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DISEASE OUTBREAKS AND AGRICULTURAL TRADE: THE CASE OF POTATOES

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Abstract

This study analyzed the impact of PVYn and potato wart disease outbreaks in PEI on the potato industry. These disease outbreaks resulted in the loss of the US seed export market to PEI producers. The effects of the disease outbreaks were mitigated through value-added processing. Price premiums for processed potatoes allowed PEI potato producers to abandon seed exports without incurring losses. Evidence is presented to suggest that other countries have also used this approach when export restrictions were placed on domestic agricultural industries. Policy response to the two disease outbreaks include: i) development of a zones policy that helped to reopen markets into the US; and ii) financial compensation to producers above the minimum levels required under the Seeds Act and Regulations. Implementation of the zones policy had beneficial impacts on the potato industry and is mirrored in other disease outbreaks. In contrast, compensation above minimum requirements may set a costly precedent for future disease outbreaks and may have caused moral hazard problems.

1.0 Introduction

The recent incidence of Bovine Spongiform Encephalopathy (BSE) or mad cow disease in Western Canada highlights the devastating impacts that disease outbreaks can have on the agrifood industry. Disease outbreaks (even those that pose no threat to human health) are often perceived as a primary health concern and can shake consumer confidence in the agrifood system. When disease outbreaks involve traded commodities, such outbreaks disrupt national and international trade, and can result in loss of important markets.

In 1989, there was a disease outbreak of the *Potato virus Y* (PVYn) in Prince Edward Island, resulting in closure of the international border into the US to PEI seed potatoes for approximately two years. The PVYn outbreak was followed with the discovery of potato wart (*Synchytrium endobioticum*) in a single field, in PEI, in October 2000. This led to a total ban on the export of potatoes (either tablestock or seed) into the US for approximately 6 weeks, after which the ban was lifted on tablestock potatoes. The ban on seed exports lasted approximately nine months.

Potato virus Y (PVY type species of the genus *Potyvirus*) is an economically important virus. PVY is transmitted by aphids and infects several *Solanaceae* crop species (Tribodet *et al.*, 2005). The most common of the PVY potato strains are PVYn and PVYo. In the case of potatoes, the viral infection induces mild mottling with occasional necrotic leaves, but has little or no damaging effect on the quality of the potato tuber. It also has some minimal effect on potato yields. By comparison, because PVYn is lethal to tobacco, it is important to contain the spread of the disease. PVYn is particularly important in the seed potato sector because the disease can be transmitted to successive crops through seed tubers.

There was also an incidence of potato wart in 2000 in PEI (Baayen *et al.*, 2005; CBC, 2004a). Potato wart is similar to PVYn in that it is not dangerous to humans but in contrast, it renders potato tubers worthless. While the potato wart discovered was limited to a single site, it can potentially have a more serious long-term impact on potatoes, lasting up to 40 years on the site where it is discovered. As a result, the PEI field where it was found was taken out of production and strict controls were placed on PEI potatoes to contain the disease.

The first objective of this study is to assess industry trends in the potato industry and their potential impacts in mitigating future disease outbreaks in the Canadian potato industry. A second objective is to assess the appropriateness of the policy responses to the PVYn and potato wart outbreaks in Canada, and to address the potential lessons that can be learned in dealing with other disease outbreaks.

The following section provides a brief outline of the PVYn crises, followed by a trend analysis of the potato market, both in PEI and for the rest of Canada to assess how a similar disease outbreak in the future could affect the Canadian potato market.

An assessment of policy response to the disease outbreaks is then presented. The study concludes with a summary and conclusion.

