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Trade and commerce in improved crops and food: an essay on food security☆

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Agricultural trade between nations is a significant proportion of total international trade. Agricultural trade in transgenic crops faces extra complications due to the existence of domestic and international regimes that focus specifically on agricultural biotechnology. These specialized regimes create legal and commercial challenges for trade in transgenic crops that have significant implications for the food security of the nations of the world. By food security, one should understand not just the available supply of food, but also the quality of the food and the environmental impact of agricultural production systems. These specialized regimes for transgenic crops can either encourage or hinder the adoption of agricultural biotechnology as a sustainable intensive agriculture. Sustainable intensive agriculture offers hope for agronomic improvements for agricultural production, socio-economic betterment for farmers and environmental benefits for societies. Sustainable intensive agriculture offers particular hope for the poorest farmers of the world because agricultural biotechnology is a technology in the seed.

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Introduction

The Royal Society recently issued a report titled ''Reaping the benefits: science and the sustainable intensification of global agriculture'' [1]. In Chapter 1 to the report, the Royal Society describes the 'urgent challenge' facing global agriculture to produce the food needed this 21st century in light of increasing population, changes in food demands and anticipated climate change. Population, food demand and climate explain the words 'sustainable intensification' in the title. As for the title's use of the word 'science', the Royal Society succinctly stated its view, ''Science must play a vital role in this response'' [2]. If science plays a vital role in promoting sustainable intensive global agriculture, then the Royal Society is guardedly optimistic that the urgent challenge will be met and that the world society will reap the benefits – adequate amounts of nutritious, safe food raised by economically, socially, politically and environmentally acceptable agricultural techniques, among which genetically modified crops will have an important place.

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Scientists and developers

Scientists have been genetically modifying plants for 25 years, since the early 1980s; developers have commercialized genetically modified crops for 15 years, since the mid-1990s. Thousands of scientific projects and field trials and a vast literature of scientific publications provide the scientific evidence that genetically modified plants and crops are efficacious and safe for humans, animals and the environment. Hundreds of millions of hectares planted and harvested with transgenic crops provide the agronomic evidence that genetically modified crops are simply new crop varieties that present no unique or different risks than crops raised through conventional or organic means.

Building upon this substantial scientific and agronomic experience, reliable studies have shown that these genetically modified crops have created positive farm income effects, nonpecuniary benefits for farmers in terms of their labor, safety and resources, important yield increases, improved environmental agricultural footprints and marked reductions in green-house gas emissions [3]. Genetically modified crops – primarily canola, cotton, maize and soybeans modified for insect-resistance and herbicide-tolerance – presently widely used have earned the label of sustainable intensification in global agriculture through the vital role of science [4].

While widely used genetically modified crops have already earned the label of sustainable intensive agriculture, the future for genetically modified crops is brighter than the past. Scientists and developers are working in the laboratories, field trials and the regulatory systems of various nations to create, test and release crops that can address the nutritional needs of the poor-crops described as Golden crops (e.g. Golden Rice) [5] or as nutritionally complete crops (e.g. cassava) [6]. Scientists and developers are similarly working to create and release safer foods (e.g. Bt-maize with fewer mycotoxins) [7] and healthier foods (e.g. high-oleic soybeans) [8] that will benefit consumers directly in both developed and developing nations. Addressing climate issues, scientists and developers plan to create and release drought-tolerant, salt-tolerant, aluminum-tolerant and nitrogen-efficient crops, so that crops can be grown on lands subject to environmental stresses [9]. Finally, biological science will not be stagnant and new techniques, procedures, knowledge and discoveries will flow forth [10]. These new genetically modified crops and these scientific advances, if wisely used, also can earn the label of sustainable intensive global agriculture.

Farmers

Farmers know their fields and know their self-interest in increased income and productivity, better allocation of labor, time and resources, and safer practices and products for themselves and the environment. Consequently, farmers around the world have adopted genetically modified crops at an unprecedented rate [11] and in the face of fierce opposition that has tried to frighten and mislead them about biotechnology [12]. Notably, 13.3 million farmers (over 90% poor resource farmers) in 25 countries (on all continents, except Antarctica) planted 125 million hectares of genetically modified crops in the year 2008 [13].

Farmers plant genetically modified crops depending upon three key factors. First, farmers must have access to seeds that are suitable for the agro-ecological conditions of their particular fields. Seeds bred for particular soils, particular temperature and rainfall zones do not perform to the optimum in other soils and zones. Second, farmers must be able to coexist with their neighbors in neighborly ways so that each farmer can choose what is appropriate for his field. Farmers must not face discriminatory rules and regulations that limit their choices and inappropriately impose liability upon them simply because they desire to grow genetically modified crops. Third, and most importantly, farmers must not be denied access to genetically modified seeds because laws prohibit the growing of genetically modified crops. When laws allow farmers the choice, farmers have chosen quickly and broadly to grow genetically modified crops in their fields.

