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The Costs of Implementing the Biosafety Protocol - A Look at China

As countries prepare to take decisions on the Biosafety Protocol's (BSP) documentation requirements for shipments of living modified organisms (LMOs) intended for food, feed and processing (LMOs-FFP), many questions remain about the appropriate ways that the BSP might be implemented and about its potential impacts. Answers to these questions are particularly important for developing countries that are large importers of agricultural commodities and have the capacity to develop biotechnology products of their own. The International Food and Agricultural Trade Policy Council (IPC) has consistently urged parties to the BSP to assess the likely impacts of the different options. As a developing country that imports large amounts of commodities, China's experience with regards to the BSP will be of interest to other developing countries as well. For this purpose, the IPC has commissioned a study on the economic impact of the BSP on China to be completed shortly, on which this report is based.[1]

Some of the BSP provisions still lack details on how they are to be implemented in practice, among them the requirements for the labeling of LMOs-FFP. Since most agricultural commodities around the world are produced and traded for food, feed, and processing, biosafety labels for LMOs-FFP could prove costly and disruptive for world agricultural commodity trade. Ultimately, the extent of these costs and disruptions will be determined by which documentation scheme for LMOs-FFP is agreed upon under the BSP and the specific circumstances of various countries that need to implement them.

The Biosafety Protocol

The Biosafety Protocol entered into force in 2003 as part of the Convention on Biological Diversity, with the main objective to contribute to the safe transfer across countries of LMOs, which will be released into the environment and could affect the conservation and sustainability of biological diversity. The BSP includes guidelines on how countries exporting LMOs need to get a green light from importing countries through the use of "Advanced Informed Agreements."

The BSP rightly does not require Advanced Informed Agreements in the case of transboundary shipments of LMOs that are intended for food, feed and processing and not for release in the environment. For these uses, the BSP requires countries to provide information about the types of LMOs present or likely to be present in bulk crop shipments through a web-based international Biosafety Clearinghouse and indicate that these shipments may contain LMOs and are intended for food, feed and processing and not for planting. The BSP, however, asked that members agree on whether more detailed labeling requirements for such shipments are necessary. Among the documentation options being considered are indicating that a cargo:

a) "**may contain**" LMOs (current BSP requirement);
b) "**contains**" LMOs and **identifying** the specific LMOs in the cargo (current practice in China);
c) "**contains**" LMOs and identifying the specific LMOs in the cargo as well as **quantifying** their amounts.

[1] Forthcoming study by Jikun Huang, Deliang Zhang, Jun Yang (Center for Chinese Agricultural Policy); Scott Rozelle (University of California-Davis); Nicholas Kalaitzandonakes (University of Missouri-Columbia).
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The parties have not been able to reach an agreement until now and another attempt will be undertaken in a meeting of the BSP parties in March 2006 in Brazil.

A technical brief produced for the IPC by Kalaitzandonakes (2004) points out that some of the BSP provisions could lead to trade restrictions and significant compliance costs. It also brings the benefits and costs of the differing options into focus and concludes that the majority of the costs will be borne by importing countries and that the costs of different options vary widely. Taking a closer look at China, which is - and will continue to be - a major importer of bulk commodities including LMOs-FFP, can help to bring about a more detailed view of the potential implications of BSP implementation.

China – Soybean and Maize Production and Trade

Soybean

No crop in China has been as affected as much by trade liberalization and rising incomes as soybeans. In the past 10 to 15 years rising incomes and other economic forces (such as migration and marketization) have greatly increased the demand for meat and other high valued food commodities. As the demand for meat has risen, livestock producers themselves have begun to demand increasing quantities of feeds, including grains and oilseeds. In addition, as the national market for food products has liberalized, there has been an increasing demand for soybean oil. During the past decade, the domestic demand for soybeans has more than doubled.

Although China is also a large producer of soybeans, its domestic production was not able to keep up with the demand. With rising pressure on prices, coupled with China's preparations for entry into the WTO, national leaders began to unilaterally liberalize soybean trade in the late 1990s and by 2000 China became the world's largest importer of soybeans (in 2005 China imported more than 24 million tons). An agricultural policy model run by the Center for Chinese Agricultural Policy suggests that the increasing demand will continue in the future: although supply will rise, demand will rise faster and hence imports can be expected to rise in the coming years.

Taking advantage of the newly opened sector and the rising demand, large domestic and foreign food corporations have invested heavily in China's soybean crushing sector. Many of the largest owners and operators are state-owned firms such as COFCO or multinationals such as ADM. Almost all of the plants and most of new crushing capacity are situated in coastal cities that have access to good port facilities.

In many cases, the firms have integrated themselves into the port off-loading, conveying, storage and delivery systems, operating some of the most efficient plants in the world best suited for processing imported soybeans. Indeed, imported soybeans have covered more than half of China's demand since 2003 (Table 1). In 2003 and 2004, on average, 55 percent of China's total soybean consumption was imported.

Table 1: Soybean trade (thousand tons) in China, 1990-2004		
	Import	Export
1990	1	948
1991	1	1117
1992	122	666
1993	100	383
1994	52	830
1995	298	380
1996	1114	190
1997	2886	190
1998	3201	170
1999	4320	207
2000	10419	215
2001	13940	262
2002	11315	305
2003	20741	295
2004	20229	349

Source: Reported in Huang et al., 2006

Not surprisingly, China is becoming reliant on the world's three major suppliers of soybeans. Between 2001 and 2005, more than 99 percent of China's soybeans came from the US, Brazil and Argentina (Table 2). During each year, the share from the US was the largest, although the relative share of the three sources of imports fluctuates over time.