2.0 Evolution of the Disease Outbreaks in Potatoes

In 1989, the tobacco virus Tobacco Veinal Necrosis (TVN) was diagnosed on tobacco plants in Ontario. TVN, also known as Potato Virus Y (PVYn), is a virus which causes necrosis in tobacco plants and can infect numerous other types of broad-leaved plants, including potatoes (Tribodet *et al.*, 2005). After the initial discovery of PVYn in Ontario, Agriculture and Agri-Food Canada (AAFC) tested for PVYn throughout Canada. Testing confirmed the highest prevalence of PVYn in PEI and, to a lesser extent, in New Brunswick. As a result of the discovery of PVYn in 1989, 1990 and 1991, the US banned imports of PEI potatoes into the US for approximately two years. Tablestock potatoes were unaffected, so long as they were treated with a sprout inhibitor. The ban on PEI seed potatoes was lifted for the 1992/93 crop year when a “zones” policy was implemented. The zones policy was the result of negotiations involving the US, AAFC and PEI, and involved: i) an eradication plan for PEI potatoes affected by PVYn; and ii) the creation of five km radius quarantine zones around detected incidences of PVYn. Initial tests in 1991 indicated “PVY” in 95 seed lots in PEI. This number was later reduced to ten when further testing detected 85 “false positives” (a harmless strain of PVY called PVYo). By the 1994 crop year, AAFC had demonstrated to the US through testing of imported US potatoes that PVYn was present in the US, at least to a similar extent as in Canada. The US could therefore no longer claim that it was a PVYn disease-free area. Consequently, all restrictions on Canadian potatoes were lifted by the US.

Since the US was assumed to be a disease free area, the US response was justified under WTO trade rules. However, there is controversy surrounding this disease free status, given the evidence that PVYn already existed in the US, despite the official US position of disease free status. The Canadian Phytopathological Society (2001) claimed that scholars were aware of PVYn in the US prior to the outbreak in PEI, and that experts were combating the disease in tobacco (a form of the virus called TVN that strikes tobacco) in North Carolina for years. Evidence of TVN in tobacco suggests that the US was already combating this disease for some time (Gooding and Tolin, 1973). Susceptibility of potatoes to the PVY strains detected in the US was never confirmed in potatoes prior to the outbreak in PEI (McDonald and Kristjansson, 1993). Furthermore, the likelihood of the disease being in the US was high once it was confirmed in PEI since potatoes had been shipped from PEI to the US for years prior to the PVYn outbreak (Singh, 1992). The policy response of the US appears excessive given the evidence. The evidence suggests that “disease free status” under the WTO rules is a difficult concept to define, and may have lead to unwarranted trade restrictions imposed by the US in the case of the PVYn disease outbreak in PEI.

As a result of the discovery of potato wart in PEI in 2000, the US imposed a total ban on PEI potatoes entering the US for six weeks between late October and mid-December, 2000 (CBC, 2004a). In November 2000, testing by AAFC showed that the

potato wart was limited to the single field. Soon after, the US lifted the ban on tablestock entering the US but not seed potatoes. The US also banned any imports of potatoes coming into the US originating within 40 kms of the infected field (i.e., approximately 12.5 percent of the area seeded to potatoes in PEI). A maximum sized bag of 22.5 kg was placed on imports into the US, and province of origin labeling (POOL) (i.e., "Product of PEI" label) was imposed. In April 2001, the US lifted its ban on seed potatoes, and cleaning and treating restrictions, but not the bag size or labeling requirements. Additional discoveries of potato wart in PEI in 2002 and 2003 were made outside of the zones but did not result in further restrictions placed on potatoes other than the requirement that the land on which potato wart was discovered be taken out of production.

3.0 Industry Trends in Canadian Potato Industry

The PVYn crisis, together with the potato wart scare, disrupted traditional established links in seed potato trade between Canada and the United States. These links were never really re-established in PEI, as illustrated in Figure 1. Figure 1 shows the value of PEI seed potato exports into the US. The value of PEI seed potatoes imported by the US shows a declining trend. From approximately \$6 million before the PVYn crisis, the value of the PEI seed potato export market into the US fell to below \$1 million by the 2004/05 crop year. Figure 1 also illustrates the shocks to the PEI export market in the US resulting from both PVYn (1991/92 crop year) and potato wart (crop year 2000/01) when the value of exports of seed potatoes into the US fell to virtually zero. The figure also illustrates that the shock associated with potato wart in 2000 was approximately one-sixth of the shock associated with PVYn. As illustrated in Figure 1, the value of seed potato exports recovered after the potato wart outbreak in 2000/01 to its pre-shut down level, still it has never reached the value from the times before PVYn outbreak in 1989. This implies that, while there seems to be a permanent effect associated with border restrictions associated with PVYn, this does not seem to be the case with potato wart.

