



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search  
<http://ageconsearch.umn.edu>  
[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

**14th International ICABR Conference**  
**on**  
**GOVERNANCE: POLICY, ENVIRONMENTAL AND HEALTH**  
**REGULATION,**  
**AND PUBLIC INVESTMENTS IN RESEARCH**

**Ravello, Italy, June 16-18, 2010**

**The Incompatibility of Science and Trade at the International Level**

By:

Stuart J. Smyth  
Department Bioresource Policy, Business and Economics  
University of Saskatchewan

William A. Kerr  
Department Bioresource Policy, Business and Economics  
University of Saskatchewan

Peter W. B. Phillips  
Johnson-Shoyama Graduate School of Public Policy  
University of Saskatchewan

## **The Incompatibility of Science and Trade at the International Level**

### **Abstract**

International trade rules based on science are not functioning efficiently. Considerable effort was put forth in the 20<sup>th</sup> century to enable politics to be removed from the frameworks that governed international trade. Some degree of success was witnessed from these efforts as numerous institutions (i.e. SPS/WTO, IPPC, OECD, Codex) were founded or their roles expanded. These institutions were established on the premise that science-based frameworks were essential to the efficient functioning of international commerce. The first decade of the 21<sup>st</sup> century would seem to suggest that these institutions are floundering and that the role of science as the basis of international trade rules is on the decline.

The evidence of international trade inefficiencies are witnessed in the case of products derived from biotechnology. The most recent example of this is the absolute halt in the international trade of flax from Canada to Europe after the trace detection of a trait that was approved for food and feed use in Canada but not in Europe. Examples of this can also be found in corn, soybeans and rice.

The success of international institutions in dealing with transformative technologies such as biotechnology has thus far been rather dismal. This paper focuses on the fundamental causes for the disruption of international trade and endeavours to provide insights into how to move forward.

*Key words:* international trade, governance, science-based regulation; knowledge management

# The Incompatibility of Science and Trade at the International Level

## 1. Introduction

The ratification of the 1924 Agreement creating the OIE reflects a desire clearly expressed by the Secretary General of the League of Nations that year. He invited various governments to designate veterinary experts “to examine the health guarantees that could be provided by cattle-exporting countries, the facilities that importing countries could accord on the basis of these guarantees and, in general, to determine the most effective means of enabling statutory veterinary measures to be applied, taking into account the economic interests of exporting countries and without prejudicing the interests of countries wishing to protect themselves against animal diseases”.

...“the Economic Committee of the League of Nations thus proposed to facilitate international trade in animals and animal products to try and reverse the *often highly overt tendency of numerous countries to use sanitary arguments purely for the purpose of economic protection*” (emphasis added) (OIE, 2000)

As illustrated by this quote from the official website of the World Organization for Animal Health (OIE),<sup>1</sup> the problem of countries using trade barriers supposedly justified on scientific criteria for nefarious purposes long predates the establishment of the current international institutional architecture in the post-Second World War period. While this institutional architecture has certainly been added to and evolved over the intervening sixty-odd years, its structure has remained largely intact (Kerr, 2000). The major rule-making body for the governance of international trade, the World Trade Organization (WTO), evolved out of the General Agreement on Tariffs and Trade (GATT) which came into being in 1947. The current WTO is an organization that has been temporarily ceded, by international standards, a considerable degree of sovereignty by its Member States. In particular, it has a binding disputes settlement mechanism and the power to approve the imposition of economic sanctions on those countries that fail to comply with the WTO obligations that they have previously agreed. Over

---

<sup>1</sup> The World Organization for Animal Health is the new name for the long standing institution – the Office International des Epizooties or OIE. When the institution was renamed in 2003 it kept its historic and well known acronym.

time, other international organizations have been given the right to govern aspects of international trade but have not been given a binding disputes settlement mechanism or the power to approve economic sanctions.

The GATT and subsequently the WTO have, over time, had considerable success in reducing tariffs and other traditional trade barriers. This has had two effects: (1) it has led to exporting firms finding their market access blocked by domestic regulations in potential importing countries that were put in place behind formerly high tariffs; and (2) governments seeking alternative ways of extending protection from foreign competition in the wake of having agreed to limit the imposition of new tariffs and the reduction of existing tariffs. Many of the domestic regulations that inhibit trade are justified on health, sanitary and phytosanitary grounds which have a scientific basis – but were not crafted with the minimization of trade effects in mind. As they were developed largely independently, they are not harmonized among countries, leading to incompatibilities that can inhibit trade. Purposeful misuse of health, sanitary and phytosanitary measures to restrict trade is hard to prove and thus has an attraction for policy makers wishing to extend protection to economic vested interests when they have agreed internationally to close off more traditional means of extending protection.

The GATT rules pertaining to health, sanitary and phytosanitary measures were relatively weak. They were, however, in keeping with the GATT's original institutional structure which made it relatively easy to garner waivers from GATT disciplines – which were extensively granted for trade in agricultural products – and where dispute settlement judgments required a consensus that included the accused. This made it easy for countries to grant protection for biologically-based products such as those arising from agriculture and to maintain trade barriers in the face of complaints from trading partners. As a result, there was little need for countries to

make use of health, sanitary and phytosanitary barriers for protectionist purposes – it was simply easier to use tariffs. The waivers granted for agriculture, however, led to a retention of high barriers to market access for agricultural products and high degrees of subsidization in the sector – significant distortions that began to spill over into other sectors and poison international relations between major trading partners (Gaisford and Kerr, 2001).

Moving agriculture under general GATT disciplines was agreed when the agenda for the Uruguay Round was set in 1986 – notice this was prior to the commercialization of any genetically modified (GM) crop. Further, the consensus-based disputes system was viewed as unworkable for the rising number of GATT Member States and a binding dispute settlement system was made part of the Uruguay Round agenda. Of course, garnering protection for vested interests in agriculture has been one of the most effective trade lobbies –this is evident broadly in both developed and developing countries. The negotiators during the Uruguay Round were very cognizant of the effectiveness of agricultural lobbies in obtaining protection and, hence, worried about the effect of bringing agriculture under GATT disciplines – thus closing off the ability to grant protection that the long-standing waivers provided – and eliminating the ability under the consensus-based disputes system to ignore complaints brought by trading partners. The vested interests in agriculture were not going to *fold up their tents and melt away* and policy makers would still be faced, at times, with requests for protection that they might wish to provide. The nefarious use of health, sanitary and phytosanitary measures was one obvious avenue for vested interests seeking protection.

To close this potential loophole, the negotiators chose science as the decision-making criteria for justifying health, sanitary and phytosanitary barriers to trade. The Agreement on Sanitary and Phytosanitary Measure (SPS) was negotiated as part of the Uruguay Round with

science enshrined as its decision-making criterion. The new WTO with a binding disputes settlement system and the SPS as one of its agreements came into force in 1995. There were high hopes for the efficacy of the SPS and its science-based focus.