Two countries can serve as examples of this third point. In Romania, farmers grew vast expanses of genetically modified soybeans until Romania joined the European Union where the law has yet to authorize their planting. By force of law, Romanian farmers were forced to stop growing a crop that they had grown willingly and enthusiastically [14]. By contrast in Pakistan, despite a legal prohibition, farmers have been so anxious to grow this improved crop that they are defying the law [15]. In this regard, Pakistani farmers are doing what farmers in India and Brazil had done previously – ignore the law to improve their lives and their farms [16].

Consumers

If we think of trade and commerce in crops and foods as a chain from production to consumption, scientists/developers and farmers are the first two links of that chain. Consumers are the last link. Consumers assuredly want safe, nutritious foods at a reasonable price. Focusing on genetically modified crops, consumers have additional preferences, that when considered nonideologically, do not constitute an entrenched public opinion against genetically modified foods. Indeed, the majority of consumers are willing to purchase genetically modified foods [17].

Consumers want accurate information communicated by trustworthy sources about genetically modified foods. Consumers may not be especially knowledgeable about the science of genetic modification and plant breeding, or about the realities of farming, but they desire to learn more. At the same time, most consumers do not consider genetically modified crops or foods a crucial issue. On their list of preferences related to food, most consumers consistently rank appearance, familiarity, freshness, price and taste as their primary preferences related to their food purchases. In flush economic times, price is less important; in lean economic times, price becomes the predominate consideration. With respect to safety concerns about food, consumers rank genetically modified foods as a low priority concern. Consumers are much more concerned about other issues related to food safety.

Taking into account the consumer preferences listed above, many consumers are willing to purchase genetically modified whole foods or foods produced with or from genetically modified ingredients. Consumers express even a greater willingness to purchase genetically modified foods if they perceive direct benefits for themselves and their families from the food [18].

A small percentage of consumers actively seek to avoid the purchase and consumption of genetically modified foods. They do so for many different reasons, but they have a strongly expressed preference for avoidance. These consumers can protect

their preference by purchasing food in niche markets that supply their preference – primarily the organic food sector where the intentional use of genetically modified seeds, crops or ingredients is expressly prohibited. Consumer preferences for organic food can be satisfied without prohibiting or stifling other consumers access to genetically modified foods.

Activist groups opposed to agricultural biotechnology consistently focus upon consumers who prefer avoidance and greatly exaggerate their numbers. In addition, activists spend considerable time and resources in attempts to frighten all consumers with false and misleading claims about the safety and nutritiousness of genetically modified foods [19]. Yet, despite the extended and colorfully bizarre campaigns against genetically modified foods, the percentage of consumers who seek avoidance remains small. Activists get media attention but have not successfully moved most consumers to a preference of avoidance of genetically modified foods.

Hundreds of millions of consumers eat genetically modified foods every day and have done so for more than a decade without a single instance of consumer harm that is unique or different in any way from conventional and organic foods. For consumers, genetically modified foods are, in fact and in truth, substantially equivalent to conventional and organic foods. Despite proclaimed perceptions, most consumers are not a blockage in the chain of commerce in genetically modified crops coming from scientists and developers and grown in farmers' fields.

Retailers: food processors and food stores

While in low-income and rural-dominated societies' consumers grow their own foods or purchase from local vendors, in the middle/higher income countries consumers purchase by far the largest percentage of their food from supermarkets [20]. The supermarket revolution of fresh foods, processed foods and baked goods has affected all countries and, indeed, the spending on processed foods is increasing fastest in developing countries [21]. Consequently, retailers are the gatekeepers to consumer choice. If retailers do not offer a particular food to consumers, consumers have no choice to buy that particular food.

