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Crop diversification and trade liberalization: Linking global trade and local management through a regional case study

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Abstract. Some models anticipate that liberalized agricultural trade will lead to increased crop diversity, while other models make the opposite claim. These positions were explored in southwestern British Columbia, Canada where, between 1992 and 1998, government subsidies and other measures designed to protect horticultural farmers were lifted, exposing these farmers to foreign competition. Public hearings on the future of agriculture provided an opportunity to tap the knowledge and experience of people affected by this transition. Analysis of transcripts from these hearings, which was confirmed by industry data, shows that trade liberalization has led to the loss of the local fruit and vegetable processing industry. Stakeholders saw the loss as a major factor affecting the choice of crops grown locally. To test this assertion, crop diversity data were analyzed, differentiating crops grown for the processing industry from those grown for the fresh market. Results show that crop diversity increased for processing crops but not for fresh crops. Farmers who used to produce commodities for the fruit and vegetable processing industry seem to have been forced to find new crops to cope with the decline in the processing industry. Here then is a case where the effects of trade were indirect (they were mediated by another variable: the loss of the processing industry) and variable (they differed for the two groups of crops). This may have significant environmental implications as scientific research shows that diverse agro-ecosystems are better able to withstand pest outbreaks and require less agri-chemicals than simple systems.

Key words: Agro-diversity, British Columbia, Canada, Environmental impact, Globalization, Stakeholder perceptions, Trade policy, Vegetable production

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Introduction

A widespread goal of many recent agricultural policies is to liberalize trade in food products (OECD, 1999). For example, although the trade in agricultural commodities has increased at least since the Second World War, three key trade agreements signed in the last 15 years have accelerated this trend in North America. The 1988 Free Trade Agreement between the US and Canada stipulated all border tariffs in place at the time would be phased out by 1998. The 1994 North American Free Trade Agreement (NAFTA) stipulated that all border tariffs between Canada, Mexico, and the United States except those on dairy, poultry, and eggs would be eliminated by 1998 (British Columbia Ministry of Agriculture Fisheries and Food, 1995). The 1994 Uruguay Round negotiations that created the World Trade Organization brought agriculture under ''normal'' international trade rules, banning subsidies and requiring the elimination of other trade-distorting practices (Ibid, 1995).

Despite the prevalence of policies that encourage agricultural trade, there is little agreement on the effect this may have at the farm level. For example, one area where scholars have tried to model the impact of trade on the agricultural landscape is on crop diversity. One school of thought suggests that under conditions of increased trade, farmers will diversify the crops they plant. According to this argument, which follows the ''neo-classical'' position, government programs that protect farmers (by guaranteeing crop prices, for exam-

ple), encourage farmers to grow only those crops the government supports (for a discussion of these issues see Marsden, 1998). If the government lowered supports in accordance with trade agreements, farmers would be forced to allocate their resources more efficiently, and this would mean planting a wider range of crops to protect against pest outbreaks, crop failure, and low market prices (Pierce, 1993). To test this hypothesis, Anderson and Strutt (1996) used quantitative models and concluded that a complete removal of agricultural subsidies would result in reduced intensive grain production in Europe and North America and a commensurate increase in the developing world. Diversification is further expected to help develop alternative or unconventional markets such as organic production, sustainable agriculture, farm-tourism, or commodities grown for niche markets (Thirsk, 1997; Bradshaw, 2004).

Other models show the opposite trend, including one that suggests that a reduction in US/European Union farm support would actually lead to increased grain production through increased input use and a greater reliance on irrigation (Ervin, 1997). This may lead to more intensive food production and increase agriculture's impact on already degraded natural resources (Bonilla and May, 1997). Other authors echo this conclusion, suggesting that global trade in agricultural commodities provides incentives for farms to become very large and specialized, dependent on environmentally fragile monocultures (Shiva, 1993; Kneen, 1999). Tisdell suggests that economic globalization, along with technological developments, encourages farmers to produce fewer types of commodities (Tisdell, 2003). This, he feels, is because farms that specialize in specific products achieve economies of scale. Therefore, trade allows regions with a comparative advantage in specific commodities to outcompete other regions (McCalla and Josling, 1985) by externalizing environmental problems (Panayotou, 1993). As a result, the global market seems to encourage farmers to become specialized producers (Andersson, 2001), a condition that stands in opposition to well managed local environments where the diversity of agricultural products is an indicator of a sustainable and resilient agro-ecosystem (Pannell and Glenn, 2000; Figge, 2004).