Table 2: Soybean import by source countries, 2001-2005					
	2001	2002	2003	2004	2005(1-11)
	In shares (%)				
USA	41	41	40	50	38
Brazil	23	35	31	28	31
Argentina	36	25	29	22	30
Canada	0.1	0.1	0.1	0.1	0.0
Others	0.1	0.0	0.0	0.0	0.8
Total	100	100	100	100	100

Note: the data are for the period of January-November in 2005.
Source: Reported in Huang et al., 2006

China is expected to continue increasing imports of soy, which will lead to increased trade with the US, Brazil and Argentina – all countries with widespread cultivation of LMOs (see Figure 1, page 5).

Maize

In many ways, the case of maize is similar to that of soybeans. Rising incomes have increased the demand for meat, and hence the demand for maize as feed. As with soybeans, China's demand for maize has also doubled in the past decade. Domestic production, however, has largely kept up with demand, and China has in fact also exported large quantities of maize (Table 3). In the late 1990s, trade policy favored maize producers, by only allowing maize imports through state traders and subsidizing exporters of maize.

Table 3: Maize trade (thousand tons) in China, 1990-2004

	Import	Export
1990	369	3405
1991	1	7783
1992	9	10365
1993	7	11183
1994	7	8907
1995	5180	164
1996	440	298
1997	2	6620
1998	250	4690
1999	70	4310
2000	2	10470
2001	33	5832
2002	8	11675
2003	1	16391
2004	2	2324

Source: Reported in Huang et al., 2006.

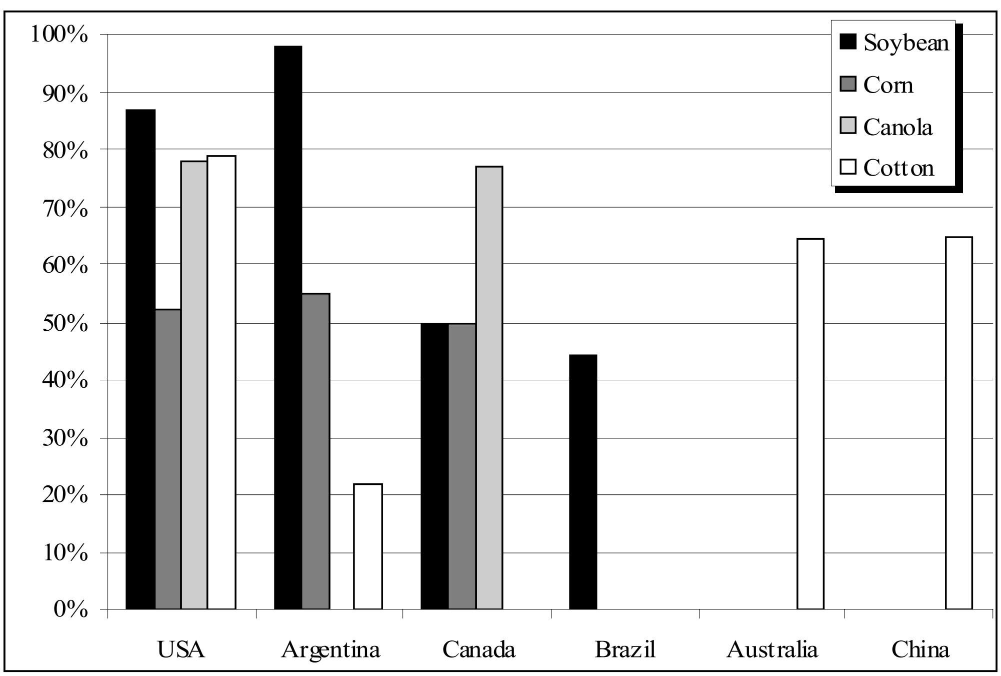
Of all the major commodities grown in China (rice, wheat, maize, cotton and soybeans), maize was receiving the highest level of protection from trade policies on the eve of the nation's accession to the WTO. For this reason, among others, maize-sown areas expanded, partly at the expense of soybeans. Furthermore, new technologies have also pushed supply up during the past decade through sharp productivity gains and rising yields. During the 1990s and early 2000s, while fluctuating from year to year, Chinese maize producers have generated a surplus and have been a net exporter of maize in every year except 1995 and 1996. In fact, in a number of years since 1990, China has been one of the two or three largest exporters of maize in the world. China's main export markets have been South Korea, Malaysia and Japan (Table 4). These countries—although differing in their importance from year to year after 2000—have accounted for 70 percent or more of China's exports.

Table 4: Maize export by destinations 2000-2004.					
	2000	2001	2002	2003	2004
	In shares (%)				
South Korea	58	51	53	49	57
Malaysia	20	23	21	15	11
Iran	1	0	0	10	0
Indonesia	0	0	0	5	1
Japan	0	0	0	5	26
North Korea	2	6	1	1	2
Others	20	20	24	16	4
Total	100	100	100	100	100
Source: Reported in Huang et al., 2006					

However, this trend is not expected to continue. Projection models by the Center for Chinese Agricultural Policy forecast that demand for maize will continue to grow rapidly in the future due to increasing demand for livestock and aquaculture products. Continued rise in demand stemming from factors related to income growth, coupled with trade liberalization (which means the price of maize will fall on a relative basis) indicate that China's role as a maize exporter is coming to the end. Most projection models predict that by 2010, China will be a net importer of maize. There may still be exports coming out of China's northeastern region to Korea and other key Asian markets, but it is forecast that imports into southern China will more than offset them. Additional growth in demand due to rising incomes and further trade liberalization will therefore make China an even more important market for both soybeans and maize.

