Trade, Agriculture, and Climate Change: How Agricultural Trade Policies Fuel Climate Change

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EXECUTIVE SUMMARY

Many governments have grudgingly come to accept, at least rhetorically, the imperatives of averting global warming. They have undertaken to stabilize greenhouse gas emissions at levels that will require substantial reductions in many developed countries. Simultaneously however, these same governments have embraced agricultural trade policies that will substantially increase the energy demands of global agricultural production and distribution systems, making it far more difficult to achieve climate change goals. This fundamental contradiction is a testament to our failure to seriously integrate environmental and economic policy.

Moreover, the enormous and increasing energy demands of global systems of agricultural production and trade are inadequately accounted for. When all of the energy demands of these systems are aggregated, agriculture is likely to emerge as the single largest source of global greenhouse gas emissions, and by a substantial margin. Thus the globalization of agricultural systems over recent decades is likely to have been one of the most important causes of overall increases in greenhouse gas emissions.

The principal mechanisms for promoting and consolidating this global model can be found in the provisions of international trade agreements that deal specifically with agriculture, such as the WTO Agreement on Agriculture. Therefore, if current energy trends are to be reversed and greenhouse gas emissions reduced, agricultural trade policies and trade rules will have to be fundamentally reconceived to reduce the energy demands of every aspect of our contemporary food systems.

Introduction

In the fall of 1999, many countries sent delegates to the Conference of the Parties, part of ongoing negotiations under the Framework to the Climate Change Convention. As most will know, the course of international climate change negotiations has been difficult and largely unproductive. Since the solemn commitments made by many nations earlier in this decade to substantially reduce greenhouse gases, emissions from those countries have actually increased, and often by double digits. One of the most important causes has been the globalization of the food production and distribution systems. Yet the impacts of agricultural production and trade systems on climate change are almost as obscure to climate change negotiators as global warming is to those responsible for international agricultural trade agreements.

Over the next several years, the World Trade Organization (WTO) is undertaking major trade negotiations, including a review of the Agreement on Agriculture. Unfortunately the impacts of these trade negotiations on climate change will not be on the WTO's agenda, and those crafting international agricultural trade rules are very likely to be oblivious to the impact of their work on global warming.

The purpose of this assessment is to expose the ways in which current agricultural trade policies contribute to rising greenhouse gas emissions by substantially increasing the energy intensity of food production, processing, packaging and distribution systems. Furthermore, because international trade policies reshape the basic infrastructure of agricultural production and distribution systems, their adverse impacts on greenhouse gas emissions will endure for decades.

International Trade and Agriculture

When representatives of the more than 130 member nations of the World Trade Organization gathered in Seattle in November 1999, agriculture was a critical and highly contentious part of their agenda. In fact there is probably no other issue that has played a more pivotal role in determining the fate of international trade negotiations. Moreover, since the advent of the WTO five years ago, the new rules for agricultural trade established at that time set the stage for a number of extremely controversial trade disputes that have undermined food safety regulations in Europe, cast a long shadow over the future of the entire agricultural economies of several developing countries, and even threatened the biodiversity of marine ecosystems.[i]

Of greatest concern currently is the further consolidation of agricultural globalization that will perpetuate the dominion of the handful of transnational agribusiness corporations that are its principle architects. The role of international trade agreements in promoting the globalization of agricultural production and distribution systems is multi-faceted and engenders several aspects of international trade policies and disciplines. In simple terms, the multifaceted dynamics of trade policy can be seen essentially as a double-edged sword cutting away all impediments to the globalization model. On the one hand, international trade rules have failed to impose any real constraint on the agricultural policies of wealthy nations that have actively promoted globalization of food production and trade. At the same time, trade disciplines have been imposed on poorer countries to frustrate the development of self-reliant agricultural policies designed to meet food security needs rather than the dictates of export markets. We will consider each of these two themes in turn.

Agribusiness and Globalization

For several decades now, the global agricultural production model has been driven by US farm policies, and by the large agribusiness corporations that have been the major beneficiaries of those policies as they sought to secure the largest share of global markets. To achieve this goal, two primary strategies have been adopted. The first is to keep international markets flooded with cheap agricultural commodities that are often priced well below the cost of production. This has required substantial farm subsidy programs in the US, as well as in other countries that wish to compete with the US for export markets. The result of this competition among heavily subsidized producers has been enormous surpluses that are then dumped onto international markets.