At the same time, there has been an expansion of the potato industry as a whole in PEI, especially processed potatoes. This is illustrated in Figure 2, a plot of the seeded area of potatoes in PEI. Seeded area grew from approximately 70,000 acres in 1988 to approximately 110,000 only ten years later in 1999. Since the year 2000, seeded area has stabilized at just under 100,000 acres. In contrast to the trend in the value of seed potato exports to the US illustrated in Figure 1, the PVYn and potato wart disease outbreaks had little (if any) impact on total seeded area in PEI. In other words, while both PVYn and potato wart had an impact on the PEI seed potato market, the impact did not carry over to the overall PEI potato market.

Figure 1: Value of PEI seed potatoes exported to the US (Source: Industry Canada 2006)

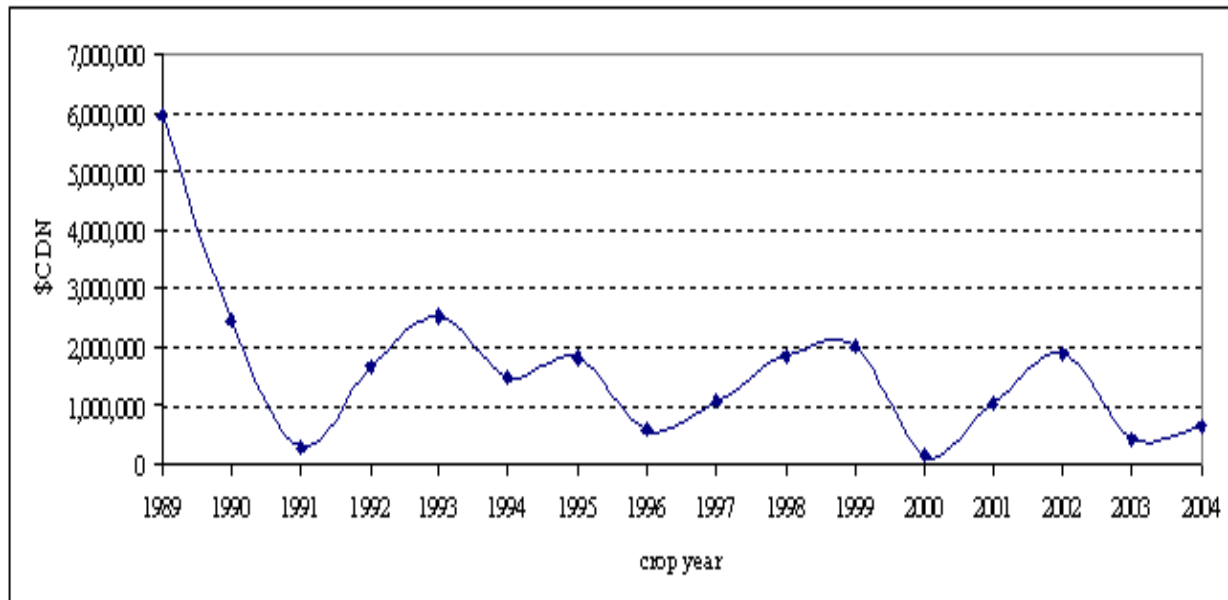
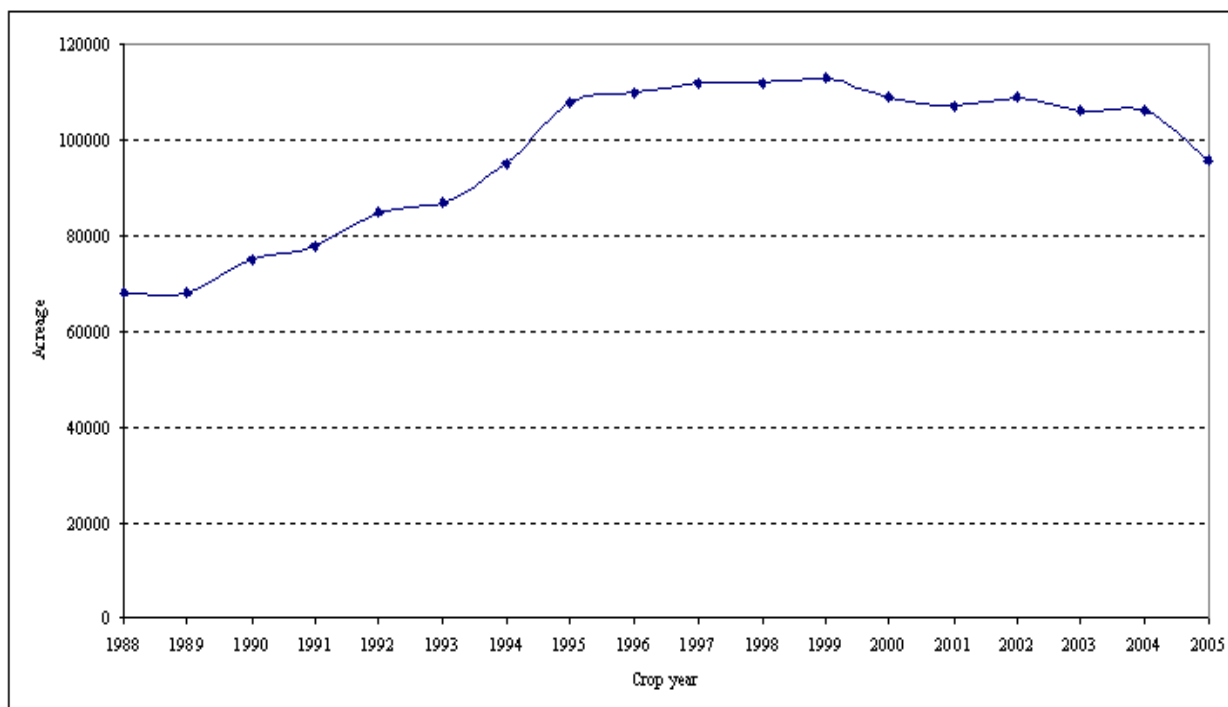


