ELSEVIER

Agricultural Economics 23 (2000) 231–240

AGRICULTURAL ECONOMICS

www.elsevier.com/locate/agecon

Food safety issues and fresh food product exports from LDCs

Laurian J. Unnevehr*

Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, 323 Mumford Hall, 1301 W. Gregory Drive, Urbana, IL 61801, USA

Abstract

Fresh food products have a high income elasticity of demand and few traditional trade barriers in high income markets. As such, they represent an important opportunity for less developed country (LDC) exporters. Fresh food product exports account for half of all food and agricultural exports from LDCs to high income countries. But these products may be subject to greater food safety risks and potential trade barriers arising from sanitary regulation. This paper reviews the challenges and issues facing LDCs in meeting food safety standards for export. These issues include: (a) the importance of fresh food product trade by region and the kinds of issues that arise from those products; (b) the role of farm to table approaches and hazard analysis critical control points (HACCP) in ensuring safety; (c) the role of the public sector in LDCs in facilitating trade; (d) the potential role of the SPS Agreement in resolving disputes and determining equivalency of standards between high and low income countries.

JEL classification: F1; O1; Q1

Keywords: Food safety; Food trade; HACCP; Less developed countries

1. Introduction

Food safety issues are becoming more important in international trade (WHO, 1998). Trade in processed and fresh food products is growing relative to trade in bulk grains, and many of these products require greater care to prevent food safety hazards. Traditional trade protection has been reduced by the 1994 GATT agreement, which means that sanitary and phytosanitary (SPS) measures assume greater importance in determining market access. Consumers in high income countries have become more aware of food safety risks and demand greater guarantees regarding product handling. At the same time, many developed countries (DCs) are modifying their food safety regulations to emphasize process control and prevention of risks throughout the production process. Taken together, these trends mean that meeting food safety standards is a challenge for food product exporters.

The less developed countries (LDCs) were predicted to benefit as a group from the 1994 GATT agreement on agriculture (Tyers and Anderson, 1992). Many developing countries have seen substantial growth in non-traditional agricultural exports of specialty food products, such as fruits, vegetables, seafood, and meats. This paper discusses the reasons why fresh food products have greater potential for food safety risks and for encountering sanitary trade barriers. LDCs need to overcome such barriers and develop the capability to guarantee the safety of food product exports, in order to fully realize gains from trade in non-traditional agricultural markets.

* Tel.: +1-217-333-3049; fax: +1-217-333-5538.
E-mail address: laurian@uiuc.edu (L.J. Unnevehr).

0169-5150/00/$ – see front matter
PII: S0169-5150(00)00095-5

This paper explores the private and public actions required to address food safety risks in fresh food product exports from LDCs. First, the export trends for fresh food products in different developing regions are discussed. Next, the growing need for farm to table management of safety and quality is outlined, and the resulting public and private actions needed to guarantee safety. Finally, the potential of the SPS Agreement under the WTO to mitigate trade barriers for LDCs is explored.

2. Fresh food product exports from LDCs

Fresh food products, which include exports of fresh meat, seafood, vegetables, and fruits, account for half of the value of total food and agricultural exports from all LDCs. In DCs, these fresh food products have a high income elasticity of demand, and in many cases have not been protected by traditional agricultural trade barriers. Trade in these products has been expanding rapidly in high income markets, and the fresh product share of agricultural trade has increased in many developing regions (Thrupp, 1995).

Fresh food product trade patterns vary between developing regions and high income markets (Table 1). These regional data show that relatively developed regions have a greater volume of exports. The Latin America/Caribbean (LAC) and East Asia (EA) regions are major participants in world food markets and have well developed market channels. They have much greater product and export market diversification than the other regions. The regions with the greatest number of low income countries, Sub-Saharan Africa (SSA) and South Asia (SA), have exports that are more concentrated in particular products. Fish and seafood trade is particularly important for low income countries in these two regions. In SSA and the North Africa/Middle East (NA/ME), exports are concentrated in one market, the European Union (EU). All regions have at least one fresh product category that has experienced major growth during the 1993–1996 time period.

These patterns suggest the kind of issues that will be important for export market development and for food safety issues in trade. Export market development and diversification are important for low income countries. Continued export market access will be important for the middle income regions. Exporters in all regions need to know how to meet standards in different markets and how to meet the increasing demand for certification of production methods, as discussed below.