While many poor countries have occasionally benefited from this abundance, they have had to abandon any prospects of establishing their own agricultural economies in the bargain, and many have become almost entirely dependent upon a continuing flow of subsidized grains and other food from the world's few exporters. In this vulnerable condition, supply disruptions, unstable currency rates and wild swings in agricultural commodity prices have often meant widespread hunger and even starvation.

The other strategy that the US has used to achieve market dominance is to challenge other countries' attempts to pursue policies of self-reliance in agricultural production that might close markets to US exports. A primary target of these efforts has been supply management systems (such as Canada's) that have successfully moderated the impact of fluctuating commodity prices for decades, in part by restricting US access to domestic markets.

In large measure these US strategies have succeeded in garnering for US-based agribusiness corporations the position of dominant players in global food markets. For example, in 1998, US exports

accounted for 25% of the wheat traded globally, 56% of the corn, 54% of the soybeans, 11% of the rice and 29% of the cotton.[ii] Moreover, in many cases only a handful of US corporations accounts for this global dominance. For example, Cargill's recent acquisition of Continental's grain division means that three companies control nearly 60% of US grain port facilities.[iii]

The WTO Agreement on Agriculture

For much of the past 50 years, the globalization of agricultural production and trade proceeded without subjecting agriculture to the disciplines of international trade rules, and agricultural policies and programs were specifically exempt under the General Agreement on Tariffs and Trade (GATT). This situation reflected the interests of many countries that wished to keep their domestic policies free from GATT oversight, not the least among these being those countries that provided domestic producers with massive subsidies to underwrite domestic production and export dumping—practices that are clearly at odds with GATT rules. Furthermore, for poorer countries, the imposition of export driven agricultural policies was accomplished through structural adjustment programs, which effectively denied those countries the opportunity to develop self-reliant agricultural policies that GATT would otherwise have allowed.

However, as agricultural subsidies continued to escalate in the war to secure export markets, they began to represent a serious drain on public finances of food exporting nations. Determined to extricate themselves from this ascending spiral, the US in 1986 seized on international trade negotiations as the opportunity to resolve the subsidies imbroglio by finding other ways to consolidate globalization goals without having to underwrite them with massive public funding. That objective was largely accomplished with the creation of the World Trade Organization in 1995, the removal of exemptions from GATT rules for agriculture, and the negotiation of an international trade Agreement on Agriculture.

Thus, any opportunity for nations to develop their own domestic agricultural policies were further undermined by global trade rules that required compliance by all governments on pain of trade sanction. No longer could governments use quantitative import or export controls to support local farm economies, implement supply management systems, further food security objectives, or increase self-reliance in agricultural production. Moreover, the limited opportunities available to use import and export tariffs to control the international flow of agricultural commodities were of little value to developing countries in a world of fluctuating currency and commodity values.

Other WTO agreements dealing with food safety regulation and intellectual property rights further consolidated the globalization paradigm by removing the opportunity to regulate biotechnology, protect biodiversity in agricultural production, or even promote consumer awareness about agricultural products.

The combined result of these trade rules and agreements was to embed the free trade vision of an integrated global agricultural economy in an extremely powerful enforcement regime aimed at ensuring compliance by all member governments. As nations gathered in Seattle in late 1999, agriculture was a central issue. In the wake of serious agricultural trade disputes among several WTO members, agricultural negotiations were contentious, but the impact of agricultural trade rules on climate change was not one of the controversies.

Furthermore, environmental groups did not make the case for addressing these implications. Their overwhelming preoccupation was with the impacts of WTO rules on environmental standards and regulations. The environmental impacts associated with the structures and systems of globalization have not yet penetrated the debates about trade and environment, such as that taking place under the auspices of the WTO Committee on Trade and the Environment.

International trade institutions are notoriously indifferent to trade regime impact on non-commercial policy objectives. It isn't surprising, therefore, that the causal relationship between agricultural trade and climate change would be obscured in that context. More difficult to understand, however, is that those working to confront climate change seem unconcerned about the fact that international trade policies are putting the goals they are working to achieve much further out of reach. Part of the explanation lies in the failure of climate change institutions to recognize the validity of their own proscriptions calling for the integration of environmental and economic policies.[iv] Governments have simply ignored the obligation to consider the impact of economic and industrial policies on their ability to meet climate change goals.

But another important factor appears simply to be methodological. When information about agriculture and climate change is presented, the most important relationships—those that reveal the food system's true energy demands when processing, packaging, and distribution are added to production—are ignored. Rather, information about energy and greenhouse gas emissions is presented in ways that obscure the important structural relationships that underlie seemingly unrelated statistics.