Figure 2: Total acreage seeded to potatoes in PEI (Source: Statistics Canada 2006)



The expansion of the potato market in PEI has been fuelled by an expansion in the processing potato market. From approximately 25 percent of the overall market in PEI during the mid to late 1980s, the processing potato market currently accounts for approximately 60 percent of total potato production in PEI (DeHann, 2006).

The expansion of the processed potato sector in PEI has little to do with PVYn or potato wart outbreaks. There has been little or no incentive for PEI producers to re-establish the seed potato market, stemming from the establishment of additional processing capacity in PEI in the late 1990s resulting in price premiums paid to PEI potato producers. There are three markets for PEI potatoes: the tablestock market, the seed market and processing market. Among the three, the tablestock market is the lowest valued. By comparison, the seed and processing markets command price premiums, as long as producers provide the quality attributes required. The establishment of two processing plants on PEI (one by Cavendish Farms, and the other by McCains Foods) resulted in higher price premiums paid to producers for processing potatoes. Thus, the new (higher) premiums to processed potatoes made the PEI seed potato market less competitive. The new processing facilities also decreased the marketing risk of processed potatoes, and increased the value of processed potatoes in PEI.

Processed potatoes offer PEI potato producers the opportunity to enter a high valued market for their potatoes without the risk of the seed market. At the same time, there was probably little or no incentive to re-enter the seed market lost during the PVYn outbreak. Based on the expansion of processing potato acreage in PEI, it seems reasonable to argue that the processed potatoes replaced seed potatoes as a high valued, high quality market for PEI potatoes. Superior managers switched their talents from seed to processed potatoes. An important outcome of the changes in the market is that another disease outbreak like PVYn would not have such a dramatic impact on the PEI potato industry. Indeed, the impact associated with the potato wart scare was much smaller than from PVYn. The reason is that processing would have destroyed the PVYn virus, thereby making disease-induced trade restrictions on (processed) potatoes unnecessary. Thus, value-added processing can, at least partially, mitigate the negative impacts of disease outbreaks.

