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Food Safety in Food Security and Food Trade

EDITED BY
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2020 VISION
FOR FOOD, AGRICULTURE, AND THE ENVIRONMENT

Introduction

Even as the most pressing challenge we face with regard to food security remains assuring that people have access to enough food to lead healthy and productive lives, food safety is gaining prominence as a global issue. This prominence is particularly evident in the international trade arena and is spilling over into the domestic agricultural and health arenas. It is time for IFPRI and the Consultative Group on International Agricultural Research (CGIAR) to take up food safety as a major cross-cutting research issue linked to plant breeding, animal health, and irrigation practices, to name a few. It is imperative that this work focus on the food safety concerns of the poor. We at IFPRI plan to make food and water safety an important theme in our policy research. By identifying key issues and perspectives on food safety in food security and food trade, this collection of policy briefs lays the foundation for this work.

We express our sincere appreciation to Laurian J. Unnevehr for identifying the key food safety issues that prevail today in food security and trade, and for assembling a powerful array of case studies from around the world that vividly illuminate the challenges and opportunities that lie ahead in this arena. In doing this work, Professor Unnevehr has helped us to strengthen and prioritize related research at IFPRI. We also warmly thank all the authors of the individual briefs for sharing their experiences and insights.

Joachim von Braun
Director General

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Head, 2020 Vision Initiative

"A 2020 Vision for Food, Agriculture, and the Environment" is an initiative of the International Food Policy Research Institute (IFPRI®) to develop a shared vision and consensus for action on how to meet future world food needs while reducing poverty and protecting the environment. This set of Focus briefs presents technical research results that encompass a wide range of subjects drawn from research on policy-relevant aspects of agriculture, poverty, nutrition, and the environment. It contains materials that IFPRI believes are of key interest to those involved in addressing emerging food and development problems.

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Food Safety in Food Security and Food Trade

Overview

Laurian J. Unnevehr

2020 Vision for Food, Agriculture, and the Environment

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Food safety is receiving heightened attention worldwide as the important links between food and health are increasingly recognized. Improving food safety is an essential element of improving food security, which exists when populations have access to sufficient and healthy food. At the same time, as food trade expands throughout the world, food safety has become a shared concern among both developed and developing countries. Governments in many countries have established new institutions, standards, and methods for regulating food safety and have increased investments in hazard control. This set of policy briefs describes how developing countries are addressing food safety issues in order to improve both food security and food trade, and discusses the risks, benefits, and costs when such policies are implemented.

WHAT IS FOOD SAFETY?

Unsafe food contains hazardous agents, or contaminants, that can make people sick—either immediately or by increasing their risk of chronic disease. Such contaminants can enter food at many different points in the food production process, and can occur naturally or as the result of poor or inadequate production practices. Hazardous agents that are receiving attention from policymakers include microbial pathogens, zoonotic diseases, parasites, mycotoxins, antibiotic drug residues, and pesticide residues. Genetically modified foods and their potential to contain allergens or toxins not found in conventional foods have begun to receive attention as well.

All countries share similar concerns about food safety, but the relative importance of different risks varies with climate, diets, income levels, and public infrastructure. Some food safety risks are greater in developing countries, where poor sanitation and inadequate drinking water pose greater risks to human health than in developed countries. The World Health Organization estimates that about 70 percent of the approximately 1.5 billion episodes of diarrhea occurring globally each year have been caused by biologically contaminated food (see Brief 2). Other risks, such as mycotoxins and food-borne parasites, are also more common in developing countries than in developed ones (see Brief 3).

Certain food safety hazards are closely linked with sanitation, water supply, food preparation, and marketing of food. Because food safety is the result of many different actions in the food supply chain, it may be difficult to address food safety issues separately from health, nutrition, and food production and marketing issues.

WHY IS FOOD SAFETY RECEIVING GREATER ATTENTION?

Food safety is receiving increased attention due to several worldwide trends affecting food systems. The growing movement of people, live animals, and food products across borders; rapid urbanization in developing countries; increasing numbers of immune-compromised people; changes in food handling and consumption; and the emergence of new or antibiotic-resistant pathogens all contribute to increasing food safety risks. Changes in food handling and consumption, for instance, include more frequent preparation of food outside the home, increased consumption of fresh and minimally processed foods, and greater consumption of fish, seafood, meat, and poultry around the world. These trends have altered both the nature and incidence of food safety risks in the world's interdependent food production and marketing system. Concerns about intentional adulteration of food from bio-terrorism have also increased attention to food safety.

As the sources and consequences of food-borne illness are better understood, developed countries are strengthening their food safety control efforts (see Brief 4). New regulatory standards have been introduced for previously unknown or unregulated hazards, such as Bovine Spongiform Encephalopathy (BSE, or "mad cow disease") in cattle. Existing food safety standards in developed countries, such as those for aflatoxins in the E.U. and pesticide residues in the U.S., have been made more stringent during the past decade. Many new regulations involve requirements for process controls such as the Hazard Analysis Critical Control Point (HACCP) system—an approach for the prevention, monitoring, and control of hazards that can be applied to any production process. New regulatory measures are based on a scientific assessment of risks, and because hazards can enter the food supply at any one of several points, such assessments are now undertaken from farm to table.

New regulations in developed countries certainly have implications for developing-country food producers and processors, and can increase the costs of exporting. During the last decade or so, developing countries' exports of fresh and minimally processed products—many of which are entering developed-country markets—have increased markedly, and include seafood, fish, fruits, and vegetables. As the case study briefs in this series clearly document, developing-country exporters frequently face difficulties in meeting the increasingly stringent food safety regulations imposed by developed countries. Technical assistance, investments by producers, and new policies in developing countries, however, have all played a role in helping developing-country exporters maintain market access.

The food system is also changing in developing countries themselves, not least because new food safety standards required by the developed world shape expectations among urbanizing consumers. Moreover, food processing and preparation has tended to move outside the household as economies develop. Supermarket chains increasingly dominate urban food retailing in middle income countries, creating new supply chains

that coexist with traditional food processing and retailing. Many kinds of hazard-mitigation activities are shifting from the household to the food industry as the food system changes, and it is not always clear who bears responsibility for food safety or its cost. Briefs in this series discuss some of the difficulties faced in the rapidly modernizing food sectors of developing countries where consumers are demanding improvements in food safety.

WHAT ARE THE POLICY ISSUES FOR THE GLOBAL FOOD SYSTEM?

Food Safety and Food Security

Different perspectives exist on how food safety issues relate to global concerns about food security. These varying perspectives arise from different perceptions and values concerning food safety risks as well as a lack of consensus on who should pay for the costs of risk mitigation. One perspective is that food safety is receiving too much attention relative to its importance for food security. In this view, global attention to the issue emanates from the concerns of high-income consumers and producers in the developed world, and does not truly reflect the most compelling food safety issues in developing countries. Food security still depends on increased food access and, from that perspective, one can argue that investments in food safety divert resources from rural development and agricultural production.

An alternative perspective is that enhanced food safety is key to improvements in health and nutrition, which, after all, is the ultimate goal of enhanced food security. Improvements in food availability will not benefit many of those at nutritional risk without corresponding improvements in the nutritional quality and safety of food as well as a reduction in food- and water-borne illness. But in order to address food safety in this context, developing countries must evaluate such investments within the overall scope of public health, nutrition, and food system policies.

One dilemma facing policymakers in developing countries is how to regulate food safety in the growing modern food sector without driving out the traditional activities that still serve an important economic function (see Brief 13). Many low-income consumers will continue to have access to food primarily from the traditional food processing and retailing sector, while those who operate in the modern sector may decide to adopt food safety standards and models from developed countries (see Briefs 12 and 14) that may or may not be useful for the food system as a whole.

Food Safety and Food Trade

How food safety relates to food security is also at issue both for developing countries seeking to export food and for World Trade Organization (WTO) members negotiating to expand food trade. On the one hand, developing countries want to increase agricultural exports for rural income generation and poverty alleviation. Although rigorous food safety regulations can hamper expansion of food trade, highly restrictive trade policies do far more damage to market access.

On the other hand, meeting food safety standards is part of successfully developing export markets. The increasingly stringent regulations in developed countries have raised the bar for food safety and quality—a bar that some developing countries have not been able to reach, leading to their exclusion from major export markets (see Brief 6). Developing countries see these issues as important to their ability to participate in and benefit from trade, and have requested assistance regarding food safety within the current WTO talks (see Briefs 5 and 11).

But even when developing countries have market access, a comparative advantage in production, and, with technical assistance and domestic investment, improved food safety, export markets may not materialize or may fail to expand. Case studies in this series document four different instances where access to export markets was denied due to sanitary or phytosanitary issues, resulting in substantial costs in terms of lost sales, market share, and investments required to reenter export trade (see Briefs 7, 8, 9, and 10). These case studies also show that, within each country, some producers may not be able to meet safety standards and thus cannot participate in export markets. These cases raise questions about whether food safety standards have adverse consequences for the structure of the exporting industry and the distribution of benefits from trade.

CONCLUDING COMMENTS

Efforts to meet food safety standards in export markets must be judged by whether such efforts generate economic gains for the domestic industry or create positive spillovers for food safety in the domestic food system. More generally, efforts to improve food safety in developing countries must be evaluated in terms of their impact on food security and poverty alleviation. Food safety issues will require policymakers in developing countries to develop better capacity for evaluating policy tradeoffs as they seek to enhance food security or to expand income generation from food trade. The global nature of the food supply will also require developed countries to consider how they might better assist developing countries to address food safety. ■

For further reading see L. Unnevehr and T. Roberts, "Food Safety Incentives in a Changing World Food System," *Journal of Food Control* 13 (March 2002): 73-76, and L. J. Unnevehr, "Food Safety Issues for Fresh Food Product Exports from LDCs," *Agricultural Economics* 23 (2000): 231-240.

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Food Safety in Food Security and Food Trade

Food Safety as a Public Health Issue for Developing Countries

Fritz K. Käferstein

2020 VISION FOR FOOD, AGRICULTURE, AND THE ENVIRONMENT

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In 1983, a group of internationally renowned experts convened jointly by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) concluded that "illness due to contaminated food was perhaps the most widespread health problem in the contemporary world," and "an important cause of reduced economic productivity." In 1992, the FAO/WHO-sponsored International Conference on Nutrition recognized that hundreds of millions of people suffer from communicable diseases caused by contaminated food and drinking water. The Conference declared that "access to nutritionally adequate and safe food is a right of each individual." In the same year, the U.N. Conference on Environment and Development recognized that food was a major vehicle for the transmission of environmental contaminants—both chemical and biological—to human populations throughout the world and urged countries to take measures to prevent or minimize these threats. In 2000, the World Health Assembly, the supreme governing body of WHO, adopted unanimously a resolution recognizing food safety as an essential public health function.

A wide range of biological and chemical agents, or hazards, causes food-borne diseases with varying degrees of severity, ranging from mild indisposition to chronic or life-threatening illness, or both. These agents include bacteria, viruses, protozoa, helminthes, and natural toxins, as well as chemical and environmental contaminants. In addition to the increase in the prevalence of food-borne illness shown through epidemiological surveillance during the last three decades, devastating outbreaks of diseases such as salmonellosis, cholera, enterohaemorrhagic *Escherichia (E.) coli* infections, and hepatitis A have occurred in both developed and developing countries. Furthermore, cholera and other diarrheal diseases, particularly infant diarrhea, which were traditionally considered to be spread by water or through person-to-person contact, were shown to be largely food-borne.

This brief reviews the incidence and health consequences of *biological* pathogens in developing countries, as these are the most important food safety risks in those parts of the world, and provides an overview of possible methods of control.

BIOLOGICAL PATHOGENS AND THEIR HEALTH CONSEQUENCES

Biological contaminants—largely bacteria, viruses, and parasites—constitute the major cause of food-borne diseases. In developing countries, such contaminants are responsible for a wide range of diseases, including cholera, campylobacteriosis, *E. coli* gastroenteritis, salmonellosis, shigellosis, typhoid and paratyphoid fevers, brucellosis, amoebiasis, and poliomyelitis. Diarrheal diseases, taken together—and especially infant diarrhea—are the dominant food-borne illness problem in the developing world, and indeed one of massive proportions.

Approximately 1.5 billion episodes of diarrhea occur annually in children under the age of 5, resulting in some 1.8 million deaths. It is estimated that up to 70 percent of diarrheal episodes may be caused by food-borne contaminants. Although many different pathogens have been identified, food contaminated with pathogenic *E. coli* causes up to 25 percent of all diarrheal episodes in infants and children, while *Campylobacter jejuni* and *Shigella spp.* account for 10-15 percent and 5-15 percent, respectively.

Infections due to helminthic parasites, such as *Trichinella spiralis, Taenia (T.) saginata,* and *T. solium*, are a worldwide public health problem, particularly affecting developing countries and are acquired through consumption of undercooked or uncooked meat. Ascariasis, one of the most common parasitic infections, is estimated to affect about one billion people. Trematodes, another type of parasite, infect some 40 million people worldwide, particularly in Asia, Africa, and Latin America. More than 10 percent of the world's population is at risk of becoming infected by these parasites, which are transmitted through the consumption of raw or inadequately processed freshwater fish, shellfish, or aquatic plants.

Food-borne illness, with the exception of a few diseases such as botulism, brucellosis, listeriosis, and typhoid fever, is often viewed as mild and self-limiting. Although this may be true in a number of cases, in many other cases the health consequences can be serious, even life threatening. This false perception has, in part, contributed to the lack of attention the problem has received. Food-borne diseases vary in their health consequences depending on the disease agent, the stage of treatment, and the duration of the illness, as well as the age and susceptibility of the individual. Acute symptoms include diarrhea, vomiting, abdominal pain, cramps, fever, and jaundice. In the case of many food-borne diseases, healthy adults recover within a few days to a few weeks from acute health effects.

Some food-borne diseases can, however, cause serious and chronic sequelae on the cardiovascular, renal, articular, respiratory, or immune systems. Examples of health complications associated with food-borne illness are reactive arthritis and rheumatoid syndromes, meningitis, endocarditis, Reiter's syndrome, Guillain-Barre syndrome, and hemolytic uremic syndrome (HUS). It is estimated that up to 10 percent of patients with enterohemorrhagic *E. coli* (including *E. coli* O 157) infection may develop HUS, with a case-fatality rate ranging from 3 percent to 5 percent. The manifestations of listeriosis may include septicemia, meningitis, encephalitis, osteomyelitis, and endocarditis. Cysticercosis, a parasitic infection that is particularly common in South America, may lead to cerebral lesions. The liver flukes *Opisthorchis viverini* and *Clonorchis sinensis* cause mechanical obstruction of the biliary tract as well as recurrent pyogenic cholangitis, and are carcinogenic to humans.

In certain population groups (for example, the elderly, infants, young children, pregnant women, the malnourished, and the immuno-compromised), the health effects of food-borne diseases may be even more serious. For example, in pregnant women listeriosis can lead to abortion, stillbirth or malformation of the fetus; the overall fatality rate is about 30 percent. In an outbreak of listeriosis in pregnant women in Western Australia, the fatality rate of infected fetuses was as high as 50 percent.

Transplacental infections of *Toxoplasma gondii*, a food-borne pathogen, may occur in some 45 percent of infected pregnant women. In 10 to 20 percent of non-fatal morbidity, the infants may suffer from damage to the central nervous system and retinochoroiditis, leading to blindness. It is believed that infected but asymptomatic infants may also develop some sequelae later in life, most commonly retinochoroiditis. It is estimated that in about 3 of every 1,000 pregnancies worldwide the fetus or infant is affected by toxoplasmosis.

Food-borne diseases are one of the most important underlying factors for malnutrition and, indirectly, for respiratory tract infections in developing countries. Repeated episodes of food-borne diseases over a period of time can lead to malnutrition, with a serious impact on the growth and immune systems of infants and children. An infant whose resistance is suppressed becomes more vulnerable to other diseases, including respiratory tract infections, and is subsequently caught in a vicious cycle of malnutrition and infection. Many infants and children do not survive under these circumstances.

POSSIBLE METHODS OF CONTROL

The health and economic consequences of food contamination often differ among countries and regions of the world and depend on factors such as climate, geography, type of crops produced, and the degree of social and economic development. Nonetheless, the basic principles for prevention and control of food contamination and thus food-borne diseases are similar. In general, three lines of defense may be envisioned.

The first line of defense aims to improve the hygienic quality of raw foodstuffs at the agri/aquacultural level. Certain zoonotic diseases, such as brucellosis or tuberculosis, can be eradicated in animals so that food of animal origin (for example, meat and milk) is free of the pathogens. But for most other animal-borne pathogens (for example, *Salmonella spp., Campylobacter spp.*), eradication of the organisms in most animal populations is currently not possible, even if good animal husbandry is strictly applied. Yet, by applying the principles of good agri/aquacultural practice and animal husbandry and by improving the environmental conditions under which animals and plants are grown, the hygienic quality of raw food products can be improved.

The second line of defense utilizes food-processing technologies. For example, pasteurization, sterilization, fermentation, and irradiation can increase the availability of foods by extending their shelf life and can contribute to their safety by reducing or eliminating pathogenic microorganisms. In countries where milk pasteurization is common practice, it has been possible to prevent many diseases transmitted through milk.

While many food technologies can be used to render food safe, accidental contamination can occur during processing and manufacturing. Therefore, the application of an effective food safety assurance system is essential. The Hazard Analysis and Critical Control Point (HACCP) system is an important development in this area. Its application would help to ensure the safety of processed and manufactured foods. Contemporary approaches to food safety foresee extension of the HACCP system throughout the food chain, from farm to table.