3. Food safety issues for fresh food product exports from LDCs

Food safety issues are more likely to be a concern in fresh food product trade than in other kinds of agricultural product trade. First, fresh products are shipped and consumed in fresh form, so handling at all points of the food chain can influence food safety and quality (Zepp et al., 1998). Manufactured or processed food products have more widely established and recognized standards, and may not deteriorate during shipping and handling. Second, standards in DC markets are based on sanitation and good manufacturing practices (GMPs) that may not exist in LDCs. Meeting such standards may require greater initial investments in quality control and sanitation in LDCs. Third, these fresh commodities are subject to increasing scrutiny and regulation in DCs as food safety hazards are better understood and more often traced to their sources. These factors suggest that meeting food safety standards may be a potential barrier to the development of fresh product exports from LDCs.

There are many different kinds of food safety hazards and their importance varies among products. Pesticide residues and microbial contamination are important hazards in fruits and vegetables. Microbial contamination, drug residues, parasites, and zoonotic diseases are issues for meat, poultry, fish, and seafood products. Mycotoxins can occur on certain plant products, and can enter animal products through the use of contaminated feeds. Adulterants are an issue for all food products. Any of these potential hazards can enter food production in either LDCs or DCs; but the risks may differ with climate, infrastructure, and methods of production and consumption.

The US food and drug administration (FDA) detention lists provide some evidence of the importance of SPS measures for LDC fresh product exports. These lists report imports detained for food safety or other technical violations. According to FAO, the US is the only country to make such lists public. The number of FDA detentions by product category for January–May

Table 1
Fresh food exports from developing regions to developed economies (value $1000)[a]

	1993	1994	1995	1996
Exports from SA to developed economies				
Meat	504	965	6222	3817
Fish	984095	1214089	1123923	1157923
Fruit	323382	353033	274545	340258
Vegetable	23552	34051	24802	30977
Total fresh	1331533	1602138	1429491	1532974
Total agriculture	2094279	2469333	2287299	2562064
Fresh exports by major market				
EEC-15	481648	544313	574765	568303
North America	345137	424455	330792	362774
Japan	508098	633836	535245	604796
Exports from EA to developed economies				
Meat	1752037	2170337	2639954	2831774
Fish	6180589	7115800	7592834	6667049
Fruit	571430	615255	571558	612534
Vegetable	1605678	1589068	1527853	1544418
Total fresh	10109734	11490461	12332199	11655776
Total agriculture	18494321	21440411	22031115	22267938
Fresh exports by major market				
EEC-15	1517342	1470719	1464765	1462797
North America	1457232	1616943	1485218	1412336
Japan	7003648	8242600	9225633	8647537
Exports from SSA to developed economies				
Meat	12549	8736	15853	10037
Fish	112585	157141	133433	156030
Fruit	21568	27274	116579	111158
Vegetable	42073	41026	75771	64499
Total fresh	188775	234176	341636	341723
Total agriculture	1361578	1492708	2105600	1835620
Fresh exports by major market				
EEC-15	176682	185692	289899	296547
North America	1563	4400	15217	16847
Japan	17393	49583	46648	39818
Exports from NA/ME to developed economies				
Meat	44490	45835	35782	35182
Fish	516072	581761	710083	688893
Fruit	879260	925457	1177424	1121315
Vegetable	429602	445244	591927	594037
Total fresh	1869424	1998296	2515215	2439427
Total agriculture	3243083	3573807	4210471	4158497
Fresh exports by major market				
EEC-15	1528169	1595445	2007326	1965509
North America	56089	52648	73739	70083
Japan	264692	326421	432279	390350
Exports from LAC to developed economies				
Meat	1142602	1307052	1352711	1362555
Fish	2646678	2980390	3559856	3628820
Fruit	3574368	3695311	4093304	4363883
Vegetable	1515060	1641050	2120384	2028570

Table 1 (*Continued*).