4.0 Similarities with Other Disease Outbreaks

A question that arises is: To what extent is the trend in the PEI potato industry towards more value added processing mirrored in the experience of other disease outbreaks? In the case of the Canadian experience with respect to the BSE outbreak, Rude *et al.* (2007) point out that several processing plants planned expansion as a result of the ban on cattle exports into the US. However, Canadian processors were reluctant to go ahead with costly expansion plans given that there was so much uncertainty surrounding how US processors would respond to the increased competition resulting from the re-opening of the border. For example, the possibility of predatory pricing strategies on the part of US processing plants when the border reopened made Canadian processors hesitate to commit large sums of money to build extra capacity.

Clearer examples of value added processing to mitigate disease outbreaks are provided by various disease outbreaks related to Avian Flu. Recent outbreaks of highly pathogenic avian influenza (HPAI) are recorded in both China and Thailand. Both of these disease outbreaks caused significant trade disruptions for these countries (Blayney *et al.*, 2006; Wang, 2006; USDA, 2007). While HPAI is detrimental to poultry flocks, the virus is killed through cooking. Hence, the majority of markets for processed poultry remained open throughout the HPAI crises in both countries and processed poultry was unaffected by bans on raw product movement.

Restructuring towards increased processing capacity occurred subsequent to the HPAI outbreaks in both countries (Blayney *et al.*, 2006). In the case of the HPAI disease outbreak in China, a major Chinese market into Japan was permanently lost. However, this resulted in large foreign investment in the Chinese poultry processing sector (Blayney *et al.*, 2006), allowing the Chinese to shift their poultry industry from one largely dependent upon raw product exports (and susceptible to disease outbreak trade restrictions) to a largely value added processing sector (and less susceptible to disease outbreak trade restrictions). Therefore, another such disease outbreak in either country would not have such a large impact on the Chinese industry.

The recent Avian Influenza disease outbreak in Saskatchewan in 2007 is also instructive. Since the poultry industry in Saskatchewan was entirely domestic (actually Provincial) and no raw product exported, there were no bans placed on Provincial or National shipments of product. Hence, the fact that the Saskatchewan poultry industry already had value added processing meant that the trade disruptions resulting from the Avian Influenza disease outbreak was almost completely mitigated.

5.0 Policy Responses to the PVYn and Potato Wart Crises

The immediate policy response by the Canadian Food Inspection Agency (CFIA) to the PVYn crisis was to institute new testing procedures to ensure the false positive testing problem was not repeated. Long term policy responses of government to the crises were remarkably similar. These responses can be classified into two types:

- 1) negotiate with the US to establish a zones policy to contain the outbreak, and lift the ban on seed potatoes entering the US; and
- 2) compensate producers for losses associated with the disease outbreaks over and above the minimum required by the Seeds Act and Regulations (e.g. Canadian Legal Information Institute, 2007).

5.1 Negotiations and zones policy

The PVYn outbreak led to the establishment of a total ban on Canadian potatoes entering the US for approximately two weeks during the 1989/90 crop year. The ban was lifted after the two week period for tablestock potatoes, but with a requirement that such potatoes be treated with a spout inhibitor. The market most affected by the PVYn

disease outbreak was the seed potato market. The ban was lifted only after the zones policy was instituted for the 1992/93 crop year, with the restriction on the importation of potatoes only applied to fields surrounding those where PVYn was found. This was the first time that a zones policy was used to contain a disease outbreak for potatoes in Canada.

A zones policy was also instituted as a result of the potato wart scare. This resulted in the ban on seed potatoes being lifted after nine months in the crop year 2000/01 (Baayen *et al.*, 2005; CBC, 2004a). In 2006, Golden Nematode was discovered in potatoes in Quebec (AAFC, 2006a; AAFC, 2006c), leading to a ban on potatoes entering the US for approximately five weeks. This ban was also lifted after negotiations between the USDA and AAFC, leading to implementation of another zones policy.