The third and last line of defense is the most critical for microbiological hazards and will protect the health of consumers when the first two fail. It concerns the education of food handlers in the principles of safe food preparation. The term "food handlers" includes professional cooks, persons handling food in food service establishments, including street vending stands and mass catering services, as well as those in charge of the preparation of food in the home. Special efforts should be made to educate those responsible for the preparation of the family's food. In this context, particular attention should be paid to women, who are usually responsible for the care of infants and young children—population groups in which morbidity and mortality rates for food-borne diseases are high.

CONCLUSION

Food should be considered not only an agricultural and/or trade commodity, but also a public health issue. Therefore, food safety has to be seen by the public health community as an essential public health function. Food safety must be integrated along the entire food chain, from farm to table, with the three sectors—government, industry and consumers—sharing responsibility. It is necessary that food safety forms an essential component of health-based nutrition policies and nutrition education. ■

For further reading see WHO, *Foodborne Disease: A Focus for Health Education* (Geneva, 2000); WHO, *Basic Principles for the Preparation of Safe Food for Infants and Children* (Geneva, 1996); WTO/WHO, WTO Agreements and Public Health (Geneva, 2002); "Food Safety and Foodborne Diseases," *World Health Statistics Quarterly* 50 (Nos. 1/2, 1997); and F. K. Käferstein, "Actions to Reverse the Upward Curve of Foodborne Illness," *Food Control* 14 (2003): 101-109.

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Food Safety in Food Security and Food Trade

Mycotoxin Food Safety Risk in Developing Countries

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A WIDESPREAD PROBLEM

Mycotoxins are produced by fungi, commonly known as mold. These toxins can develop during production, harvesting, or storage of grains, nuts, and other crops. Mycotoxins are among the most potent mutagenic and carcinogenic substances known. They pose chronic health risks: prolonged exposure through diet has been linked to cancer and kidney, liver, and immune-system disease. Because mycotoxins occur more frequently under tropical conditions and diets in many developing countries are more heavily concentrated in crops susceptible to mycotoxins, these chronic health risks are particularly prevalent in developing countries. In addition, mycotoxins can be present in livestock feed, reducing productivity in meat and dairy production. If these toxins find their way from feed into milk or meat, they become a food safety hazard in these products too.

Mycotoxins that pose human health risks include aflatoxins, deoxynivalenol (DON), fumonisins, ochratoxins, and ergot alkaloids. Some are produced before harvest (DON, ergot); some during and immediately following harvest (fumonisin, ochratoxin); and a few predominantly during storage (aflatoxin). Generally, tropical conditions such as high temperatures and moisture, monsoons, unseasonal rains during harvest, and flash floods lead to fungal proliferation and mycotoxins. Poor harvesting practices, improper storage, and less than optimal conditions during transport and marketing can also contribute to fungal growth and proliferation of mycotoxins.

Among the mycotoxins, aflatoxins raise the most concern. Aflatoxin B1 is found widely and in greater concentrations than other naturally occurring forms of aflatoxin throughout the world in foods such as maize, peanuts and peanut products, cottonseed and its extractions, and, to some extent, chilies, peppers, and pistachio nuts. Aflatoxin M1, a metabolite of aflatoxin B1, may occur in milk and its products if obtained from livestock that have ingested contaminated feed. Though high incidences of aflatoxin M1 have been reported in many parts of the world, the contamination levels usually have not been considered a serious public health problem.

Human exposure to levels of aflatoxins from nanograms to micrograms per day occurs through consumption of maize and peanuts, which are dietary staples in several tropical countries. The chronic incidence of aflatoxin in diets is evident from the presence of aflatoxin M1 in human breast milk in Ghana, Nigeria, Sierra Leone, Sudan, Thailand, and the United Arab Emirates, and in umbilical cord blood samples in Ghana, Kenya, Nigeria, and Sierra Leone. Frequent consumption of low levels of aflatoxin has been associated with chronic diseases like cancer.

DON occurs in grains such as wheat, barley, oats, rye, and maize. The total dietary intake of DON, mostly from wheat, is a potential health risk wherever wheat is consumed as a staple diet. Fumonisins are found worldwide, primarily in maize and its products and sorghum. Human exposure is highest in regions like Transkei, South Africa, where moldy, home-grown maize, damaged by insects, is often consumed. Ergot is caused by the fungus species *Claviceps* in pearl millet in India and East Africa, in sorghum wherever the crop is grown, and in wheat in the United States.

HEALTH IMPLICATIONS

Aflatoxins, DON, fumonisins, and ergot alkaloids have been implicated in acute mycotoxicosis (the result of consumption of high levels of mycotoxins over a short period of time) in both humans and farm animals. Outbreaks of aflatoxic hepatitis in humans have been reported in India, Kenya, and Malaysia. Epidemiological studies carried out in several parts of Africa and Asia indicate a correlation between exposure to aflatoxins and primary liver cancer. The risks associated with exposure to aflatoxins are enhanced by simultaneous exposure to the hepatitis B and possibly hepatitis C viruses. Recent studies carried out in West African countries, including Benin, The Gambia, and Togo, indicate chronic exposure of population groups and fetuses to dietary aflatoxins. Children exposed to aflatoxin may become stunted, underweight, and more susceptible to infectious diseases in childhood and later life. Many acute disease outbreaks from exposure to DON have been reported in China and India. Consumption of ergot in pearl millet and other grasses has resulted in acute nausea, vomiting, and dizziness in India and East African countries, and gangrene, a classic ergot poisoning symptom, in Ethiopia. Consumption of moldy sorghum or maize contaminated with fumonisin has been associated with an outbreak of disease in India. Fumonisin has also been associated with occurrences of esophageal and liver cancer and with the development of neural tube defects in the womb.

ECONOMIC LOSSES AND IMPACT ON INTERNATIONAL TRADE

Mycotoxin contamination in agricultural commodities has considerable economic implications. Losses from rejected shipments and lower prices for inferior quality can devastate developing-country export markets (see Briefs 6 and 15 for examples).

The toll of the effects on human health includes the cost of mortality—the cost of productive capacity lost when people die prematurely—and the cost of morbidity—losses resulting from hospitalization and the cost of health care services, both public and private. Finally, there is the intangible cost of pain, suffering, anxiety, and reduction of the quality of life.

Costs to farmers include reduced income from outright food or feed losses and lower selling prices for contaminated commodities. The economic impact on livestock production includes mortality as well as reductions in productivity, weight gain, feed efficiency, fertility, and ability to resist disease. Both quantity and quality of meat, milk, and egg production decreases. It is estimated that in Indonesia, the Philippines, and Thailand, 5 percent of the maize and peanuts produced are discarded because of fungi contamination. The annual cost of contamination due to aflatoxin and other molds in these countries in terms of product spoilage, human health effects, and losses in the poultry and pork sectors was calculated to be 477 million Australian dollars about a decade ago.

Any economic costs must be weighed against the costs of preventing mycotoxins through better production, harvesting, and storage practices. The latter costs are likely to be considerable. Member states of the African Groundnut Council—The Gambia, Mali, Niger, Nigeria, Senegal, and Sudan—have calculated the annual cost of implementing a program to reduce aflatoxin contamination at US$7.5 million.

PREVENTION

Intervention strategies to reduce exposure to mycotoxins can be undertaken at the individual or community level. Individuals can attempt to change their diets to avoid risky foods such as maize. Physical sorting of contaminated grains or nuts could also be useful. The use of the chemicals oltipraz and chlorophyllin could reduce exposure to aflatoxins.

At the community level, mycotoxin formation in crops can be limited before harvest through good agricultural practices such as rotating crops, irrigating to eliminate drought stress, controlling weeds, cultivating mold-resistant stocks, and introducing biocontrols such as nonmycotoxigenic fungal strains. Postharvest measures include drying rapidly by mechanical means and keeping crops dry. Sorting out contaminated nuts by physical means, sorting by color, and washing with water will also reduce mycotoxins. Chemical methods of detoxification include ammoniation processes.

Some successful measures to control mycotoxins that developing countries have undertaken during the last four decades include

- segregation of contaminated peanuts in Malawi,
- detoxification of peanut meal for export in Senegal,
- regulation of mycotoxins in animal feed according to the susceptibility of the animal species in Zimbabwe,
- selection of peanut varieties less susceptible to aflatoxin contamination in Burkina Faso, and
- improvement in produce-handling practices during the 1960s in Nigeria and the 1990s in The Gambia.

Many of these practices could be refined and adopted by other countries. However, such efforts are more likely to bring market rewards when there is an export or livestock feed market. Without price incentives, people are not likely to be motivated to reduce chronic risks that are not apparent to them.

REGULATION

Most importing countries regulate mycotoxins, thus affecting international trade. As Brief 6 points out, these stringent standards may have only modest implications for human health. The Food and Agriculture Organization of the United Nations (FAO)/ World Health Organization (WHO) Codex Alimentarius Commission concluded recently that populations with a low prevalence of hepatitis B infection are unlikely to achieve a dramatic decrease in liver cancer cases by imposing more stringent aflatoxin standards for foods, including milk. Hence, more stringent international aflatoxin regulatory standards are not considered an option by international organizations such as FAO and WHO.

CONCLUSIONS

Increased production of cereals will be needed in the future to satisfy growing food demand in developing countries and feed demand in the newly industrializing countries. Under these circumstances, occurrence of mycotoxins in agricultural commodities will continue to remain on the health and economic policy agenda. In parts of the world where food supplies are limited, drastic regulatory measures to lower mycotoxin standards would lead to food shortages and higher prices. The observation made during the outbreak of aflatoxin hepatitis in western India in 1974 that "starving to death today by not consuming contaminated food in order to live a better life tomorrow is not a practical option" is relevant even after 30 years. Thus, any preventive measures must be pro-poor, well-focused, and cost-effective. A focus on high-risk agricultural commodities during high-risk seasons in high-risk areas among high-risk population groups for selected mycotoxins would yield the greatest public health benefit. Monitoring human population groups for diseases attributable to mycotoxins, coupled with implementing appropriate prevention and control measures, including decontamination and detoxification, would ensure a food supply free from mycotoxins. Such investments would be returned many times over in better human and animal health and reduced economic losses. ■

For further reading see International Agency for Research on Cancer (IARC), *Some Traditional Herbal Medicines, Some Mycotoxins, Napthalene and Styrene*, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans 82 (Lyon: IARC Press, 2002); World Health Organization (WHO), *Evaluation of Certain Mycotoxins in Food*, 56th Report of the Joint FAO/WHO Expert Committee on Food Additives, WHO Technical Report Series 906 (Geneva, 2002).

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Food Safety in Food Security and Food Trade

Trends in Food Safety Standards and Regulation: Implications for Developing Countries

Julie A. Caswell

2020 VISION FOR FOOD, AGRICULTURE, AND THE ENVIRONMENT

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Food safety is affected by the decisions of producers, processors, distributors, food service operators, and consumers, as well as by government regulations. In developed countries, the demand for higher levels of food safety has led to the implementation of regulatory programs that address more types of safety-related attributes (such as bovine spongiform encephalopathy (BSE), microbial pathogens, environmental contaminants, and animal drug and pesticide residues) and impose stricter standards for those attributes. They also further prescribe how safety is to be assured and communicated. Liability systems are another form of regulation that affect who bears responsibility when food safety breaks down. These regulatory programs are intended to improve public health by controlling the quality of the domestic food supply and the increasing flow of imported food products from countries around the world.

Common to the adoption of new regulations by developed countries is the application of risk analysis principles. Under these principles, and in line with the World Trade Organization's (WTO's) Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement), countries should base their regulatory actions on scientific risk assessment. In addition, a country should be able to clearly link its targeted level of protection, based on a scientifically assessed risk level, to its regulatory goals and, in turn, to its standards and inspection systems. Finally, the risk management options chosen should restrict trade as little as possible.

Despite similarities in approach among developed countries, to date they have made only mixed progress toward aligning their regulatory requirements. Countries are struggling with the task of identifying key risk issues and choosing regulatory programs to control those risks. They emphasize different risks, apply different levels of precaution, and choose different regulatory approaches. The regulatory systems of countries are a mix of old laws and newer regulations that frequently do not apply consistent standards across products, risks, or countries of origin. Finally, countries may be tempted to use food safety regulations as a means of protecting domestic industries from foreign competition.

These features of food safety regulation in developed countries have several implications for developing countries. First, they determine access to growing markets for food exports, particularly high-value fresh commodities such as those discussed in other briefs in this collection. When standards differ, this can create additional barriers for developing-country exporters. Second, these features determine the issues that will be addressed in international forums, such as the Codex Alimentarius Commission (see Brief 5). Third, they create expectations among developing-country consumers regarding acceptable levels of safety and set examples for emerging regulations in developing-country food systems (see Brief 13). This brief reviews emerging regulatory approaches and the implications for developing countries.

REGULATORY APPROACHES

Countries regulate food safety through the use of process, product (performance), or information standards. Process standards specify how the product should be produced. For example, Good Manufacturing Practices specify in-plant design, sanitation, and operation standards. Product (performance) standards require that final products have specific characteristics. An example is the specification of a maximum microbial pathogen load for fresh meats and poultry. Finally, information standards specify the types of labeling or other communication that must accompany products.

While these categories provide a neat breakdown, in practice most countries use a combination of approaches to regulate any particular food safety risk. For example, specifications for acceptable in-plant operations may be backed up with final product testing to monitor and verify the success of safety assurance programs. Labeling that instructs final consumers on proper food handling techniques may further back up these systems.

MAJOR REGULATORY TRENDS IN DEVELOPED COUNTRIES

- *Stronger public health and consumer welfare emphasis in decisions by regulatory agencies.* The increasing use of the risk analysis framework for regulatory decision-making focuses attention on the effective control of public health risks as the ultimate goal of regulations, rather than intermediate steps such as assuring that accepted practices are used in production. This in turn leads to a focus on the food supply chain, on identifying where hazards are introduced into it, and on determining where those hazards can be controlled most cost effectively in the chain. This approach is referred to as "farm to table" or "farm to fork" analysis. When the supply chain extends across international borders, risk analysis may encompass farm or processing practices in developing countries.

- *Adoption of more stringent safety standards, with a broader scope of standards.* Food safety standards are becoming more stringent in developed countries on two fronts. First, in many cases food safety attributes that were previously regulated are being held to more precise and stringent standards. For example, rather than assuring meat product safety simply through process standards, those products may be required to meet specific pathogen load standards for *E. coli* or *Salmonella*. Similarly, tolerances for aflatoxin may be lowered as more information and better testing become readily available.

Second, the scope of standards is broadening, as new risks become known. For example, the European Union, the United States, and other countries have instituted strict feeding restrictions to avoid the spread of BSE in cattle. In addition, the European Union has recently established a regulatory program to control human exposure to dioxins through the food supply. These evolving standards create continuing challenges for producers and regulatory agencies in exporting countries.

- *Adoption of the HACCP approach to assuring safety.* During the 1990s, developed countries made a strong shift toward requiring the Hazard Analysis Critical Control Point (HACCP) approach to assuring food safety. Under HACCP, companies are responsible for analyzing how hazards such as food-borne pathogens may enter the product, establishing effective control points for those hazards, and monitoring and updating the system to assure high levels of food safety. These HACCP systems are usually predicated on the processing plant having an adequate system of sanitary operating procedures already in place. HACCP does not prescribe specific actions to be taken in a plant: the company chooses its methods for controlling hazards. HACCP systems make clear that the central responsibility for assuring safety belongs to a company; the regulator's job is often shifted from one of direct inspection to providing oversight for the company's operation of its HACCP plan. Since HACCP is primarily a process standard for company-level activity, inspection to assure compliance is challenging for imported products coming from plants in other countries. Some countries, such as those in the European Union, have mandated HACCP for all levels of the food supply chain, while others such as the United States have mandated it for specific sectors (meat slaughter and processing, for example).

- *Adoption of hybrid regulatory systems.* Mandatory HACCP may be combined with performance standards for finished products. The performance standards (a minimum incidence of Salmonella in finished products, for example) provide a check on whether the HACCP plan is performing adequately. The increased use of performance standards has been facilitated by the development of more accurate and speedier testing procedures, particularly for pathogens. Eventually such tests may make it easier for exporters to demonstrate and verify a particular level of safety.

- *Increased reliance on certification, including traceability.* In developed countries, regulatory systems increasingly require that safety assurance actions be documented internally by the company and externally to government agencies. The system may require documentation tracing a food product back through the supply chain to its source or forward through the chain to the consumer. For example, the European Union is moving forward with mandatory traceability for all food products. The quality control systems required by buyers (such as supermarket chains) have frequently moved faster in the direction of certification and traceability requirements than have government programs, leading to a complex interaction of public and private requirements for food producers and suppliers. (How these developments have affected exporters is discussed in Brief 8.)

- *Greater transparency for national regulations.* National-level regulation has become more transparent in several respects largely because of the requirements of the WTO. National governments must clearly state the reasoning and rationale behind their regulations and notify WTO members about the requirements of a regulation and the timing of its enforcement. Regulations may be challenged under the WTO dispute process. As a result, national regulators can no longer ignore the trade impacts of their regulatory choices. This may make it easier to address food safety standards as barriers to trade.

- *Export of some regulatory responsibility and burden.* HACCP and other certification approaches to food safety assurance are process oriented. Assuring compliance for imported products may require oversight and inspection of farms or plants in other countries. One approach to accomplishing this is to require that exporting countries have in place a regulatory structure (a competent authority) deemed acceptable to the importing country. This has resulted in some exporting of regulatory responsibility and burden to other countries as the price of entry into developed-country markets (see Brief 9).