	1993	1994	1995	1996
Total fresh	8878707	9623803	11126256	11383829
Total agriculture	20208460	24041579	26785083	26941091
Fresh exports by major market				
EEC-15	3231957	3573598	4085944	4242138
North America	4981718	5212549	6029344	6017713
Japan	646095	861490	1045083	1148604

[a] Source: UN ComTrade database. SA includes Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. EA includes China, Kampuchea, Laos, Vietnam, Fiji, Hong Kong, Indonesia, South Korea, Kiribati, Macau, Malaysia, Papua/New Guinea, Philippines, Singapore, Solomon Is, Thailand, Tonga, Samoa, Taiwan. SSA includes Angola, Burundi, Comoros, Djibouti, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Seycehlles, Somalia, Sudan, Tanzania, Uganda, Zaire, Zambia, Zimbabwe, Benin, Burkina Faso, Cameroon, Cape Verde, Central African, Republic, Chad, Congo, Cote d' Ivoire, Equitorial Guinea, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Sao Tome & Princip, Senegal, Sierra Leone, and Togo. NA/ME includes Algeria, Egypt, Iran, Iraq, Israel, Jordan, Lebanon, Morocco, Oman, Syria, Tunisia, Turkey, Yemen, and Yemen Dem. Rep. LAC includes Haiti, Antigua, Argentina, Bahamas, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominica, Ecuador, El Salvador, Grenada, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, St. Chris/Nev, Saint Lucia, St. Vincent, Suriname, Trinidad/Tobago, Uruguay, Venezuela, Belize, Guatemala, Guyana.

1999 are summarized in Table 2 for the five most important categories, plus meats. These data are for a limited time period, but they give some indication of product categories where sanitary issues arise. The top three categories are vegetables, fishery products, and fruits, showing the importance of SPS issues for these fresh commodities. Meats had very few detentions, presumably due to the pre-certification of inspection systems in exporting countries carried out by USDA/FSIS and mandated by the US food safety legislation specific to meats. Table 2 also reports the two countries accounting for the largest number of detentions in each category. Detentions occur at a low frequency for many different exporting countries, as seen by the small number accounted for by the top two countries, which were all low and middle income countries.

FAO (1999) summarized the FDA data by reason for detention and region of the world for 1996/1997 (Table 3). Most detentions were for contamination of food with insects and rodent filth, followed by microbiological contamination, and pesticide residue violations. Over half of the rejections are attributable to lack of basic food hygiene and failure to meet labeling requirements (FAO, 1999). Pesticide residue violations were relatively important for LAC; microbiological contamination was more important in violations from Africa or Asia. These patterns reflect the relative importance of fruits and vegetables in LAC exports compared to exports of seafood and fishery products from Asia and Africa.

Overall, the FDA data confirm that SPS standards are important challenges to fresh food product exports from LDCs. Successful exporters meet food safety

Table 2
US FDA import Detentions by product category, January–May 1999 (number of detentions for the top five product categories plus meat products)[a]

Product category	Number of detentions	Top countries (no detentions)
Vegetables/vegetable products	1991	Guatemala (73), China (25)
Fishery/seafood products	1661	Thailand (30), India (18)
Fruits/fruit products	962	Mexico (36), Taiwan (7)
Candy w/o choc/special/chew gum	345	Mexico (15), Lebanon (2)
Spices, flavors and salts	212	Brazil (15), India (5)
Meat, meat products, and poultry	8	Not available

[a] Source: US FDA import retention reports, available at http://www.fda.gov//ora/oasis/ora_oasis_det.html.

Table 3
Number of contraventions cited for US FDA import detentions for the period July 1996–June 1997[a]

Origin/ reason for contravention	Africa	LAC	Europe	Asia	Total
Food additives	2 (0.7%)	57 (1.5%)	69 (5.8%)	426 (7.4%)	554 (5.0%)
Pesticide residues	0 (0.0)	821 (21.1%)	20 (1.7%)	23 (0.4%)	864 (7.7%)
Heavy metals	1 (0.3)	426 (10.9%)	26 (2.2%)	84 (1.5%)	537 (4.8%)
Mould	19 (6.3%)	475 (12.2%)	27 (2.3%)	49 (0.8%)	570 (5.1%)
Microbiological contamination	125 (41.3%)	246 (6.3%)	159 (13.4%)	895 (15.5%)	1425 (12.8%)
Decomposition	9 (3.0%)	206 (5.3%)	7 (0.6%)	668 (11.5%)	890 (8.0%)
Filth	54 (17.8%)	1253 (32.2%)	175 (14.8%)	2037 (35.2%)	3519 (31.5%)
Low acid canned food	4 (1.3%)	142 (3.6%)	425 (35.9%)	829 (14.3%)	1400 (12.5%)
Labeling	38 (12.5%)	201 (5.2%)	237 (20.0%)	622 (10.8%)	1098 (9.8%)
Other	51 (16.8%)	68 (1.7%)	39 (3.3%)	151 (2.6%)	309 (2.8%)
Totals	303 (100%)	3895 (100%)	1184 (100%)	5784 (100%)	11166 (100%)