Fifteen years later there is little doubt that science-based decision-making has not proven to be an effective way to isolate SPS-based trade measures from protectionist influences. While not confined solely to issues pertaining to GM products,<sup>2</sup> the commercialization of the products of modern agricultural biotechnology has brought to the fore the deficiencies of attempting to use science to govern trade matters when biologically-based products are involved. Granted, biotechnology represents a transformative technology that has led to a threat of disequilibrium in the agricultural sector and angst for other groups in civil society – both of which can be expected to lead to an increase in protectionist pressure (Phillips 2007). Given that both the fear of disequilibrium and angst has not been distributed evenly among major trading partners, this has led to differing demands for protection. At one extreme, this has precipitated a major rift between the US and the EU over the basis of rules for trade in GM products (Isaac and Kerr, 2007). This rift has led to attempts to have the WTO supplanted by alternative, non-science based, trade institutions such as the Cartagena Protocol on Biosafety to the Convention on Biological Diversity (Hobbs *et al.*, 2005, Holtby, *et al.* 2007). Further, there has been a widespread debate as to whether the products of modern biotechnology might be sufficiently unique that they require separate institutional arrangements for their governance, both domestically and internationally. Given an apparent institutional void, a number of international institutions have attempted to move in and fill the gap in the institutional architecture but none has been able to assert its primacy (Smyth *et al.*, 2009). They have all stumbled on the

---

<sup>2</sup> For example, see Kerr and Hobbs (2002) for a discussion of the WTO case involving the imposition of an import ban on beef produced using growth hormones justified on the basis of scientific uncertainty.

operationalization of science as a decision-making criteria. While the operationalization of any new decision-making system might be expected to have some teething problems that need to be worked out over time, in the case of science-based rules for the imposition of trade barriers, after fifteen years there is no indication of progress.

If the only effect of the ongoing absence of a functioning science-based system for the imposition of trade barriers was short run disruptions to trade flows, then the economic losses involved might simply be chalked up to the enduring and fundamental trade compromise between protectionism and trade liberalization – there never has and never will be *free trade* (Kerr, 2007; Gaisford and Hester, 2007). The international rules of trade are replete with inhibitors to trade flows (e.g. tariff use is widespread) and decision rules that have been operationalized in sub-optimal ways (e.g. anti-dumping) (Barichello, 2007; Kerr, 2006). The problem with the current science-based system is that it is opaque. The result is that, in the era of globalization, the international business environment is very risky for those that have invested in biotechnology. In other words, if a new product based on biotechnology is developed there is no assurance that it can be traded. If a country is a major trader of a product where a biotechnology innovation is reaching the commercialization stage, it may not wish to jeopardize its exports by licensing the innovation domestically. All of this uncertainty inhibits innovation. Thus, the economic costs of the current opaqueness of the system extends far beyond those associated with the disruption of current trade flows. Given the potential of biotechnology to enhance human welfare<sup>3</sup> (Gaisford *et al.*, 2001; Holtby *et al.*, 2007; Phillips *et al.*, 2006; Smyth *et al.*, 2004), developing a more transparent decision-making mechanism would seem imperative – the opportunities forgone are simply too great. Thus, a hard look at the fifteen year experience with

---

<sup>3</sup> Of course there may be risks associated with biotechnology that must be carefully assessed in determining the potential.



science-based decision-making in the area of SPS-based measures is timely. The system needs either to be abandoned as a failed experiment or fixed. The time for procrastination or tinkering around the edges has, arguably, passed.

The following section undertakes a detailed assessment of science-based trade barriers. Section 3 offers a preliminary assessment of the costs of incomplete regulatory systems. Section 4 offers one way forward and the final section offers some concluding thoughts.

## **2. Science-based decision-making and trade barriers**

From the perspective of those interested in the institutional architecture of international trade policy, the overarching concern with the decision-making mechanisms put in place is whether they can be captured or otherwise manipulated by narrow vested interests when the intent of the trade rules is to serve the general good. Experience teaches international trade professionals that protectionists are tenacious, resourceful, inventive and tireless – after all there is usually a lot at stake (Kerr and Foregrave, 2002; Kerr, 2003). Protectionists should not be underestimated. The idea that there are those who do not have the general good as their objective is often a surprise to those in the scientific community and others in the regulatory system who do not have an appreciation of the social sciences. This is patently obvious in, for example, multilateral environment agreements (MEAs) where the trade rules have been crafted by, for example, environmental scientists (Hobbs *et al.*, 2005; Kerr and Hall). Thus, trade policy professionals often appear paranoid to non-specialists while trade policy professionals feel that trade-policy novices are particularly naïve. The latter is often perceived as arrogance (or professional rent seeking) on the part of trade policy professionals. Assuming for the moment that the trade policy professionals have a point, two questions arise within the context of science-

based decision-making in trade policy: (1) who has an interest in harnessing science-based decision-making to their vested interest? and; (2) how is the current system open to capture or manipulation?

Producers in import competing industries faced with strong competition from imports have been perceived as the primary seekers<sup>4</sup> of economic protection since the days of Adam Smith (1776).<sup>5</sup> In part, this is because the organizational costs associated with rent-seeking activities tend to be small for producers relative to those of widely dispersed groups such as consumers or environmentalists. Further, however, the economic model that underpins international trade policy<sup>6</sup> predicts that consumers will be losers if trade restrictions on imports are imposed – prices rise, making consumers worse off – and, hence, they will never request them from their government. Of course, producers win from the imposition of trade barriers – and thus have an incentive to ask for protection – the traditional producer vested interest in protection. The only other actor in this simple model is the government that is either the recipient of tax revenues or a dispenser of subsidies.<sup>7</sup> The model assumes perfect knowledge meaning that there are no environmental externalities – and thus no need for environmental advocates to be included. Similarly, perfect knowledge means that consumers understand any ethical aspects of the products they are faced with and factor any concerns into their purchasing decisions – and thus there is no need for ethical advocates (e.g. animal rights, child labour, etc.). It also means there is no need for labeling requirement for imports. The model upon which the trade

---

<sup>4</sup> Other producer-based rent seeking activities such as requesting export subsidies and trade distorting domestic subsidies are also manifest at times but relief from competition from imports, one suspects, is the overwhelming source of requests for protection.

<sup>5</sup> An accessible version of Smith's classic treatise on economics is Smith (1994).

<sup>6</sup> Formally it is a partial equilibrium-comparative static model applied to one market at a time (Kerr, 2007).

<sup>7</sup> In some cases governments have a vested interest in these revenues – for example developing countries may be dependent on tariffs for the majority of their tax revenues and, thus, may have a vested interest in resisting the reduction of tariffs. Given that in all developed countries and many developing countries tariffs are such a small portion of total tax revenues, it is common to ignore this trade policy motivation (see for example Zhang and Kerr, 2009).

architecture was based also assumed an industrial structure of perfect competition so that market power is not a concern. It was only long after the current international trade architecture was put in place that economist began to incorporate aspects of imperfect competition into their trade models (Benarroch, 2007)

Thus, the underlying model predicts that producers, no one else, will request protection. As a result, the entire international trade architecture is based on governments needing to respond to producer requests for protection (Kerr, 2010). Trade agreements arise from governments understanding there are gains from turning beggar-thy-neighbour, non-cooperative trade war games into cooperative games through negotiation (Gaisford and Hester, 2007; Gaisford and Kerr, 2003). Trade agreements also recognize that, at times, governments may need to respond to protectionist pressures from producers. The rules represent a compromise between governments' ability to respond to producer requests for protection and the costs associated with choosing to exercise those options. Governments have not negotiated that ability to respond to any other groups asking for protection. This is fundamental to the question of science-based decision-making.