CONCLUSION

Developed countries have been building food safety regulatory systems that are increasingly comprehensive (covering more safety attributes) and more stringent (establishing stricter standards for those attributes). They are adopting a mix of regulatory approaches depending on the problem addressed, including process standards such as HACCP, performance standards for testing final products, and even increased labeling to communicate about food safety to consumers. These trends will continue unabated in the future, with the result that over time food safety standards will become increasingly demanding. How these trends are influencing developing countries' food exports and food markets is discussed in other briefs in this collection. ■

For further reading see S. J. Henson and J. A. Caswell, "Food Safety Regulation: An Overview of Contemporary Trends," *Food Policy* 24 (No. 6, 1999): 589-603; T. Otsuki, J. S. Wilson, and M. Sewadeh, "Saving Two in a Billion: Quantifying the Trade Effect of European Food Safety Standards on African Exports," *Food Policy* 26 (No. 5, 2001): 495-514; and J. A. Caswell, "International Food Inspection," in *Encyclopedia of Life Support Systems*, Article 5.18.3.5 (Paris: United Nations Educational, Scientific, and Cultural Organization, 2003).

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Food Safety in Food Security and Food Trade

Food Safety Issues in International Trade

Spencer Henson

2020 VISION
FOR FOOD, AGRICULTURE, AND THE ENVIRONMENT

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While not trade measures per se, food safety regulations and standards can impede trade and significantly affect the ability of developing countries to access markets, particularly in industrialized countries (see Brief 6 for examples). In part, this reflects the growing use of these measures globally in response to the rapid increase in scientific and technical understanding of food-borne hazards to human health (see Brief 4).

In extreme cases, countries are denied access to export markets: their exports may be banned from other countries because they fail to meet food safety standards, or the costs of compliance may be prohibitively high. Outright bans are mostly applied as temporary measures when acute food safety issues are identified (see the account of Nile perch exports from Kenya to the European Union in Brief 8). Even when exporters can comply with food safety requirements, their competitiveness relative to other exporters may be diminished because of their relatively high compliance costs (see Briefs 7 and 9). Both macro- and microeconomic effects of food safety regulations can be extremely damaging for export-oriented countries.

In developing countries compliance may require action by both government and individual exporters. Introducing certification procedures would be a government action, for example, while improving hygiene in processing facilities would be a private action. Typically, the less developed a country, the higher the costs of compliance, since its food safety capacity and regulations tend to be less strict.

Most of the effects of food safety requirements on trade stem from government regulation. It is increasingly recognized that voluntary food safety standards can also impede trade (see Brief 12). Exporters may comply voluntarily with established standards because customers require it or to meet food safety regulations. If such standards are so widely applied that in effect they become mandatory within a product market, exporters may have little or no choice but to comply.

The case studies in this set of briefs show how food safety requirements have affected exports of fish, groundnuts, meat, grains, and fresh fruits and vegetables. In some cases, exporters have been unable to gain market access because of stiff requirements; in others, existing export flows are threatened or curtailed by new regulations.

Food safety requirements in export markets can have a profound impact on the way that supply chains for agricultural and food products in developing countries operate. For example, evidence suggests that exporters of fresh vegetables in Kenya have responded to stricter pesticide controls in the European Union by procuring from a few large commercial farmers who are easier to oversee than numerous small-scale producers. Similarly, the European Union's stricter hygiene requirements for fish and fishery products have induced the Indian shrimp sector to employ a permanent workforce instead of casual labor.

THE SPS AGREEMENT

To establish and enforce rules regarding the application of food safety, the Sanitary and Phytosanitary (SPS) Agreement of the World Trade Organization (WTO) permits countries to take legitimate measures to protect the life and health of consumers (as well as animals and plants), provided such measures can be justified scientifically and do not unnecessarily impede trade. The Agreement requires that risks be kept to an acceptable level, however. WTO members are asked to accept the food safety measures of other members if they impose an equivalent level of protection. Before any new measure is implemented, a formal notification must be submitted through the WTO and a minimum period provided for comments from other members.

The SPS Agreement makes specific reference to international standards as the benchmark against which national measures are judged. In the case of food safety, the key international standard-setting body is the Codex Alimentarius Commission. The international harmonization of food safety measures potentially benefits developing countries, although many do not have the capacity to participate effectively in the Codex Alimentarius. Consequently international standards may fail to take adequate account of their needs and special circumstances (see Brief 11).

Given that developing countries typically implement less strict food safety regulations and standards than industrialized countries, in principle the SPS Agreement should help to facilitate trade by improving transparency, promoting harmonization, and preventing the implementation of measures that cannot be justified scientifically. Much depends, however, on the ability of developing countries to effectively participate in the reformed trade arena. The Agreement itself tries to facilitate this by acknowledging the problems that developing countries face in complying with SPS measures and allowing for special and differential treatment. For example, members are instructed to take account of the special needs of developing countries, particularly the least developed, when adopting food safety and other SPS measures. Such needs might include extended time for meeting new standards or the provision of technical assistance.

Implementation issues—many involving the SPS Agreement—for developing countries were negotiated prior to the 2001 Doha meeting of the WTO. Participants agreed that (1) better guidelines are needed to help establish equivalent regulations in different countries; (2) to encourage participation in standard setting, developing countries will receive assistance from five major international organizations; and (3) developing countries should receive financial and technical assistance, for example to facilitate participation in international standard-setting organizations.

CONSTRAINTS TO COMPLIANCE

Considerable investment is required to enhance food safety capacity in developing countries, in order to comply with regulatory requirements in export markets and in the SPS Agreement. Given that industrialized countries largely set the standards that apply in world trade, the burden of retooling often falls heaviest on developing countries. Moreover, at the current time many developing countries lack the necessary capacity to use the provisions of the SPS Agreement to defend their exports against questionable food safety measures or to justify the food safety requirements they apply to imports.

Capacity to implement effective food safety controls is of vital importance to agricultural and food exports from developing countries. For example, importing countries frequently require guarantees that minimum standards of hygiene have been applied in the manufacture of a food product or that fresh fruits and vegetables do not have excessive residues of pesticides. The exporting country must be able to comply with these requirements and to demonstrate that compliance has been achieved. While basic scientific and technical infrastructure is clearly vital, administrative structures, management, financing, and human capital are also important elements. Indeed, the experiences of many countries suggest that the lack of efficient management or sustainable levels of resources can seriously compromise the effectiveness of food safety controls.

The role of the private sector is often neglected in discussions of national food safety capacity. Often, however, it is through the specific actions of individual producers and processors that compliance with food safety requirements is achieved. An example is the application of Hazard Analysis Critical Control Point (HACCP) approaches and other hygienic practices by private enterprises in the production, processing, and handling of agricultural and food products. Further, capacity building in the private sector can complement, and indeed may be a substitute for, the development of public sector capacity. An example is investment in laboratory testing facilities. In a number of developing countries, the private sector has established its own laboratories, either within individual enterprises or through an industry organization, because public capacity is insufficient to meet SPS requirements in export markets.

In many developing countries a multitude of government ministries, departments, and agencies are involved in food safety matters. Furthermore, the responsibilities of these various parts of government are often not clearly defined or they overlap in responsibilities. Poor communication and coordination are other problems. As a consequence, administrative response to changing food safety requirements in export markets can be slow and bureaucratic. Therefore, while changes in food safety requirements may be communicated well ahead of time, there are numerous examples of developing countries struggling to comply at the last minute.

In certain circumstances the structure and modus operandi of production systems and supply channels for agricultural and food products in developing countries may be incompatible with food safety requirements in industrialized country markets or they may impose greater costs of compliance. For example, supply chains with large numbers of small-scale producers or intermediaries can be difficult to coordinate and control. Furthermore, traditional methods of production may conflict with highly developed food safety requirements and, in the most extreme cases, are prohibitively expensive. In turn, compliance with SPS requirements in export markets can induce changes in production systems and supply channels.

CONCLUSIONS

Food safety regulations and standards are increasingly influencing the ability of developing countries to access markets for agricultural and food products, particularly in industrialized countries. The rudimentary and outdated food safety controls of many developing countries may provide adequate protection to the domestic population, but they are ill-equipped to meet export market requirements. Further, developing nations are unable to participate effectively in the international institutions that have evolved to establish global food standards and provide rules for the implementation of national measures. However, countries or private suppliers that invest in the required capacity to meet changing food safety standards may enjoy a strategic advantage.

A number of intergovernmental agencies (such as the Food and Agriculture Organization of the United Nations, the World Health Organization, and the World Bank) and national donors have provided technical assistance to enhance food safety capacity in developing countries. The WTO's SPS Committee attempts to monitor these efforts and to provide a mechanism through which developing countries can channel their requests for assistance. It has also tried to address developing countries' concerns about the provisions of the SPS Agreement and how they are being applied by WTO member countries. The international standard-setting organizations have also explored ways to increase participation of developing countries in their activities. In many countries, however, capacity for food safety remains far below international standards, and food safety requirements continue to act as a significant barrier to markets of industrialized countries. ■

For further reading see S. J. Henson and J. Wilson, *Understanding the Nature of Sanitary and Phytosanitary Capacity*, (Washington, D.C.: World Bank, 2002); S. J. Henson, R. J. Loader, A. Swinbank, M. Bedahl, and N. Lux, *Impact of Sanitary and Phytosanitary Measures on Developing Countries*, (Reading, UK: Centre for Food Economics Research, University of Reading, 2000); IICA (Inter-American Institute for Co-operation in Agriculture), *Food Safety in International Agricultural Trade* (Costa Rica, 1999).

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Food Safety in Food Security and Food Trade

Balancing Risk Reduction and Benefits from Trade in Setting Standards

John Wilson and Tsunehiro Otsuki

2020 Vision for Food, Agriculture, and the Environment

Focus 10 • Brief 6 of 17 • September 2003

CONFLICTING FOOD SAFETY STANDARDS

Growing concern over health risks associated with food products has prompted close examination of sanitary and phytosanitary (SPS) standards in industrialized countries. Standards are employed to protect human health from toxic additives, contaminants, toxins, or disease-causing organisms in foods and beverages, as well as to protect animal and plant health from diseases. Measures used to protect health include outright bans, standards that dictate the conditions under which products must be produced and/or characteristics of the end products, and labelling and other information requirements.

The World Trade Organization (WTO) Agreement on Sanitary and Phytosanitary Standards promotes harmonizing national standards with international standards and adopting standards set by organizations such as the joint Food and Agriculture Organization of the United Nations (FAO)/World Health Organization (WHO) Codex Alimentarius Commission (Codex) for food safety. The Agreement permits importing countries to impose more stringent measures than the international standards. But it requires scientific justification if differing standards create an obstacle to trade. In this respect, international standards may be considered a baseline for WTO members to follow. Trade disputes are likely to arise when differences in standards generate significant cost to exporting countries and deviate from principles of international science and best practices in risk assessment.

Both anecdotal and case-study evidence indicates that the cost of food-safety regulations indeed can be significant. This is especially true for developing countries attempting to penetrate developed-country agricultural markets. In low- and middle-income countries, for example, the share of food exports in total trade remained high at approximately 13 percent in the 1990s. If increasingly restrictive sanitary and phytosanitary measures limit market access, these countries will incur significant export losses. Therefore, a more detailed picture of the trade-off between appropriate levels of risk to human health and the costs of differing levels of food safety standards on trade is increasingly important in a public policy context.

The need for such a picture is reflected in the increasing frequency with which developed and developing countries have notified the WTO about national sanitary and phytosanitary standards. These notifications have increased fourfold between 1995 and 2002.

Since regulatory requirements and product standards are substantially different across countries, typically between developed and developing countries, trade disputes in a non-harmonized system are inevitable. One example of the widely different approaches to standards and food safety among trading partners is the European Union's (EU's) maximum allowable level of aflatoxins in imports of cereal, dried and preserved fruit, and nuts. This regulation, implemented in April 2002, has generated concern among exporting countries (many of them developing countries): Argentina, Australia, Brazil, Canada, Colombia, India, Indonesia, Malaysia, Mexico, the Philippines, Senegal, South Africa, Thailand, Turkey, Uruguay, and the US.

This example points to the conflicting interests, perceptions of risk, and estimations of what constitutes international scientific best practices regarding food safety. It also highlights the challenges developing countries face in meeting ever more stringent regulatory standards. The criteria to determine whether standards are "too high" or "too low" are likely arguable. In some cases, definitive judgments on risks to human health are not even possible, because risks and trade losses associated with regulatory regimes cannot be identified due to a lack of data and an analytical framework. Even in cases where risks and trade losses can be identified, social or political priorities attached to public health and trade tend to differ across countries and can trump scientific evidence. New approaches to quantifying the costs and benefits associated with changes in standards, therefore, are increasingly important.

THE IMPACT ON TRADE

A limited number of attempts have been made to quantify the impact of SPS standards on trade. Calvin and Krissoff have measured this impact by calculating the price effects of SPS standards on Japanese imports of U.S. Red and Golden Delicious apples. The tariff-rate equivalent of the Japanese standards came to 27.2 percent during 1994–97, which is high compared with the actual tariff rate of 19.3 percent. On the other hand, the SPS standards saved an estimated 26 percent of Japanese output from an outbreak of fire blight diseases.

The aforementioned EU regulation of aflatoxins imposes high costs on developing countries. Otsuki, Wilson, and Sewadeh have estimated the impact of changes in the EU standards for aflatoxin contamination levels on bilateral trade flows using trade and regulatory survey data for 15 European countries and 9 African countries between 1989 and 1998. They concluded that a 1 percent reduction in the amount of aflatoxin contamination of cereals and dried fruits and nuts would reduce trade flow by 1.1 percent for cereals and 0.43 percent for dried fruits and nuts. Among dried fruits and nuts, groundnuts were particularly sensitive to the aflatoxin standard, their trade flow decreasing by 1.3 percent with a 1 percent change in the standard.

Otsuki, Wilson, and Sewadeh compared three regulatory scenarios: (1) a pre-EU-harmonized standard (status quo), (2) an international standard indicated by guidelines set by Codex,

and (3) the new EU-harmonized standard implemented in April 2002. They found that the EU-harmonized standard imposed a considerable loss of revenue from cereal, edible nut, and dried and preserved fruit exports by African countries. The Codex standard imposed the least costly trade impediments of all three standards. The EU-harmonized standard decreased African export revenue from Europe by 59 percent for cereals and 47 percent for dried and preserved fruits and edible nuts, compared to export revenue under the pre-EU-harmonized standard. This decrease amounts to approximately US$400 million. Compared to the Codex guidelines, the EU-harmonized standard decreased the value of African exports by US$670 million.

Wilson and Otsuki extended this analytical approach to 15 importing (4 developing) and 31 exporting (21 developing) countries. The results confirm the findings of their previous study, which showed that the aflatoxin B1 standard negatively affected trade in cereals and nuts, but not in dried and preserved fruits.

Wilson and Otsuki also found that adopting the Codex standard for aflatoxin would increase cereal and nut trade among countries in the study by US$6.1 billion, or by 51 percent above the 1998 value of trade resulting from standards imposed individually by these importing countries. The Codex standard would generate US$12.2 billion or 67 percent more than the value of exports if all 15 importing countries harmonized their standards with the EU-harmonized standard.

Wilson, Otsuki, and Majumdar studied the issue of antibiotics, which has been a high priority for WHO and the Office International des Epizooties (OIE). Their study attempted to determine whether maximum residue limits on tetracycline (a widely used antibiotic) affect beef trade. For 6 importing and 16 exporting countries, the results suggested that a tighter regulation of tetracycline, namely a 10 percent increase in regulatory stringency, would lead to a decrease in beef imports by 5.9 percent.

If all 6 importing countries adopted the Codex guideline, the total trade value of beef would reach US$8.8 billion—US$3.2 billion, or 57 percent, higher than the value of total trade under the pre-EU-harmonized level and US$5.1 billion higher than the trade value under the EU-harmonized level. If all importers adopted the Codex standard, beef exports from the Organisation for Economic Co-operation and Development (OECD) countries in our sample would increase significantly. The low-income countries in our sample would decrease their beef exports.

Scientific research on the relationship between health risks and the amount of intake of aflatoxins and antibiotics is inconclusive. To date, a risk assessment completed by the FAO/WHO Joint Expert Committee on Food Additives (JECFA) provides the most comprehensive information on aflatoxin risk to human health. Based on JECFA's study, Otsuki, Wilson, and Sewadeh calculated that the new EU standard would reduce approximately 1.4 deaths per billion people a year, compared to the Codex standard. A report of the Institution of Medicine in the United States estimates that 6 to 20 deaths per year in the US population are attributable to subtherapeutic uses of penicillin and/or tetracyclines. These findings suggest that it is difficult to justify trade losses based on gains in public health, although these cases cannot be generalized.

CONCLUSIONS

The case studies noted above suggest that sanitary and phytosanitary standards—set at levels more stringent than those suggested by Codex standards—can severely limit access to international export markets. But, at the same time, less-stringent standards do not necessarily help developing countries, as the case of beef indicates. A common international framework and common criteria to weigh the benefits and costs of regulations are clearly difficult to establish. Nonetheless, these case studies indicate that public policy decisions need to be informed by empirical evidence on the trade impact of standards set at differing levels of regulatory stringency. Moreover, the current international standards and regulatory system need careful review, because governments continue to set national standards that do not align with international standards.