[a] Source: FAO, "The importance of food quality and safety for DCs", Committee on World Food Security, 25th Session, Rome, 31 May to 3 June, 1999, at http://www.fao.org/docrep/meeting/x1845e.htm.

standards, as evidenced by the comparable safety between domestic and imported produce in the US (Zepp et al., 1998). How to manage and reduce food safety risks is discussed next.

4. The growing importance of farm to table management of food safety

There is growing adoption in the food industry of management practices that focus on prevention and control of food safety hazards (Martin and Anderson, 2000). Many hazards are expensive to test for and may enter food products at several points in the production process. Therefore, documented production practices, that are verified to prevent and control hazards, are becoming accepted as the most cost-effective means of reducing food safety hazards. While testing and verification are essential for establishing good process controls, testing can never be practical as the only means of monitoring safety.

Management of food safety hazards is part of a trend towards greater quality management to meet increasingly specialized product specifications and niche market demands. Such approaches, sometimes characterized as total quality management, provide quality assurance that products will meet complex specifications (Mazzocco, 1996). Internationally recognized certification, often through the ISO, is increasingly applied to food production and processing (Caswell et al., 1998). The ISO provides a "standard for standards" through application of a framework for verifying the elements of a firm's production process that assures quality.

The hazard analysis critical control points (HACCP) system is a subset of more general quality management systems, and is used to address food safety hazards that can be introduced at different points in the food chain or are difficult to measure (Unnevehr and Jensen, 1999). An advantage of HACCP is to focus resources on the most important control points, which can minimize resources used to improve safety. Properly applied, HACCP may lead to process redesign, which can reduce the cost of providing quality (Mazzocco, 1996). HACCP involves analysis of the entire system, with the corresponding need to coordinate preventive actions throughout the production process.

The HACCP system has been used by private firms since the 1960s, but during the 1990s, the public sector adapted the concept for food safety regulation. The HACCP system has been mandated by government regulation for some part of the food system in the EU, Australia, New Zealand, Canada, and the US. HACCP regulations have varied widely among countries, and this type of regulation has been controversial in terms of both industry cost and public health benefit (Unnevehr and Jensen, 1999).

These trends have implications for LDC exporters. Farm to table process control to manage both quality and safety is increasingly in demand in high income markets, and new institutions are evolving to certify production practices for meats and horticultural

products (Unnevehr et al., 1999). Thus, there are market incentives for LDC exporters to adapt these management practices and to coordinate safety and quality management more closely with importers. At the same time, the growing use of HACCP in public regulation means that it has become an SPS measure that will influence international trade, as we discuss below.

5. Two examples of food safety issues for non-traditional fresh food exports

The following two cases show the importance of meeting SPS standards for developing new export markets. They also demonstrate the importance of managing quality and safety throughout the food production process and the public sector role in facilitating improved safety and market access.

5.1. Snow pea exports from Guatemala (from Sullivan et al., 1999)

Non-traditional agricultural exports from Central America grew at 16% between 1983 and 1997. These exports, which are particularly important in Honduras, Guatemala, and Costa Rica, go to both North America and Europe. Case studies in Guatemala found that chemical overuse or use of pesticides not allowed in the US was the primary factor contributing to high detentions and rejection rates for shipments at ports-of-entry in the US. During 1984–1994 over 3000 Guatemalan shipments valued at over $18 million were detained and/or rejected at US ports of entry for chemical residue violations. Snow peas are an important non-traditional export from Guatemala, and insect and disease infestations have led to excessive reliance on chemical control measures. The 1995 leaf miner crisis resulted in a USDA plant protection quarantine (PPQ) for all Guatemalan snow pea shipments. Research sponsored by the Guatemalan government and USAID identified the leaf miner species as not exotic to the US, and therefore not a threat to US producers, and recommended control strategies to reduce chemical residues. Snow peas cultivated under integrated pest management had reduced pesticide applications and lowered product rejection rates. The PPQ was removed in 1997, re-establishing a $35 million annual market for Guatemala. Imports from Guatemala remain under automatic detention by the FDA due to frequent pesticide violations.