A third position is that the impact of such global forces as de-regulated trade varies greatly between region and commodity. According to this school, economies are best viewed as open and complex adaptive systems that evolve through time reaching multiple states of equilibrium that are never stable for long (Faber et al., 1995; Ramos-Martin, 2003). This has led some to suggest that predicting the effects of liberal agricultural policies on land use and the environment is beyond current scholarship (Potter, 2000). Others suggest that it is necessary to include local participation in research to understand how global forces play out (Reed and Dougill, 2002) and that individual residents are ideally placed to understand how their communities have changed over time and what benefits or challenges these changes have wrought (Kloppenburg et al., 2000; Morse et al., 2001; Bell and Morse, 2004). Without the input of the people who live in an area, scholarship may miss contextual information that is vital to understand how global forces, like trade liberalization, will be manifest in specific regions (Geertz, 1973; Homer-Dixon, 1995; Fraser et al., 2003).

Despite this rich theoretical debate, there are relatively few empirical studies based on work in the English-speaking Northern Hemisphere that link trade deregulation with specific changes in land management except in a vague way. For example, Hernandes and Maya (2002) suggest that integration in the global market led to an expansion in Mexican wheat production and a subsequent development of a poultry industry. This research provides some insight into how trade has changed local landscapes but is more an institutional analysis than an account of shifting land use patterns. Similarly, Higgins and Jussaume (1998) point out that globalization has led to an expansion of global supply chains. That trade has an impact on farm diversity is suggested by Friedland et al. (1981) who show that the global market for tomatoes emerged after a series of policy changes in the US that created incentives for Californian farmers to specialize in tomato production to the exclusion of most other products. Again, this research only hints at changes in land management. Hespanha (1997) shows that a reduction in government programs and integration in the single European market in 1993 resulted in a precipitous decline in small farms in Portugal. His work suggests that the surviving farms were large, modern operations whose costs were low enough to compete with international markets. However, this research only provides tangential references to changes in land use and crop diversity. Finally, Winters et al. (2002) suggest that "proving" the specific effects that trade liberalization have on particular regions or groups is extremely difficult since the effect of trade can be mediated by other factors such as regulatory issues or the price of labor. As a result, the purpose of this paper is to explore the effects of agricultural trade deregulation by using community perceptions to help explain changes in crop diversity during a period of transition from government protection to international competition.

Locale

This research was conducted in the highly productive horticultural region in southwestern British Columbia, Canada (Fraser, 2004). This is an ideal locale to study the effect of the transition from an agricultural system dominated by government support to a system driven by competitive trade. Government support for farmers in

British Columbia has declined from $80 million/year in 1985 to approximately $30 million year in 1998 (Government of Canada, 1999). The total provincial budget for agriculture has also dropped from $105 million Canadian in 1992 to a proposed $45 million in 2004 (British Columbia Agriculture Council, 2004). In southwestern British Columbia, this has mostly affected horticultural producers since the government still supports the region's other main commodities (poultry, eggs, and dairy) through a supply managed quota system. Starting in the early 1990s, tariffs on fresh fruit and vegetables imported into British Columbia were reduced initially by 15%, though some tariffs, like those that were imposed on fresh raspberries, were eliminate outright. By the beginning of 1998, all remaining tariffs imposed on American vegetables imported into British Columbia were eliminated and, in 1997, Canada signed trade agreements with Chile and Israel liberalizing the movement of products among these countries (Agriculture and Agri-Food Canada, 1999). This transition also reflects changes at the national level in response to international trading agreements. At the beginning of the 1990s, the Canadian government provided 30% of Canadian farm income. By 1998, this had fallen to 15% (OECD, 1999). These trends represent a rapid shift from government protection for farmers to competition in global markets. As a result of these changes, in 2000, Agriculture and Agri-Food Canada concluded that "The fresh vegetable market has become a truly North American market where production shortages in one region are balanced off by imports from other regions" (Agriculture and Agri-Food Canada, 2000). Therefore, of all farm sectors in British Columbia, the horticultural industry and fruit and vegetable processing industry have experienced the largest impact of trade (British Columbia Ministry of Agriculture Fisheries and Food, 1995).