Understandably, retailers are sensitive to protecting their brand names, their market share, their reputation and their profitability. But this sensitivity to protecting their legitimate self-interest means that retailers are also subject to activist groups threatening to disrupt retail operations with demonstrations, boycotts and consumer scares based on misinformation, ideologically driven advertising and media distortions. Retailers can thus become quite risk-averse to a new food or a new food technology relatively quickly and easily. As Sir Terry Leahy, chief executive of the UK retail food chain, Tesco, stated in the London City Food Lecture in February 2009,

> ***"It may have been a failure of us all to stand by the science. Maybe there is an opportunity to discuss again these issues and a growing appreciation by people that GM could play a vital role in feeding the world's growing population." [22]***

If retailers had stood with the science of genetically modified plants for food, retailers would have linked scientists/developers and farmers to consumers. Genetically modified foods would be products in trade and commerce no different than other foods in trade and commerce. Genetically modified foods would trade and retail in domestic and international markets like their equivalent foods. While equivalency between genetically modified foods and other foods was not the issue before the World Trade Organization (WTO) in the dispute between Argentina, Canada and the United States versus the European Union, relating to the EU *de facto* moratorium on approving imports of genetically modified foods and crops, the WTO ruled in favor of Argentina *et al.* on the basis that the EU was acting without a scientific basis for its moratorium. The WTO ruling stood with science [23].

As everyone knows, genetically modified crops and foods have not been treated like equivalent crops and foods from conventional and organic agriculture. Specifically from the retailers' perspective, genetically modified foods in many countries must carry labels that impose costs upon retailers while exposing the retailers to targeted campaigns by activists against retailers' ingredient and stocking policies. In light of retailers' sensitivities and risk aversion, mandatory labeling has meant that, in many situations, retailers have attempted to source nongenetically modified ingredients and have tried to avoid stocking genetically modified foods. While activists have touted labels as providing consumer choice, proclaiming the consumer right-to-know, the consumer reality is just the opposite – the denial of consumer choice – because retailers have often refused to offer consumers choices [24].

Leaving aside the legal question as to whether mandatory label laws for genetically modified foods violate the World Trade Agreements [25], mandatory label laws have factually reduced consumer choice and commercially pressured retailers into avoiding genetically modified foods. By so doing, retailers, as the gatekeepers to consumer choice, have blocked consumers from purchasing products that have already shown huge agronomic, environmental, health and economic benefits for sustainable intensive global agriculture and for food security for societies around the world. Even worse, unless retailers change their policies, possibly by influencing public policy to change the mandatory label laws, retailers have forgone for themselves and their customers the scientific and technological advances in agricultural biotechnology that are immediately on the horizon and reasonably expected in future years. By shunning genetically improved crops, retailers could limit their consumers to foods that are less healthy and less safe.

Food and feed traders: exporters and importers

Food and feed traders are the link in the chain of commerce connecting farmers to retailers and on to consumers. While information about available products compared to requested products, and about general market specifications compared to niche market specifications, constantly travels back and forth through the chain of commerce, information mismatches can and do occur. In a basic sense, exporters can only ship products that farmers produce while importers can only sell products that retailers demand. In addition to the demands of the market, food and feed traders must also comply with international and domestic laws that govern trade in food and feed. In attempting to satisfy both market and legal demands, food and feed traders become important

gatekeepers to the cost of food/feed and the availability of food/feed through the international trade in agricultural commodities.

In some countries, responding to retailers asking for nongenetically modified crops and foods, importers have requested that exporters segregate crops and foods between conventional/organic and transgenic. If importers do not find the requested nongenetically modified crops and foods in the exports from a particular country, the importers seek alternative suppliers in other countries. Importers who request these segregated goods assuredly pay for the increased costs associated with segregation. Exporters assuredly are willing to engage in segregation to satisfy the importer's demand so long as the importer pays an appropriate price premium. Markets and contractual obligations usually are adequate to meet this demand for segregation among crops and foods [26]. Moreover, these segregated markets and contractual obligations can function easily and efficiently in accordance with ordinary trade rules established under the WTO Agreements.[1]

However, genetically modified crops and foods/feeds are subject to the Cartagena Protocol on Biosafety (CPB) and to various national legal regimes that focus specifically on agricultural biotechnology. Thus, exporters and importers of genetically modified crops and foods/feeds must comply with these additional legal requirements. These additional legal requirements can create trade disruptions, thereby undermining the smooth flow of agricultural products in international trade that is needed for food/feed availability and food/feed security in developed and developing nations [27]. (This essay focuses on possible trade disruptions and does not focus on international legal issues, i.e. whether the WTO agreements, the CPB, and these specialized domestic legal regimes are compatible or incompatible. Concerning these international legal issues, read [28].)

Simply by their existence, the CPB and special domestic regimes focusing on agricultural biotechnology create disincentives for countries to adopt or to trade in genetically modified crops and foods/feeds. These specialized regimes express, either implicitly or explicitly, the scientifically incorrect message that agricultural biotechnology creates risks that are unique and different from conventional/organic agricultural products. Thus, countries in food crises may deny their citizens access to genetically modified foods even though those same foods are consumed by hundreds of millions of citizens in developed countries on a daily basis [29].