5.2. Frozen shrimp and prawns from Bangladesh (from Cato and Dos Santos, 2000)

Bangladesh exported $288 million of frozen shrimp and prawns to the EU, the US, and Japan in 1996. In July 1997, the EU banned imports of fishery products from Bangladesh. EU inspections of processing plants in Bangladesh determined that deficiencies in infrastructure and hygiene resulted in a potentially high risk to public health. In the US market, Bangladesh seafood was placed under automatic detention, so that each shipment is tested (at the expense of the importer) and allowed to enter only if it meets safety standards. In 1997, 143 shipments of frozen shrimp from Bangladesh to the US were detained, usually for microbial contamination with *Salmonella*. In order to overcome these problems, both industry and government made major investments in more modern plants and laboratories and in personnel trained in HACCP procedures. HACCP was implemented as a nation-wide program in December 1997. This quality assurance legislation was recognized as acceptable to the EU, and the EU import ban was lifted for six approved establishments in December 1997.

6. Private and public actions to coordinate quality and safety standards in export markets

In the above cases of exports from Bangladesh and Guatemala, food safety hazards had to be reduced through changes in production practices and both private and public actions were needed to resolve SPS barriers to market access. Public actions included research, new regulation, and public infrastructure. Private actions included changes in production practices and sanitation investments. Thus, there are two issues for the private and public sectors in LDCs. The first is how to accomplish the vertical coordination needed to meet export standards. The second is how to decide when to undertake costly investments that support greater food safety. Each issue is considered below.

With respect to vertical coordination to meet quality and safety standards, all of the many different models for coordination in private markets can be

found in LDCs. Production in an LDC might be tightly controlled by a multinational firm for export to a high income market, e.g. Kenya vegetables for the UK market (Unnevehr and Hirschhorn, 2000). The production process might be wholly owned or contracted with local growers. Alternatively, local growers may be coordinated through an exporting firm that provides guidance on quality standards and assurances to importers, e.g. Ivory Coast fruits for the EU market (Unnevehr and Hirschhorn, 2000). Market exchange based on industry recognized grades and standards also occurs, but is much less effective in certifying food safety than in certifying food quality, because of the high costs of testing for many hazards.

To facilitate vertical coordination, the public sector in an LDC can play a role in testing and certifying certain kinds of export quality, such as whether a country is free of an animal disease. Another type of public action would be regulation that is recognized by the importer as providing the basis for safer production (Horton, 1998), such as HACCP in the Bangladesh example. Information about potential export markets, which is often part of publicly funded export promotion programs in LDCs, can include information about how to meet sanitary measures. LDC governments can request that standards be made transparent by importing countries, to facilitate private sector response. The public sector in the importing DC may also facilitate trade by providing pre-certification for exports through in-country inspections of the production processes, such as those carried out by the USDA. This can substantially reduce costs associated with detentions and rejections. An importer can also provide guidelines, such as the US FDAs suggested good agricultural practices for fruits and vegetables, which can be used as a standard in private transactions. All of these actions to facilitate vertical coordination can help to establish that LDC production has equivalent safety to DC production.

The second issue is evaluating investments to improve food safety. Several factors will determine whether the value of exports provides sufficient returns. Thilmany and Barrett (1997) examined the potential impacts of technical barriers to trade, and found them to be ambiguous. On the one hand, the cost of meeting higher standards reduces returns to exporters. This may be particularly true for food safety standards, because the marginal costs of investments to improve food safety may be higher in LDCs, where fewer basic sanitation services are available. On the other hand, if the higher standard resolves consumer uncertainty about product quality then demand shifts outward in the importing country and returns to exporters increase. The latter case may be most relevant to LDCs who are in many cases developing new DC markets for non-traditional exports. Resolving food safety uncertainty can ensure existing markets and bring about new market possibilities. Efforts to improve food safety could help LDC exporters to capture greater value for their products and might provide spillover benefits for domestic consumers in LDCs. Thus, the impact of SPS measures on LDC welfare is an open question.