Progress must be made to support harmonization of international SPS standards set by international standard-setting bodies. A concerted effort to identify key standards affecting food safety that have not been harmonized by international bodies, and efforts to identify action that can accelerate this process through international consensus, would help avert trade friction caused by divergent national standards. ■

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Food Safety in Food Security and Food Trade

Case Study: Guatemalan Raspberries and *Cyclospora*

Linda Calvin, Luis Flores, and William Foster

2020 Vision for Food, Agriculture, and the Environment

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The Guatemalan raspberry industry began exporting to the United States in the late 1980s, filling a market niche in the spring and fall when supplies were low. By 1996, Guatemalan raspberry exports were increasing rapidly, up 113 percent from the previous season. That spring and early summer, the U.S. Centers for Disease Control and Prevention (CDC) and Health Canada received reports of more than 1,465 cases of food-borne illness from Cyclospora, a protozoan parasite. Although no one died, the large number of cases generated substantial adverse publicity. Initially, investigators linked the outbreak to California strawberries, but they finally decided that it was associated with Guatemalan raspberries. This case study reviews the efforts to resolve this food safety problem. It is a cautionary tale about the serious impact a food safety outbreak can have on a promising industry.

By the time raspberries were identified as the most likely source of contamination, the Guatemalan spring season was over, so the United States took no immediate regulatory action. The U.S. Food and Drug Administration (FDA) and the CDC sent a team of investigators to Guatemala to observe growing conditions. Because Cyclospora was relatively unknown and had never before been associated with raspberries, no one knew which farms or berries were contaminated, how they became contaminated, or how to solve the problem.The Guatemalan Berry Commission (GBC), a growers' organization, responded slowly to the outbreak. Growers came to no consensus on whether there was a problem and were reluctant to accept the FDA's assertion that the contaminated product came from Guatemala, since the claim was based on epidemiology alone with no physical proof. (In fact, the FDA did not find physical evidence of Cyclospora contamination on Guatemalan raspberries until 2000.) Microbial contamination is often low level and sporadic, which makes it difficult to detect. And with perishable produce there is rarely anything left to test by the time an investigation begins. Some growers suspected that the problem was really a trade barrier to protect the U.S. industry from Guatemalan competition. Lack of scientific information compounded the industry's problems in formulating a response.

By 1997, the GBC had developed a system to characterize a farm's risk potential: only low-risk farms could export in the spring season. However, the plan had no enforcement mechanism and no traceback system. That spring another large outbreak of food-borne illness in the United States and Canada implicated Guatemalan raspberries. After consulting with the FDA, the GBC voluntarily stopped exporting raspberries to the United States in May 1997.

After a second season of contamination problems, both the GBC and the government of Guatemala realized that more stringent controls and enforcement were required. In November 1997, the Guatemalan government created a commission with enforcement power to lead the effort to improve food safety. But in December, the FDA, not yet convinced the problem was resolved, issued an import alert, denying all Guatemalan raspberries entry into the United States. An import alert for a specific product from an entire country, rather than from specific firms, was an unusual response, and one used only after all other means of resolving the problem were exhausted. With good traceback, the FDA might have been able to target just those growers with a problem, but in this case the FDA could not identify the problem farms. An import alert without physical evidence was also highly unusual at that time. Since 1997, however, the FDA has become less reluctant to deny imports on epidemiological evidence alone.

Many organizations helped the Guatemalans solve the Cyclospora problem. The FDA, CDC, Health Canada, and the Canadian Food Inspection Agency all provided advice and technical assistance. The GBC also sought help from the Food Marketing Institute in Washington, D.C., which represents U.S. retail buyers.

In 1999, three years after the first outbreak, the United States allowed entry of raspberries produced under the Model Plan of Excellence (MPE), a mandatory joint program of the GBC and the government of Guatemala. The MPE requires export growers to comply with a detailed program of food safety practices and to pass frequent inspections by the Integral Program for Agricultural and Environmental Protection, a Guatemalan public-private organization, as well as undergo FDA audits. A code is applied to each container of raspberries, which allows it to be traced back to an individual grower. With traceback, the export authority of any firm associated with a food safety problem can be revoked. Based on traceback, the FDA concluded that several outbreaks due to Cyclospora contamination in the United States in 1999 were not associated with Guatemalan berries. In 2000 there were two outbreaks traced back to one Guatemalan farm, which was removed from the MPE program. No outbreaks have been associated with Guatemalan raspberries since 2000. To help meet the cost of the MPE program and public relations work, the GBC charges producers a fee per box of exported berries.

The MPE has been a technical but not an economic success for the raspberry industry. Although the MPE is arguably the strictest industry-wide program for raspberry production in the hemisphere, the Guatemalan industry has shrunk dramatically. In 1996, before the contamination problem began, the number of raspberry growers was estimated to be 85; by 2002, only 3 remained. In 2001, Guatemalan raspberry exports

to the United States were only 16 percent of the 1996 level (see figure). For many growers, the decision to leave the industry was based on losses incurred as foreign demand collapsed and export markets closed, rather than on the costs of implementing the MPE.

U.S. fresh raspberry imports, 1990–2001

Source: U.S. Department of Commerce.

While Guatemala worked to increase food safety, other competitors, such as Mexico, made inroads into its U.S. market. Prior to the 1996 outbreaks, the size and growth of Guatemalan and Mexican exports to the United States were similar. Today Mexico supplies about half of U.S. raspberry imports. It has been difficult for the Guatemalan industry to recover from the negative publicity. With back-to-back outbreaks in 1996 and 1997, many buyers decided to purchase raspberries elsewhere.

The problem with raspberries also adversely affected other products such as blackberries, with 2001 exports only 52 percent of their 1996 level. In addition to food safety as a possible reason for shrinking exports, blackberry growers faced decreased demand because retailers prefer to buy a mix of berry products. When Guatemala could only provide blackberries, many buyers purchased from other regions. Nonberry products suffered only temporary decreases in demand.

Looking at the raspberry industry alone, the costs of developing and running the MPE program seem to exceed the benefits. At first no one had any idea of how costly it would be to resolve the contamination and reputation problems. But some believe that Guatemala really had no choice: it had to deal with Cyclospora. For example, if Guatemalan officials had determined that raspberries posed a great risk and banned exports, doubt about the extent of the problem might have affected demand for the rest of Guatemala's agricultural export industry. But the scientific knowledge and institutional framework developed through the MPE program is a public good that also benefits other producer groups. Some growers use the MPE food safety recommendations voluntarily but with only monthly inspections. For raspberries, the almost-daily field and warehouse inspections during the export season are the most expensive part of the program and are thought to be too costly to replicate for industries with no history of contamination. Grower organizations for mangoes and several types of vegetables encourage their members to comply voluntarily. Thus when looking at the entire Guatemalan agricultural export industry, the benefits of MPE appear much larger and may perhaps exceed the costs.

The Guatemalan problem with Cyclospora was a critical event in the produce industry. Producers everywhere noted the devastating impact a food safety problem could have on an entire industry and learned important lessons: (1) delay in addressing such a problem may adversely affect an industry's exports and reputation; (2) the FDA may make decisions on trade restrictions based on epidemiological evidence alone without physical evidence; (3) improved traceback allows trade restrictions to be targeted at individuals with contamination problems and not at the entire industry; and (4) strong grower organizations can improve an industry's ability to deal with food safety outbreaks. When the California strawberry industry was initially and incorrectly implicated in the 1996 outbreak, Guatemalan growers saw the California Strawberry Commission respond quickly and strongly to the negative publicity. The GBC learned from that experience and has significantly improved its ability to deal with such a situation, should one occur in the future. ■

For further reading see L. Calvin, W. Foster, L. Solorzano, J. D. Mooney, L. Flores, and V. Barrios, "Response to a Food Safety Problem in Produce: A Case Study of a Cyclosporiasis Outbreak," in *Global Food Trade and Consumer Demand for Quality*, ed. B. Krissoff, M. Bohman, and J. Caswell (New York: Kluwer Academic/Plenum, 2002).

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Food Safety in Food Security and Food Trade

Case Study: Kenyan Fish Exports

Richard O. Abila

2020 Vision for Food, Agriculture, and the Environment

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Food safety and quality have become increasingly important in international fish trade. Stringent conditions imposed by major fish-importing nations in the developed world, which take in 80 percent of global fish exports, give food safety priority over price as the main determinant for market access. Nearly half of fish exports originate from developing countries, which have limited capacity to invest in the rigorous fish safety measures demanded by importing countries.

Food safety is important because fish are particularly prone to rapid pathogenic contamination. The main safety concerns are unhygienic handling during and after fish harvest, insufficient refrigeration, substandard processing, and poor packaging. In fish-producing countries, failure to apply adequate quality and safety measures leads to losses at various stages of fish marketing. Postharvest fish losses include physical loss from poor handling and preservation; economic loss when spoilage occurs or when higher costs are incurred in reprocessing fish; and nutritional loss when fish is unsafe to eat. In addition, due to poor safety measures, large quantities of fish are processed into fish meal for feed when they could have been better used for human food.

The economic costs of spoilage go beyond immediate product loss. The costs associated with fish-borne illnesses; the rejection, detention, and recalls of products in export markets; and bad publicity for the affected country, are huge. According to some estimates, the consumption of unwholesome fish and fishery products accounts for as much as 30 percent of all food-borne illnesses in the world. Nearly 10 percent (13 million metric tons) of the world's total fish production is lost as a result of spoilage. Considering the high global demand for fish and scarce natural resources, this waste alone justifies efforts to improve quality and safety in the fish trade.

THE FISH TRADE IN KENYA

Kenya has a long history of fishing. The Luo, Luhya, and Abasuba ethnic groups have been active fishermen for more than five centuries. Until 20 years ago nearly all fish caught in Kenya was consumed within the country. Kenya only started to export fish in the early 1980s, when fish processing factories were established around Lake Victoria.

The total annual production of fish in Kenya is approximately 180,000 metric tons, but is declining. About 92 percent of this fish comes from Lake Victoria, and the rest from the Indian Ocean (4 percent), inland lakes and rivers (3 percent) and aquaculture (1 percent). Nile perch, which constitutes about 50 percent of the fish caught in Kenya, is the main export, earning about US$50 million annually. Other commercially important species in the domestic market are the small sardine fish *dagaa* (30 percent) and tilapia (10 percent). Of the 18 fish processing and exporting firms now in Kenya, 10 specialize in Nile perch products and 7 handle marine products such as shrimp, other crustaceans, and tuna.

The table below shows that the volume of Nile perch exports from Kenya has picked up again following export bans by some EU countries in 1997–99. Fish exports, however, still earn less than horticultural crops, coffee, and tea. Because the country needs foreign exchange for its international purchases the Kenyan government is keen to promote fish exports.

Nile perch exports by market region, 1996–2001

	Export volume (metric tons)					
Market region	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
European Union	10,388	6,882	2,320	742	1,680	3,818 (21%)
Far East	1,801	2,664	2,201	2,722	4,146	4,650 (26%)
Israel	3,431	4,244	5,252	5,529	7,185	7,530 (42%)
Others	1,120	929	1,394	2,894	2,468	1,947 (11%)
Total	**16,740**	**14,719**	**11,167**	**11,914**	**15,479**	**17,945**

Source: Kenya Fisheries Department.

SAFETY CONCERNS

Concerns about the safety of fish from Kenya first arose in November 1997 when Spain and Italy both banned fish imports from Kenya, claiming the presence of Salmonellae. Although some member states of the EU continued to import fish from Kenya on bilateral agreements, Kenya's fish exports to the EU declined 34 percent and foreign exchange earnings from fish dropped 13 percent between 1996 and 1997. Following reports of a cholera outbreak in Kenya and neighbouring countries in January 1998, the EU again banned imports of chilled fish products from Lake Victoria, citing poor hygiene standards. This ban caused a 66 percent drop in the fish exports to the EU and a 32 percent drop in foreign exchange earnings from the previous year. A third ban in April 1999 followed a report that pesticides had been used in Lake Victoria to kill fish. This ban resulted in a further 68 percent decline in fish exports.

Before the export bans, the EU accounted for about 62 percent of all fish exported from Kenya. Among the new markets that emerged during the ban, Israel became the most prominent single importer of Kenya's fish, a position it has retained to date. Other markets emerged in the Far East, North

America, the Middle East, and other African countries. The EU is still the preferred market for fishery products from Kenya because of its relative proximity, which allows for greater profit margins. Thus, meeting safety standards in the EU is important for the industry's future.

FISH SAFETY LEGISLATION

As a condition for exporting fish to the EU, all Kenya's fish factories have instituted stringent quality control procedures like the Hazard Analysis Critical Control Point (HACCP) (described in Brief 4). New institutions have emerged to implement the additional regulations required for exporting fish. The fish industry is now governed directly by at least six sets of standards operated through several Kenyan agencies and the EU. The Fisheries Department, which is the national institution mandated to manage the fisheries sector, controls fish quality through provisions in the Kenya Fisheries Act and the Fish Quality Assurance Regulation 2000. The Kenya Bureau of Standards, which sets and supervises standards for manufactured goods, also has defined standards for fish processing and exports.

However, the most significant regulations for the fisheries sector are those of the EU, specifically EU directives 91/493/EEC and 98/83/EEC. These standards are enforced through "the competent authority" approved by the EU (in this case, the Fisheries Department) with periodic audits by EU inspectors. In summary, the EU Directive 91/ 493/EEC lays down the requirements for handling and marketing fishery products. The directive is based on HACCP principles, and it defines the practices governing fish production, handling, processing, packaging, and transporting of fishery products destined for the EU. It also imposes strict standards regarding construction of buildings, equipment, purification tanks, and storage tanks intended for holding fish prior to export. On-premise laboratories, strict record keeping, and accurate labelling are other requirements. EU conditions also require that fish processors and exporters organize an industry association to ensure self-monitoring on matters of fish quality. Kenya is still in the process of developing institutions to meet all of these EU conditions.

IMPACTS OF SAFETY MEASURES

The stringent regulations have important socioeconomic consequences in poor, fish-exporting countries such as Kenya. The costs to fish-processing factories of restructuring their facilities and production lines are significant. In addition fishermen have to invest in newer, cleaner boats and preservation facilities, while fish transporters must increase spending on refrigerated trucks. Private and public costs are incurred in retraining fishermen and other workers on hygienic fish-handling practices. Governments also must pay to set up laboratories to monitor fish quality and to inspect fish production systems.

To meet the EU safety requirements, Kenya has decided that fish destined for the export market will land in only 5 fishing villages (out of nearly 300 at present). The designated villages will be provided with hygienic fish handling and preservation facilities. However, fishermen from elsewhere will incur higher transport costs to bring fish to the designated villages, thus reducing their net income. The proposed changes will create room for middlemen to operate between the fishing areas and the centralized collection points. This will counter present efforts to reduce the number and influence of middlemen in the fishing industry. While moving fishermen higher up in the marketing chain so that they earn more for their fish should be the right approach, the proposed changes will have the opposite effect.

The new costs in the fish production and marketing chain mean that the final product is too expensive for the domestic market; ultimately the fish must be exported in order to recover costs. Furthermore, the drive to earn foreign exchange means that all resources available to the fisheries sector are spent to meet export market conditions. Little effort goes to setting and enforcing domestic-market standards. Thus, the costs of producing high-quality fish for export largely fall to local communities, while they also bear the cost of consuming unwholesome fish.

In conclusion, Kenya faces important challenges in implementing stronger food safety measures, especially in light of its small development budget. It cannot export fish unless it incurs huge costs. The importing countries must be ready to pay higher prices to meet part of these costs. Fortunately, since Lake Victoria has a near monopoly on Nile perch, perch prices can be adjusted to cover some of the costs of the safety measures. Ultimately a partnership between Kenya's government and industry, with strong support from the EU, will ensure that safety in the fish sector is improved. Care must be taken, however, to ensure that fish quantities for export are environmentally sustainable and consistent with food security objectives. ■

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Food Safety in Food Security and Food Trade

Case Study: The Shrimp Export Industry in Bangladesh

James C. Cato and S. Subasinge

2020 VISION FOR FOOD, AGRICULTURE, AND THE ENVIRONMENT

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By the end of the 1970s, the Bangladesh seafood processing industry had expanded rapidly. But sanitary facilities, technology adaptation, and adequate training did not keep pace. Shrimp exports suffered in the late 1970s, and the U. S. Food and Drug Administration placed seafood imports from Bangladesh under automatic detention. This was only the beginning of the export market problems arising from substandard product safety and quality that Bangladesh's shrimp industry faced over the next two decades. This case study illustrates the actions taken by Bangladesh, with the aid of external partners, to overcome substantial obstacles to participation in world shrimp markets.

THE NEED TO BUILD A SAFE INDUSTRY

Recognizing both the potential for Bangladesh's exports and the problems with safety and quality of the product, the Food and Agriculture Organization of the United Nations (FAO) helped Bangladesh develop product standards, regulations, and fish inspection schemes in the early 1980s. In 1983, the Bangladesh government created a Fish and Fish Product Ordinance (Inspection and Quality Control) and in 1985 upgraded the inspection laboratory and its personnel.

FAO initiated a 1996 project to assist in the preparation of a fish safety and quality control program for the shrimp and fish plants in Bangladesh, based on the Hazard Analysis Critical Control Point (HACCP) approach. The program provided training in HAACP procedures to both the public and private sectors. It also informed the government about new requirements of major importing countries. A parallel Common Fund for Commodities/FAO project carried out by the Intergovernmental Organization for Marketing Information and Technical Advisory Services for Fishery Products in the Asia Pacific Region (INFOFISH) focused on the export promotion of value-added products and their sustainable development. Activities ranged from industry training to the development of export opportunities. Despite these efforts to upgrade product quality and safety, Bangladeshi shrimp exporters continued to suffer from real problems and those that importers perceived as real.

In 1997, the fourth leading export item in Bangladesh was frozen shrimp and fish, with a 7.3 percent share of the total export market. The major importers at the time were the European Union (EU), accounting for 34–50 percent of Bangladesh's exports, the United States at 23–38 percent, and Japan at 15–26 percent, depending on the year. At that time, the value per kilogram of Bangladesh's frozen shrimp was lower than average for the Asian region. Furthermore, Bangladesh had a reputation for producing seafood that sometimes did not meet minimum international standards as specified by the Codex Alimentarius Commission. With a low percentage of the world market, a lower-valued product, and a negative reputation in quality, Bangladesh has been a price-taker, rather than a price-setter.