When considered in aggregate, agriculture arguably contributes more to climate change than any other single sector of the world's economy. While a growing world population plays an important role, two other factors account for agriculture's enormous and growing energy appetite. First, agricultural industrialization has displaced human and animal energy inputs with electricity and fossil fuels. Much of the productivity gains claimed by modern industrial agricultural systems are illusory when productivity is measured against all energy inputs. In fact, industrial agricultural systems are less energy efficient than the indigenous models they have displaced.

Second, globalization is substantially increasing agriculture's energy demands. According to the free trade vision of an integrated global agricultural economy, every region of the world would become a producer of specialized agricultural commodities, supplying its own needs by shopping in the global marketplace. Food is grown not by farmers for local consumers, but by large corporations for global markets. As local production and supply systems are displaced by regional and international ones, agricultural commodities need to be transported over increasingly longer distances, and must be processed and packaged to survive the journey. The thrust of present agricultural trade policies, such as those engendered in the WTO Agreement on Agriculture, is to consolidate and extend these global systems of agricultural production and trade.

There is an urgent need to recognize and address the fundamental contradictions between policies needed to combat climate change and agricultural trade policies. This paper has been written to encourage those involved in both international trade and climate change negotiations to recognize the imperative of reconciling two agendas that are clearly on a collision course.

Before proceeding we should add one note of caution. The absence of any reliable data makes predictions about the overall contribution of agriculture to climate change a matter of considerable speculation. In citing the various available statistics, we hope to provoke a more thorough assessment of these issues. The data presented underscores the need for a much more thorough assessment of these critical relationships, not to offer proof of our thesis.

The Contribution of Agricultural Production, Processing, Packaging and Distribution Systems to Overall Greenhouse Gas Emissions

Table 1 provides a breakdown of greenhouse gas emissions from various sources. While the data is specific to Canada, it is typical of the way in which information about greenhouse gas emissions is compiled. The contributions of agriculture represent about 3.4 percent of total carbon dioxide emissions. Presented in this way, agriculture's contributions to climate change seem relatively unimportant and fail to attract attention.

Table 1: Canadian Sectoral Energy Distribution and Associated Carbon Dioxide Emissions in 1996[v]

SECTORS	Energy Use (petajoules)	Carbon Dioxide Emissions (megatonnes)
Residential	1453	71.2
Commercial	1000	51.6
Industrial	2926	138.8
Transportation	2029	139.9
Passenger	1317	89.8
Freight	651	45.6
Off Road	64	4.4
Agriculture	224	14.3
Total	7632	415.9

Other sources of information about agriculture and greenhouse gas emissions are somewhat more revealing. Table 2, for example, provides a somewhat more inclusive picture by also providing data about food processing and beverages. But even these figures ignore the substantial contributions associated with other elements of agricultural systems. Lamentably, we have been unable to find any source that attempts to account for all of the greenhouse gas emissions properly allocated to agricultural production and distribution systems.

Table 2: Canadian Greenhouse gas emissions by sector, 1985[vi]

Sector	CO_2 kilotonnes	CO_2 equiv., kilotonnes	CO_2 rank out of 50 sectors	CO_2 equiv. rank out of 50 sectors	% of CO_2 equiv. from 50 sectors
Electric power & utilities	84540	85300	1	1	26%
Transport industry	33713	34784	2	2	11%
Primary metals	24492	25060	3	3	8%
Agriculture	9526	24663	8	4	9%
Food processing	4773	4816	15	16	
Beverages	1054	1064	30	30	
Remaining 44 sectors	132083	147906			46%

But while it is impossible to find any comprehensive account of these inputs, the data that is available strongly suggest that agricultural systems are the single largest source of global greenhouse gas emissions. Moreover, when information about trends is considered, increases in the energy demands of the agricultural sector appear to offer the best explanation for why increases in greenhouse gas emissions have been growing so rapidly.

Industrial Agricultural Production

It is important to begin with as comprehensive an account as possible of all of the inputs properly attributable to agriculture. The tools with which we have transformed the modern farming industry—heavy machinery, monocultures, biotechnology and chemicals—have caused considerable damage to soil fertility, water quality, public health and viable farm economies. More to the point for our present purposes however, the industrial agricultural model has made the productivity of farmland ever more dependent upon massive infusions of energy to produce and operate farm machinery, produce petrochemical-based fertilizers and pesticides, and transport feed, water, and manure to and from enormous livestock feedlots. Estimates are that we expend more than ten times as much energy to produce food as we actually derive from consuming it.[vii]

While the numbers are somewhat out of date, the following table is illustrative of the significant energy demands associated with fertilizer production, which—next to the fuel and electricity used in production—represents the second largest energy demand of agricultural production. Notably, some fertilizers are also particularly potent greenhouse gases. Yet these inputs are typically excluded from calculations of the sector's energy demands.