After the Uruguay Round was completed – and thus the international trade architecture was frozen until the completion of the next round of negotiations<sup>8</sup> – and the new science-based SPS rules were put in place, new sources of requests for trade barriers from governments quickly increased in prominence. Some consumers began asking that a range of products be excluded from their market – beef produced using growth hormones (Kerr and Hobbs, 2002); goods produced using child labour (Bakhshi and Kerr, 2008); goods produced from animals caught in leg-hold traps (Kerr and Hobbs, 1994); goods produced from seal pups (Kerr, 2010); meat

---

<sup>8</sup> The Doha Round was launched in 2001 but, as yet, it has not been successfully concluded. Thus, the Uruguay Round outcome is the core of the current international trade architecture – although some of the architecture lies outside of the WTO structure.

produced under certain animal welfare standards (Hobbs *et al.*, 2002) and a host of others. By relaxing some of the assumptions of the trade model that underpins the international trade architecture it can be shown that, under certain circumstances, both consumers and governments concerned with the general good may wish to exclude products from their markets (Gaisford *et al.*, 2001).

In a similar fashion, environmental advocates have become much more prominent in asking their governments for trade barriers since the end of the Uruguay Round. For example, the US government put trade barriers in place against tuna from countries whose tuna fishing practices were considered to be detrimental to dolphins. There have been initiatives to require ecological or green labeling of imports. There has been lobbying against imports of tropical timber from endangered rainforests. There are efforts to limit imports of petroleum products derived from the oilsands in Canada. There has also been a broader and ongoing debate over whether international trade contributes to environmental degradation (Belcher *et al.*, 2003; Copeland, 2007).

While little is actually known about the proportion of consumers that feel trade barriers are needed to keep products out of their markets or how widespread the anti-trade sentiment is in the environmental movement, what is clear is that these sentiments are sufficiently widespread that politicians have, in some circumstances, felt that they could not be safely ignored. Certainly, some consumers and environmentalists have strongly held beliefs. Some politicians have been willing to acquiesce to consumer or environmental requests for protection. The problem, however, is that there is no mechanism in the WTO that allows them to directly respond to these requests. Given that many of the products that consumers and environmentalists would like to have restrictions on market access imposed arise from biologically-based production, there is the

potential to use SPS justifications to respond to such requests for protection – and, in fact, governments have few alternatives.

Nowhere has the pressure to limit imports been stronger in some countries than for the products of biotechnology. This is because the technology has attracted the interests of four distinct groups in civil society that tend to have strong preferences. No other issue has produced such a convergence of interests. Among some consumers there is an unease about modern food production and distribution – concerns with pesticide residues, antibiotics in animal production, preservatives and additives, hormones, etc. Demand for organic or natural foods are manifestations of these preferences. Genetic modification represented just one more *unwanted* tampering with the food supply for consumers with this particular set of preferences. While many consumers do not share these concerns, those holding these perspectives (and often having strong preferences) have lobbied hard to have GM-products banned from their markets.

Those with strong preferences related to the protection/preservation of the natural environment are often concerned about industrial and agricultural pollution and the market failures associated with them. They tend to be suspicious about claims that introducing new substances into the natural environment will not be harmful. The introduction of GM-seeds into the natural environment was considered to be far too risky – environmentalists tended to think that sufficient testing had not been done in the case of this new and transformative technology. Again, some environmental organizations lobbied hard to keep GM-products out of their environment, in part by denying international suppliers market access.

For some in civil society, GM products raise considerable ethical issues (Gaisford *et al.*, 2001; Isaac, 2007a). For example, the ability to use modern biotechnology to transfer genes between species in ways that cannot happen through natural selection (e.g. the metaphoric

insertion of a ‘fish gene’ into a tomato) is considered by some to be using science outside the boundaries of what is ethically acceptable – literally *playing God*. For others it was just the first step on the *slippery slope* to human cloning or unnatural extensions to the human lifespan. Those who raised these and other ethical objections to biotechnology also made it clear to decision-makers that they did not want such products in their market no matter the source – either domestic or foreign.

Finally, there are those in civil society that believe that large corporations have too much economic power in the economy and/or have too much influence over consumers. These concerns long pre-date the commercialization of GM-products. Having most of the techniques associated with the production of genetic improvements and the genetic material itself held on a proprietary basis as intellectual property by large agribusiness firms has led some to worry that multinational corporations have far too much control over the food supply (Isaac and Kerr, 2004; Isaac *et al.*, 2004) . Limiting market access is one way to reduce the influence of the large agribusiness firms that develop and own much of the existing biotechnology that has been commercialized. Their voices were added to the others wishing to limit market access for GM-products.

The convergence of these four groups comprised of individuals with generally strong preferences has made biotechnology the lightning rod for the arguments over science-based decision-making in international trade. Agricultural producers in countries where the imports of GM products have been restricted have, for the most part, largely been silent over the issue of market access. Nevertheless, if trade barriers are put in place to placate the demands of consumers, environmentalists or others they still act to benefit producers – restricting imports raises the price domestic producers receive. Thus, there is suspicion that consumers are not

sovereign in their decision-making and lobbying efforts – that they have been captured by traditional producer-based vested interests (Kerr, 2010).

Hence, there are a large range of vested interests that would like market access restricted for a range of products – vested interests for which no provisions have been made in the international trade architecture. Given that many of the issues pertain to biologically-based product to which SPS trade provisions may apply, there would seem to be ample incentive to attempt to harness science-based decision-making for protectionist purposes. Until such time as the international trade architecture can directly accommodate government actions that respond to requests for protection from non-traditional sources such as consumers and environmentalists – an accommodation that is likely to be very difficult (Perdikis *et al.*, 2001) – science-based decision rules will be subject to a high degree of attention aimed at harnessing them to protectionist causes.

In retrospect, the decision to incorporate science as a decision-making criteria in the SPS was probably naïve and accompanied by a considerable degree of ignorance regarding the feasibility of operationalizing such decision-making. The naivety may have stemmed from a common perception among social scientists – who likely comprise the bulk of trade negotiators – that the physical sciences (the *hard* sciences) provide definitive answers.<sup>9</sup> Despite this commonly held perception among social scientists, the reality is that the *hard* sciences are actually constituted in almost a diametrically opposite configuration, both at any particular point in time and dynamically. The scientific method is based on challenging the accepted wisdom. Science does not provide definitive answers, it is based on theories and empirical testing. Thus, any scientific conclusion is, in fact, defined by explicit or implicit probabilities. For example, it is not possible to reach an outcome that something is *100 percent safe* from using the scientific

---

<sup>9</sup> Relative to the (*soft*) social sciences which, by comparison, provide only *fuzzy* answers to questions.

method. It may be 99 percent safe or 99.9 percent safe or 99.99 percent safe but that means that there is a one percent, or 0.1 percent or 0.01 percent probability that it will be unsafe. Thus, no scientific conclusion is definitive – this weakens science as a mechanism upon which decisions are to be based.

In the absence of *definitive answers*, what might be used as a decision-making criterion is the ‘scientific consensus’. This would appear to be what the framers of the SPS may have had in mind. That they put considerable faith in the ability to arrive at a scientific consensus is evidenced by the provisions in the SPS that recognize international standards devised by the Codex Alimentarius Commission (Codex), the OIE and the International Plant Protection Convention (IPPC) and the allowance for temporary *precautionary* trade restrictions when existing scientific information is insufficient (Isaac, 2007b). In the latter case, evidence of their confidence in the ability to reach a scientific consensus is found in the SPS Agreement’s Article 5:7 which states “In such circumstances, Members shall seek to obtain additional information necessary for a more objective assessment of risk and review the sanitary or phytosanitary measure accordingly within a reasonable amount of time.” It seems clear that the expectation was that objective answers could be obtained relatively quickly and not that scientific uncertainty would continue for long periods or possibly indefinitely. Objective measures were required, and expected, for decisions to be made.