As with soybeans, the majority of China's maize imports are likely to come from the few major exporting countries that dominate international maize markets and have widespread LMO production, namely the US, Argentina, Brazil and South Africa (Figure 1). The expected future increases of soybean and maize imports and the fact that the main exporters to China are countries with widespread cultivation of LMOs, suggests that compliance costs associated with the BSP could be significant.

Figure 1: Adoption of LMOs in Various Crops and Major Exporting Countries in 2005



Source: USDA NASS, USDA FAS, AAFC, and ISAAA

While China is such a large importer, one should also consider the impact of the BSP on China as an exporter, if it were to grow GM maize in the future. [2] Moreover, China will incur BSP costs related to its rice exports if it goes ahead with the commercialization of GM rice, which is currently at the field trial stage in China.

China's Biosafety Regime

When evaluating the potential impacts of implementing the BSP, activities for both setting up and operating the necessary biosafety bureaucracy as well as ensuring compliance must be considered. On both such sets of activities China has important advantages that are not shared by many other developing countries. Aided by its strong centralized governance, sound scientific infrastructure and large number of scientists, China has developed a comprehensive biosafety regulatory system in the course of the last 15 years. The Joint Monitoring and Management Commission (JMM) is the institution charged with directing and creating China's policy on GM regulation. The JMM was established by the State Council, China's highest governmental body. The JMM is composed of the highest representatives from the Ministry of Agriculture (MOA), the National Development and Reform Commission (NDRC), the Ministry of Science and Technology (MOST), the Ministry of Health (MOH), the Ministry of Commerce (MOC), the National Inspection and Quarantine Agency, and the State Environmental Protection Authority (SEPA). This group of officials is responsible for the coordination of key issues related to biosafety, including the responsibility to examine, approve, and develop all policies and regulations that relate to GMO production, labeling of the GM product in the marketing chain and GMO imports and exports. (See appendix Figure 3)

China's biosafety regime functions relatively well with regards to monitoring and regulating imports of LMOs, partially because imports only occur in a limited number of places (i.e. ports), the system is better funded because it is easier to collect taxes from a limited number of importers, and because it parallels China's regular quarantine system.

If a GM event is approved after undergoing regulatory review in China, the MOA then places the event on a list of products approved for import.[3] Exporters still have to apply to the MOA for an export shipment approval for each and every shipment. In the documentation, exporters certify that LMOs included in the shipments are all approved by the MOA.

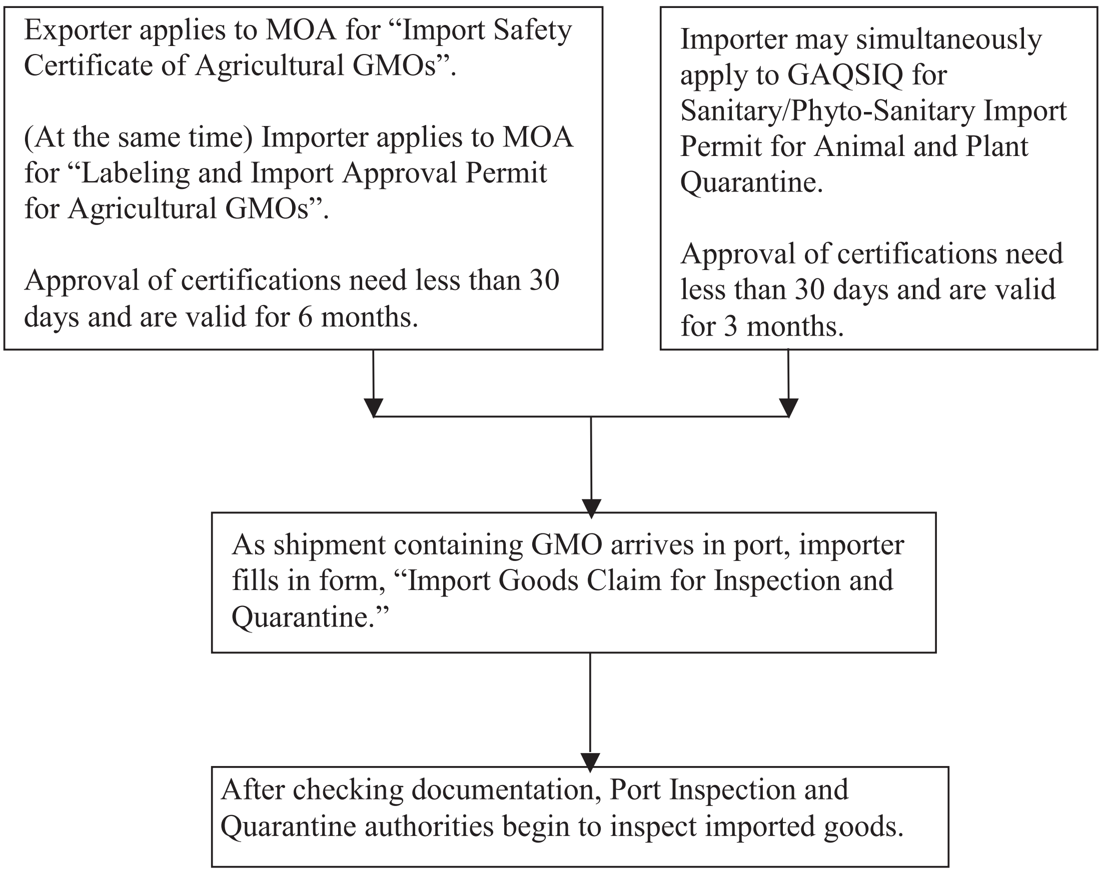
[2] While many observers believe it is inevitable that China will introduce GM technologies in almost all crops in the future, and not just cotton, there are a number of reasons that production of GM maize (or soybeans) might not be allowed in the next few years. First, damages from insects for maize producers are much less severe than they are for cotton producers. The productivity of cotton has been shown to have risen by more than 20 percent due to the adoption of Bt-varieties. When leaders chose to extend Bt-cotton, however, they consciously made a decision to not require cotton farmers to cultivate a non-Bt refuge (as a strategy to maintain the efficacy of the Bt-cotton by not allowing the main pest of cotton, the bollworm, to build up resistance). One of the main reasons for their choice of this strategy (that is not requiring a refuge) was that in much of China, cotton is planted in close proximity to maize (that is, farms and regions have a large diversity of crops planted within the same region). Because of this, and due to the fact that maize acts as a refuge for bollworms, if China was also to extend Bt-maize, at least part of the gain from the new technology will be offset by the increased need to have refuges in the cotton sector. Ultimately, however, China is expected to commercialize Bt-maize, especially since there are other traits (e.g. herbicide resistance, other insect resistance, drought resistance, modified oil and protein) which will be considered. Nevertheless, given the short term perspective of this study, it is assumed here that no GM corn is produced in China and hence no BSP compliance costs are evaluated for China 's maize exports. Clearly such costs should be considered in future analyses. It is assumed in this study that China will not be exporting GM maize from northern China. However, because the country will almost certainly be importing LMO maize into southern China, there is the possibility that LMO maize could appear as foreign matter (e.g. from residual maize left in the holds of transport barges that are used for both imported maize and exported maize). Although such possibility is ignored here, it is recognized that if Chinese exporters must adhere to the BSP and file for export approval for such varieties (and incur the testing costs), it will face additional export-related cost of the BSP.