Table 3: Gross Estimates of Annual Energy Use in Agriculture[viii]

Source	Year	Equiv. Motor Fuel-Gallons		Gal. Gas per US Indiv.	BTU Equivalent*	
FARM IMPLEMENTS						
Operation	1965	7	billion	35.0	940	trillion
Production of		800	million	4.0	108	trillion
FARM CHEMICALS						
Production, fertilizers	1969	6	billion	30.0	800	trillion
Production and processing, petrochemicals		360	million	1.8	48	trillion
FARM ELECTRICITY						
Consumed	1970	370	million	1.9	50	trillion
For production of		1.1	billion	5.6	150	trillion
FOOD PROCESSING		7.4	billion	37.2	1,000	trillion
		23.03	billion	115.5	3,096	trillion**
TOTAL US ENERGY CONSUMPTION	1970				64,000	trillion

*Total does not include energy used by food transportation or support industries of power plants and farm-equipment plants.
**135,000 BTU/gal.

Significant as these estimates are, they still overlook the largest energy demands associated with industrial agriculture—the packaging, transportation and marketing of agricultural products. When these inputs are included, the input/output equation becomes even more lopsided. As the following data for some agricultural products reveals, we use enormous quantities of energy to produce very modest quantities of food energy.

Food processing, packaging and preparation.

Taken from David and Marcia Pimentel's excellent work on the subject, the following two tables identify the energy inputs needed to produce, process, package, and transport a can of corn (455 grams) and 140 grams of beef, respectively. In the case of the former, the input/output ratio is roughly 9:1. But this seems modest compared to energy required to bring a quarter pound hamburger to the dinner table, which exceeds the food value of that hamburger by a factor of 35:1.

Figure 1: Energy Inputs for a 455 g (375 kcal) of sweet corn[ix]

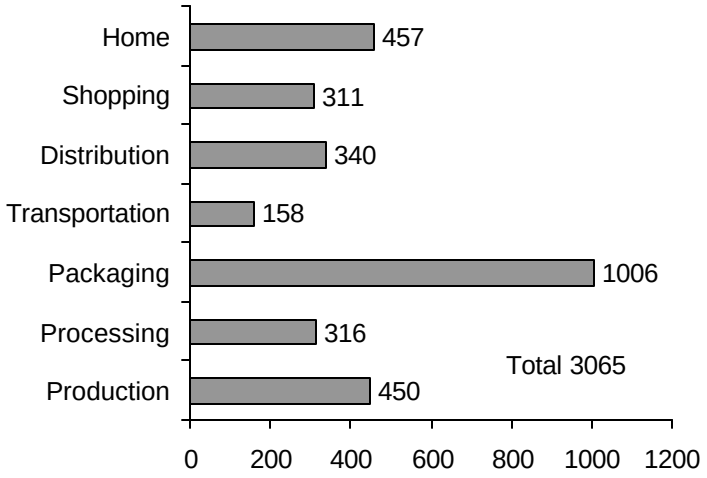
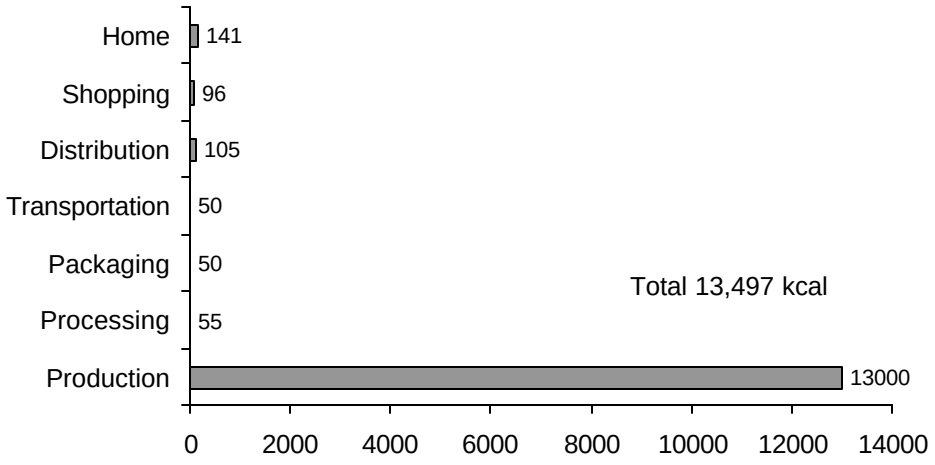