THE EU BAN

On July 30, 1997, the EU banned imports of fishery products from Bangladesh as a result of EU inspections of Bangladesh's seafood processing plants. Inspections found serious deficiencies in the infrastructure and hygiene in processing establishments and insufficient guarantees of quality control by Bangladeshi government inspectors. The ban was estimated to cost the Bangladesh shrimp-processing sector nearly US$15 million in lost revenues from August to December 1997. (In this brief all dollars are US dollars.) The impact on both the industry and the economy of Bangladesh was substantial.

The only way Bangladesh can improve its export position in the shrimp market is to improve the safety and quality of its exports. Safety improvements over the last two decades, with a major effort in the late 1990s, have been made by the industry and government, and by bilateral and multilateral agencies providing technical assistance. While the short-term loss in foreign currency from the EU ban was high for a developing country, the ban did increase the commitment by industry and government to raise product quality to meet international standards. Both exporters and government made major investments in plant infrastructure and personnel training in order to achieve international technical and sanitary standards. This included new employee acquisition and employee training, sanitation audits, plant repair and modification, new equipment, new laboratories, and other costs.

INVESTING IN SAFETY

Some upgrades were in progress at the time of the EU ban. By 1997, the Bangladesh shrimp processing industry had invested $17.6 million in plant upgrades, the government had invested $382,000 in laboratory and personnel upgrades, and outside partners had invested $72,000 in training programs in Bangladesh. Unfortunately, these improvements were not in place early enough to prevent the ban. The total fixed investment cost of $18 million was only slightly more than the nearly $15 million in lost revenue from the ban over a period of five months. These improvements would have almost been paid for had they been implemented in time to make the ban unnecessary. Research has also determined that the annual recurring costs to maintain HACCP programs and meet international standards would be $2.2 million for industry and $225,000 for government.

Subsequent inspections by the EU determined that some plant improvements now met EU standards. Subject to certain

provisions, the EU ban was lifted for six approved establishments for products prepared and processed after December 31, 1997. By July 1998, a total of 11 plants had been approved for export to the EU. Collective efforts by the industry, the Bangladesh Department of Fisheries, and the Bangladesh Frozen Food Exporters Association have continued to strengthen the export-processing sector. By 2002, out of 65 plants licensed for export by the government, 48 plants had EU approval.

THE CHALLENGES AHEAD

As the industry faces new challenges, ensuring safety and quality continue to be important elements in industry development. One concern is the sustainability of shrimp production. The revamped factories, having greater capacity, are mostly operating at about 20 percent of capacity due to limited supplies of shrimp. This has resulted in a growing focus on sustainability in the production sector with increased emphasis on hatchery production of shrimp post larvae for seeding the ponds, rather than harvesting from natural stocks. As hatchery production expands, Bangladesh has also placed increased emphasis on good aquaculture practices as well as certification of aquaculture facilities.

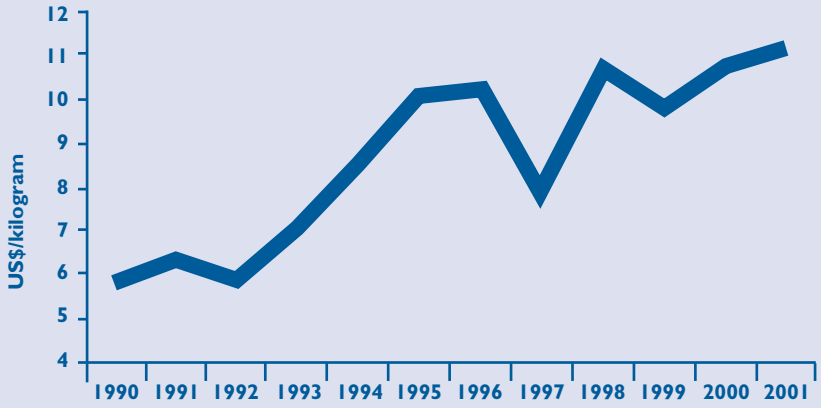
A second challenge is the need to become more diversified in terms of both products and markets. A large number of export processors are now producing increasing amounts of value-added products such as individually quick-frozen, peeled and deveined, and butterfly cut shrimp, as well as cooked products. In 2001 these value-added exports made up almost 25 percent of the total exports of 32,500 metric tons, valued at $363 million. Technical assistance from FAO and INFOFISH continues to play a role in industry development by transferring simple, low-cost technologies for adding value and by matching buyers and sellers to facilitate market diversification. Industry and the government also continue to upgrade the export sector as a whole.

Improvements are making a difference because the unit price of exports has risen steadily over recent years, in contrast to the sharp decline in 1997 (see the figure). Some exporters are now recording an average unit price of more than $15 per kilogram, a price comparable to that received by major exporters from the region. The average volume of exports has also increased from about 24,000 metric tons in 1990–92 to about 30,200 metric tons in 1999–2001. Improvements in food safety have thus set the stage for Bangladesh to become more competitive in the global market for seafood. Moreover, improvements in the shrimp sector have undoubtedly impacted the seafood and food-processing sectors as a whole, due to the intertwined nature of the food-processing industries in the country. Even in 2002, however, Bangladeshi shrimp exporters did experience some safety problems, and more testing laboratories were established.

Developing countries can often compete in world food commodity markets because export products can be produced at a lower cost than in developed countries, provided the product can meet minimum safety and quality standards. To accomplish this, developing countries need assistance not only with technology, but also with training workers to use technology and conform to world food-handling, sanitation, and personal hygiene standards. This normally requires a cooperative effort between a country's industry and government and its external partners. The Bangladeshi shrimp export case demonstrates that these efforts can be successful. It shows that developing countries, with careful guidance and focused effort, can successfully face the challenges of the global market. ■

For further reading see J. C. Cato and C. A. Lima dos Santos, "European Union 1997 Seafood Safety Ban: The Economic Impact on Bangladesh Shrimp Processing," *Marine Resource Economics* 13 (No. 3, 1998): 215–227; J. C. Cato and C. A. Lima dos Santos, "Costs to Upgrade the Bangladesh Frozen Shrimp Processing Sector to Adequate Technical and Safety Standards and to Maintain a HACCP Program," in *The Economics of HACCP: New Studies of Costs and Benefits*, ed. L. Unnevehr (St. Paul, Minn., USA: Eagan Press, 2000); and M. Rahman, *Market Access Implications of SPS and TBT: Bangladesh Perspective* (Jaipur, India: CUTS Centre for International Trade, Economics and Environment, 2002).

Value of Bangladesh's Shrimp Exports, 1990–2001



Sources: FAO Commodity Updates and Bangladesh Frozen Food Exporters Association.

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Food Safety in Food Security and Food Trade

Case Study: Reducing Pesticide Residues on Horticultural Crops

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2020 VISION
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Production and export of horticultural products are increasing rapidly in many developing countries. From 1970 to 2002, fruit and vegetable production in developing countries almost quadrupled from 256 to 960 million metric tons, while exports more than tripled from 1.9 to 6.5 million metric tons. Demand for these high-value commodities is stimulated by income growth, reductions in transportation costs, and, in some cases, increased market access. Production for export is often encouraged as a means of generating foreign exchange, increasing incomes to producers, and providing employment for the rural poor. Importing countries benefit from increased supplies of products that historically have been scarce and expensive in the off-season.

Rapid growth in horticultural production has been accompanied by heavy use of pesticides and by heightened concern over health effects associated with pesticide use and abuse. Heavy pesticide use occurs, in part, because numerous pests attack horticultural crops, including the fruit itself, reducing market value and yield on high-value crops. Pesticide use raises safety concerns for agricultural workers who apply pesticides. Concern is particularly high in flower production because of heavy spraying in enclosed conditions. Potential food safety risks from pesticide residues are also a significant issue for importers of fresh fruits and vegetables and a market-risk factor for exporters who may have shipments detained or rejected if residues exceed allowable limits.

Countries must strike a delicate balance between minimizing pesticide residues and maintaining other aspects of product quality, while also trying to eliminate pests from horticultural shipments. Pests, particularly exotic or potentially invasive ones, can cause detentions at ports as quickly as pesticide residues can. Rejection of even one shipment because of the discovery of an unknown pest at a port can result in the exporting country being placed on a quarantine list for that commodity, thus eliminating one import market. Repeated violations of residue requirements can result in automatic detention (inspection or fumigation or both) of all shipments from a country until it can document sufficient preinspection quality control. Developing countries are especially vulnerable to detentions as many of their horticultural exports are nontraditional ones for which preinspection protocols may not exist. Therefore, these countries seek pest management approaches that minimize pesticide use and residues, while providing high-quality, pest-free produce under preinspection procedures that can be documented.

Integrated pest management (IPM) systems that rely on biological, cultural, and other less chemically intensive approaches to pest management are one answer. IPM systems have been developed for several horticultural commodities in developing countries to minimize residues and provide preinspection documentation. These systems require cooperation between the public and private sectors and between exporters and importers. The three examples below demonstrate how applied research to support IPM can reduce pesticide use, residues, and export barriers. These examples are drawn from collaborative efforts under the U.S. Agency for International Development (USAID)-funded Integrated Pest Management Collaborative Research Support Program (IPM CRSP).

SNOW PEAS IN GUATEMALA

Commercial production of nontraditional fruits and vegetables for export has been the fastest growing segment of the agricultural industry in Central America for the past 20 years. Since the early 1990s, horticultural exports from Guatemala have been plagued by detentions and rejections at U.S. ports because of the presence of pesticide residues or pests themselves. Snow peas (*Pisum sativum*), a primary Guatemalan vegetable export, have been under automatic detention by the U.S. Food and Drug Administration (FDA) since 1992, initially because of pesticide contamination and recently because postharvest handling programs did not meet FDA requirements for preinspection protocols. From 1995 to 1997 all Guatemalan snow pea imports were quarantined (rejected) by the U.S. Department of Agriculture when the presence of the leaf miner *Liriomyza huidobrensis* was discovered in a shipment. The result has been reduced competitiveness for Guatemalan snow pea exports since 1992, and losses of $35 million per year during a ban from 1995 to 1997.

The government of Guatemala, in collaboration with IPM CRSP, provided research and technical assistance that resolved the snow pea leaf-miner quarantine problem. Researchers discovered that the leaf miner found during the 1995 inspection was not a species exotic to the United States and consequently did not threaten U.S. producers. The Guatemalan government undertook IPM research and developed strategies to reduce pesticide use and residues on snow peas and to enhance product quality. The IPM program has an onfarm research and training component and a preinspection component for postharvest handling, so that most snow peas are produced and handled in a manner consistent with U.S. standards. Snow pea IPM systems in Guatemala have been included in government-supported integrated crop management demonstration and training programs that cover practices such as pest identification and monitoring, trap cropping, soil disinfection, biorational pesticide use, and variety selection.

About half the snow peas produced in Guatemala come from one of three systems: farms that both grow and ship, cooperatives that market for many producers, or growers who

produce under contract to export firms. All of these supply channels have good preinspection protocols. Independent producers supply the other 50 percent of snow peas in open market areas. Many of these producers have not adopted preinspection protocols, which is why Guatemalan snow peas are automatically inspected in U.S. ports, even though the U.S. has lifted the ban. The IPM CRSP, the Government of Guatemala, and private exporters are working together to improve practices among independent producers. For those growers who have received training in IPM and preinspection protocols since the program began in the mid 1990s, rejections at U.S. ports have been reduced by 50 to 75 percent.

HOT PEPPERS IN JAMAICA

The Caribbean region, including Jamaica, is exporting increased quantities of vegetables, including hot peppers. Because Jamaican peppers have arrived at U.S. ports infested with gall midge (the pest was found in more than 100 shipments in 1998), the U.S. Animal and Plant Health Inspection Service (APHIS) instituted mandatory fumigation. Pepper exports from Jamaica declined by more than two-thirds from 1997 to 2000 as a result of the added cost of this fumigation. In response, USAID's IPM CRSP program and several agencies of the Jamaican government developed a multifaceted IPM program. As a result, shipments found to be infested with gall midge have dropped by more than 90 percent. APHIS removed the mandatory fumigation requirement in 2002, provided growers met several conditions: they had to participate in the IPM field control program, and those with shipments rejected for the midge would be removed from the program.

In this case, IPM strategies involve (1) improving cultural practices and reducing pesticide use in the field, (2) substituting a less costly and an environmentally safe fumigant for methyl bromide when pre-clearance fumigation is needed, (3) instituting a system that enables each shipment to be traced back to the grower, (4) monitoring gall midge progression in the field, and (5) training extension officers and farmers. The hot pepper case illustrates the importance of multi-institutional farmer-to-consumer strategies for implementing a successful IPM program. More than 400 farmers have been assigned traceability numbers so far this year.

HORTICULTURAL CROPS IN MALI

The growth of commercial agriculture in many African countries, including nontraditional periurban horticultural crops, has resulted in increased pesticide use in that region. Horticultural crops, produced in Mali after the subsistence crop harvest, are exported to Europe during the winter months to provide supplementary income to producers. As markets develop abroad, and food safety standards continue to tighten domestically and internationally, environmental quality laboratories (EQLs) are needed to satisfy market requirements for safe foods. In Mali, the IPM CRSP joined with local agencies to develop IPM programs to manage disease and insect pests while reducing pesticide use on vegetables such as green beans. These IPM programs train farmers in field schools and provide technical support and equipment such as EQLs for residue analysis. Through these investments, Mali is developing a quality-assurance program that can meet the stringent requirements of horticultural import markets in Europe. Such efforts show that African nations, which have historically applied fewer pesticides than other countries, are increasingly forced to address pesticide residue issues and can do so successfully.

CONCLUSION

These three cases illustrate (1) the need to institute preinspection programs that include both farm-level IPM and postharvest quality-control mechanisms if a country hopes to reduce pesticide residues and remain competitive in international markets for horticultural products, (2) the need for public/private partnerships to facilitate adoption and documentation of appropriate pest control procedures, and (3) the benefits of cooperation between public agencies in exporting and importing countries in developing preinspection protocols. The Guatemalan snow pea and the Jamaican hot pepper cases illustrate the potential that IPM research, combined with stringent preinspection programs, has for improving market access. The Guatemalan case also demonstrates the difficulty of instituting widespread preinspection programs to meet stringent guidelines when thousands of small farmers are involved. But market requirements may eventually force a shift toward more structured marketing channels if horticultural exporters are to meet quality and safety guidelines. If farmers fail to meet these guidelines, they will be excluded from lucrative markets. Smaller producers, therefore, will likely be forced over time to increase in size, produce under contract, or join a marketing cooperative in order to survive as exporters. ■

For further reading see IPM CRSP, *Ninth Annual Report 2001-2002* (Blacksburg, Va., USA: Office of International Research, Education, and Development (OIRED), Virginia Polytechnic Institute and State University, 2003); and J. W. Julian, G. H. Sullivan, and G. E. Sanchez, "Future Market Development Issues Impacting Central America's Nontraditional Agricultural Export Sector: Guatemala Case Study," *American Journal of Agricultural Economics* 82 (November 2000): 1177–1183.

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Food Safety in Food Security and Food Trade

Case Study: India Responds to International Food Safety Requirements

Shashi Sareen

2020 VISION
FOR FOOD, AGRICULTURE, AND THE ENVIRONMENT

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As awareness grows about food safety issues, the need for countries to provide greater assurance about the safety and quality of food also grows. The increase in world food trade and the advent of the Sanitary and Phytosanitary (SPS) Agreement under the World Trade Organization (WTO) have also raised interest in food safety requirements. To ensure a strong presence in global markets, India realizes the need to meet these challenges and keep pace with international developments. This brief reviews (1) how India utilizes the international framework for food safety standards set forth by the Codex Alimentarius Commission (hereafter referred to as Codex), and (2) how India provides safety assurances for exports and promotes access to international markets for exporters.

CODEX STANDARDS AND INDIA'S FOOD SAFETY SYSTEM

The SPS Agreement provides for harmonization of the SPS measures of member countries with the international standards set by Codex. The Agreement, however, allows members to lay down more stringent standards than those of Codex, providing they can be scientifically justified (see Brief 5).

In India, international standards, guidelines, and recommendations are increasingly used to guide domestic as well as international trade. The Directorate General of Health Services in the Ministry of Health and Family Welfare is working to integrate Codex standards into national food laws as much as possible. Where specific local needs justify more stringent requirements, specifications are being fixed based on scientific data. India is now reorienting its food laws to emphasize food safety as well as food quality. National standards for both domestic and export trade lay down parameters for pesticide residues, antibiotic residues, heavy metals, aflatoxin, pathogens, and other contaminants.

The Export Inspection Council of India (EIC), the official certification body for exports, is developing standards for exports based mainly on Codex, but it also takes into account that an importing country may impose stiffer requirements.

Because Codex standards are increasingly used as a benchmark for global trade, India has increased its participation in several Codex committees to ensure that domestic conditions are reflected in the development of international safety standards, thereby facilitating acceptance of Indian products in global markets. At Codex meetings, India has proposed that risk assessment studies be conducted in developing countries and that the resulting data be taken into consideration when framing Codex standards. Within India, risk analysis and setting of national standards are supported by new data generated at several research institutes.

The Hazard Analysis Critical Control Point (HACCP) approach has been recognized by Codex as a tool for assessing hazards and establishing control systems that focus on preventive measures rather than relying primarily on end-product testing. Besides incorporating the HACCP approach into the new hygienic codes, Codex is developing guidelines for applying HACCP systems to small or less-developed businesses. The Codex HACCP and food-hygiene standards have been adopted by the Bureau of Indian Standards, the national standards body in India. Food processing units are being encouraged to adopt these systems on a voluntary basis.