[3] Recognizing the comprehensiveness of regulations outside of China, national leaders, at least so far, have taken a fairly accepting view of results from biosafety procedures that affect imported GM commodities. If the gene under question has passed through the biosafety regulatory process in the United States or Canada, it has generally been assumed to meet China's food safety and environmental regulations. The only additional requirements are imposed when a foreign technology is imported into China. In this case, the new technology must be tested for its efficacy in controlling pests and/or disease under actual field conditions in China.

At the same time, importers must apply for import permits. The application for an import permit, which is much like the export permit, lists the LMOs that will be brought in. Today, the requests for export or import permits take no more than 30 days to execute. [4]

Once the shipment arrives in port, the local authorities are responsible for ensuring compliance of the shipment with the approval certificates. When the shipment arrives, typically, the importer files a form called the Import Good Claim for Inspection and Quarantine. This request references the exporter and importer approval certificates. It also states that the shipment is within compliance (see Figure 2).

Figure 2: Import Procedures for GM Soybean in China, 2005.



Source: Reported in Huang et al., 2006

Once the form is filed, the biosafety authorities in the port begin the inspection procedure. When the tests prove the importer is in compliance, the shipment is released for unloading as long as the fees for the tests have been paid. According to regulations, for the first 10,000 tons, 20 samples are randomly chosen. After the first 10,000 tons, an additional sample is randomly chosen for each 1,000 tons. Therefore, for a 60,000 ton vessel that is fully loaded, a total of 70 samples need to be tested. The tests are done in a local lab that is under contract to the port biosafety authority. The tests performed are essentially equivalent to a test needed to identify whether or not the shipment contains LMOs or not and what types of LMOs are present. There is no requirement under the system in China

[4] Procuring the importation of a large soybean or maize load to China from one of the main exporters is a time consuming process. From the time the initial order is placed until taking delivery it typically takes 3-6 months. Requests for import permits are typically initiated early in the process. Hence, issuance of import and export permits within a month's time does not restrict or add any holdup costs to the importation process beyond the actual costs of the permits.

today to determine the share of each type of LMOs in the shipment. When comparing China's current biosafety regulation with the international procedures being debated about the BSP, China's procedures already exceed the current "may contain" labeling regime as they seek to identify the particular type of LMO in the cargo.

Establishing and Operating Biosafety Regulations

In order to evaluate the potential impacts of the BSP, both the bureaucratic costs of setting up and operating biosafety regulations and the compliance costs from implementing them must be considered. Unlike many developing countries, China has a biosafety regime in place. Developing countries that are evaluating the implications of the BSP could therefore find China's experience with setting up a biosafety regulatory framework and associated outlays of interest.

As a result of increasing imports of LMOs-FFP and the commercialization of Bt-cotton, China raised its annual budget for biosafety related activities significantly over the past several years. When China started its commercialization of Bt-cotton in 1997, the budget allocated to both biosafety research and regulatory management was trivial. In 1997, it was estimated the total budget allocated to both biosafety research and administration of biosafety management was only US$ 120,000 (Table 5). Nearly half of this budget was used in biosafety research (e.g. food safety and environmental safety) on Bt-cotton lines that were generated by the Chinese Academy of Agricultural Sciences. Another large share was used for covering regulatory costs of running the Biosafety Committee.