Figure 2: Energy inputs to supply 140 g of beef (375 kcal) to the table[x]



Judging from the data in the following table, the energy equation for various foods differs considerably. The same is true even for the same food product when different packaging or processing choices are made. For example, the energy required to freeze a kilogram of corn is more than 300% greater than that required to can it. This means that for frozen corn, we are using two and half times its energy food value just for processing.

Table 4: Energy inputs for processing various products[xi]

Product	Kcal/kg	Remarks
Fruit and vegetables (canned)	575	
Fruit and vegetables (frozen)	1,815	
Flour	484	Includes blending of flour
Baked goods	1,485	
Breakfast cereals	15,675	
Meat	1,206	
Milk	354	
Dehydrated foods	3,542	
Fish (frozen)	1,815	
Ice cream	880	
Chocolate	18,591	
Coffee	18,948	Instant coffee
Soft drinks	1,425	Per liter

Unfortunately, the information available about the energy demands of food processing, packaging and preparation is anecdotal and, as noted above, we can find no source that attempts to aggregate this data for particular or global food systems. The systems are complex, and the input/output equation changes dramatically with choices about processing and packaging options. The question we must answer is this: if climate change imperatives dictate that we reduce the energy intensity of these systems, what types of food systems are necessary to reduce the need for food processing and packaging? We will return to this question after considering another major energy demand of agriculture—transportation.

Transportation

Food transportation systems are complex, and the food on our table often arrives after taking a lengthy and often circuitous journey—from primary producer, to processing and packaging factories, to regional and then local distribution centers, to retailers, and then home. At times the input/output equation seems absurd. For example, it takes 36 times more energy to move a head of lettuce from California to New York than it contains—1800 kilocalories versus 50 kilocalories. When fresh strawberries are flown to New York in the early spring, the input/output equation is actually 87:1.[xii]

As the 'strawberry equation' indicates, energy transportation demands vary considerably with the particular mode of transportation. For example, shipping can demand as little as 10% of the energy required by trucking. According to data compiled in 1982 for the US, the average distance that goods moved from producer to consumer was 1,000 kilometers.[xiii] Given the mix of transportation modes then in operation, this required approximately 640 kilocalories per kilogram—that is roughly 0.60 kilocalories per kilogram per kilometer. We know that since 1982, agricultural production systems have been transformed. Regional and global production and distribution systems have displaced local ones. This transition has obviously increased the energy demands of moving inputs to the farm, as well as outputs from it. Unfortunately, we were unable to find any comparative estimates of the average distances now traveled by these same agricultural commodities.

The data available to those working to address climate change frustratingly obscures the underlying and structural relationships that are fueling the increasing energy demands of so many countries. Energy/CO_2 estimates are provided for commercial transportation and industrial processing, but no effort is made to disaggregate that data to identify the portion attributable to moving, packaging and processing agricultural commodities. By casting a wider net, researchers capture information that produces a much different picture of the underlying causes of global warming.

For example, researchers in the UK estimated the total energy demands of UK food-related industries as a percentage of total UK energy use—28%. The study is more than 20 years old and predates a great deal of centralization that has occurred since that time. Clearly the substantially greater distances associated with North American food systems would mean that the relative proportion of energy consumed there by the agricultural sector would be even greater than this 28% estimate.[xiv]

For present purposes, if we accept this estimate as roughly accurate, agricultural production and distribution systems emerge as the single largest sectoral input to greenhouse gas emissions. Table 2 allocates roughly 9% of Canadian greenhouse gas emissions to agriculture, food processing and beverages. Other agriculturally related energy inputs are undifferentiated and represented under the headings of electric power and utilities, transport industries, and primary metals.

If the contributions of these sectors are reassigned to account for the relative proportion needed to manufacture farm machinery, transport trailers, railcars, and industrial boilers used for food processing, a very different picture of greenhouse gas emission sources soon emerges. When the

energy demands of packaging and transportation are also included, food production and distribution systems represent the largest source of greenhouse gas emissions in Canada—and by a substantial margin.