There were two additional reasons to examine the effects of trade liberalization on crop diversity in this region. First, provincial legislation prevents the non-agricultural use of farmed land. In an effort to preserve local food production in the early 1970s, the province of British Columbia designated all high quality farmland in the province as "agricultural land reserve" (ALR) where non-agricultural land use would be strictly controlled. This means that urban encroachment and land speculation do not influence farm management, reducing the possibility of these factors shaping farm decisions.

Second, despite a number of different types of farms in southwestern British Columbia, the specific region studied in this paper is quite homogenous. The farming community of Delta, at the west end of the Fraser River, is generally made up of small vegetable farms with an average field size of 6 hectares, an average farm size of 41 hectares, and average gross farm receipts of slightly above $50,000 (CAD)/acre. There is very little livestock production in this area (less than 20% of farms have livestock, representing less than 20% of gross farm receipts) and over 80% of farms produce field vegetables like potatoes, corn, and peas (Artemis Agri-Strategy Group, 2002). These commodities are traded openly on un-regulated markets and must compete with horticultural production from around the world (Government of Canada, 1995).

During the past decade and a half, international trade in horticultural commodities has increased. Vegetable imports to British Columbia grew from $200 million (current Canadian dollars) in 1993 to $370 million in 2003 (Industry Canada, 1999). Data from Statistics Canada show that although British Columbia has never been a net exporter of vegetables, its trade deficit grew by approximately 20% between 1991 and 1999, and California alone accounted for 50% of the British Columbia vegetable trade deficit in 1999 (Industry Canada, 1999).

Furthermore, this locale is relevant to this study because a wide range of literature, including comments made by local producers themselves, suggest that increased trade has changed the way food is produced. For example, some are concerned that British Columbian farmers are being forced to cut corners since they now face competition from jurisdictions that have lower environmental standards (Barisoff, 1998). Others suggest that British Columbia farmers are at a comparative disadvantage with regions that have longer growing seasons or a larger land base (Evans, 1999). Still others argue that these trade agreements have led to a re-organization of the North American food processing industry, which in turn affects the markets that farmers access (Agriculture and Agri-Food Canada, 2001).

Methods

Three sets of methods were used in this study. First, to assess stakeholder perceptions, the research employed a qualitative method to analyze transcripts from a series of public hearings on agriculture. In 1998, the government of British Columbia established a Select Standing Committee on Agriculture, Fisheries and Food. The committee was born out of the concern that "the free trade agreement and federal cutbacks in farm safety nets would have a significant impact on British Columbia agriculture." (Select Standing Committee on Agriculture and Fisheries, 2000). The Committee engaged in a public consultation process between October and December, 1999, holding 16 public hearings throughout British Columbia, and receiving 318 oral and 422 written submissions (Select Standing Committee on Agriculture and Fisheries, 2000). An axial coding process to add key words was used to analyze the transcripts. This method roughly followed the process suggested by Grounded Theory, a qualitative method

designed to help researchers systematically collect and analyze data and construct theoretical models on social phenomena (Glaser and Strauss, 1967; Corbin and Strauss, 1990). This assessment suggested that increased international trade led to a decline in the fruit and vegetable processing industry in southwestern British Columbia, causing a loss in large-scale markets for local producers and leading these producers to diversify crops as they searched for alternative markets. The people who presented at the public hearings were self-selecting and in all likelihood represented a sample of stakeholders who had some grievance about the way the government treated the agri-food sector in the province. This bias may not be as serious as it seems, however, since the standing committee heard presentations from an extremely large range of stakeholders. This included representatives of radical NGOs (''The Raging Grannies''), senior business executives from a number of grocery retailers, spokespersons from farmer groups representing all the major commodity groups (dairy, poultry, eggs, turkey, horticulture, beef, grain), food processors, health advocates, academics, and politicians.