The establishment of zones policies to contain disease outbreaks is probably the most lasting and effective method to mitigate the impacts of disease outbreaks in potatoes. There are two advantages of this type of policy. First, it limits the affected area to the minimum acceptable to both the exporter and importer. Given that different diseases have different abilities to spread and different impacts, it seems reasonable to negotiate these on a piecemeal basis among the affected parties. This certainly is better than the initial banning of imports from arbitrary political boundaries like the Province of PEI.

Second, the zones policy is consistent with the overall thrust of the World Trade Organization's (WTO's) "Agreement on the Application of Sanitary and Phytosanitary Measures" policy on the control of disease outbreaks (WTO, 2007). Zones and their relationship to international trade has recently been a major topic of discussion by WTO members. At the level of the WTO, these discussions take place under the moniker "regionalization". The term regionalization refers to how a country that is not disease free can divide its national territory into "regions" that are declared disease free so that product from disease free regions can flow into international markets even though the total territory of the country is not disease free. This allows trade to flow from disease free areas without blanket bans on the whole national territory. From the perspective of the US, even the initial ban of seed entering the US was probably consistent with regionalization, since the bans were placed on individual Provinces and not the country as a whole. Furthermore, the ban was placed only on seed potatoes, and not tablestock.

Under the present notion of regionalization, much of the discussion surrounds the establishment of regions for specific diseases where the country in question is not presumed to be disease free (e.g. Loppacher *et al.*, 2006). In this sense, the regionalization discussion tends to be more reactive than proactive in nature. A more proactive approach can be found in the notion of developing *ex-ante* zones policies. The idea of *ex-ante* zones policies is that, if a disease strikes, a country has a containment strategy with which to demonstrate to trading partners that the situation is under control, with the hope of minimizing the trade disruptions associated with potential disease

outbreaks. There is some evidence that the trade disruptive effects of the recent foot-in-mouth disease outbreak in the UK was at least partially mitigated because UK officials had an *ex-ante* zones policy in place before the discovery of the disease (Council of the European Union, 2003). There is also evidence that the Thailand government developed an *ex-ante* zones (called compartments) policy for Avian Influenza (USDA, 2007). Regardless of its impacts on trade, the development of *ex-ante* zones policies boosts consumer confidence in the health and safety of the food system by demonstrating the governments are prepared to deal with disease outbreaks when they happen.

The history of disease outbreaks in potatoes and the development of zones policies emphasize that zones policy development ought to be both *ex-ante* and the result of at least bilateral or, better yet, multilateral negotiations. For example, the policy developed by the UK to contain the foot-in-mouth disease outbreak was unilateral in nature, and was not accepted by some of its EU trading partners when the disease outbreak occurred. Had these discussions taken place with trading partners and agreements on zones secured *ex-ante*, then they may have been more effective in mitigating the trade impacts of this disease outbreak. It is also likely that *ex-ante* negotiations over such disease outbreaks may be much more balanced, since *ex-ante*, it is not clear which country will be struck by the disease and which country will restrict imports. It is likely that more equal treatment will be given to both domestic as well as foreign industries in an *ex-ante* negotiation process.

It could be true that countries are reluctant to develop zones policies that are unilateral and *ex-ante* because the existence of such plans indicate to other trading partners an admission of susceptibility that may diminish the bargaining power of the country that develops such plans in future negotiations. This could be an example of a “hold up” problem (Edlin and Reichelstein, 1996) in the development of *ex-ante* disease outbreak plans. Furthermore, the mere expression of interest in negotiating certain diseases may signal to negotiating partners the fear of an outbreak that may limit the ability of a country to develop an efficient zones policy through bilateral or multilateral negotiations.

A final lesson that can be taken from the experience of disease outbreaks in potatoes as they relate to the development of zones policies is that the list of diseases included in the discussions during multilateral negotiations ought to be comprehensive in nature. The frequency with which disease outbreaks with significant trade impacts have struck the PEI potato industry implies that such occurrences may not be unusual events. Indeed, in 2006, another disease outbreak, this time of Golden Nematode, occurred in Quebec, (with a closely related disease occurrence in Idaho). This resulted in border closings to Quebec potatoes of approximately two weeks before a zones policy was implemented. Therefore, over the last twenty years, there have been three disease outbreaks that have resulted in trade restrictions imposed on potatoes crossing the US/Canada border.