This picture is certainly worrying for several reasons. To begin with, in the process of modernizing agricultural production, we have actually tied the future of what should be a renewable resource, farmland, to a non-renewable resource, fossil fuels. But it is the increasing energy demands of global agricultural systems that is particularly problematic given the imperatives for reducing greenhouse gas emissions.

For example, according to a relatively recent estimate by Natural Resources Canada (Table 5), agricultural energy use increased by 9.3% between 1990 and 1996 with CO_2 emissions growing by 8% during this same period. Unfortunately, this estimate only considers on-farm energy use. Furthermore, the energy demands of agricultural production appear to be growing relative to other commercial energy demands. According to the *Handbook of Energy for World Agriculture*, commercial energy used for agricultural production as a percentage of total commercial energy grew by over 12% from 1972 to 1982 in developed countries. For developing countries, the increase was approximately 30% for this same period, probably driven by the first "green revolution," which brought industrial and energy intensive agricultural production systems to many third world countries.[xv]

Table 5: Sectoral Activity, Energy Use and Carbon Dioxide Emissions Growth, 1990-1996 (percent)[xvi]

SECTORS	Energy Use	Carbon Dioxide Emissions
Residential	12.3	12.0
Commercial	12.0	4.9
Industrial	11.8	5.6
Transportation	10.2	10.2
Passenger	9.8	9.8
Freight	11.0	11.0
Agriculture	9.3	8.0

Conclusion

If the energy requirements of agriculture are to be substantially reduced to combat climate change, it seems clear that a wholesale revision of current agricultural policies is needed to reverse present trends. Every aspect of the current industrial model must be examined. Key priorities include reducing energy inputs to transportation, processing and packaging, which together represent the largest portion of agriculture's enormous and growing energy appetite.

It seems undeniable that to achieve this goal, the distance between producer and consumer must be radically shortened to reduce the energy demands of transportation, as well as to eliminate much of the need for processing and packaging. This will mean re-establishing the local production and distribution systems that have only recently been dismantled in the cause of

globalization. It will mean diversifying agricultural economies to meet the needs of local communities, rather than international markets. It will also mean producing food rather than agricultural commodities. Finally, it will mean local self-reliance rather than global inter-dependence.

It is inconceivable that this transformation will occur as a result of environmental measures that are developed as an afterthought to the restructuring of the world's agricultural production and trade systems. Rather, we must find a way to encourage those engaged in combating global warming to look behind the symptoms of increasing greenhouse gas emissions to identify the underlying and structural factors that are fueling these trends. At the same time, we must persuade the authors of contemporary agricultural policy to recognize the collision course they have set with climate change imperatives. While it has become common for governments to pay lip service to the notion of integrating economic and environmental policy, examples of governments actually attempting to act on this commitment are very rare.

There is probably no other element of the Climate Change Convention that has been more studiously ignored than the invocation for all governments to:

> *take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects [Art 3 Principles 3 . . .] and to take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions . . .[Art 4 (f)] all in an effort to return by the end of the present decade to earlier levels of anthropogenic emissions of carbon dioxide and other greenhouse gases . . . [Art.4 2(a)]*

The failure of governments to live up to these commitments is nowhere more apparent than in the arena of trade policy given that the principle devices for promoting and consolidating the globalization of agricultural systems are the agriculture sections of international trade agreements negotiated by the very countries purporting to act on climate change. Needless to say, no assessment of the impact of these trade rules in accordance with the direction of Article 4(f) of the Climate Change Convention has ever been carried out.

This paper was written to stimulate awareness about the critical inter-relationships that exist between international agricultural trade policies and global warming. The evidence, while largely anecdotal, strongly supports the urgent need for a comprehensive and thorough assessment of the complex inter-relationships between agricultural trade and the environment. It is critical that this be accomplished before further steps are taken down a path that appears to be headed for an ecological dead-end.

About the Author

This report was prepared by Steven Shrybman, Executive Director of the West Coast Environmental Law Association and Member of the Board of Directors at the Institute for Agriculture and Trade Policy. Mr. Shrybman is the author of a study on the impact of the WTO on environmental issues carried out for the Common Front on the WTO, a coalition of unions,

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About the Institute for Agriculture and Trade Policy

The Institute for Agriculture and Trade Policy (IATP) was established in 1986 as an independent non-profit and tax-exempt research, education and advocacy organization. The Institute for Agriculture and Trade Policy promotes resilient family farms, rural communities and ecosystems around the world through research and education, science and technology, and advocacy.

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