The second step was to use industry statistics such as data on the productivity of the processing industry and its contribution to provincial GDP to confirm stakeholder perceptions that the local processing industry had indeed declined and that the volume of trade in horticultural commodities had increased over the period studied (1992–1998).

Third, quantitative statistical methods were applied in order to test the hypothesis that changes in crop diversity were related to changes in the processing industry. Crop data was used to see if the total area occupied by the four, most-planted processing crops increased or decreased between 1992 and 1997. This was to test whether the transition from government support to market forces resulted in more crop diversity. A simple and commonly used formula to determine the variance of a sample was used as a way to measure the ''relative specialization'' of processing and fresh crops grown on horticultural farms in the southwestern British Columbia between 1991 and 1998. This formula is useful because it allows changes in the diversity of crops to be tracked overtime specifically with reference to a baseline year, in this case 1991. The formula used to determine the yearly relative specialization score is as follows:[1]

$$\text{For each year, } R = \sum_{i=1}^{n} \left[\frac{(x_i - x_a)^2}{x_a} \right]$$

R = The relative specialization score for crops in an area for a given year

i = each crop grown in the region

n = total number of crops grown in southwestern British Columbia

x_i = total area planted to crop i

x_a = mean area planted to each of the n crops in each year

Results were standardized so that R = 1 in 1991, the first year data were obtained. Although this is a relatively short time period, the years studied (1990–1998) were critical as border tariffs were phased out between the early 1990s and 1998. Furthermore, it was not possible to obtain crop diversity data prior to the early 1990s (local authorities such as the British Columbia Vegetable Marketing Association did not keep data before this time). Therefore, while conclusions need to be taken cautiously, this represents a rare opportunity to observe changes in land management over a period when the economic environment changed rapidly.

Results

Step 1: Analyzing stakeholder perceptions

The transcripts showed that many of the stakeholders identified changes in the processing sector as a significant factor that affected agriculture in the region. The processing industry is important to local producers because it provides a market where farmers can sell slightly blemished crops that are not suitable for fresh sale (these ''seconds'' might represent as much as 80% of a farmers' crop). However, since British Columbia cannot produce crops year-round like California or Mexico, stakeholders asserted that the food processing industry has left the province. According to the stakeholders, global trade facilitated this process by making it easy for processors to purchase and ship commodities around the world.

The significance attributed to changes in the processing industry was measured in three ways. First, the loss of the processing industry came up in 51 separate quotes during the oral submissions to the committee (on average, each topic analyzed came up in only 21 quotes). Second, all but one of the stakeholder groups mentioned that the food processing industry in British Columbia had declined and that this had an impact on the way food was produced (the only group not to mention the processing industry were the politicians who presented to the committee). Third, although there was considerable disagreement among the stakeholder groups on many of the issues discussed (such as public responsibility for helping primary producers, the impact of major retail stores, and the best role for government), there was a general consensus on the impact of trade on the processing industry and how this affected farmers. Civil servants, farmers, academics, members of non-governmental organizations and food industry businesses (except food retailing) all argued that international trade had led to a

decline in the processing industry and that this had affected how farmers produce crops. For example, a consultant hired by the standing committee to collate and synthesize testimonies noted:

> Over the last ... 15 or 20 years [we have seen] the closure of a large number of substantial processing plants [that] has had a number of implications as far as the industry is concerned.

The Chair of one of the local Food Policy Councils reported on the impact as perceived by producers:

> One ... farmer said [to me]: "We had four canneries in this area years ago. We had fields of tomatoes and apple orchards, and now with the global economy, etc., we don't have any of that anymore." They've all closed down, because we've got, you know, the supermarkets. It's just more difficult for those types of businesses to stay in business, and they've basically shut down.