The reality, of course, is that there is no deterministic reason for a scientific consensus to arise. There will always be scientists who do not accept the conventional wisdom and, in fact, challenging the conventional wisdom is central to the dynamic process of scientific progress (Khachatourians, 2001). Thus, on any issue, there will likely be scientists that can be found that will question any claimed scientific consensus. While international standards organizations such



as the Codex, the OIE and the IPPC may arrive at international standards for, for example, food safety, this does not mean that there is an actual scientific consensus.

As science does not provide definitive answers and a scientific consensus is an illusion, it means that policy makers must draw what often appear to be arbitrary *lines in the sand*. This opens the door for manipulation of those *line-in-the-sand* decisions to seek protectionist outcomes. For example, the imposition of a trade barrier justified on SPS grounds requires that the barrier (the measure) have a scientific justification and that there be a risk (Buckingham and Phillips, 2001). Individual countries, however, are allowed to set their own levels of what are considered acceptable risks – because science cannot provide zero risk nor any definitive objective guidance regarding acceptable levels of risk. If individual countries set their own standards for acceptable risk, those decisions are open to protectionist influence. Countries can set zero as their acceptable level of risk – which is operationally impossible for exporting firms or countries to achieve. Even if operational tolerances are set at non-zero levels – but very low – the costs associated with testing and segregating supply chains can be as an effective trade barrier as any tariff (Maltsberger and Kalaitzandonakes, 2000). While it might be possible for governments to negotiate mutually agreed tolerance levels, there is no requirement to do so. Governments faced with strong protectionist pressures have been strategically reluctant to do so.

Beyond the arbitrary nature of deciding on the acceptable level of risk, there are a number of other aspects of science that fail to provide definitive answers and, hence, are open to capture or manipulation for protectionist purposes. There is the vexing question of: *How much science is enough?* The world related to the safety of food additives or pharmaceutical use is complex. People are not homogeneous in their genetic makeup and environmentally determined tolerances. Further, the substances that individuals imbibe, inhale, and otherwise take into their

bodies varies tremendously. Food safety testing is, however, not costless. Thus, determining the safety of a product is conducted on sample populations and sub-populations. The reality is that there are always additional sub-populations that can be tested (e.g. pregnant women taking pharmaceutical X and who smoke; men over sixty with a history of heart disease and using insulin). Thus, even if a product has been determined as being safe in a number of markets, an importing country can always argue that tests on further sub-populations should be conducted. This was, for example, one of the arguments used by the EU to maintain its import ban on beef produced using growth hormones when faced with reports from its own scientific experts that there was no evidence that this product represented a risk (Roberts, 1998) – they would not remove the import ban because not enough science had been done. While it is certainly possible for countries to negotiate common standards in this area, science provides no definitive answers. Thus, countries can chose not to conclude such negotiations or to unilaterally determine when sufficient science has been done – something that can be used to extend protection if it is being requested.

Even if there is international agreement on scientific standards there is a wide array of institutional arrangements that are open to manipulation. Scientific training and certification varies among countries. Science itself cannot determine if the training of scientists in exporting countries is sufficient or that the certification procedures for, as an example, medical doctors are sufficiently rigorous. Again, these are arbitrary lines in the sand that can be established by importing governments. Similar issues can surround the efficacy of testing laboratories, the certification of testing facilities, the quality and level of staffing in laboratories and the oversight of these facilities. Bent on responding to requests for protection, the institutional hurdles that can be put in place are only confined by the inventiveness of the bureaucrats charged with devising

them. The central point, however, is that there is no objective science that can be used to make such choices.

Probably nothing better illustrates the difficulties associated with science-based decision systems than the long wrangle over operationalizing precaution. The central question related to precaution is: How should decisions be made when scientific uncertainty exists? The prudent response is that a new technology, for example, should not be licensed under situations of scientific uncertainty. That idea is not controversial and, in fact, it has been incorporated in a range of international treaties and agreements including the WTO. It has also become an important element of EU domestic policy in a number of areas. Precaution sounds like it is science-based. The problem comes with trying to operationalize when precaution might be appropriate. The crux of the matter is defining when scientific uncertainty has been reduced sufficiently for a new technology to be allowed into the consumption market or the natural environment. Of course, the problem is that scientific uncertainty cannot be reduced to zero. If scientific uncertainty exists when precaution is accepted as a legitimate criteria, however, then the technology should not go forward. The result is that no new technology would ever be accepted. Given that humankind's progress is based on the adoption of new technologies, precaution carries a very high opportunity cost over the long run.

Protectionists (and those who wish to limit new technologies domestically) have seized on precaution as the mechanism to allow the achievement of their ends. It is often called the *precautionary principle* – and in some civil society circles approaches a mantra. Given its inherent simplicity, and hence appeal, it has been formally incorporated into EU policy and, for example, the BSP – but without really answering the question as to how it is to be operationalized to make decisions. Those that seek to deny new technologies can always trot out

evidence of scientific uncertainty, pulling the precautionary trigger to stifle new technologies and to inhibit further investment in innovation. In its internal deliberations on the precautionary principle the EU has suggested that scientific decision-making be abandoned – that science should only inform the decision and that decision-makers should be allowed to take other criteria, including economic criteria, into consideration when invoking the *precautionary principle*. Allowing economic criteria (among others) takes such decisions out of science-based criteria, effectively re-politicizing the decision process (Kerr, 2001). Environmentalists (and others) have pushed hard and continue to push hard to have the *precautionary principle* incorporated as the decision-making criteria in international agreements because they understand that removing scientific uncertainty is not feasible – thus giving them the ability to thwart any new technology they do not like. Of course, if there is a technology they find acceptable then they simply need not trot out evidence of scientific uncertainty. Thus, *the precautionary principle* becomes a powerful instrument in the protectionist's tool kit.

Van den Belt (2003), however, has shown that the *strong version*<sup>10</sup> of the precautionary principle is logically inconsistent as a decision-making criteria. If it is not possible to rule out a catastrophic event arising from adopting the new technology it is equally not possible to rule out a catastrophic event arising from not adopting a new technology. Given this logical inconsistency, using precaution as a criteria will require a weaker version of the precautionary principle where decisions are made under conditions of non-zero risk. As a result, one is back to *arbitrary lines in the sand* drawn by governments. This is not scientific-based decision-making and open to protectionist influence.

There are other institutional rigidities that make scientific decision-making difficult. Given that delay can be valuable to protectionist interests – for example, delay in arriving at an

---

<sup>10</sup> Which requires the total removal of scientific uncertainty and promoted by environmentalists.

agreed scientific standard in bodies like the Codex, OIE or IPPC because trade barriers will not be removed until a standard is agreed – institutional constraints may inhibit timely decision-making. In the absence in internationally agreed standards for, as an example, food safety, countries have developed their own domestic standards and procedures. As scientists in different countries are trained somewhat differently, the mandates related to food safety differ and the development of domestic standards will have followed alternative trajectories. Devising international standards, however, means that standards need to be harmonized. The bureaucrats – often scientists – tasked with negotiating common standards, however, want their domestic standards to become the standard to which others harmonize. This is not necessarily only hubris – there may be good reasons for such an egocentric approach to harmonization negotiations.