Public sector investments can be important in supporting specific private actions. The public sector can conduct research, as in the Guatemalan example above, to improve production practices. Infrastructure investments in water supply, rural electricity, or transportation may be fundamental to improvements in food processing and handling. Sometimes key bottlenecks, such as cold storage facilities in a fishing port, can be addressed by public investment, made possible by fees for cost recovery (Unnevehr and Hirschhorn, 2000).

Jaffee (1992) reviewed success stories in exporting high-value food commodities from low and middle income countries, and his conclusions relate to the above issues of coordination, investment, and the role of the public sector. He found that successful exporters were able to compete on quality and product differentiation, not just as a source of low-cost supply. The private sector played the dominant or exclusive role in developing the export market and a high degree of vertical integration was an important feature of successful export production. Often foreign direct investment played a role, but was not the main reason for industry success. Government assistance was important in providing necessary infrastructure, certification that standards were met, market information about standards in importing countries, and research to improve production methods.

7. The SPS Agreement under the WTO

While exporters must meet the quality and safety demanded by import market consumers, there are

international trading rules to ensure that public standards are applied fairly and equally to both domestic and imported products. The 1994 GATT agreement included the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), which covers trade measures that protect human, animal, or plant life or health. Under this agreement, WTO members support the following principles:

- *Transparency* — Nations are required to publish their regulations and provide a mechanism for answering questions from trading partners.
- *Equivalence* — Member nations must accept that SPS measures of another country are equivalent if they result in the same level of public health protection, even if the measures themselves differ. The same level of health protection should apply to both domestic and imported products.
- *Science-based measures* — Regulations cannot impose requirements that do not have a scientific basis for reducing risk.
- *Regionalization* — The concept of pest- or disease-free areas within an exporting country is recognized. Exports can be allowed from such areas, even if other areas of an exporting country still have the disease or pest.
- *Harmonization* — Member nations recognize the desirability of common SPS measures. Three international organizations are recognized sources of internationally agreed-upon standards: the Codex Alimentarius Commission (Codex), the International Office of Epizootics (OIE), and the International Plant Protection Convention (IPPC).
- *National sovereignty* — Countries may choose a risk standard that differs from the international standard. This recognizes that individual nations are unwilling to subscribe to uniform international standards for all hazards.
- *Dispute Resolution* — There is a clearly defined mechanism for resolving disputes between countries in a timely manner. The dispute settlement panel is expected only to state whether the SPS measures under question have a scientific basis and are consistently applied.

The existence of the SPS Agreement has provided a catalyst for regulatory reform (Roberts, 1998). The US recognition of disease-free zones for Argentine beef and for Mexican avocados is an example of implementation of the principles of the SPS Agreement. Another example is the settlement of some complaints through formal negotiations under the SPS dispute process. Worldwide efforts to better document SPS measures are a response to the agreement's mandate for greater transparency.

These achievements have been put at risk by disputes between the US and EU. In response to a complaint from the US and other meat exporters (Canada, Australia, New Zealand, and Norway), a dispute panel ruled that the EU ban on growth hormones in meat did not have a scientific basis. As the EU refused to remove the ban, the US has placed tariffs on some food product imports from the EU. There is also dispute about the acceptability of genetically modified food crops. In both cases, the ability of exporting producers to guarantee proper use of risky inputs is at issue. These controversies highlight the importance of guaranteeing safe production practices from farm to table and demonstrate that different approaches to regulating biosafety will be difficult to resolve. These controversies create uncertainties about the acceptability of production methods and products across potential markets.

8. Potential issues for LDCs in future trade negotiations

How to regulate trade of potentially risky food and agricultural products continues to be a contentious issue in international trade negotiations. Resolving these disagreements in a way that will not hinder growth and development for LDCs is a serious challenge. LDC exporters would benefit from recognition of equivalence across high income markets and from the use of transparent product standards.