The president of the British Columbia Vegetable Marketing Association noted that changes in trade policy had precipitated an exodus of potato processors from the provinces and this had an impact on the potato acreage in the area:

> Our potato and vegetable processing industry this year, in 1999, is down at 6,500 acres. At the start of this decade it was well over 10,000. At one point, when the Free Trade Agreement was signed, it was around 15,000 acres. But since that agreement was signed, it's continued to decline.

A senior civil servant noted that the disappearance of the processing industry in British Columbia was part of a continental trend:

> Food processing is consolidating all over North America. ... This is one of the big challenges that our industry is dealing with: the fact that the people they sell their products to, their crops to, have more and more market power ... For every farmer that produces a crop, there are only two buyers.

A number of stakeholders, including at least one farmer, a local food advocate and an academic who was speaking on behalf of a group of rural geographers, argued that the food-processing sector was in decline and that this affected farm economies:

> Island farmers also need access to an environment that encourages food processing on the Island. The trend has been to close down and move plants off [Vancouver] Island. We should have our own cannery again. This would be great. We would provide employment and sell – you know, air cargo out – our canned green peas.

> Instead of focusing on the mass production of undifferentiated goods, I see B.C. farmers producing a lot more of what's called differentiated goods, especially for niche markets. So the focus is no longer on quantity but on quality, and output tends to be more diversified.

The only notable exception to this perspective was comments made by members of the large supermarket chains who stressed how their companies support local processors:

> Our ... processing plant processes and packs approximately 40 million pounds of frozen fruits and vegetables annually. Those are bought from approximately 120 local growers. We pay in excess of $50 million to that.

As a result of this analysis, it seems reasonable to conclude that the general perception of most stakeholders is that international trade has led to a reduction in the local fruit and vegetable processing industry in Southwestern British Columbia.

Step 2: Confirming stakeholder perceptions

Stakeholder concerns over the processing industry are born out by empirical evidence. Until the late 1980s, there were a number of major vegetable processors operating in the southwestern British Columbia: Nallies, Lucerne (owned by Safeway), Fraser Valley Foods, Royal City, and Snowcrest. Today, Snowcrest is the only significant vegetable processor in the region. The rest of the fruit and vegetable factories moved to other regions in North America in the early to mid 1990s, citing poor economies of scale, high capital costs, and high land prices in British Columbia (Kneen et al., 1999). Between 1984 and 1995, the contribution that food and beverage processing made to provincial GDP declined by approximately 40% in British Columbia (Agriculture and Agri-Food Canada and Department of Foreign Affairs and International Trade, 1997; Ference and Weicker Ltd, 2000). Ference and Weicker Ltd. (2000) also observed that the processing industry is smaller in British Columbia than would be expected given the size of the province's population. British Columbia has 12.7% of Canada's population yet only 7.2% of the total food and beverage processing in the country.

Taken together, stakeholder perceptions and industry statistics present a consistent picture – trade agreements have lead to changes in the fruit and vegetable processing industry, and these changes have affected the types of crops farmers can choose to plant. Based on this, it is possible to hypothesize that the effect of international trade will be different for farmers who produce crops for the fresh market as opposed to those who produced crops to be sold to the processing industry.

Step 3: Observing change in diversity

Analysis of the horticultural data showed that, over the 1990s, production of large monocultures for processing was replaced to a degree by other more diverse crops for the fresh market. First, Table 1 shows that all four of the most-planted processing crops (corn, green peas, broccoli, and potatoes) declined from a total of 15,142 hectares to 13,365 hectares in the province, while the four most-planted fresh crops showed no significant change over the same period (British Columbia Ministry of Agriculture Fisheries and Food, 1999). The processed crops were replaced by a range of vegetable crops (such as specialty salad greens), various perennial berries (such as high bush blueberry) as well as forage grasslands. Most of the specialty salad greens and berries were grown for fresh local markets (Artemis Agri-Strategy Group, 2002), the majority by organic farmers growing for affluent and discriminating urban consumers. Organic production in British Columbia has grown from virtually nothing 10 years ago to 135 registered vegetable producers with an estimated 1,340 acres in 2000 (Parsons, 2000). There has also been a significant increase in the area planted to forage legumes (such as clover) and other grasslands (often a mix of fescue and vetch) since the early 1990s. Second, the relative specialization score for processing crops declined by an average of 9.9% each year between 1990 and 1998, whereas the score for all crops declined only 3.9% each year. By contrast, the score for fresh crops was stable throughout this period (Figure 1, $P < 0.01$). Moreover, the total area of processed crops dropped from 47% to 29% of the land base while fresh crop have risen from 53% to 71% (Figure 2). Thus, much of the diversification of crops previously noted is explained by increased diversity in the processed crops alone. Evidently, farmers who grew crops for processing rather than for fresh sale diversified to a greater degree than those who relied on fresh sales.