The frequency of occurrence seems to imply that a comprehensive approach to disease outbreaks may be more appropriate than the *ex-post*, one disease approach used in the past. While the occurrence of disease outbreaks in potatoes is somewhat predictable, the actual disease to strike potatoes is unpredictable. Therefore, bilateral negotiations between the US and Canada over all potentially trade threatening diseases that may strike potatoes ought to take place. These negotiations ought to outline border restrictions, zones policies, etc. in the event of a disease outbreak from a comprehensive list of potentially trade threatening diseases for potatoes. That way, in the event that a disease outbreak occurs, policies already agreed to can be implemented to ensure minimum trade disruptions while maintaining health and safety standards. Recent examples of this approach in other industries and countries have been limited to a few specific diseases, such as BSE and Avian Influenza. What the history of disease outbreaks in potatoes suggests is an expanded list, which would include bilateral negotiations that include a study of a greater number of diseases, including those that have not yet occurred.

The successful development of zones policies depends on domestic factors as well. The handling of the PVYn incident and eradication efforts in Canada were not well received by all farmers, especially in areas outside of PEI. In *Adams v. Borrel*, it was claimed that the zones policy caused hardship for New Brunswick growers. The plaintiffs did not oppose zones directly but rather opposed certain aspects of the zones policy. Although it was ruled that Agriculture Canada met the standard of care and provided a reasonable duty of care to prevent the spread of PVYn and the case was dismissed, it is interesting to consider the legality of zoning in general. It is a common understanding among legal scholars that when WTO agreements and domestic laws conflict, WTO agreements take precedence. In addition, no domestic subject can appeal WTO regulations since there is no private rights protection under the WTO. Therefore, producers could not appeal directly Canada's obligations under the Sanitary and Phytosanitary Measures of the WTO agreement with respect to mandated zones. Producers could appeal zoning proposed by Canadian agencies, however, it is almost certain that international law would prevail over Canada's normative law. The evidence therefore suggests that, even when comprehensive zones policies are developed, domestic political realities may make such policies infeasible, especially if they are developed without prior consultation with domestic groups that may be harmed by their implementation.

Such a comprehensive approach to disease outbreaks will require genuine commitments by all member nations. Evidence suggests that noncompliance to WTO commitments frequently occurs by a select group of nations. By the end of first quarter in 2007, 109 panel and panel/Appellate Body reports were adopted because of disputes over WTO commitments, and of these, violations of WTO commitments were found in 90 percent of the cases (Wilson, 2007). Such a statistic suggests that significant noncompliance to trade commitments occurs. Furthermore, according to Wilson (2007) only 17 of 150 member nations (with the EU counted as one member) were ever subject to a ruling of the WTO panels or Appellate Body, and the US alone was the subject of 33 of the 109 rulings. As a result, given a possible long and

protracted set of negotiations that may take place even if a comprehensive agreement is reached on disease outbreaks and zones policies, these agreements may not be effective in mitigating the trade disruptions.

Of further concern is the self-enforcement component of the current WTO system. The only enforcement mechanism in the current system is retaliation. Small economies may therefore be at a disadvantage since in reality retaliation may not be feasible. Participation in the dispute settlement process may not occur when the expected costs of the dispute resolution outweigh expected returns, or if uncertainty of success is high (Bown, 2005). Therefore, violations in trade obligations such as those regarding disease outbreaks will likely occur if the nation experiencing the disease outbreak does not have the capacity to inflict welfare losses on their noncompliant trading partners.

The PVYn case PEI is an example how a country can slow and even temporarily block trade despite evidence that it is itself not disease free. While the U.S. claimed that they were free of PVYn, empirical evidence from within the U.S. suggested that PVYn had existed in the U.S. prior to the outbreak in PEI. Eventually Canada was successful in demonstrating that PVYn existed in the US and so the US position of not accepting the scientific community's evidence to claim disease free status and to continue the ban on PEI seed potatoes was temporary in nature. However, the fact that the PEI seed potato industry never fully recovered from the ban highlights the fact that even temporary bans can permanently disrupt markets, especially markets where reputation is important, like the seed potato market.