If a bureaucrat agrees to harmonize to a foreign (or compromise) standard they may be accused of one of two things. First, if they claim they are agreeing to a different standard because it is higher than their domestic standard, then they can be accused of previously not doing their best to protect their citizens – they allowed a lower standard to be used when they knew a better standard existed.<sup>11</sup> On the other hand, they cannot claim that the new standard is lower than their existing standard because they could be accused of trading off the safety of their citizens to gain a trade (or some other) benefit. Admitting to lowering safety standards to satisfy foreigners is akin to political suicide. It may be possible to claim that the new harmonized standards are equivalent to the existing domestic standard even if differences exist. Equivalence can be difficult to defend when differences between the old and new standards are pointed out by those wishing to maintain existing standards for protectionist purposes. Given the perils associated with agreeing to harmonized standards, delay may be the preferred strategy for those responsible for negotiating harmonized standards. Certainly, the development of harmonized standards at the

---

<sup>11</sup> If they claim that they did not know about the new, better standard, they could be accused of incompetence.

Codex, OIE and IPPC seems a very long process—the Codex effort to create an international standard for the labeling of products of genetic engineering began in 1993 and there is no end in sight yet (MacKenzie 2001). Of course, given the differences in training and the domestic institutional culture, bureaucrats may well believe that their existing domestic standards are superior and see no reason to change to accommodate international trade obligations (Kerr, 1997). These inherent biases toward delay play into the hands of those that garner rents from delaying the development of harmonized international standards.

Thus it seems clear, as the old cliché suggests, that both *motive and opportunity* exist and protectionists appear to have been adept at acting on them. Fifteen years of tinkering has not been able to effectively operationalize science-based decision-making pertaining to SPS matters. More fundamental changes are likely required.

### **3. The Costs of Incomplete International Regulations**

The international trade of grain and oilseed commodities functions based on agreed upon thresholds for standard crop production aspects such as low level presence of other commodities and weed seeds. Thresholds also exist for less desirable features of crop production such as insect fragments, stones and manure. While one, or some, could dispute the safety of consuming some of the items that are co-mingled into crop commodity exports, at some point, trade negotiators realized that the establishment of these thresholds were required to facilitate trade. Grain trade experts suggest that international trade in grain and oilseeds functions at the 95% purity level. The ability to export at higher purity levels does exist, but importers will have to pay a premium to import these products, organics is an example of the higher purity level and higher price.

The commercialization and wide adoption of GM crop varieties in North America has, at times, resulted in the manipulation of thresholds. As was highlighted in the above section, safety is the trigger mechanism for much of the frustration. Canada and the US commercialize new crop varieties using science-based regulations, meaning that all risks pertaining to safety, be it environmental, food or feed, are addressed prior to regulatory approval being granted. Where international commodity trade is affected, is in the EU's decision-making process relating to both the import of, and production of, GM crop varieties.

To ensure that there is no ceding of sovereignty, the European Food Safety Agency (EFSA) is responsible for approving GM varieties for food and feed use and production. While Canada and the US are moving towards a policy of asynchronous approval for GM crop varieties, Europe is steadfastly insisting that safety of GM crop varieties is a crucial issue, so much so, that Europe insists on, as was stated above, conducting science with even greater subsets. It appears that the much hoped for SPS Agreement, that instead of facilitating trade between North America and Europe in GM products via European regulatory acceptance of North American food, feed and environment safety studies, is rather being used to frustrate trade in GM commodities by European insurances about the safety of GM products and the need to undertake further testing.

Between June 1999 and August 2003, the European Union implemented a moratorium on the approval and import of GM crops and food products. This moratorium was ultimately ruled by the WTO to be illegal,<sup>12</sup> and by 2004, the EU Commission called for all member states to begin developing frameworks for co-existence. This section will illustrate the inconsistent

---

<sup>12</sup> Argentina, Canada and the US filed an unfair trade barrier argument against the EU with the WTO. In February 2006, the WTO ruled in favour of Argentina, Canada and the US, indicating that the moratorium was illegal.

application of regulations and in particular the manipulation of science-based regulation pertaining to co-mingling.

Smyth *et al.*, (2002) identify two instances where seed varieties in Europe were found to contain trace amounts of GM varieties. In May 1999, the Swiss Department of Agriculture announced that two Pioneer Hi-Bred non-GM corn varieties, imported and distributed by Eric Schweizer Samen AG, had been found to contain trace amounts of GM varieties. Based on PCR tests, the level of co-mingling ranged from 0.1% to 0.5% (Fürst, 2002). Pioneer distributed enough seed to plant an estimated 400 hectares, of which, about half had been seeded at the time of detection. The GM traits that were identified were not approved for import or commercial release in Switzerland. As a result, the fields that were planted were burnt or controlled with herbicides. The importing firm agreed to pay compensation of 700 Swiss francs per hectare.

The second incident, in the spring of 2000, announced that the EU found a breeders lot of canola seed imported by Advanta that contained 0.4% unapproved GM traits (Agneta, 2000a). Advanta quickly determined that the unexpected presence of GM canola was caused by gene flow from GM foundation seeds that had been planted in a neighboring field. Canadian seed growers had followed isolation rules but the genes still moved into the conventional foundation seed. The total acreage in most countries (except Britain) was insignificant with Sweden and Germany having 300 hectares and France having 600 hectares. The European countries faced a cost in dealing with this problem, France ordered all 600 ha to be ploughed down and Sweden allowed the canola to be harvested but prohibited the canola from entering the domestic or European market. In Britain, over 15,000 hectares were planted and had to be destroyed. It was speculated (Agneta, 2000b) that the cost of compensation from Advanta would exceed one million pounds.



In August 2002, the United Kingdom's Department for Environment, Food and Rural Affairs (DEFRA) announced that they had been advised by Aventis CropScience Ltd. (now Bayer CropScience) of some impurities in canola seed that was being used for Farm Scale Evaluation field trials in England and Scotland (Scottish Government, 2002). The initial discovery was done through a routine audit conducted by the Scottish Agricultural College and the level of co-mingling was 2.8%. Given the time of the discovery, the crops were harvested and the resulting seed was destroyed.

Trace amounts of GM canola were detected in Canadian mustard exports to Europe in March 2003 (Western Producer, 2003). A mustard shipment in late 2002 was tested and found to contain trace amounts of GM material. Since there were no GM mustard varieties in Canada at this time (and none exist at present either), the European importers conducted further tests and determined that the trace amounts of GM material were GM canola. According to export standards, mustard exports are allowed to contain 1% canola and since 75% of the canola produced in Canada at the time was GM, it was not surprising that trace amounts would be co-mingled. There is no report on what the European importers did with the mustard shipment.

The response of EU regulators in perhaps, the most widely known case of co-mingling – StarLink, was again, one of co-operation (Paarlberg, 2001). Prior to the implementation of the moratorium, the EU did approve a small number of GM crops for production within the EU and Paarlberg identifies that the EU regulators worked with the US to allow small levels of co-mingling in corn exports so that their actions were not seen to be undermining their own approval of GM crops, nor an admission that the EU regulatory system was not science-based.

Clearly, there is ample evidence that while the EU moratorium was in place, both import shipments of commodities or crop production in Europe, were affected by the detection of trace

amounts (as high as 2.8%) of unapproved GM varieties. While this caused some concern, triggered a proportionate regulatory and industrial response and, in some instances, triggered financial compensation, the response of the EU to the low level presence of GM varieties conformed to the science-based international rules of trade. Risks were identified, isolated and managed in proportion to their effect on the health and safety of their marketplace.