Discussion

The paper began by establishing three opposing views on possible effects of international trade on agricultural specialization. The first was that government support programs encourage farmers only to produce crops that benefit from subsidies, price supports, or insurance (three common governmental policies), and that if these programs are removed, farmers will diversify their operations. The second view was that international trade encourages farmers to specialize only in those crops for which they have a comparative advantage, even if this results in ecologically fragile monocultures. The third position was that equilibrium models are too static and that local contextual factors will play a determining factor in farm specialization. Data presented here seem to support this third position and the changes in on-farm crop diversity in southwestern British Columbia appear to confirm the assertion that there are ''multiple equilibria'' in this economy depending on the type of farm and the farm's relationship to food processing (Hoff and Stiglitz, 2001).

For horticulture farms in southwestern British Columbia, increasing international competition has meant that fruit and vegetable-processing plants have relocated to other geographic regions. Specifically, North American fruit and vegetable processing is now centered in California, where the combination of a long growing season, technologically sophisticated producers, and a large urban market, reduce costs and guarantee a stable quantity and quality of supply (Connor and Shiek, 1997). For example, although California has just 8% of US irrigated cropland (California has roughly three million irrigated acres), it produces 50% of the American fruit, nut, and vegetable harvest (McClurg, 2000). This has allowed California to become the center of food processing for most of North America. The state dominates the North American tomato, tomato paste, and tomato sauce industry, which is the second largest processed vegetable industry on the continent after frozen potatoes. California's share of the American canned vegetable market is 45%–50%. It also has the second largest frozen fruit industry. This state is the leader in what Connor and Schiek (1997) call demand-oriented processing – industries that locate close to consumers because the final product is fragile (e.g., potato chips)

Table 1. Acres of top four crop processing crops in British Columbia 1992–1997.

	1992	1993	1994	1995	1996	1997
Potatoes	4,985	5,800	5,355	5,090	4,950	4,030
Sweet Corn	1,671	1,631	1,525	1,635	1,752	1,457
Green Peas	1,530	1,427	1,518	1,376	727	779
Broccoli	980	1,072	1,522	1,523	1,225	774
Total top four	9,166	9,930	9,920	9,624	8,654	7,040
Total of ALL crops	15,142	15,817	16,310	16,033	15,240	13,365
% of top four crops	60	62	60	60	56	52

Calculation based on British Columbia Ministry of Agriculture Fisheries and Food, 1999 and Statistics Canada, 1998.

