of the benefits from GM crops went to big GM seeding companies. Additional concerns for GM varieties relate to admixture and outcrossing with conventional crops and to the pernicious stranglehold of Western multinationals on intellectual property rights (IPR) covering transgenic technology. In terms of outcrossing, opponents are particularly concerned about the possibility that transgenic crops currently unauthorized for mass planting could transfer traits to conventional crops cultivated in farms or admix with them.

Although scientists have done a lot to popularize knowledge of transgenic technology and GM crops/foods, and also made explanations to these arguments, this is far from enough. People always have more questions than the answers and examples based on scientific research data. Thus, more safety and biosafety research should be conducted in larger scales, though economically these studies are not profitable, they are keys to ensuring public supports. Health-related research deserves more attention, and mainstream GMO scientists should be actively engaged with the health research. Biosafety and environmental (ecological) impacts of GMOs are not supplementary research to new variety development, but should be placed more central. More public funding should be allotted to monitor the consequences of GMOs in the real environments. In the long-term, agricultural biotechnological studies should spend more on those that can bring benefits to consumers who are also general public. Research should show the absolute and irreplaceable advantages of adopting GM crops.

Besides, the overall communication system in the Chinese society does not favor constructive and dialogue—based interactions regarding GMOs or related issues. Although Chinese scientists have made great progresses from basic plant research to GM crop breeding under government's strong financial support, most of the institutes in which they work are research-oriented, lack proper outreaching functions, leading to a poor capacity in dealing with the concerns from the public and argues from the anti-GMO groups and individuals. Rarely do these institutes have an effective science communication and outreach department and neither are there enough funding or incentives to support scientists to do public communications. Science community's slow reaction to GMO-related events has resulted in unbalanced information flow in media. Compared with the West, the existing science community in China is used to advertising scientific achievements, but less experienced in publicizing the knowledge behind. While scientists have been able to refute most of anti-GMO claims, they lack the decisive evidence proving the very low occurrence of GMO-related risks. The statement that GMO is no more risky than conventional crops in terms of health and environmental threats is likely true, not persuasive enough.

Another important issue is the integrity of policies and the coordination among different sections. Although much progress has been made, the systematic framework on GMO governance needs to be strengthening. Different appeals/concerns—food safety, biosafety, scientific competitiveness and economic independence—have resulted in disconnected rules and regulations. The approval for field trial of GM varieties is now a very slow process, and it can take years to approve the import of new GM products. Industries have low R&D capacity and incentive to commercialize academic research in agricultural and plant biotechnologies. Relatively poor management leads to very tedious licensing revenues for agricultural biotechnology firms. The government responses to accidents—such as newly identified leaking of GM rice seeds—are also slow and of ten messy.

Media performances regarding GMO reporting are varying, which can hardly be defined as negative in general, or friendly. But no matter positive or negative, media coverage of GMO issues has not produced constructive effects. State media like the People's Daily or Guangming Daily report GMO issues mostly in a responsible tone, praising the scientific achievements and avoiding the potential confusions and rumors. Scientific media, while confirming the powerfulness of GMOs, commonly have a more balanced tone and are ready to report the potential health and ecological challenges. However, some liberal media and urban tabloids enjoy the negative side of GMO issues (not just the GMOs themselves). Media professionals generally have poor science training and weak qualification to deal with scientific issues and most of them cannot distinguish between mainstream scientific conclusions and the often misleading scientific claims.

Globalization has been a double-edged sword to China's agricultural biotechnology development. It has played a crucial role in brewing and promoting GMO controversies, and the economic and business considerations have escalated the debates. While introducing advanced technologies and capitals, it also brings in anti-GMO resources. Globalization has brought in international anti-GMO forces, who hope to make China an anti-GMO center, as symbolized by the recent 2014 Beijing Food Safety & Sustainable Agriculture Forum and its Beijing Declaration.

As in most other high-tech fields, economic consideration is the basic driving force for Chinese policymakers to support agricultural biotechnology. When some anti-GMO groups and individuals tuned in on the imported GM soya's a "disastrous" impact on local soya, the talk has a strong influence and triumphs over the claim that China should develop its own GM soya. While pro-GMO experts have proposed solutions based on developing China's own agricultural biotechnology, those people stressing the protection of domestic agriculture have converged a non-GM status, even though many of them are not anti-GMO activists. The sensationally and emotionally striking power of agricultural protectionists' anti-GMO talks is hardly counterbalanced by pro-GMO's brighter future scenario.

Based on the above analyses on issues confronting GMOs in China, a multi-level strategy is needed to offer possible solutions to the current dilemma regarding GMOs. Communication should be considered a central and an indispensible part of efforts to develop GMOs in China. Scientists should have more active and strategic interactions with the public and the media, seriously hear the public voice and questions, and never dismiss the public concerns with the pretext that the latter is scientifically illiterate. Scientists should also frequently contact experts in other areas. GMO issues are based on science, but there are beyond science. Institutions related to GMOs in China should be transparent, clean and venerable, and wherever scientists are able to influence policymakers, they should speak out to persuade the latter to improve their governance capacity in the field.

Finally, public participation with science model is a correction to the traditional one-way information flow by stressing the equal right of the citizens to dialogue with scientists. Even though a complete adoption of the model is unrealistic in contemporary China, participation from a wide range of people should be at least trialed in controversial fields like GMOs.

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