Within the framework of the existing SPS Agreement, there are at least three issues specific to LDCs. The first is the role of the Codex, the OIE, and the IPPC in setting internationally recognized standards. Many LDCs do not have the capacity to participate in these international organizations and it is not clear that their interests are always taken into account (Henson and Loader, 1999). Learning how to participate effectively involves capacity building within the public sector in LDCs and may also involve forming coalitions around issues of mutual regional interest. FAO is providing some assistance to LDCs on this issue and the Codex

has regional committees. The two most active exporting regions, EA and LAC, have regional level efforts to coordinate monitoring and to harmonize food safety regulation (PAHO/WHO, 1997; ASEAN, 1999). Such efforts might provide some economies of scale in public activity for small, low income countries seeking to develop better food safety systems.

A second issue is the difficulty in determining equivalence in food safety. The growing adoption of HACCP as a regulatory standard by many industrialized countries has led the Codex Alimentarius to consider guidelines for setting microbiological safety criteria and for establishing HACCP programs. One difficulty in setting these criteria is that there is no internationally agreed-upon procedure for carrying out a microbiological risk assessment (ICMSF, 1997). In the absence of such an agreement, the Codex has recommended the application of HACCP as the preferred method for ensuring microbiological safety. In fact, the ICMSF explicitly recognizes HACCP or good practices as a substitute for explicit microbiological standards (ICMSF, 1997, p. 120; ICMSF, 1998). Hathaway (1995) has challenged this view that HACCP requirements can substitute for explicit microbiological criteria. He argues that HACCP should provide some quantifiable risk reduction, not merely the assurance that hazards have been reduced by some unspecified amount.

These opposing views relate to a critical issue for international food trade: How will equivalence among HACCP regimes in different countries be determined? For example, can seafood produced under HACCP in Thailand be exported to the US, where HACCP is mandated for domestic producers? Or, will it be necessary to specify microbiological criteria and actual risk levels that HACCP should achieve? In practice, both microbiological criteria and the existence of process controls will likely be considered (Kvenberg, 1998). But the extent to which HACCP will substitute for imported product testing is likely to be an area of controversy in international food trade for the foreseeable future, and one which is particularly relevant to fresh food exports from LDCs.

The third issue is whether a domestic food safety regulatory system is becoming a necessary prerequisite for participation in trade. Requiring equivalent systems rather than equivalent outcomes for specific products would be very burdensome for many low income countries. Some public capacity for risk analysis is necessary for participating in international trade negotiations. Some control over animal and plant hazards, or monitoring of imports to prevent hazards may also be necessary to ensure trade participation. It is possible that such capacity can be developed at a regional level, if there are common trade interests and similar risks. A full scale legal framework for food safety regulation with minimum standards is expensive for small low income countries, and may be counterproductive in any country without sufficient public capacity for enforcement.

9. Conclusions

Fresh food product markets provide significant opportunities for LDCs to develop non-traditional agricultural exports. These products have high income elasticities of demand in high income markets and face fewer traditional protectionist barriers. However, these products are also more likely to carry food safety risks and to encounter SPS measures as barriers to market access. Thus LDC exporters must learn to supply safe products and to defend their interest in transparent, equivalent standards.

Future growth in exports or the capture of new markets by LDCs will take place within a changing context for quality control in DCs. Private firms increasingly seek to manage both quality and safety from farm to table. Thus certification of production practices is becoming more important. At the same time, public regulation is making increasing use of process control and hazard prevention, through mandating the application of HACCP. This places greater pressure on LDC exporters to develop quality management systems that will be recognized in high income markets. Whether this will encourage greater vertical integration through multinationals remains to be seen. An important question for future research is whether higher standards for exports will close markets to LDCs or spur investments in value-added production in LDCs.

Successful export market development will also require public actions by LDC governments. These actions will vary with the type of product, hazard, and the level of the country's development. Such actions may include research to improve production methods,

testing and certification of product, implementation of new regulation, negotiating pre-certification by importer governments, and participation in international negotiations regarding SPS measures. Evaluating how best to support improved market access for fresh food exports will be an increasingly important issue for LDC governments.

Acknowledgements

The author thanks Daniel Nche and Azita Amjadi of the World Bank for research assistance. She also thanks Cees DeHaan, Lynn Brown, Steve Jaffee, and Nancy Hirschhorn of the World Bank for comments on earlier versions of this work.