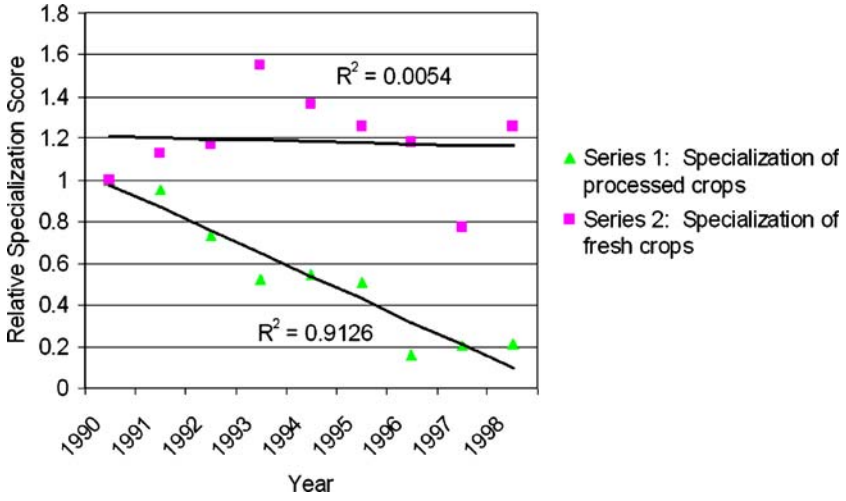

Figure 1. The relative specialization score for fresh crops and processed crops grown in southwestern British Columbia, Canada, and their linear regression over years 1990–1998. The linear regression is statistically significant ($P < 0.01$) for processed but not for fresh crops. Years with a higher score have less crop diversity. Scores are standardized so that 1990 = 1. Calculated from British Columbia Ministry of Agriculture Fisheries and Food, 1999.

– as well as supply-oriented industries like lettuce, where the major cost is obtaining the raw product.

This was not always the case. Earlier in California's history, it was a marginal grain producing region (Stoll, 1998). Between the 1880s, when fields were first cultivated, and 1927, California fruit producers were able to corner 67% of the US canned fruit market. The reasons for this explosion are varied but include its excellent year-round climate, abundant ground water for irrigation, and near-by affluent urban population. Farmers in California also have a long tradition of working together, having developed standardized packaging and grading systems early in the twentieth century (Stoll, 1998). Developments after World War II facilitated this process,

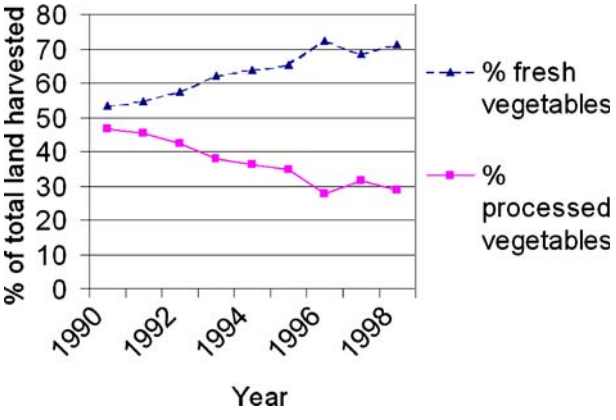

Figure 2. Percentage of the total harvested area used for fresh or processed vegetables in British Columbia. Calculated from British Columbia Ministry of Agriculture Fisheries and Food, 1999.

when consumer demand for fresh produce, better storage and refrigeration technology, and global trade reinforced an integrated network of agri-food companies to deliver fresh food to economically privileged consumers (Friedland, 1994).

According to Agriculture and Agri-food Canada (1998), changes in food processing reflect a larger reorganization in the industry, one that followed the implementation of the US Canada Free Trade Agreement. This reorganization has resulted in fewer factories in marginal areas like British Columbia and increased production in central areas such as California (Ibid).

This is consistent with a model put forward by Connor and Schiek (1997) that divides food processing factories into three categories: (1) demand oriented processors that locate close to customers because product delivery costs are a high proportion of total costs (this could be because products are perishable or easily damaged); (2) supply oriented industries that locate close to producers because their major costs are inputs that are expensive to transport (e.g., fresh seafood and sugar beets easily spoil before processing); and (3) "footloose" processors that use a wide variety of edible inputs and need expensive packaging. These factories will move wherever they can establish themselves at the lowest cost and tend to congregate in the same region in order to lower shared infrastructure costs (Connor and Schiek, 1997). According to Connor and Schiek, fruit and vegetable canning and freezing are examples of "footloose" industries since a single cannery or freezing factory may process a large number of commodities and because the manufacture of cans represent a relatively high proportion of the production costs (Winson, 1992). Since

southwestern British Columbia did not have a sufficient concentration of food processors to begin with, once trade barriers were removed, it made economic sense for the few remaining fruit and vegetable processors to move to California, where the infrastructure was already developed to process these commodities for a continental market. This conclusion has a number of important implications.