More specifically, the CPB contains two provisions especially applicable to food traders: Article 18 on Handling, Transport, Packaging and Identification and Article 27 on Liability and Redress. Both articles address topics purposefully left unresolved when the CPB text came into final form in Montreal in 2000 because the Parties to the Protocol could not reach agreement. In 2009, the Parties are still not in agreement about these topics, though they have promised to reach agreement in 2012 and 2010, respectively.

With respect to Article 18, those opposed to agricultural biotechnology demand that Parties to the Protocol make it legally binding that food/feed traders specifically identify every possible transgenic trait that might be contained in a shipment of bulk grains or oil seeds and quantify the percentage of each trait in each shipment. Of course, the greater the demands for identification and quantification, the greater the cost becomes for testing, handling, cleaning, segregation, etc. The costs rise very quickly and, at some point, prohibitively for engaging in trade in genetically modified crops – as shown in a careful study from Brazil [30]. By contrast, Article 18(2)(a) would also allow, if the Parties so agree, that agricultural shipments need only state on the shipping documents that the shipment ''may contain'' genetically modified products and that these are not intended for introduction into the environment of the importing nation, but rather are only for processing into food and feed products. If this ''may contain'' option were the ultimate agreement in 2012, this statement on the shipping documents imposes no measurable additional costs upon food/feed traders and creates no significant trade barriers for genetically modified agricultural commodities.

With respect to Article 27 on liability and redress, those opposed to agricultural biotechnology urge the Parties to adopt a civil legal liability regime using strict liability for damages expansively defined (e.g. alleged social, ethical and cultural damages) backed by mandatory insurance or compensation funds. Under such a regime, the liability risks for developers and food/feed traders in genetically modified crops would be enormous and an international liability regime would become a significant hindrance to trade in genetically modified agricultural commodities. By contrast, Article 27 also allows Parties to agree to an administrative system of liability limited to significant adverse or negative environmental harms while focusing on environmental remediation, not monetary damages. As of December 2009, the Parties appear most favorably inclined toward an administrative system as the appropriate legal regime under Article 27 [31]. If Parties agree to an administrative system, the impact on trade in genetically modified crops would probably be minimal because agricultural trade for ten years has involved great quantities of genetically modified crops without a single instance of significant adverse or negative environmental impact.

In contrast to the CPB, the European legal regime for the importation of genetically modified agricultural commodities has had a disruptive impact on agricultural trade. The European system has been very slow to approve transgenic traits for food or feed and has a 'zero tolerance' for unapproved traits. As a consequence of these two European attributes, food/feed traders have become hesitant to engage in agricultural trade with European nations. Feed prices, particularly, have escalated sharply in Europe [32]. Moreover, the European situation is likely to get significantly worse in the coming years as more countries grow several transgenic traits on their agricultural lands [33]. Until Europe quickens the pace for approval and develops a tolerance level for unapproved traits, the European legal regime will continue to have a disruptive impact on agricultural trade [34].

Conclusion

Science in agriculture is essential to feed, clothe and nourish the health and well-being of human beings. Scientists and developers can deliver the benefits of science in agriculture to farmers who will readily adopt these agricultural improvements. But scientists, developers and farmers cannot bring these benefits to consumers unless food traders can export and import genetically modified

[1] The relevant World Trade Organization Agreements are the General Agreement on Tariffs and Trade (GATT 1994), the Sanitary-Phytosanitary Agreement (SPS), and the Technical Barriers to Trade Agreement (TBT). There is another WTO agreement on Trade-Related Intellectual Property Rights (TRIPs) that is not directly pertinent to this essay.

crops free from debilitating legal regimes and unless retailers offer consumers product choices using ingredients from improved crops. Consumers can benefit themselves with safer, more nutritious, environmentally friendly and (probably) less expensive food, if they avoid believing ideologically motivated misinformation and food scares about genetically modified foods and feeds. Poor farmers and poor consumers especially are likely to be the principal beneficiaries of agricultural development flowing from genetically improved crops [35]. But the past 30 years clearly shows that society will not benefit from genetically modified crops without great effort and difficulty.

In the early 1500s, Raphael painted representations of the cardinal virtues – prudence, justice, fortitude and temperance [36] – on the walls of the Vatican Palace. Scientists, developers, farmers, food traders, retailers and consumers will need to exercise these cardinal virtues for scientific rationality lest we let our fears and our passions deny humanity the benefits of genetically improved crops. We must have a habitual and firm disposition to pursue the good in science and to choose concrete actions for the good of humanity through transgenic plants for food security in the context of development [37].

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