Table 5: Estimated government budgetary allocations on agricultural biosafety research and regulation implementation in China, 1997 to 2004.

	Biosafety research budgets (million **RMB**) (a)	Biosafety administrative budget (million **RMB**) (b)	Total biosafety budget (million **RMB**) (c)=a+b	Total biosafety budget (million **US$**)	As share of biotech research budget (%)
1997	0.45	0.56	1.01	0.12	0.23
1998	0.58	0.60	1.18	0.14	0.20
1999	0.72	0.66	1.38	0.17	0.16
2000	1.71	0.70	2.41	0.29	0.28
2001	8.69	0.77	9.46	1.14	0.82
2002	11.68	3.38	15.06	1.82	1.11
2003	17.92	5.46	23.38	2.83	1.44
2004	18.64	5.52	24.16	2.92	NA

Note: budgets are deflated by CPI and in 2000 constant prices. The total government expenditure on agricultural biotechnology is from a recent CCAP survey of agricultural biotechnology institutes and administrative agencies.

Source: Reported in Huang et al., 2006

Table 5 shows that there have been substantial increases in government budgetary allocations for research on and the management of agricultural biosafety. The rapid growth of agricultural biotechnology and the commercialization of Bt-cotton in the late 1990s posed a challenge to the capacity of China's biosafety regulation. In response to this challenge, China raised the annual budget for agricultural GMO biosafety research from a little over US$ 80,000 in 1999 to nearly US$ 1.5 million in 2002. By 2004, the annual operating expenditures for agricultural GMO biosafety research reached almost $2.5 million. Currently, China spends about US$ 3 million annually on agricultural biosafety related works (excluding the expenditure required to implement its labeling and market inspection duties inside China and at the border).

Testing Costs for LMOs-FFP

Beyond bureaucratic costs, additional compliance costs are incurred for the implementation of the biosafety regulation at a country's borders. A portion of such compliance costs – the costs of testing imports and exports of LMOs-FFP – is somewhat easier to calculate. To estimate such costs one needs the number and size of the vessels that bring soybeans and maize to China; the cost of testing for different types of ships; and an assessment of other, non-testing costs. Such costs are presented in Table 6 for the three alternative LMO-FFP labeling regimes currently under discussion.

Table 6: Estimated total costs for laboratory and other related costs for LMO at border in China in 2005.

	"May Contain LMOs"	"Identifies LMOs" (Current case)	"Quantifies LMOs"
Soybean (import)			
Cost per sample (US$)	286	358	481
Cost per ton (US$)	0.34	0.43	0.57
Total cost (million US$)	8.32	10.40	13.98
Import price in Jan 2006 (US$/ton)	282	282	282
Share of import price (%)	0.12	0.15	0.20
Maize			
Cost per sample (US$)	286	716	1332
Cost per ton (US$)	0.34	0.85	1.59
For import:			
Import price in Jan 2006 (US$/ton)	140	140	140
Share of import price (%)	0.24	0.61	1.13
Total cost (million US$)	0	0	0
For export:			
Export price in Jan 2006 (US$/ton)	135	135	135
Share of export price (%)	0.25	0.63	1.17
Total cost (million US$)	0	0	0

Data source: Reported in Huang et al., 2006

Note: costs include laboratory testing cost (about 70%) and other service charges (about 30%) to importers if the Biosafety Protocol would be applied in 2005. China did not import maize and did not export GM maize in 2005, so the total estimated costs associated with the Biosafety Protocol were zero.

Almost all of soybean imports to China arrive in large, panamax-type vessels that average a little over 60,000 tons. Considering first the “may contain” labeling regime and given China’s sampling and testing procedure, China’s biosafety inspectors tested 29,040 samples of LMOs from the 420 vessels in 2005 (Table 6). The current unit cost of testing soybeans for the presence of LMOs in China is US$ 286. The costs include both the laboratory testing costs (about 70 percent of the value) and the other service charges assessed by the port (about 30 percent) on a per sample basis. This means that in 2005 the total charges for biosafety testing for soybeans was more than US$ 8.3 million (row 3). Given the average import price of soybeans in 2005 was US$ 282, the average price of testing was about 0.15 percent of the price of soybeans.

More demanding testing regimes that identify the LMOs or quantify them imply higher testing costs. When using the strictest criteria (which requires the lab to verify the shares of each type of each LMO in the vessel), the cost rises to US$ 481 per sample and the total testing costs increase to US$ 13.98 million, or 0.2 percent of the import price.

Calculations of the costs for testing maize are necessarily more tentative as no such tests have yet been performed in China in the absence of imports. Nevertheless, calculations suggest that per sample, per ton and as percent of the import maize price, testing maize cargoes is substantially more expensive that testing soybean ones. This is mostly because there are more maize LMOs in the market today (there are 8) than soybean LMOs (there is 1).

Since the same vessels are tested at the point of export using the same sampling protocols, additional testing costs are incurred. For context, the testing costs for maize and soybean exports in the US are presented in Table 7.

Table 7: Estimated LMO testing costs and other fees of exporting soybean and maize from the USA.