First, although trade liberalization is a widespread policy goal, the impacts of trade may be indirect and site specific. Therefore, it may be misleading to assume that the benefits of international trade will inevitably follow the signing of trade agreements.

A second important point is raised by the expansion of grasslands from roughly 30% to 36% of the land base in the area studied. This shift was caused partly by a program run by a local conservation group that pays farmers to turn fields into grasslands to increase raptor habitat. Funded by a number of public and private sources, the Delta Farmland and Wildlife Trust (DFWT) pays farmers to establish a mix of native grasses and clover for one to 5 years. Farmers are paid $150/acre/year if they chose to cut the grass for hay or $300/acre/year if they leave the grass in the field. This gives farmers an "...opportunity to improve soil structure and organic matter, while simultaneously providing habitat for wildlife" (Delta Farmland and Wildlife Trust, 2000). However, the amounts paid to farmers are far below what they could expect if they were growing vegetables for sale (standard figures suggest that an acre of sweet corn netted farmers about $2,700 (CAD)/acre in the late 1990s). Therefore, part of the DFWT's success in convincing farmers to devote fields to environmentally beneficial grassland is that the loss of the processing industry has taken away the market for higher-value crops.

Finally, the evidence presented here hints at the fact that changes in crop management may have resulted in some environmental improvements. First, the increase in grasslands definitely provides environmental benefits. Second, the switch from a horticultural industry based on producting four processed vegetables to one based on fresh produce may have two environmental benefits. First, crop rotation is extremely important, especially for potatoes where pests can quickly build up over time to epidemic levels (Scholte, 1992; Umaerus, 1992). The reduction in the land devoted to crops like potatoes (which is still the most widely planted annual in the region) implies that farmers are using more diverse crop rotations than in the past. Second, these changes seem to have gone hand in hand with increases in the province's organic sector, and the evidence suggests that as farmers lost traditional conventional markets they were forced to innovate. Marketing directly to environmentally conscious urban consumers seems to have been one such response. Finally, while international trade affects crop diversity generally, there also may be significant environmental implications that are not linked to specific crops. For example, the literature dealing with agriculture's affects on the environment is nearly unanimous in its condemnation of monocultures. Specializing in only one crop is seen to undermine genetic diversity, makes fields susceptible to pest outbreaks and requires energy-intensive and polluting inputs. Agricultural systems with rich crop diversity are supposed to be better able to withstand ecological disturbances than simple ones (Altieri, 1999). Diversity is also one way of reducing the negative externalities associated with conventional farming. Therefore, if competitive trade influences on-farm specialization, it may have significant environmental impacts. (Paoletti et al., 1992; Stinner et al., 1997; Figge, 2002).

Conclusion

The purpose of this research was to provide a locally grounded and empirical assessment of the theoretical debate on the effect of trade deregularization on crop diversity in a specific agricultural region. A number of key points emerge from this analysis. First, the effect of international trade was principally manifest in this region through a loss in the processing industry, which caused farmers to lose their traditional markets for processed vegetables. This forced farmers to innovate with new markets including organic production. The loss of valuable vegetable markets also made a local conservation initiative that paid farmers a small amount to plant environmentally beneficial grasslands economically attractive.

Therefore, instead of postulating general effects of trade liberalization, this paper suggests that theories on the effect of trade may be too prescriptive. Rather, scholars of international trade need to understand how context-specific variables mediate the effect of economic globalization. Although making specific policy recommendations are beyond the scope of this paper, it is clear that policy makers must not assume any single or particular effect(s) of large-scale economic forces like trade liberalization but seek to understand the mechanisms whereby these forces are manifest in different localities.

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Notes

1. Statistical variance is a relatively simple way of assessing how much variation exists in a sample. It is useful to measure crop diversity because it provides results where higher numbers indicate years during which the crops were more specialized. This formula also distinguishes between cases in which the same numbers of crops are differently distributed. For example, if on one farm four crops each occupies 2 hectares, the variance or ''relative specialization score'' would return a value of 12.25. If, however, one crop occupied 5 hectares while the other three only were on 1 hectare each, the relatively specialization score would be 21, indicating a more specialized landscape and less crop diversity.

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