5.2 Compensation to producers

The compensation history of the PVYn and potato wart outbreaks indicates compensation levels above the minimum recommended under the Seeds Act and Regulations. The Seeds Act and Regulations provides only for compensation for product destroyed at market prices. It does not provide for other losses, such as those resulting from lost markets, interrupted markets, loss in prestige or any other extraordinary costs.

Nevertheless AAFC provided compensation above that provided by the Seeds Act and Regulations in all cases, with little or no discussion about whether such compensation is in the public interest. AAFC purchased potatoes that were not infected by the PVYn virus in 1991 for \$3.00/cwt from PEI and New Brunswick potato producers (JRG Consulting Group, 2003). Additional compensation of approximately \$15 million was given to PEI potato producers as an out-of-court settlement related to the PVYn disease outbreak. Compensation resulting from the potato wart outbreak to potato producers by the PEI government amounted to 10 cents per kg (CBC 2004b). Federal government support of \$12.6 million was given to PEI potato producers to dispose of the surplus caused by the potato wart zones policy (Parliament of Canada, 2001).

Government compensation to potato producers above that required by law resulting from disease outbreaks could have negative impacts on government responses in the future. Compensation above the minimum could imply an implicit obligation by government that could set a precedent for future disease outbreaks of a larger and more costly nature. The fact that AAFC compensated PEI potato producers with \$15 million after already purchasing surplus potatoes could have encouraged New Brunswick producers to initiate their lawsuit against the CFIA for additional compensation. Furthermore, as a result of the 2006 Golden Nematode outbreak in Quebec, \$5.4 million in compensation was awarded to 28 Quebec potato producers. It seems that AAFC has, at least implicitly, agreed that producers affected by such disease outbreaks are due compensation above that required by the Seeds Act and Regulations, since in all cases as they relate to potatoes in Canada such compensation has been forthcoming. This could set a precedent for future disease outbreaks, especially for BSE which has potentially large industry effects and therefore costs.

Goodwin and Vado (2007), make the point that government policies related to risk insurance for agriculture in the US may be creating moral hazard problems. Compensation given to potato producers in Canada as a result of disease outbreaks in potatoes may also be contributing to the overall moral hazard problem of risk management policies developed by governments for agriculture.

6.0 Summary and Conclusion

The PVYn and the potato wart outbreak led to a ban on PEI seed potatoes entering the US. The seed potato market in PEI did not recover from these market shocks. However, the PVYn and potato wart outbreaks did not result in any long term losses to the PEI potato industry even though there seems to have been permanent losses to the PEI potato industry in the seed market, especially resulting from the PVYn disease outbreak. In fact, the PEI potato industry as a whole has expanded tremendously over the last two decades, largely due to expansion of processing capacity by McCains Foods and Cavendish Farms. The PEI potato industry has been transformed from a seed and tablestock potato producing industry to a processing and tablestock producing industry.

As a result of the increased valued-added processing, another PVYn disease outbreak in PEI would likely have only a minor disruption to PEI potato industry because the Province has largely abandoned this market. However, this has come at the expense of reduced competition among the buyers of PEI potatoes since the expansion of the industry was fuelled by processing capacity expansion by two processors: Cavendish Farms and McCains foods. There is evidence that other countries may have also pursued this strategy in response to other disease outbreaks.

The response of government to the PVYn and potato wart outbreaks was twofold: 1) develop a zones policy to reopen the US border to seed potatoes; and 2) compensate potato producers beyond the minimum required by the Seeds and Regulations Act. Negotiations with the US have resulted in a zones policy solution,

where the details of the zones policy depend on the nature of the disease outbreak. Reductions in the length of subsequent bans of seed potatoes into the US with new potato disease outbreaks suggests that zones policies have become more effective over time. The development of zones policies that are *ex-ante*, result from multilateral negotiations, and encompass a comprehensive list of diseases are needed.

Compensating producers above levels required under the Seeds Act and Regulations could have set a costly precedent for compensation for other crops and disease outbreaks. Furthermore, compensation may be contributing to a moral hazard problem for future disease outbreaks in Canadian potatoes.

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