	"May Contain LMOs"	"Identifies LMOs"	"Quantifies LMOs"
Soybeans			
Cost per sample (US$)	216	216	324
Cost per ton (US$)	0.30	0.30	0.44
Export price in Jan 2006 (US$/ton)	245	245	245
Share of FOB price (%)	0.12	0.18	0.18
Total cost (million US$)	8.33	8.33	12.5
Maize			
Cost per sample (US$)	456	792	1536
Cost per ton (US$)	0.67	1.16	2.26
Export price in Jan 2006 (US$/ton)	105	105	105
Share of FOB price (%)	0.64	1.14	2.15
Total cost (million US$)	34.2	59.3	115.1

Data Source: Reported in Huang et al., 2006

Note: costs include laboratory testing costs (about 80%) and other service charges (about 20%)

When testing soybeans under the least strict criteria "may contain LMOs" and "identifies LMOs" a qualitative PCR test for the event GTS40-3-2 is used at a laboratory cost of US$ 180 per sample. Along with 20 percent in service charges, the cost for this test is US$ 216 per sample. When using the more strict criteria a quantitative PCR test for the same event is performed at the cost of US$ 324 per sample. Hence, all soybean test costs in the US are lower than those in China. An estimated 965 vessels averaging 29,210 tons cargo is subjected to a similar testing regime as that in China. Accordingly, on average, 40 samples are collected and tested from each soybean export vessel from the US with an average tonnage of 730 tons per sample and an estimated total cost of US $8.3 – US$ 12.5 million. Expressed as percent of the export soybean price, testing costs in the US vary from 0.12 – 0.18 percent.

Testing costs for US maize exports, however, are more expensive. With 8 commercial events in production, the costs of the three testing regimes are significantly different. Under the least strict criteria "may contain LMOs" a PCR test for 35S and GA21 is sufficient implying laboratory costs of US$ 380 per sample. Along with 20 percent charges, the testing expenditure is equal to US$ 456 per sample. The more demanding regime that "identifies LMOs" requires a qualitative PCR test for the events MON810, NK603, TC 1507, MON863, BT11, 176, T25 and GA 21. The laboratory expense for such a test is US$ 660 per sample. The most restrictive regime "quantifies LMOs" requires a quantitative PCR for the same events as above at the cost of US$ 1,280 per sample. After service charges, the per sample costs for this most restrictive regime is US$ 1,536.

With an estimated 2,270 bulk vessels averaging 22,450 tons of cargo, an average of 33 samples are taken and tested resulting in an average tonnage of 680 tons per sample. The overall testing costs for maize exported from the US then range from US$ 34 to US$ 115 million. As a share of the export maize price, testing costs represent 0.64 percent to 2.15 percent – certainly significantly higher than in the case of China.

One should note that testing costs for soybeans, in China and elsewhere, will increase over time to the level of the tests for maize, as additional soybean LMOs will be commercialized in the future.

Impact Analysis of BSP on China Using GTAP

The impact of BSP testing costs on China's (and global) trade were analyzed using the Global Trade Analysis Project (GTAP) and the test costs estimates above. GTAP is a multi-region, multi-sector computable general equilibrium model which has been used to generate projections of policy impacts in a number of other studies.

All the assumptions and data sources for the GTAP analysis are detailed in Huang et al. (2006). Because of uncertainties in the final wording of the BSP, the analysis examines the impacts of all three alternative labeling scenarios. A number of impacts are examined. The first and most direct is the impact of the BSP testing costs on soybean and maize prices. While this is primarily influenced by the direct costs of testing, as prices rise from the added costs, consumers in the importing countries demand less and domestic producers supply more (because they are facing higher, quasi-BSP-protected price). The price impacts in the analysis account for both direct and indirect price effects. Given the change in prices, the effect on international trade and domestic and world production are also evaluated.

As expected, after the implementation of the BSP in 2010, the international price of soybeans and maize rises (Table 8). Depending on what decision is taken on the criteria for testing international shipments for LMOs, the international price of soybeans rises by 0.07 to 0.11 percent (columns 1 to 3, row 1). Reflecting both the fact that the cost of testing is relatively higher (on a per ton basis) and the more complicated nature of testing, the international price of maize rises proportionately more under all three scenarios, from 0.31 to 1.07 percent (columns 4 to 6, row 1).

Table 8. Impacts (%) of Biosafety Protocol on international and domestic prices of soybean and maize under alternative scenarios in 2010.

	Soybean				Maize		
	I	II	III		I	II	III
International prices	0.07	0.10	0.11		0.31	0.56	1.07
Domestic prices							
China	0.06	0.08	0.10		0.09	0.17	0.33
NAFTA	-0.03	-0.05	-0.07		-0.05	-0.09	-0.17
South & Central America	-0.02	-0.03	-0.04		-0.04	-0.07	-0.13

Data Source: Reported in Huang et al., 2006

Because of the nature of the responses of producers and consumers around the world with regards to the extra cost of testing, the increase in the international price is less than the cost of the testing. The reason for this can be seen in Table 9. When import and export prices rise internationally due to the cost of testing required by the BSP, world trade in soybeans falls (columns 1 to 3, rows 1). At higher world prices, importers demand less soybeans, US$12.1 million less when using criteria I ("may contain" clause). When the strictest criterion is imposed, world trade decreases by 18.7 million. World trade for maize falls from between US$ 20.2 and 74.7 million due to the BSP (columns 4 to 6, row 1). Of course, when importers demand less, the international price falls, and so the final impact on world prices is less than the rise in price due to testing.

Table 9. Impacts of Biosafety Protocol on international trade of soybean and maize under alternative scenarios in 2010.