Since the end of the moratorium, co-existence has been the buzz phrase and has led to more extreme and far-reaching responses. In 2006, trace amounts of an unapproved GM event were detected in US rice exports to Europe. In what has become known as LL601 rice, the widespread presence of this variety resulted in an announcement from the EU on August 20<sup>th</sup>, 2006, that Europe would not accept further rice shipments from the US (Li *et al.*, 2010).

Smyth *et al.*, (2010) discuss the trade implications in US-EU corn trade following the commercialization of Herculex corn. Again, the event was approved in the US, but not in the EU and in spite of US testing prior to export, trace amounts were discovered in Europe. The detection of this variety of corn, released by Pioneer Hi-bred in 2006 caused corn gluten feed exports from the US to the EU to drop by 30-40%. What is interesting in this case is that Pioneer submitted notification of import into the EU for Herculex I in 2000 (Europabio, 2006). By 2006, Heculex I had received approval for feed and food use, as well as planting. The problem arose when Herculex (R) Rootworm varieties were detected in shipments coming from the US. These varieties were ultimately approved by the EU in 2009. For the three year period though corn trade was disrupted.

The first variety of GM flax, CDC Triffid, was developed at the University of Saskatchewan. Field trials began in 1989 and approval for livestock feed use in Canada was received in 1996, with food approval coming in 1998. Feed and food approval was received the

same year for the US market. In the winter of 1998-99 European flax importers raised concerns about the commercial production of GM flax. Given that an average 70% of Canadian flax production is exported to Europe, pressure from both the European importers and domestic producers resulted in the decision to voluntarily withdraw GM flax. Genetically modified flax was deregistered in Canada in 2001 and all known quantities were transported, crushed and/or destroyed.

In September 2009, the European Union's Rapid Alert System for Food and Feed (RASFF) announced the detection of GM Triffid flax in food products in Germany. By the end of September, most Canadian flax in Europe was in quarantine and flax trade between Canada and Europe was suspended, pending identification of the source of co-mingling and the implementation of testing protocol that could provide assurance to European importers that Canadian flax exports would be free of GM flax. Trade has come to a virtual standstill as testing protocols are implemented. Costs are mounting on both sides of the Atlantic and the testing of on-farm flax in Canada reveals that of the 3,200 samples tested as of February, 2010, about 9.5% of samples have tested positive--3.2% show a co-mingling level above 0.01% while 6.3% of the samples have tested below 0.01%. Triffid flax never received variety approval in Europe, hence the problem.

When it comes to the importing of soybeans from the Americas, it is a considerably different issue. The use of soy in animal feed in Europe is considered a staple and 75% of the soy used in the European animal feed industry is imported from Argentina, Brazil and the US (LEI, 2009). The adoption rates for GM soy in these three import sources in 2007 was estimated to be 95%, 66% and 91% respectively.<sup>13</sup> European import regulations allow for up to 0.9% of approved GM material, 0.5% of unapproved GM material that has been positively reviewed by

---

<sup>13</sup> Some less substantiated references have soybean adoption rates in Brazil in the low 80% range.

the European Food Safety Authorities (EFSA) and 0% of GM material that has not been approved by EFSA. The challenge for European soy importers is that it takes considerably longer for EFSA to approve new GM events than it does in other countries. A study by the Dutch research institute LEI (2009) estimated that if EFSA reviews took longer than two years and import thresholds remained at 0.9%, then the cost of importing a tonne of soy would rise from 290 Euros to 7,747 Euros. With so little availability of non-GM soy, it is widely speculated in the grain trade industry that Europe is importing shipments of soybeans that are testing positive for GM soybeans at low levels.

Europe's determination to source non-GM soybeans has led them to seek new supply markets. It was announced in 2009 that the EU had recently begun to source non-GM soybeans from India (Layadi, 2009). Importing non-GM soy to feed to animals in Europe while millions of people suffer from malnutrition and starvation in India, raises some provocative ethical questions. The reality of the situation is that Europe cannot knowingly import soy from any of the Americas and expect it to be at less than 0.9% GM content. Clearly, the science-based regulations are being manipulated due to the importance of soy in the European feed industry. Meanwhile, Canadian flax exporters languish.

International grain and oilseed commodity trade cannot, and will never be able to, function at the level of zero percent co-mingling. Over time, thresholds in this industry have developed and been agreed upon as mechanisms that facilitate trade in commodity agriculture. However, the insistence of zero percent presence of GM events already approved in other jurisdictions, raises some consternation. The intentions of the SPS Agreement were to facilitate trade between countries, allowing one country to accept the regulatory efficacy of another nation.

Clearly, the additional health and safety testing arguments advocated by Europe are a manipulation of the intentions of the SPS Agreement.

#### **4. A framework for analysis**

Ultimately, regulatory systems are specialized forms of knowledge systems. Thus, the challenges of developing and operating regulatory systems can be recast as a case of knowledge management. A major challenge when dealing with something as nebulous as ‘knowledge management’ is that there is no single way to define or examine it. Legal scholars, economists, philosophers, business analysts, political scientists and sociologists, to name a few, have all examined and framed ‘knowledge management’ in the context of both the underlying assumptions about motivations and the institutional focus of their work. Unfortunately, the field is filled with competing views that do not necessarily add up to a coherent analysis. One way to frame an analysis is to explicitly map the institutional systems that are engaged in creating and managing knowledge and then to move to the individual level, where people, alone or in association with others, use a set of norms, rules or processes, in the context of the prevailing institutions, to achieve some purpose.

On the institutional front, Phillips (2007) asserts that our society is fundamentally faced with a complex systems problem when considering how to govern knowledge. Boulding (1970) suggested three distinct domains—the compulsory, the contractual and the familistic—yield three different methods of integration: coercive states that distribute rights and obligations; *quid pro quo* exchanges in the market governed by supply and demand; and voluntary dealings, where cooperation, reciprocity and solidarity engage community and society (Paquet, 2001). Boulding (1970) argues that society can be viewed as a triangle (his ‘social triangle’), where all

organizations—including the state, the market and civil authorities—are built on one or a balance of the three relationship systems. The triad of institutions—governments or states, the market and social or familial organizations—each have specific institutional attributes that make them more effective at producing particular types of goods (Picciotti, 1995). The government sector is best at producing public goods, such as basic scientific knowledge and public health and safety—low excludability makes privatization infeasible while the low voice component makes it difficult for the collective sector to organize. The private sector tends to dominate whenever clear and enforceable property rights make rival goods excludable. In the context of knowledge, this would be knowledge embedded in specific products and services. The property of exclusion allows private firms to sell at the marginal cost of production. The participatory sector is best at governing common pool goods (e.g., various types of knowledge, such as standards)—the collective group will usually have more information that will enable them to more effectively manage the resource and capture the benefits. At the individual level, different disciplines posit different human motivations to individuals, such as utility maximization, profit optimization, belonging, power, fulfillment, meaning and happiness. None of these fully explains the motives around knowledge creation and management.

Ostrom (2005) offers a ‘universal framework’ to assess how individuals might interact in pursuit of knowledge management. She argues that whether a participant is an individual or an institution, one must make assumptions about three components of human behaviour in order to animate institutional analysis. Her ‘institutional analysis and development’ (IAD) framework contends that decision systems (in our case read regulatory systems) fundamentally have three key elements:

1. the way that participants acquire, process, represent, retain and use *information*;

2. the *valuation* that participants assign to actions and outcomes; and
3. the process (maximizing, satisficing, or using diverse heuristics) that participants use for *selecting* particular actions or strategic chains of actions in light of their resources. (Ostrom 1995, 103).