EXPORT INSPECTION AND CERTIFICATION

In view of the import controls being imposed by importing countries, export controls have acquired renewed relevance. Export certification, which had been made voluntary with liberalization, has once again been made mandatory by the Indian government in sensitive areas such as marine, milk, meat, poultry, and egg products and honey.

Inspection and certification in India has a regulatory basis in the form of the Export (Quality Control and Inspection) Act of 1963. The EIC was set up under this Act with statutory status to certify the quality of products for exports. Under the EIC, there are five Export Inspection Agencies (at New Delhi, Kolkata, Kochi, Chennai, and Mumbai) that carry out inspection and certification activities, with 41 suboffices and laboratories to provide backup. All inspection agencies are gearing up to implement ISO 17020, "General Criteria for the Operation of Various Types of Bodies Performing Inspection," issued by the International Organization for Standardization (ISO), as well as the Codex "Guidelines for the Design, Operation, Assessment, and Accreditation of Food Import and Export Inspection and Certification Systems."

The main system of export inspection and certification being followed in the Indian food sector is the Food Safety Management Systems-based Certification (FSMSC), which is founded on international standards including HACCP, Good Management Practices (GMP), and Good Hygiene Practices (GHP). Under this certification system, exporting firms are approved based on an assessment of how they measure up against international requirements. Approval is normally granted for two years, and the responsibility for maintaining quality lies with the firm. However, periodic surveillance, in the form of monitoring visits, supervisory visits, and corporate audits, is carried out to ensure continued conformity to the requirements. Through this system, international requirements are met and rejections reduced at the importing end.

All units approved by EIC necessarily have to implement HACCP/GMP/GHP at all stages of food production, in addition to meeting end-product requirements. There are also various export promotion bodies under the Ministry of Commerce and Industries that assist processors in implementing safety and quality-control systems. Today more than 1,000 units in India have been certified for HACCP, of which at least 400 are under compulsory export certification.

The export certification system is based on an HACCP approach that requires the processor to deal with the hazards

arising from contaminants in the raw material as well as during processing. Surveillance involves checking hygienic conditions in and records maintained by the units, and drawing and testing samples for various contaminants to ensure safety of the product.

The SPS Agreement encourages member countries to recognize the concept of equivalence in different safety measures. If the exporting member objectively demonstrates to the importing member that its measures achieve the importing member's appropriate level of sanitary or phytosanitary protection, the importing member is obliged to accept these measures. India is seeking equivalence agreements with the health authorities of major trading partners. The EIC has already been designated a competent authority by the European Commission (EC) for marine products and basmati rice and by the U.S. for black pepper. For these commodities the EIC has the authority to approve unit exports. It is awaiting similar recognition from the EC for egg, milk, and poultry products. The EIC has also signed equivalence agreements with Australia for marine products and with Sri Lanka for 86 items. It is negotiating an agreement in various sectors with Singapore and will soon have an agreement with Italy.

Under such agreements, in addition to recognition of EIC certification, both sides will exchange information on specifications, methods of sampling, inspections and tests, provisions for retest and appeal in case of rejections, and return of rejected consignments. Such agreements facilitate trade and also lead to less frequent inspection and rejection of India's products in overseas markets.

To meet these obligations, India needs to strengthen its regulatory framework. This process would include upgrading testing facilities to meet international as well as importing-country requirements; upgrading human capabilities or empowering personnel in areas of testing, risk analysis, and development and auditing of HACCP plans; developing GMP/GHP/HACCP modules for implementation at both domestic and export levels; and establishing databases on requirements of importing countries.

India is either funding these upgrades itself or seeking assistance under programs funded by the Food and Agriculture Organization of the United Nations (FAO) or the EC. Initiatives include

- ***Upgrading of laboratories.*** Laboratories are being strengthened in terms of equipment, manpower, and systems. The EIC laboratories used for export testing have been furnished with state-of-the-art instruments. To meet the requirements for testing, specifically for testing for chloramphenicol, nitrofurans, and other antibiotics, the EIC labs and five other government labs now have the capability to test at 0.02 parts per billion.
- ***Training and technical assistance.*** Training efforts in India focus on developing and upgrading skills of industry and government personnel. A Human Resource and Quality Development Centre has been established under the EIC. It offers EIC certification personnel a chance to keep abreast of the latest developments and take training programs for implementing and monitoring food-product certification. Similar training and awareness programs are being organized for industry on various issues, including HACCP, testing, milk quality, and rice quality.
- ***Establishing a database on importing-country requirements.*** Information on regulations and specifications regarding methods of sampling, inspection, and testing in various countries is often unavailable or available only in the language of the importing country. This lack of clarity about specific requirements can sometimes lead to rejection at the point of import. EIC is building a database of requirements of major import partners that can be accessed by exporters. Technical assistance in this area has been sought from the EC.

Some importing countries are imposing unjust measures that conflict with Codex and impede trade. Some of these measures include applying standards more stringent than Codex without carrying out a risk analysis, destroying nonconforming consignments, imposing new requirements without notification or information, and applying test methods that may be different from internationally specified ones. To work out solutions to such issues, India is entering into dialogue with importing governments.

CONCLUSION

The safety measures described here have led to increased export of food products and fewer inspections and rejections. The impact has been especially significant in the marine sector, in which export certification has been in operation since 1997. In other areas such as milk and egg products, in which certification has only recently been introduced, efforts are still underway to obtain recognition of Indian certification by the EC, Australia, and other countries so that Indian products can gain access to these markets.

In spite of all of the measures taken by India and other developing countries to improve quality and strengthen safety systems, rejections by developed countries continue as they impose additional, new, and often unjustifiable SPS requirements. Such requirements include testing a wider range of antibiotic residues, destroying rejected consignments, specifying requirements without scientific justification, and using highly sensitive test methods based on testing capability rather than scientific need. These measures raise testing costs and lower competitiveness of exports from developing countries.

India is trying to take advantage of WTO nontariff agreements to address these obstacles. Thereby, Indian producers are hoping to gain further access to global markets while providing safe products. Developed countries need to recognize these efforts and make their own efforts to facilitate trade, rather than to impose new nontariff measures to protect their producers. ■

For further information see the Export Inspection Council website at <www.eicindia.org>.

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Food Safety in Food Security and Food Trade

Case Study: Supermarkets and Quality and Safety Standards for Produce in Latin America

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2020 VISION FOR FOOD, AGRICULTURE, AND THE ENVIRONMENT

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Food safety standards that developed countries impose on developing-country exports have sometimes created a barrier to market access. But in Latin America today, the standards set by supermarkets in the region affect local producers far more than do those imposed by developed countries. Latin American farmers sell 2.5 times more to supermarkets within their own countries than they export to the rest of the world. Drawing on case studies from several Latin American countries, this brief focuses on how supermarkets in the region have gone about imposing quality and safety standards on producers of fresh fruits and vegetables for the domestic market.

Supermarkets in Brazil, Costa Rica, Guatemala, Honduras, and Nicaragua hold 75 percent, 50 percent, 35 percent, 20 percent, and 10 percent of the retail food market, respectively. Supermarkets' share of the retail market in fresh produce lags behind their overall share of the retail food market. In Brazil, for example, supermarkets claim only about 30 percent of retail trade in fresh produce; the figure in Costa Rica is barely 10 percent. But supermarket retailing is rapidly overtaking traditional forms of food retailing in all of Latin America.

Supermarkets in the region have an incentive to impose quality and safety standards on fresh fruits and vegetables because doing so improves the health value of produce and the state of public health. Moreover, supermarkets have the kind of large consumer base and efficient retail approach that allows them to make profits from imposing quality and safety standards. Since supermarkets buy a significant portion of local produce and have the appropriate monitoring capacity, they can demand safety and quality from their suppliers of fresh produce. Higher standards for fresh produce may alter the structure of production in that sector and affect the rate of return of small producers diversifying into those commodities.

THE EVOLUTION OF SUPERMARKET PROCUREMENT OF FRESH PRODUCE

Procurement systems for the supermarket chains in the study countries have changed as follows: (1) they have shifted away from reliance on traditional wholesale markets for fresh produce toward the use of specialized wholesalers dedicated to supermarkets; (2) procurement has been consolidated through the use of centralized distribution centers that serve the entire supermarket chain in a zone or a country. The specialized wholesalers classify the quality of products collected from suppliers, often produce fruits and vegetables themselves, and often have semi-contractual relations with suppliers (providing them with credit or technical assistance, or specifying the quality and safety standards required by final buyers).

Why has the shift from traditional wholesalers towards specialized wholesalers occurred? Supermarket chains tend to find that traditional wholesalers provide an inferior product because they do not adhere to quality and safety standards and that they provide inadequate service because they wield significant bargaining power in the wholesale markets. Supermarkets continue to procure from traditional, or nonspecialized, wholesale markets only when they cannot make arrangements directly with producers through existing distribution centers.

SUPERMARKETS AND THE IMPLEMENTATION OF PUBLIC AND PRIVATE SAFETY STANDARDS

It is important for supermarkets to distinguish between quality and safety issues with regard to fresh fruits and vegetables. In general, the primary standard imposed by supermarket chains in the study countries is for quality, relating to appearance and size. This standard is strictly enforced and monitored in every shipment from the distribution centers of specialized wholesalers responsible for procurement of fresh produce. Interview after interview in our studies clearly shows that once the hurdle of cost is passed, quality becomes the central focus of the procurement agent. In the predominant supermarket chains in the most demanding consumer markets, particularly Brazil and, increasingly, Costa Rica, product safety nearly matches quality as the main consideration in procurement after cost.
Supermarkets compete with each other primarily on the basis of cost, and therefore tend to stay within 10-30 percent of prices set at the street fairs and central markets that still dominate informal, or traditional, retail of fresh produce.

Thus, quality becomes crucial in differentiating the supermarkets' product from that of traditional markets and street fairs. With the help of centralized, mass procurement of products adhering to specified quality standards, supermarkets hope to drive down costs over time while maintaining quality, and thus increase market shares. Supermarket chains are helped in this regard by their decision not to pay producers a price premium for goods of high quality. Instead, they set a price and then screen for minimum levels of quality. In all the chains we studied, the supplier must maintain quality and bears the cost of products that do not meet specified quality standards.

With respect to the safety issues (presence of microbial pathogens or pesticide residues) related to fresh fruits and vegetables, sharply declining levels of standards are imposed by supermarkets as one goes from the more developed to the less developed countries within Latin America. Safety standards are made more stringent when both the incentives for raising standardsædue to the "quality consciousness" of consumers, for exampleæand the capacity to impose standardsærising from the ability to institute public food safety regula-

tions and perform pesticide and E. coli testsæincrease with countries' income and development levels.

In Brazil and Costa Ricaæthe only two countries in which supermarket chains impose and enforce safety standards for fresh produceæpublic regulations or standards governing fresh produce safety exist, but they were instituted only in recent years. These regulations generally are not applied in the informal retail sector and wholesale markets for fresh produce. Enforcement of public regulations tends to be the domain of the modern, large-scale food industry, which has the incentive and capacity to carry out such work. Moreover, in the case of the Brazilian chains, the safety standards applied are private standards that go beyond the requirements of public regulations.

How the chains use safety as a marketing tool varies. The lead chains in both Brazil and Costa Rica do not make specific product safety claims, but they do allow suppliers to use such labelingæeven though the chains do not verify the claims on the labels. Supermarket chains in both countries, however, do tell consumers that they test for water safety and pesticide residues in an effort to project a more positive image of their fresh fruits and vegetables.

In Guatemala, Honduras, and Nicaragua some products are sold with organic labels, and a few products from a major supplier are sold with third-party certification for food safety. But the supermarket chains do not require or enforce any fresh produce safety certification except for organic produce. Some suppliers do undertake voluntary safety labeling on a few products, in order to gain a competitive edge.

The use of safety labeling in Guatemala is the result of a unique program that promises to be adopted by Guatemalan supermarket chains and that could be a useful model for other countries. The Agricultural and Environmental Integral Protection Program (PIPAA) is a public-private entity that is in charge of meeting the export standards required by importing countries. After managing the snow pea pesticide dilemma of 1991-1993, as well as the raspberry Cyclospora case since 1996 (see Briefs 7 and 10), this entity now has years of experience in working with international agencies on the quality of export products. PIPAA's expertise has been funneled into a new service known as the Safety Certification Seal to address local and regional market certification needs. Some producers that supply the biggest supermarket company in Guatemala are upgrading their production systems with this new program, though it is not yet mandatory. The leading chain in Guatemala, La Fragua, is, however, creating its own safety labelæthe Paiz Labelæwhich it will put on packages and produce from suppliers that are certified by PIPAA. La Fragua will use its Paiz Label in lieu of the PIPAA label because they, and retailers in general, want safety labels that provide a competitive advantage to their stores, and not to their suppliers.

CONCLUSIONS

The key points concerning quality and safety standards and the procurement systems that supermarkets in Latin America use for fresh produce can be summarized as follows: (1) the incentive to apply both quality and safety standards will increase as supermarkets cater to richer consumers, because consumers with relatively high incomes have the luxury of worrying about the quality and safety of produce; (2) in the short to medium run, the incentives for supermarkets to "get quality right" will be stronger than those to "get safety right" for most fresh fruits and vegetables (leafy green vegetables are the exception because they have an image among consumers in most countries of being potentially unsafe); (3) private safety certification will adopt public safety standards where they exist, or will conform to internationally established safety standards, such as Good Agricultural Practices; and (4) supermarkets' capacity to implement quality and safety standards will increase as their buying power exceeds that of suppliers, or, in other words, the more they centralize their own procurement systems and rely on contracts and direct relationships with producers.

The case studies drawn on for this brief show how rapidly the adoption of quality and safety standards for fresh produce is influencing markets in Latin America. The vast majority of fresh fruits and vegetables currently acquired by supermarkets come from medium to large farms. As supermarkets compete with each other and with the informal sector, they will not raise consumer prices in order to pay for the farm-level investments needed to meet quality and safety requirements. Thus a challenge is presented to farmers. Who will pay for safe-water wells; for latrines and hand-washing facilities in the fields; for record-keeping systems; and for clean packing houses with cement floors? The supplieræor farmerædoes and will bear the financial burden of these costs. Small farmers face an especially difficult challenge, because they lack access to credit and have the burden of large fixed costs. Higher quality and safety standards mean that consumers will ingest fewer pesticides and harmful microbes, and generally eat higher-quality fresh produce, but they also mean that agricultural development programs must take on the responsibility and challenge of assisting small farmers in making the transition to producing safer and higher-quality produce. This is especially important in the study countries, given their weak public support systems for agriculture. ■

For more information see T. Reardon and J.A. Berdegué, "The Rapid Rise of Supermarkets in Latin America: Challenges and Opportunities for Development," *Development Policy Review* 20 (No. 4, 2002): 317-34; and L.A. Thrupp, *Bittersweet Harvests for Global Supermarkets: Challenges in Latin America's Agricultural Export Boom* (Washington, DC: World Resources Institute, 1995).

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Food Safety in Food Security and Food Trade

Case Study: Beef Industry in China

Colin G. Brown and Scott A. Waldron

2020 Vision for Food, Agriculture, and the Environment

Focus 10 • Brief 13 of 17 • September 2003

The beef industry provides a window on food safety issues in China's rapidly developing economy. This industry provides particularly useful insights because the government has targeted it for development and because it is dominated by household slaughtering and wet markets, making food safety concerns pervasive.

Balancing industry growth and development with improved food safety is not a straightforward matter. Regulations and policy initiatives aimed at modernizing Chinese beef supply chains for the mass market along Western lines are not necessarily desirable or feasible. However, greater consumer assurance about the inspection of cattle slaughtering and beef distribution may help grow the mid-value sector of the Chinese beef industry, which is vital to sustainable industry and rural development.

BEEF SUPPLY CHAINS, CONSUMER PREFERENCES, AND FOOD SAFETY

The Chinese cattle and beef industry is extremely diverse. (For the purposes of this brief, only key aspects relevant to food safety will be discussed.) Prior to market-oriented reforms that began in the late 1970s, beef in China came from cull cattle only. A state network produced and distributed almost all of this beef among the Muslim (mainly Hui) community.

In the 1980s, market-oriented reforms had various impacts. First, restrictions on the slaughter of cattle were removed and specialized beef cattle production began to occur. Second, many households became involved in slaughtering and selling cattle and retailing beef and offal. Slaughter households competed with state abattoirs under the General Food Company (GFC) network. Many county-level abattoirs were established from the mid-1980s onward as a result of fiscal reforms that encouraged local investment and in response to a growing demand for beef in China and other countries, such as the former Soviet Union.

Although the beef industry in China is diverse, a simplified distinction can be made between the mass market and the remaining premium market. The mass market accounts for almost 90 percent of all cattle slaughtered in China. Sold as fresh, low-value, undifferentiated beef in local wet markets, mass-market beef comes primarily from cattle killed by slaughter households. Most of these households are of Hui ethnicity and many also operate beef stalls. The remaining beef sold in wet markets comes from GFC abattoirs. However, the price of beef received at these markets (around RMB14/kilogram, approximately US$1.70 when these prices were observed) is insufficient to maintain the viability of GFC abattoirs, which need to sell at least some of their beef in premium markets. Slaughter households generate modest profits of around RMB0.32/kilogram of beef by selling in the mass market, while GFC abattoirs incur a loss of around RMB2.53/kilogram of beef. GFC abattoirs cannot compete with slaughter households because of their higher overhead and labor costs. Thus many GFC abattoirs have been "mothballed," operated at very low levels of capacity, or undergone restructuring.