	Soybean				Maize		
	I	II	III		I	II	III
	In million US$						
World trade	-12.1	-16.4	-18.7		-20.2	-40.2	-74.7
China's import	-3.9	-5.4	-6.2		-6.1	-12.1	-22.5
NAFTA's export	-7.8	-10.2	-10.7		-21.7	-43.4	-81.3
South & Central America export	-7.8	-10.9	-13.3		-10.6	-21.1	-39.2
	Percentage changes (%)						
World trade	-0.08	-0.11	-0.12		-0.23	-0.47	-0.87
China's import	-0.06	-0.08	-0.09		-0.56	-1.12	-2.08
NAFTA's export	-0.10	-0.13	-0.14		-0.44	-0.87	-1.63
South & Central America export	-0.11	-0.16	-0.19		-0.70	-1.40	-2.60

Data Source: Reported in Huang et al., 2006

In absolute terms the amount of trade that is affected by 2010 is large and rises as the criteria for assessing the presence of LMOs become increasingly strict (Table 9, row 1). In percentage terms the effect is small (Table 9, row 5). World soybean trade falls from between 0.08 and 0.12 percent of the baseline rate in 2010. The volume of maize falls more, up to 0.87 percent. The reason is that even though on an absolute basis the decline is large, the volume of world soybean and maize trade is enormous and the price effect of testing imposed by the BSP is small in percentage terms.

While the trade flows fall for all the countries that are involved with China's soybean trade (Table 9, rows 2 to 4; rows 6 to 8), the direction of the impact of the domestic price changes depending on whether the country is a net exporter (e.g. NAFTA countries or South and Central American countries) or importer (e.g. China). In the case of China, the difference between implementing and not implementing its domestic biosafety regulations (which is equivalent to scenario II), means that China's domestic price of soybeans is higher by 0.08 percent and the domestic price of maize is higher by 1.12 percent. In contrast, the domestic prices of soybeans and maize fall in the NAFTA and South and Central American countries. In other words, the BSP acts exactly like a tariff, keeping trade down and forcing prices up for importing countries and reducing domestic price in exporting nations.

When domestic prices rise in importing countries and domestic prices fall in exporting countries, the analysis shows that that there is an effect on production in each individual country, even though the overall effect on world production is small (almost zero—Table 10). When China's domestic price rises due to biosafety regulation, producers, seeing a higher price, respond by producing more. In contrast, in exporting countries, the lower domestic prices induce producers to cut back on production.

Table 10. Impacts of Biosafety Protocol on world and domestic production of soybean and maize under alternative scenarios in 2010.

	Soybean				Maize		
	I	II	III		I	II	III
	In million US$						
World	3.1	4.2	4.6		8.5	17.3	33.4
China	4.1	5.4	5.9		10.8	21.7	41.0
NAFTA	-7.4	-9.6	-9.8		-20.6	-41.2	-77.3
South & Central America	-6.9	-9.7	-11.6		-7.5	-14.9	-27.7
	Percentage changes (%)						
World	0.007	0.010	0.011		0.017	0.034	0.065
China	0.130	0.173	0.188		0.097	0.195	0.369
NAFTA	-0.052	-0.067	-0.068		-0.097	-0.193	-0.363
South & Central America	-0.055	-0.076	-0.091		-0.104	-0.206	-0.382

Data Source: Reported in Huang et al., 2006

Further Considerations for China and Other Countries

The costs of implementing the BSP are not static: they increase as a country's amount of imports and exports rises. Moreover, an inevitable increase in the amount of GM varieties being commercialized leads to increased implementation costs, especially if the parties to the BSP agree on qualitative and quantitative documentation requirements rather than the "may contain" option.

Since compliance costs per vessel are relatively fixed, China, which generally receives large shipments of 60,000 tons per vessel, will have relatively lower costs than small developing countries, which receive smaller cargoes.

It is also important to note that test-driven compliance to BSP requirements will, inevitably, create uncertainties due to potentially differing test results at the points of export and import, which can lead to demurrage and rerouting costs. This is an important point since demurrage charges for large vessels can add up quickly. For instance, one extra day of wait at a Chinese port for a loaded vessel costs, on average, US$ 50,000 in port charges and hire fees alone. Fuel charges, product quality deterioration, and other costs further add to these expenses. Rejection and redirection of a vessel to an alternative destination or its origin, results in even larger cost increases.

To illustrate this point, it is useful to consider some recent controversial rejections of Brazilian exports to China, which allegedly contained soybeans coated with carboxin – a fungicidal seed treatment with a reddish dye. Such presence prompted the General Administration of Quality Supervision, Inspection, and Quarantine (AQSIQ) to impose quarantine. A total of 42 loaded vessels were first held up over a period of three months at various Chinese ports and ultimately turned away. The incremental demurrage costs in this case were estimated at approximately US$ 400 million. Hence, if biosafety assessments increase the chance of holdups and rejections of import loads at the point of entry, such costs could dwarf direct compliance costs for testing

Political Economy Considerations

As the potential impacts of the BSP are evaluated, the influence that different regulatory agencies can exert through their interpretation and practical implementation of national biosafety policies also need to be considered. In the case of China, for instance, there is discussion of an emerging competition among ministries for the responsibility of implementing the BSP.