This framework, which defines the scope and way relevant information is agglomerated, explicitly identifies the normative value placed on that knowledge and then identifies the process of selecting a pathway of management in the context of constraints (e.g. a budget constraint or bounded rationality), can be used to consider the structure and function of ‘science-based regulation’.

In the context of our case, the underling information, valuation and selecting rules involved in ‘science-based’ decision-making need to be unpacked. While a daunting task, this is not an insurmountable challenge. The discussion in Section 2 about the discretion exercised by regulators in the system highlights many of the critical control points in the system. The ISO standard model for industry to develop hazard analysis critical control points (HACCP) plans offers a template for the articulation of generally accepted practices and for the identification and normalization of contested practices.

## **5. Conclusions**

Politics has always and is continuing to distort international trade. It was anticipated that the SPS Agreement would provide a solution to this challenge, but it too, has failed to stem the tide of trade-distorting policies. In fact, it would appear that the politicization of international trade, especially in agricultural products, has simply continued to increase over time and that the commercialization of GM crops has only furthered this cause.

Agricultural production is heavily protected in many countries and there is a strong lobby group in most of these countries working to ensure that this system of support is not soon ended. The willingness of governments to abandon or selectively use science-based regulations in order to preserve domestic agricultural markets or to favour one market over another is apparently so commonplace that little to no concern is raised over the distortion of trade that results. This obvious manipulation of science-based regulation ultimately reveals that the system as it is currently formulated is no longer capable of underpinning international trade.

The reasons behind this abandonment of science-based regulations need to be examined and a fresh approach to facilitating undistorted trade needs to be offered. Part of the challenge is that view is that some disembodied stock of knowledge, often called ‘science’ can fully delimit the acceptable from the unacceptable. Our analysis reveals that there is no definitive set of ‘science’ facts that can underpin decision-making for transformative technologies like GM foods. This does not mean that the science-based system should be replaced by government preference—rather it highlights the need to more clearly and concretely define the appropriate human institutions that can develop and use the ‘scientific consensus’ that is needed to make decisions that further the public interest.

In short, the effort to develop an effective regulatory and trade system that facilitates optimal market adoption is not complete. The integration of agriculture into the WTO, the adoption of a binding DSM and the incorporation of the international food standards setting organizations (Codex and IPPC, OIE) in the trade regulatory system were all vital steps. But they should not be viewed as the end of the process. Rather, they provide the launching pad for a process to develop a more highly integrated and effective regulatory system for new agri-food technologies.



## References

- Agnet. (2000a) EU Member States Must Enforce GM Crop Rules. May 18<sup>th</sup>.
- Agnet. (2000b) GM Crop Compensation Set to Cost Company Millions. June 2<sup>nd</sup>.
- Bakhshi, S. and W.A. Kerr (2008) Incorporating Labour Standards in Trade Agreements: Protectionist Ploy or Legitimate Trade Policy Issue?, *International Journal of Trade and Global Markets*, 1 (4): 373-391.
- Barichello, R.R. (2007) Administrative Procedures, the Distribution of Costs and Benefits, and Incentives in Anti-dumping Cases, in W.A. Kerr and J.D. Gaisford (eds.) *Handbook on International Trade Policy*, Edward Elgar, Cheltenham, pp. 360-367.
- Belcher, K., A.L. Hobbs and W.A. Kerr, 2003, The WTO and Environmental Sustainability: Is there a Conflict?, *International Journal of Environment and Sustainable Development*, 2 (1): 2-18.
- Benarroch, M. (2007) Economies of Scale, Imperfect Competition and Market Size, in W.A. Kerr and J.D. Gaisford (eds.) *Handbook on International Trade Policy*, Edward Elgar, Cheltenham, pp. 141-149.
- Boulding, K. (1970), 'Organizers of social evolution', chapter 2 in K. Boulding (ed), A primer on social dynamics: history as dialectics and development, London, Collier MacMillan Ltd, pp.19-36.
- Buckingham, D. and P. Phillips. 2001. Hot Potato, Hot Potato: Regulating Products of Biotechnology by the International Community. *Journal of World Trade* 35(1), pp. 1-31.
- Copeland, B.R. (2007) Trade and the Environment: What Do We Know? in W.A. Kerr and J.D. Gaisford (eds.) *Handbook on International Trade Policy*, Edward Elgar, Cheltenham, pp. 414-426.
- EuropaBio. (2006) *Herculex I (1507) Maize: Safety and General Characteristics*. Available online at: <http://www.europabio.org/InfoOperators/Herculex%20I.pdf>.
- Fürst, I. (2002) Swiss Soiled Seed Prompts Tolerance Question, *Nature Biotechnology*, 17: 629.
- Gaisford, J.D., J.E. Hobbs, W.A. Kerr, N. Perdikis, M.D. Plunkett (2001) *The Economics of Biotechnology*, Edward Elgar, Cheltenham.
- Gaisford, J.D. and W.A. Kerr (2001) *Economic Analysis for International Trade Negotiations*, Edward Elgar Press, Cheltenham.

- Gaisford, J.D. and W.A. Kerr (2003) Deadlock in Geneva: The Battle Over Export Subsidies in Agriculture, *International Economic Journal*, 17 (2): 1-17.
- Gaisford, J.D. and A. Hester (2007) Why Are There Trade Agreement? , in W.A. Kerr and J.D. Gaisford (eds.) *Handbook on International Trade Policy*, Edward Elgar, Cheltenham, pp. 57-70.
- Hobbs, A.L., J.E. Hobbs, G.E. Isaac and W.A. Kerr (2002) Ethics, Domestic Food Policy and Trade Law: Assessing the EU Animal Welfare Proposal to the WTO, *Food Policy*, 27: 437-454.
- Hobbs, A.L., J.E. Hobbs and W.A. Kerr (2005) The Biosafety Protocol: Multilateral Agreement on Protecting the Environment or Protectionist Club?, *Journal of World Trade*, 39 (2): 281-300.
- Holtby, K.L., W.A. Kerr and J.E. Hobbs (2007) *International Environmental Liability and Barriers to Trade*, Edward Elgar, Cheltenham.
- Isaac, G.E. (2007a) Ethical Issues in Trade, in W.A. Kerr and J.D. Gaisford (eds.) *Handbook on International Trade Policy*, Edward Elgar, Cheltenham, pp. 404-413.
- Isaac, G.E. (2007b) Sanitary and Phytosanitary Issues, in W.A. Kerr and J.D. Gaisford (eds.) *Handbook on International Trade Policy*, Edward Elgar, Cheltenham, pp. 383-393.
- Isaac, G.E. and W.A. Kerr (2004) Bioprospecting or Biopiracy? – Intellectual Property and Traditional Knowledge in Biotechnology Innovation, *The Journal of World Intellectual Property*, 7 (1): 35-52.
- Isaac, G.E. and W.A. Kerr (2007) Whose Vision of the Future? The Entrenched International Conflict Over Genetic Modification, *The Geneva Post Quarterly*, 2 (1): 87-107.
- Isaac, G.E., N. Perdakis and W.A. Kerr (2004) Cracking Export Markets with Genetically Modified Crops – What is the Entry Mode Strategy?, *International Marketing Review*, 21 (4/5): 536-548.
- Kerr, W.A. (1997) Removing Health, Sanitary and Technical Non-Tariff Barriers in NAFTA, *Journal of World Trade*, 31 (5): 57-73.
- Kerr, W.A. (2000) A New World Chaos? – International Institutions in the Information Age, *Journal of International Law and Trade Policy*, 1 (1) 1-10.
- Kerr, W.A. (2001) The World Trade Organization and the Environment, in H.J. Michelman, J. Rude, J. Stabler and G. Storey (eds.) *Globalization and Agricultural Trade Policy*, Lynne Rienner, Boulder, pp. 53-65.