Hygiene in the mass market is poor, both for cattle slaughtering and beef distribution. The risk of food contamination is extremely high, but its severity is tempered by the short time interval between slaughter and consumption (often 8 to 16 hours) and by Chinese cooking methods. Although consumers in this low-value market may have food safety concerns, price is paramount. Both slaughter households and markets are supposed to be inspected, but this does not occur, even for beef sold in various markets in Beijing.

About 10 percent of slaughtered cattle is sold through a small but growing premium market. For the highest quality beef, five-star restaurants and hotels and related outlets purchase at prices of up to RMB150/kilogram. These prices apply to specific cuts of beef that carry an assurance of safety and such quality attributes as tenderness. Much of this extremely limited market is supplied by overseas beef exporters, although some comes from a select group of trusted Chinese suppliers. Modern abattoirs have been built and some GFC abattoirs refurbished to exacting hygiene standards with the aim of supplying this high-value domestic market as well as lucrative export markets in Japan and South Korea.

The mid-value part of the premium market is the most rapidly growing part of the beef sector. Its prices modestly exceed those in the mass market. Price premiums relate not so much to quality attributes—although the beef is more differentiated than in the mass market—but to the assurance of a safe product. Beef sold through state stores, sourced from abattoirs perceived to be regularly inspected, or sold in markets promoting hygiene and "guaranteeing" safe beef, serves the mid-value market. Beef sold in state stores typically commands a premium of around RMB6/kilogram over the mass-market price. Consumers who buy mid-value beef are affluent urban residents concerned about food safety and willing and able to pay a premium for safe beef.

In response to food safety concerns, the Ministry of Agriculture has established "Green Food" certification for a wide range of foods, including beef. In the cattle production stage, certification prohibits the use of growth promotants, imposes withholding periods for some veterinary products, and sets national standards that must be met on the use of feed additives and antibiotics. In the processing and distribution stages, hygiene levels are set in conjunction with the Ministry of Health. Surveys reveal that affluent consumers are prepared to pay premiums of 20 to 30 percent for a variety of "Green Foods."

KEY REGULATORY MEASURES

The Chinese government's response to public concerns over the safety of meat products encompasses many segments of the beef marketing chain, making inspection mandatory from the ante-mortem to the retail outlet stages. At the beef distribution stage, the intent has been to close down smaller, less hygienic markets and restrict the sale of beef to larger wholesale and retail markets that have higher standards and are regularly inspected. However, many smaller beef dealers remain outside the practical control of local government health and hygiene authorities.

Another important regulation has been the restriction of livestock slaughter activities to designated locations. These measures have their origins in 1992 rules that initially targeted the pig industry but which were implemented more widely and forcibly in 1997. Despite efforts at enforcement over several years, there is still a great deal of variation in the way this regulation has been interpreted in different regions. Some regions have banned household slaughtering. Others have decided that designating slaughter points does not prohibit household slaughtering—it only requires that slaughtering occur at designated and inspected facilities. The regulation seeks to ensure proper ante- and post-mortem inspection of cattle and more hygienic slaughtering, but the reduction in number and the centralization of slaughter points also facilitates the collection of slaughter and product taxes.

IMPROVING FOOD SAFETY AND RURAL DEVELOPMENT

Linkages between the beef industry's development and food safety vary among different value segments of the beef market. In the low-value mass market, the upgrading and centralization of markets and slaughter facilities will increase costs in what is an already competitive food market in which consumers resist higher prices. Introducing more stringent hygiene standards for beef marketing may increase supply costs beyond those that consumers are willing to pay, pricing beef out of local markets.

Many GFC abattoirs see food-safety regulations as advantageous because they restrict competition from household slaughtering. However, even if some regions do interpret regulations in a way that effectively bans household slaughtering, GFC abattoirs are unable to profitably supply low-value mass markets.

One way to achieve the multiple objectives of maintaining a vibrant household slaughter sector, improving inspection and hygiene, and utilizing existing GFC abattoir facilities is to operate GFC abattoirs as designated slaughter points that offer slaughter facilities. Slaughter households could use the facilities for a fee but retain ownership of the beef and by-products. If centralized abattoirs facilitate timely and efficient distribution of wet beef to consumers, they will reduce both risk (through greater inspection and cleaner facilities) and hazard (through more timely distribution). However, in rural areas where designated slaughter points are not available, systems must be put in place to ensure efficient redistribution of beef to local wet markets. Otherwise centralization of slaughtering will increase the hazard and be counterproductive in terms of food safety.

For slaughter households, designated slaughter points may overcome some of the problems of a fragmented system by providing access to centralized cold storage and distribution facilities as well as to a more competitive and larger trading environment for beef and by-products. Such facilities come at a cost. Given the already low margins of slaughter households, they are unlikely to slaughter at these points. If public benefits arise from designated slaughter points—be they health- or tax-related—there might be grounds for subsidizing and promoting these facilities and services. Such investments may be better for local governments than large-scale, top-down projects if the goals are to provide the local mass market with safer beef while maintaining participation from local slaughter and trading households.

The situation for premium markets is very different, because efforts to assure safer beef are likely to grow the premium market. A system that enhances consumer knowledge and belief in food safety will facilitate the payment of premiums by more affluent consumers—premiums needed to ensure a more sustainable cattle production and slaughter sector in China. By not being able to guarantee product safety through the market, up-market hotels and restaurants have been forced into making direct arrangements with particular beef suppliers. The costs to enter these barely competitive direct marketing arrangements can be significant, especially when hotels are trying to decrease their food storage capacity. Thus measures aimed at developing greater safety assurance may also expand this up-market segment.

CONCLUSIONS

Following rapid, production-driven growth during the 1980s and 1990s, the cattle and beef industry in China is now entering a phase of modernization and maturation. A key facet of this maturation is attention to food safety and development of quality assurance systems. Although such attention is warranted and desirable, food-safety measures carefully targeted to each market segment are needed to avoid unintended adverse effects and to meet industry and rural development objectives. ■

For further reading see C. G. Brown, J. W. Longworth, and S. A. Waldron. "Food Safety and Development of the Beef Industry in China," *Food Policy* 27 (2002): 269—84; J. W. Longworth, C. G. Brown, and S. A. Waldron, *Beef in China: Agribusiness Opportunities and Challenges* (St. Lucia: University of Queensland Press, 2001); and S. A. Waldron, C. G. Brown, and J. W. Longworth, *Rural Development in China: Insights from the Beef Industry* (Aldershot, UK: Ashgate Publishing, 2003 forthcoming).

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Food Safety in Food Security and Food Trade

Case Study: The Poultry Industry in Colombia

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2020 Vision for Food, Agriculture, and the Environment

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As developing countries open their economies further to trade, their food industries are striving to raise safety and quality standards in order to compete in new markets. Such is the case with the Colombian poultry industry, which is confronting challenges arising from World Trade Organization (WTO) efforts to reduce trade barriers and from regional free trade agreements such as the Andean Community of Nations (ACN) and the Free Trade Area of the Americas. Critical questions face the Colombian poultry industry: Is it ready to compete with foreign poultry producers on price, quality, and safety? Can industry efforts to produce better quality products assure an increased share of domestic and regional markets? This brief reviews the private initiatives undertaken by the Colombian poultry industry to assure food safety in light of these questions.

THE POULTRY INDUSTRY

Poultry constitutes one of the most dynamic food industries in Colombia. In the last 20 years, domestic production has increased nearly fourfold, while chicken and egg consumption per capita has tripled. Today, poultry is the second largest source of protein, accounting for 40 percent of total meat consumption and 10.5 percent of agricultural gross domestic product.

Trade liberalization policies and participation in regional free trade agreements have substantially affected the industry. Input supply sources have expanded and input prices have fallen. While inputs may be more readily available under free trade, the market for poultry products has become more competitive. At the same time, demand in developing countries is expanding rapidly. For Colombian producers to take advantage of new markets, however, their prices must be competitive. The industry is responding with a strategy to reduce costs that includes widespread vertical integration and rapid consolidation. Significant cost reductions have been achieved in the past 10 years, yet import prices of various poultry products are still below domestic prices and the industry is striving for further efficiency. Managers believe that improved efficiency can open new markets in neighboring ACN countries such as Venezuela and Ecuador.

The industry recognizes that while cost-reduction initiatives are necessary to compete, product quality and safety are also critical. The industry has two compelling reasons to improve quality and safety. First, food safety and animal health regulations have often been used against Colombia and other Andean countries to restrict their poultry trade. As Colombian standards improve and rules are defined for the trade of fresh products under the WTO's Sanitary and Phytosanitary Standards (SPS) agreement (see Brief 5), it will become easier to meet health and safety standards, thus facilitating trade. Second, as consumers' awareness of food safety increases, the market is likely to reward producers who meet safety standards and punish those who do not. These reasons, along with new regulations, have motivated the industry to launch a quality assurance program (QAP).

FOOD SAFETY REGULATION IN COLOMBIA

In 1997, the government approved a food safety regulation to be enforced by the newly established National Institute for Food and Drug Surveillance (INVIMA). This rule substantially increases standards for fresh products and shifts the emphasis from inspection of final product to process control. The rule requires companies to document compliance with Good Manufacturing Practices (GMPs). It also embraces the minimum standards defined by the Codex Alimentarius Commission. In 2002, the government approved a regulation that recommended adoption of Hazard Analysis Critical Control Point (HACCP), established parameters for certification of HACCP plans, and defined rules for quality assurance labels.

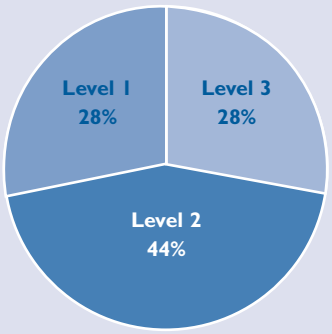
THE QUALITY ASSURANCE PROGRAM AND ITS IMPACT

Public regulation sets the context for private efforts. In 1998, the National Federation of Poultry Producers (FENAVI) responded to the combined challenges of increased competition, stricter regulation, and trade liberalization by launching an industry-wide QAP. Financial support comes from a FENAVI-administered fund, into which each producer pays according to its volume of production. The program, which brought together all 50 Colombian poultry processing companies, initially emphasized education about quality assurance systems and process-control approaches to food safety. In the next stage, 20 processing plants were selected to take part in a HACCP pilot plan. Each poultry processor formed a quality assurance group responsible for implementation, and FENAVI visited each plant to provide on-site training and assess the companies' GMP/HACCP plans. These assessments rated sanitary profiles, cleanliness and disinfection, training, equipment and instrument calibration, and HACCP plan implementation.

In 2000, FENAVI started the second phase of the QAP, extending participation to 32 companies. To develop a baseline for measuring program performance, these companies were divided into three levels (see figure). In 2000, Level 1 included 9 companies that had fully implemented GMPs and developed their HACCP plan. They were believed to be ready for certification within six months. Level 2 consisted of 14 companies that had implemented 8599 percent of their GMPs, were

completing process modification investments, and were developing their HACCP plan. Finally, Level 3 included 9 companies with the lowest levels of GMP/HACCP implementation. FENAVI estimated that companies in levels 2 and 3 could achieve certification in 12 to 18 months. Meanwhile, a system to monitor progress was put in place, which included an annual visit to each company to rate its QAP.

Companies complying with the Quality Assurance Program, 2000



Source: FENAVI.
Note: Level 1 represents the highest degree of compliance.

By the end of 2002, the QAP had achieved the following goals:

- Significant progress in the implementation of GMP/HACCP: 26 companies had operating HACCP plans and had achieved at least 85 percent compliance with the recommended sanitary practices.
- Seven companies obtained HACCP certification, and INVIMA expects to certify another nine companies in 2003.
- Annual costs of the QAP were estimated at about 1 percent of the annual sales of the participating companies.
- Benefits of the program include increased durability of products in storage; adoption of new technologies that help lower production costs; fewer returns from buyers; and increased control of production processes.

REMAINING CHALLENGES

The QAP achievements are significant, yet several problems remain. First, in Colombia and other Andean countries, a large number of small poultry establishments operating in the informal economy are not regulated by the government. These companies have lower production costs and much lower food safety standards than their legally established counterparts. Therefore, one of the most important questions facing the industry is whether HACCP should be mandatory, so that all poultry-processing establishments are inspected and competing under similar conditions. While such a mandate would require all companies to invest in food safety, it might also restructure the industry and reduce opportunities in the informal sector.

A second issue is the lack of market incentives for investments in food safety. While the QAP raises the industry's already high costs, most industry executives agree that consumers will not pay higher prices for safety. They concede, however, that consumers may increase purchases from companies with higher standards.

To increase the demand for safe, high-quality poultry, the industry needs an aggressive strategy to educate consumers about the benefits of safer and higher quality products, but it is difficult to launch an advertising campaign when not all of the companies participate in the QAP. Should the QAP be made mandatory and FENAVI empowered to conduct an advertising campaign emphasizing the safety and quality of poultry products?

A third problem is top management's moderate level of commitment to the QAP. In the absence of price premiums and demonstrated demand for food safety, quality assurance is not a priority for many companies. Consequently, many have been slow to implement their QAPs. To secure stronger management commitment, FENAVI must document the program's benefits, such as more efficient production, lower volume of returns, and increased control of production processes. Economic studies should be conducted to show how quality assurance can increase market share.

CONCLUSIONS

This case study shows how an industry in a developing country deals with the increasingly pressing issue of food safety in the context of domestic and regional markets. In the case of the Colombian poultry industry, the QAP was possible because the industry took the initiative privately and funded it cooperatively through FENAVI. Although this three-year-old program has produced substantial benefits, its ultimate success will depend on answers to these essential questions:

- Will the industry succeed in creating marketing incentives for food safety investment by educating consumers about food safety?
- Will the industry agree to make participation in the quality assurance program mandatory?
- Will industry executives view quality assurance as a long-run strategy to gain market share in domestic and regional markets? ■

For futher reading see FENAVI's website <http://www.fenavi.org>.

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Food Safety in Food Security and Food Trade

Case Study: Reducing Mycotoxins in Brazilian Crops

Elisabete Salay

2020 VISION FOR FOOD, AGRICULTURE, AND THE ENVIRONMENT

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Mycotoxins are toxic chemical compounds produced by molds, which can have important consequences in human and animal health (see Brief 3). The most important mycotoxin types are aflatoxins B1, B2, G1, and G2; fumonisin B1; T-2 toxin; zearalenone; ochratoxin A; and deoxynivalenol. In humans the presence of mycotoxins in foods can be cumulative, leading to cancers and immune-deficiency diseases. Immediate, acute symptoms may also occur. Either way, the effects are not entirely understood. In animals, mycotoxins can reduce production efficiency, increase the death rate, and reduce feed conversion efficiency. When present in feed, some mycotoxins can pass into eggs or milk and subsequently prejudice human health.

The economic consequences of the presence of mycotoxins in food, feed, and agricultural crops can be severe. In fact, mycotoxins jeopardize the safety and availability of the food supply in many countries. The Food and Agriculture Organization of the United Nations (FAO) has estimated a worldwide loss of about one billion metric tons of foodstuff per year as a result of mycotoxins.

The control of mycotoxins is a complex process: an integrated quality control program is needed throughout the production chain, since molds producing mycotoxins can either penetrate food before harvest or contaminate food products during the postharvest stages. To protect public health, governments have implemented different types of safety control procedures, including the setting of permitted limits for mycotoxins.

On the international commercial scene, some countries have established rigid standards for mycotoxins in food and feed that have negatively affected the exports of developing countries. Although the Sanitary and Phytosanitary (SPS) Agreement of the World Trade Organization recognizes the standards established by the Codex Alimentarius Commission, countries in the European Union and some Asian countries have set maximum limits for mycotoxins that in some cases are stricter than those recommended by the Codex. This is allowed under the SPS agreement as long as it is supported by scientific risk assessment. However, these stricter standards can pose additional barriers for exporting countries. A World Bank study estimates that European Union regulation of aflatoxin costs African countries US$670 million each year in export losses (see Brief 6).

Not only has the international food market become more stringent, but in Brazil companies and consumers alike have become increasingly concerned about the dangers of mycotoxins in the diet. Both public and private initiatives have been put forward to deal with the mycotoxin problem.

Brazil has not estimated its economic losses from these contaminants, nor is there an official data bank on the occurrence of mycotoxins in food products. Although not always representative of Brazil as a whole, surveys carried out by research groups indicate that aflatoxins are present in peanuts and fumonisins in maize, and that contaminants can be found in other food crops as well.

INITIATIVES IN THE PUBLIC SECTOR

In Brazil, the only food safety standards for internal consumption defined by law are for aflatoxin. These standards are set by the Ministry of Health for industrialized products (with some exceptions such as beverages), and by the Ministry of Agriculture, Livestock and Supply for animal feeds, products of animal origin, and agricultural products, among other food and feed commodities. The standards allow a maximum of 20 micrograms of aflatoxins B1 + B2 + G1 + G2 per kilogram of peanuts, peanut butter, maize grain, or maize flour destined for human consumption. And the standards call for a maximum of 50 micrograms of total aflatoxins per kilogram of raw materials destined for feed use. The Codex Alimentarius Commission and the European Union have suggested maximum limits lower than the Brazilian standard for aflatoxins in peanut products that are subject to further processing (15 micrograms in the case of the Codex and 10 micrograms in the case of the EU). For foods for direct human consumption, the European Union recommends an aflatoxin maximum of 4 micrograms per kilogram of product.