SEPA, whose role in GMO management in the past has been less central than other agencies/ministries, has taken on a more aggressive role and is seeking to gain more of a formal place in the implementation of the BSP. This kind of competition almost certainly is part of the everyday give and take that occurs among ministries looking to expand their influence. In this case, however, there is the additional dynamic that many in SEPA are thought to be less favorably inclined towards biotech and GM foods and so the outcome of any shift in responsibility of implementation of biosafety regulation could affect the way the regulations are used and practically implemented. These are arguably less easily quantifiable considerations but important nevertheless.

Concluding Comment

The biosafety regime in China already exceeds the “may contain” provisions currently foreseen by the BSP. The bureaucratic costs of running this system have been highlighted, although China will also incur some additional costs in participating in the Biosafety Clearinghouse.

This paper has focused on the costs involved in establishing and implementing biosafety regulations that China is incurring in order to comply with the BSP in its present form. Moreover, it was shown that additional testing required for the more detailed documentation requirements being considered will increase these costs significantly.

Some of the direct compliance costs for testing imported commodities have been quantified. These provide insight on the time and expense that are necessary for the establishment, operation and implementation of a biosafety regulatory policy consistent with the BSP.

While China, given its role as a large importer of commodities, itself provides an interesting case study of the costs involved in implementing the Biosafety Protocol, it is also illustrative of the greater costs that would be incurred by smaller and poorer developing countries, with less scientific expertise which need to set up biosafety regimes from scratch.

Sources

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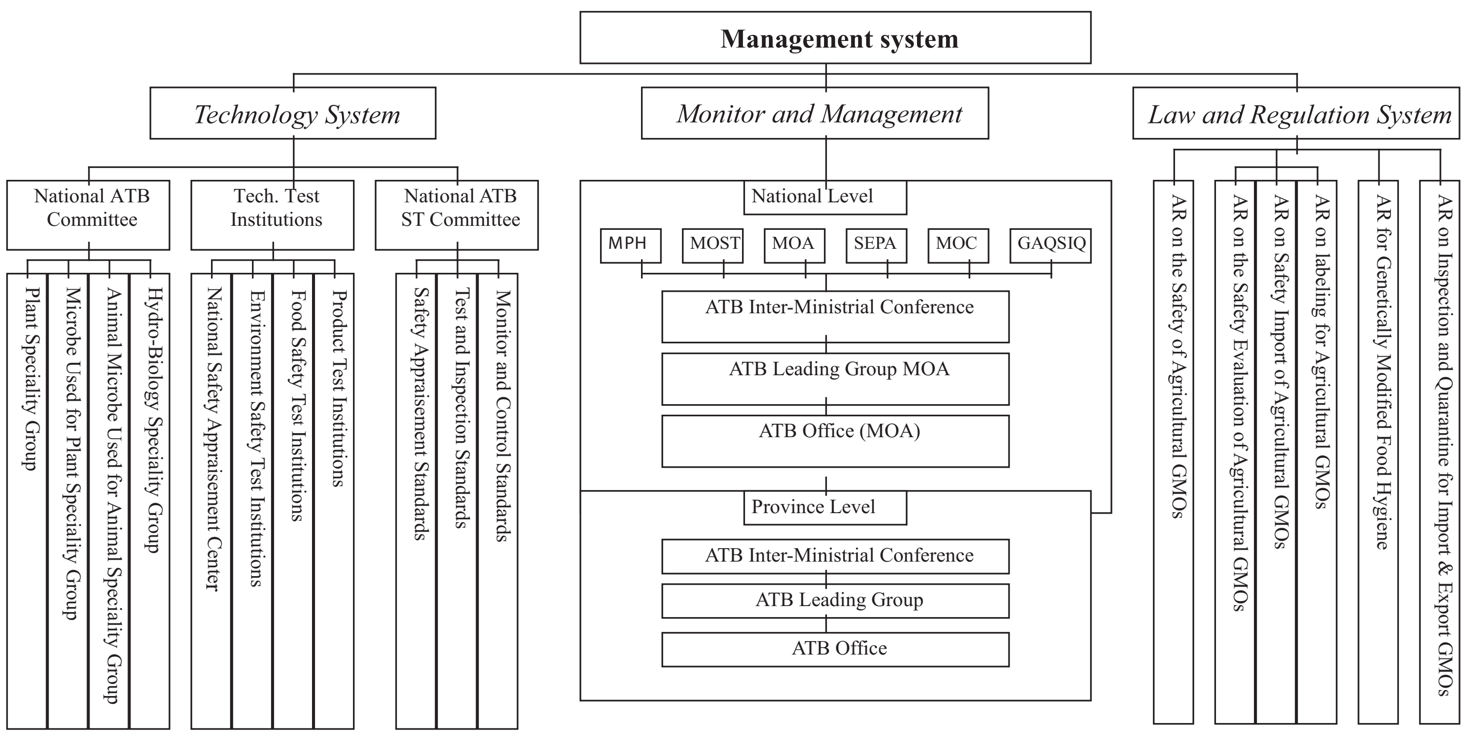
Appendix

Figure 3: China's Agricultural Transgenic Biosafety Management and Legislative Framework



Source: Reported in Huang et al., 2006

Notes:
AR: Administrative Regulations
ATB: Agricultural Transgenic Biosafety
MOA: Ministry of Agriculture
MOC: Ministry of Commerce
MOST: Ministry of Science and Technology
MPH: Ministry of Public Health
SEPA: State Environmental Protection Administration
ST: Standardization Technology
GAQSIQ: General Administration of Quality; Supervision, Inspection and Quarantine

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