- Kerr, W.A. (2003) “The Free-traders Win the Debates but the Protectionists Win the Elections”: The Curious Case of MCOOL in the US 2002 Farm Bill, presented at a workshop entitled Farm policy Developments and Policy Tensions Under NAFTA – Ninth Agricultural and Food Policy Tensions Under NAFTA, Policy Disputes Information Consortium, Montreal, Canada, April 23-26, <http://pidc.tamu.edu/farmpolicy/kerr.pdf>.
- Kerr, W.A. (2006) Dumping: Trade Policy in Need of a Theoretical Make Over, *Canadian Journal of Agricultural Economics*, 54 (1): 11-31.
- Kerr, W.A. (2007) Introduction to Trade Policy, in W.A. Kerr and J.D. Gaisford (eds.) *Handbook on International Trade Policy*, Edward Elgar, Cheltenham, pp. 1-8.
- Kerr, W.A. (2010) What is New in Protectionism?: Consumers, Cranks and Captives, *Canadian Journal of Agricultural Economics*, 58 (1): 5-22.
- Kerr, W.A. and R.J. Foregrave (2002) The Prophecies of the Naysayers – Assessing the Vision of the Protectionists in the U.S.-Canada Debate on Agricultural Reciprocity, 1846-1854, *Journal of International Law and Trade Policy*, 3 (2): 357-408.
- Kerr, W.A. and S.L. Hall (2004) Multilateral Environmental Agreements and Agriculture: Commitments, Cooperation and Conflicts, *Current Agriculture, Food and Resource Issues*, 5: 39-52
- Kerr, W.A. and J.E. Hobbs (1994) A New Era of ‘Corn Laws’: Agricultural Trade with the European Community – 1992 and Beyond, in G.M. MacMillan (ed.), *The European Community, Canada and 1992*, The University of Calgary, Calgary, pp. 91-102.
- Kerr, W.A. and J.E. Hobbs (2002) The North American-European Union Dispute Over Beef Produced Using Growth Hormones: A Major Test for the New International Trade Regime, *The World Economy*, 25 (2): 283-296.
- Khachatourians, G.G. (2001) How Well Understood is the Science of Food Safety? in P.W.B Phillips and R. Wolfe (eds.) *Governing Food: Science, Safety and Trade*, McGill-Queens University Press, Kingston, pp. 13-23.
- Layadi, R. (2009) Protecting European Quality Agriculture: Non-GM feed supply and production. Presentation made to the Co-Extra International Conference. June 2-5, Paris, France.
- LEI. (2009) *EU Policy on GM Soy: tolerance threshold and asynchronous approval*. LEI Wageningen UR: The Hague.
- Li, Y., E. J. Wailes, A. McKenzie and M. Thomsen. (2010) LL601 Contamination and its Impact on U.S. Rice Prices. *Journal of Agricultural and Applied Economics* 42(1), 31-38.

- MacKenzie, A. 2001. International Efforts to Label Food Derived Through Biotechnology. In Phillips, P and R. Wolfe (eds), *Governing Food: Science, Safety and Trade*, McGill University Press/Queens School of Policy Studies, Montreal.
- Maltsberger, R. and N. Kalaitzandonakes (2000), 'The Hidden Costs of Identity Preservation', *Feedstuffs*, 72(36), 1-2.
- Office International Des Epizootics (OIE) (2000) *A Short History of the Office International des Epizootics*, Paris ([www.oie.int/eng/OIE/en\\_histoire.htm](http://www.oie.int/eng/OIE/en_histoire.htm)).
- Ostrom, E. 2005. Understanding institutional diversity. Princeton: Princeton University Press.
- Paquet, G. (2001), 'The new governance, subsidiarity and the strategic state', in OECD, *Governance in the 21<sup>st</sup> Century*, Paris: OECD, accessed on August 20, 2005 at <http://www.oecd.org/dataoecd/15/0/17394484.pdf>
- Paarlberg, R. L. (2001) Shrinking International Markets for GM Crops? Presentation to the Agriculture Outlook Forum 2001, February 22-23. Available online at: <http://ageconsearch.umn.edu/bitstream/33093/1/fo01pa01.pdf>.
- Perdikis, N., W.A. Kerr and J.E. Hobbs (2001) Reforming the WTO to Defuse Potential Trade Conflicts in Genetically Modified Goods, *World Economy*, 24 (3): 379-398.
- Phillips, P.W.B. (2007) *Governing transformative technological innovation: Who's in charge?* Edward Elgar, Wallingford, UK.
- Phillips, P.W.B., S.J. Smyth and W.A. Kerr (eds.) (2006) *Governing Risk in the 21<sup>st</sup> Century*, Nova Science Publishers, New York.
- Picciotto, R. (1995), 'Putting institutional economics to work: from participation to governance', *World Bank Discussion Paper 304*, accessed on August 15, 2005 at [http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/1995/09/01/000009265\\_3961219115337/Rendered/PDF/multi\\_page.pdf](http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/1995/09/01/000009265_3961219115337/Rendered/PDF/multi_page.pdf)
- Roberts, D. (1998) Preliminary Assessment of the Effects of the WTO Agreement on Sanitary and Phytosanitary Trade Regulations, *Journal of International Economic Law*, 1: 377-405.
- Scottish Government (2002) Unauthorised material in GM crop trials, News Release, <http://openscotland.net/News/Releases/2002/08/2066>.
- Smith, A. (1994) *An Inquiry into the Nature and Causes of the Wealth of Nations*, The Modern Library, New York.
- Smyth, S.J., A.B. Endres, T.P. Redick and D.L. Kershen. (2010) *Innovation and Liability in Biotechnology: Transnational and Comparative Perspectives*. Cheltenham, UK: Edward Elgar.

- Smyth, S.J., P.W.B. Phillips and W.A. Kerr (2009) Global Governance Quandaries Regarding Transformative Technologies for Bioproducts, Crops and Foods, *Journal of World Trade*, 43 (6): 1299-1323.
- Smyth, S.J., P.W.B. Phillips, W.A. Kerr and G.G. Khachatourians (2004) *Regulating the Liabilities of Agricultural Biotechnology*, CABI Publishing, Wallingford.
- Smyth, S.J., Khachatourians, G.G. and P.W.B. Phillips (2002) Liabilities and Economics of Transgenic Crops, *Nature Biotechnology* 20: 537-541.
- Van den Belt, H. (2003) Debating the Precautionary Principle: “Guilty Until Proven Innocent” or “Innocent Until Proven Guilty”?, *Plant Physiology*, 132 (July): 1122-1126, <http://www.plantphysiol.org/cgi/reprints/132/3/1122.pdf>.
- Western Producer (2003) GM canola found in mustard load, March 10.
- Zhang, S. and W.A. Kerr (2009) *Revisiting Barriers to Trade: Do Foregone Health Benefits Matter?*, CATPRN Working Paper No. 2009-03, Canadian Agricultural Trade Policy Research Network, 109pp., [http://www.uoguelph.ca/~catprn/PDF/Working\\_Paper\\_2009-03\\_Zhang-Kerr.pdf](http://www.uoguelph.ca/~catprn/PDF/Working_Paper_2009-03_Zhang-Kerr.pdf).