References

ASEAN website: http://www.aseansec.org/ viewed 28 July 1999.

Caswell, J., Bredahl, M.E., Hooker, N.H., 1998. How quality management metasystems are affecting the food industry. Rev. Agric. Econ. 20, 547–557.

Cato, J.C., Dos Santos, C.A.L., 2000. Costs to upgrade the Bangladesh frozen shrimp processing sector to adequate technical and sanitary standards. In: Unnevehr, L.J. (Ed.), The Economics of HACCP. Eagan Press, Saint Paul, MN, in press.

FAO, 1999. The importance of food quality and safety for developing countries. Committee on World Food Security, 25th Session, Rome, May 31–June 3, at http://www.fao.org/docrep/meeting/x1845e.htm.

Hathaway, S.C., 1995. Harmonization of international requirements under HACCP-based food control systems. Food Control 6, 267–276.

Henson, S., Loader, R., 1999. Impact of sanitary and phytosanitary standards on developing countries and the role of the SPS Agreement. Agribusiness 15, 355–369.

Horton, L.R., 1998. Food from developing countries: steps to improve compliance. Food Drug Law J. 53, 139–171.

International Commission on Microbiological Specifications for Foods (ICMSF), 1997. Establishment of microbiological safety criteria for foods in international trade. World Health Statist. 50, 119–123.

International Commission on Microbiological Specifications for Foods (ICMSF), 1998. Potential application of risk assessment techniques to microbiological issues related to international trade in food and food products. J. Food Prot. 61, 1075–1086.

Jaffee, S., 1992. Exporting high-value food commodities: success stories from developing countries. World Bank Discussion Papers No. 198.

Kvenberg, J., 1998. What's new for HACCP? Paper Presented at the NE-165 Conference on the Economics of HACCP, June 15–16, Washington, DC.

Martin, S.A., Anderson, D.W., 2000. HACCP adoption in the US food industry. In: Unnevehr, L.J. (Ed.), The Economics of HACCP: Studies of Costs and Benefits. Eagan Press, Saint Paul, MN.

Mazzocco, M., 1996. HACCP as a business management tool. Am. J. Agric. Econ. 78, 770–774.

Pan American Health Organization and World Health Organization (PAHO/WHO), 1997. Integration of food protection in the region of the Americas. Report from the 10th Inter-American Meeting at the Ministerial Level on Animal Health, Washington, DC, April, pp. 23–25.

Roberts, D., 1998. Preliminary assessment of the effects of the WTO agreement on sanitary and phytosanitary trade regulations. J. Int. Econ. Law, 377–405.

Sullivan, G.H., Sanchez, G.E., Weller, S.C., Edwards, C.R., 1999. Sustainable development in Central America's non-traditional export crops sector through adoption of integrated pest management practices: Guatemalan case study. Sustainable Dev. Int. 1, 123–126.

Thilmany, D.D., Barrett, C.B., 1997. Regulatory barriers in an integrating world food market. Rev. Agric. Econ. 19, 91–107.

Thrupp, L., 1995. Bittersweet Harvests for Global Supermarkets: Challenges in Latin America's Agricultural Export Boom. World Resources Institute.

Tyers, R., Anderson, K., 1992. Disarray in World Food Markets. Cambridge University Press, Cambridge.

Unnevehr, L.J., Hirschhorn, N., 2000. Food Safety Issues in the Developing World. World Bank Technical Paper No. 469.

Unnevehr, L.J., Jensen, H.H., 1999. The economic implications of using HACCP as a food safety regulatory standard. Food Policy 24, 625–635.

Unnevehr, L.J., Miller, G.Y., Gomez, M.I., 1999. Ensuring quality and safety in farm level production: emerging lessons from the pork industry. Am. J. Agric. Econ. 81, 1096–1101.

WHO, 1998. Food Safety and Globalization of Trade in Food: a Challenge to the Public Health Sector. WHO/FSF/FOS/97.8 Rev 1.

Zepp, G., Kuchler, F., Lucier, G., 1998. Food Safety and Fresh Fruits and Vegetables: Is There a Difference Between Imported and Domestically Produced Products? Vegetables and Specialities/VGS-271. Economic Research Service, USDA, April, pp. 23–28.