In 2001, the Ministry of Agriculture, Livestock and Supply instituted efforts to promote better controls and monitoring throughout the food system. The new program integrates the activities of monitoring, control, inspection, and tracking of contaminants, including mycotoxins. It will be implemented throughout the production chain, promoting and instituting Good Manufacturing Practices and Hazard Analysis and Critical Control Points (HACCP) principles in order to certify conformity with national standards for mycotoxins. Given the related safety mandates of the Ministry of Agriculture, Livestock and Supply and the Ministry of Health, the program will involve joint action by these two ministries. The Ministry of Health has proposed norms for Good Manufacturing Practices for the processing industry, and these are currently in the public consultation phase.

In January 2002, changes were made in laboratory certification procedures. A laboratory authorized by the Ministry of Agriculture, Livestock and Supply must test for the presence of mycotoxins in food such as peanuts, peanut products, and Brazil nuts, if an importing country requires such tests. In addition, all batches of peanuts and peanut products, maize and maize products, dried fruits, and popcorn can only be imported after a test for mycotoxin has been conducted. Importing or exporting companies have to bear the costs for these tests.

INITIATIVES IN THE PRIVATE SECTOR

During the 1960s and until the beginning of the 1970s, Brazil produced up to 1 million tons of peanuts annually. It exported this crop largely in unshelled and shelled form, as pressed meal, and as oil. Partly because of the aflatoxin problem, peanut exports and total peanut production have fallen continuously since the 1970s. At present, Brazilian production is in the neighborhood of 197,000 tons per year, in marked contrast with other traditional producers such as India (4 million tons), China (1.9 million), and the United States (1.7 million). Brazil currently exports extremely small quantities of peanuts.

The occurrence of aflatoxins has not only reduced exports of peanuts themselves, it has also raised concerns among Brazilian consumers and businesspeople about their candy industry. Currently, Brazilian peanuts are mostly consumed in the form of sweet and savory candy. Note that Brazil is the second largest candy manufacturer in the world and an exporter to the rest of Latin America. In 2001, the Brazilian Association of Cacao, Chocolates, Candies and Byproducts Industry (ABICAB) created the "pro-peanut" program, with the objective of offering safe peanut products to consumers. As a result quality control of products on the market is carried out in a systematic and methodical way. Product samples are collected and tested for aflatoxins. If a food item is found not to be in compliance with Brazilian standards, the producer may be notified directly or even denounced to the Ministry of Health. Safe products receive the "ABICAB Peanut Quality" seal. In promoting the consumption of peanuts, ABICAB also disseminates positive information about the product and stimulates the development of new technologies throughout the peanut production chain. Peanut candy can already be found on the Brazilian market bearing the ABICAB seal, thus fulfilling a consumer demand. ABICAB hopes first to help the national market recover and then to expand exports of peanut products.

In 2001/02 Brazil produced 35.3 million tons of maize. The private sector is working to reduce mycotoxins in maize used for animal feed (about 65 percent of national production). A survey of the maize-based animal feed companies, which operate mostly in the domestic market, showed that the majority already carried out mycotoxin analyses, at least for aflatoxin, which is subject to government regulation. However, a good number of feed companies also controlled levels of unregulated mycotoxins, such as zearalenone, ochratoxin, T-2, vomitoxins, and fumonisins. They did so because they raised livestock, and mycotoxins can reduce the efficiency of livestock production. These companies also invested in broad contaminant controls to increase their competitiveness and fulfill client demands. The companies do believe, however, that the costs of mycotoxin analyses are very high, with capital investment of about US$55,900, and between US$0.02 and 0.06 per ton of feed per month.

CONCLUDING THOUGHTS

Both the public and private sectors in Brazil are making a concerted effort to control mycotoxins in foods consumed by both humans and animals. These initiatives appear to be driven by both the international food market and the domestic food and feed market. Additionally, public and private actors realize that problems arising from mycotoxin contamination can affect the market for an entire production sector and not simply the market for isolated companies that fail to implement adequate food safety controls. Therefore, incentives exist for industry-wide improvement. The public sector has played a significant role in defining standards by regulating the maximum permitted limits for all mycotoxins that represent a danger to consumer health—an important step in guaranteeing food safety. Given that mycotoxin contamination can originate either before or after harvest, it should be controlled at all stages of the production chain. To achieve this, government, in partnership with the private sector, must maintain and expand its recently implemented programs, including the principles of Good Manufacturing Practices and HACCP. ■

For further reading see T. Otsuki, J. S. Wilson, and M. Sewadeh, "Saving Two in a Billion: Quantifying the Trade Effect of European Food Safety Standards on African Exports," *Food Policy* 26 (2001): 495-514; and E. Salay and A. Z. Mercadante, "Mycotoxins in Brazilian Corn for Animal Feed: Occurrence and Incentives for the Private Sector to Control the Level of Contamination," *Food Control* 13 (No. 2, 2001): 87-92. Also see the websites of the Brazilian Sanitary Surveillance Agency (www.anvisa.gov.br), the Brazilian Association of Cacao, Chocolates, Candies and Byproducts Industry (www.abicab.org.br), and the Ministry of Agriculture, Livestock and Supply (www.agricultura.gov.br).

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FOOD SAFETY IN FOOD SECURITY AND FOOD TRADE

Food Safety and GM Crops: Implications for Developing-Country Research

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2020 VISION FOR FOOD, AGRICULTURE, AND THE ENVIRONMENT

FOCUS 10 • BRIEF 16 OF 17 • SEPTEMBER 2003

In the developing world the approval and cultivation of genetically modified (GM) crops is largely limited to the commercial production of insect-resistant cotton in Argentina, China, India, Mexico, and South Africa. Approvals of GM crops used for food or feed lag far behind cotton: a single transgenic maize event (an instance of genetic modification) has been approved in the Philippines and South Africa, and a single transgenic soybean event has been approved in Argentina, Mexico, South Africa, and Uruguay. Argentina has also approved six GM corn events for cultivation. In contrast, 11 food and feed crops representing over 47 transgenic events have been approved for cultivation in the developed world.

This gap in approvals is unfortunate, because crop biotechnology, appropriately applied, has the potential to address key production constraints affecting resource-poor farmers. Currently, important public- and private-sector research is underway to help meet the productivity needs of these farmers. This research is built on the transformation of local crop germplasm and the expression of locally important traits. The work involves national research programs in developing countries and international centers. To date, over 50 crops have been transformed in 16 developing countries, incorporating a wide range of genes for insect, fungal, viral, and bacteria resistance; protein and quality improvements; herbicide tolerance; and salt and drought stress.

However, the value of these novel crops will be realized only after they are approved for cultivation by national regulatory authorities. Obtaining environmental and food safety approval is difficult though, given current institutional capacities, technological capabilities, and political decisions regarding regulation in developing countries. In fact, the approval process, while addressing safety concerns, can also be a significant constraint to introducing GM seeds in the developing world. Many countries, such as Zambia and Zimbabwe, also maintain GM-free policies to certify and protect domestic food markets and beef exports to Europe.

Over and above having to increase regulatory capacity, developing countries face competing regulatory paradigms in the developed world. Although governments have reached relatively clear agreement on the scientific principles of food safety assessment, they have not reached consensus on the extent of data required to comply with these principles or on the role of data in overall decisionmaking. As a result, developing countries face the following questions: What information will assure developed countries that they are importing safe food? How and by whom should this information be generated? And how should it be shared for maximum advantage? Furthermore, developing countries will have to assess how their exports will be affected if developed countries require labeling of GM foods. In approving GM crops, developing countries evaluate not only how GM seeds impact agricultural productivity, but also how GM products influence their participation in global trade.

FOOD SAFETY IN GM CROPS

Plant breeders have continuously introduced new crops, genes, and traits into our diet and farming communities with few food and feed safety problems. We know, however, that some traditionally developed foods that contain allergenic proteins can cause mild to severe reactions from milk, shellfish, soya, peanuts, wheat, tree nuts, and eggs. Furthermore, traditional breeding of products such as potatoes can cause elevated amounts of endogenous toxicants such as glycoalkaloids. By comparison, no approved biotechnology product has been found to produce allergic or toxic reactions.

However, concerns with genetically engineered crops persist partially because of the perception that gaining access to a wider range of genetic diversity, crossing species barriers, and introducing foods with additional proteins present safety concerns via our diets. The main source of worry is the potential for allergic reactions. One example of allergenic concerns arose in the summer of 2000, when traces of StarLink™ corn were detected in some food products, such as taco shells. StarLink™ was approved for use in animal feed, but not for human consumption. Approval for human consumption was withheld because the Bt Cry9c protein in corn did not disappear as quickly as other Bt proteins in test assays. The unintentional commingling of StarLink™ with corn in the food chain led to concerns about food safety. The U.S. Food and Drug Administration (FDA) developed a method to detect the antibody indicating hypersensitivity to the Cry9c protein. The FDA evaluated the actual case samples against reference samples. It sent the data to the Centers for Disease Control, which compared case values with control values. These studies found no allergenic reactions associated with Cry9c.

REGULATORY APPROACHES TO FOOD SAFETY FOR GM FOODS

The Organisation for Economic Co-operation and Development (OECD) defines food safety as "reasonable certainty that no harm will result from intended uses under anticipated conditions of consumption." To arrive at reasonable certainty, the OECD uses the concept of substantial equivalence (as developed by the World Health Organization, the OECD, and the Food and Agriculture Organization of the United Nations), because conventional toxicology cannot adequately evaluate novel foods. Substantial equivalence "embodies the idea that existing organisms used as food, or as a source of food, can be used as the basis for comparison when assessing the safety of human consumption of a food or food component that has been modified or is new." The concept also serves as the premise for work

based on the Codex Alimentarius, which has become the seminal global reference point for consumers, food producers and processors, national food control agencies, and international food trade.

Substantial equivalence offers a science-based approach for comparing genetically modified foods with an existing or conventionally bred counterpart. Providing clear analysis of differences and similarities between these foods can help structure a safety assessment, but by itself, substantial equivalence is not a safety assessment. This concept has been the target of criticism, as some believe it does not provide enough information to determine safety.

Data that help determine or explain similarities and differences between GM and traditional foods come largely from molecular and protein characterization, which, some propose, can involve testing to determine gene expression patterns, protein profiling, changes in protein expression, and differences in metabolic capabilities. One difficulty in utilizing this information is that the biological significance and safety implications of the data may not be established.

The application of characterization and feeding methodologies also presents problems. Standards used in the U.S. or Europe to determine food safety present significant difficulties in the developing world. Even though food safety data generated by one country can be submitted and accepted in another, countries may not be aware of data generated elsewhere. Countries may also seek additional feeding trials or molecular studies over and above commonly required tests. If generation of additional data requires sophisticated technologies, as is the case for protein profiling, then developing countries will be strained to comply with food safety standards. Developing countries themselves have called for additional animal feeding studies, to assure those concerned about the safety of animals that may consume GM products in the field.

Food safety assessments are essential to GM approvals and, as such, need to be started early in the process of GM crop development. Commercial providers of GM crops often complete food safety assessments with seed or other material harvested from confined trials (that is, before committing to extensive seed production). For developing countries, such a sequence in GM crop development may be problematic, because they may have few laboratories and scientists capable of food safety testing, may lack information on the tests or data required, and may not have fully anticipated funding needs. In addition, it is often difficult to obtain approval for multilocation, confined field trials, and yet these trials are needed by scientists to obtain material for safety evaluations. For these reasons, food safety testing, including generation of data and regulatory review, has become one of several problematic issues in the regulation of GM crops.

While the proponent of a given GM event is expected to test for safety (rather than a regulatory agency), a competent regulatory authority needs to review the data. However, it is for each developing country to determine how, when, and to what extent regulatory agencies themselves will be involved in testing. The challenge of assuring safety becomes more complicated as the range of GM products expands and the chance that a substantial comparator crop exists decreases. Difficulty in reaching international agreement on food safety standards and scientific uncertainty about how to evaluate safety, coupled with the lack of a clear, "one-window" approach for regulation in developing countries, means that developed and developing countries lack a clear, uniformly accepted path to regulatory approval of GM foods.

WHAT DOES THE FUTURE HOLD?

It is often stated that GM products pose no new food safety risks when compared to traditionally produced foods, and to date, no safety problems have been identified for GM products approved for use. Most GM products are considered substantially equivalent to traditional counterparts, with exceptions for certain well-defined differences. Safety evaluations focus on these defined differences. For developing countries, the need to make such assessments raises questions about who will generate the data; which approach will be followed (substantial equivalence or some other); and what degree of uncertainty about food safety developing countries will permit?

The present atmosphere surrounding genetically engineered crops has led to a situation where food safety assessment is not just about science, but also about perceptions, concerns, and standards about how to assure "safety." As scientific opportunities advance, agreement on reasonable standards of safety for developing countries will be critical. This will also allow for and encourage exchange of data, which will help ensure that data requirements are manageable not only among OECD countries, but across the developing world as well. As part of capacity building for biotechnology and biosafety, competency in assuring food safety for GM crops is essential. This competency will enable countries to conduct independent research when necessary. Building such capacity also creates sufficient infrastructure to allow scientifically defensible decisions in the face of food safety questions colored by each country's perceptions and circumstances. ■

For further reading see K.T. Atherton, *Genetically Modified Crops – Assessing Safety* (London: Taylor and Francis, 2002) and *Safety Aspects of Genetically Modified Foods of Plant Origin*, Report of a Joint FAO/WHO Expert Consultation on Foods Derived from Biotechnology (Geneva: WHO, 2000).

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Food Safety in Food Security and Food Trade

Food Safety Policy Issues for Developing Countries

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2020 Vision for Food, Agriculture, and the Environment

Focus 10 • Brief 17 of 17 • September 2003

Food safety issues have attracted international attention because they play an increasingly important role in determining whether developing countries have access to export markets. At the same time, food suppliers in developing countries face the challenge of improving food safety for their growing urban middle classes, and the large burden of disease that poor food safety generates in developing countries is more widely appreciated. Because developing countries produce and consume more perishable foods than before, such as meat, milk, fish, and eggs, food safety has become especially important to domestic consumers and in trade among developing countries.

EVALUATING THE PUBLIC SECTOR ROLE IN FOOD SAFETY

Actions by firms or households are frequently undertaken to improve food safety, and market incentives can be sufficient in bringing about successful private efforts to meet quality and safety standards. Public sector activities are frequently unnecessary if they simply displace such private sector or household activities. But when is public intervention necessary?

The "public goods" nature of many food safety activities is one reason for public intervention. Individual producers or firms may not be able to adequately control an environmental food safety hazard without cooperative effort, thus the public sector may be needed to enforce controls, certify sanitary conditions, or invest in the necessary supporting infrastructure. In domestic markets, consumers cannot always judge food safety or avoid the hazards that endanger the safety and quality of food. And public intervention may sometimes be needed to protect vulnerable groups—such as small children—by setting minimum safety standards. In export markets, the public role is clear in government-to-government negotiations regarding market access.

Public sector interventions to improve food safety can be evaluated in terms of the benefits gained and costs incurred. Improved food safety results in enhanced consumer well-being and increased life expectancy, and the monetary value of these improvements can be measured in greater productivity levels and reduced health care costs as food-borne illness declines. Such benefits must be weighed against the costs of public actions or investments to improve food safety. Because there is no direct market for health, monetary value estimates of these benefits are not easily obtained, and public health investments are sometimes evaluated in terms of how cost-effectively they meet predetermined goals. In some cases a fixed amount of public resources is allocated to actions that have the greatest impact on public health.

The relative importance of food safety risks differs with climate, diet, income levels, and public infrastructure. Poor sanitation and inadequate drinking water pose a much greater hazard to public health in developing countries than in developed ones. As such, public health interventions within developing countries might differ from interventions that would address export market access.

Because interventions targeted to domestic public health may not directly improve export product quality, there may be both tradeoffs and synergies between food safety interventions for these two different goals. The benefit from public action to help industry meet export market standards can be measured in the value of additional exports. The two kinds of benefits resulting from improved food safety in a developing country—improvements in public health and increased export earnings—will differ in terms of their magnitude, distribution and ramifications, and thus will be difficult to compare. Separate public agencies may be responsible for public health and export market development, making such comparisons unlikely. Export earnings, more easily measured in direct monetary terms, may provide more compelling political reasons for public action in support of food safety in the short run.

However, investments to meet export market standards have synergistic benefits for domestic food safety. These synergies are more likely to occur when the export product is also consumed domestically, the investments affect a large portion of production, and the safety requirements do not price the food out of the range of the majority of domestic consumers. If such conditions are met, the investments in infrastructure or in food safety regulations then have the potential to benefit domestic consumers.

Is it desirable for a developing country to have a "dual standard" for food safety, with one standard for exported products and another for products consumed domestically? New export markets can provide income generation and may be expected to improve health and well-being in the exporting country indirectly, primarily by increasing household income. But the relative importance of certain food safety risks and the market mechanisms for determining who bears the costs of mitigating those risks will differ between most developing countries and most industrial countries. Thus it may not be beneficial for export standards to apply to domestic production, even when the commodity is widely consumed locally. What is important is that governments establish an inclusive, transparent and well-informed process whereby each country can decide the merits of a single- or dual-standard system.

EXAMPLES OF PUBLIC ACTIONS TO IMPROVE FOOD SAFETY

Public sector actions to support improved food safety can be placed into five categories:

Policymaking at the national level is needed to establish effective food safety regulation, which requires the capacity for assessing food safety risks, the establishment of priorities for

policy intervention, and the ongoing monitoring and evaluation of food safety risks. Establishing a legal and regulatory framework is often a necessary first step towards achieving export market access. In Bangladesh, for example, Hazard Analysis Critical Control Point (HACCP) regulations based on the HACCP model adopted in major export markets during the 1990s were part of a package of activities required to regain export market access following an E.U. ban (see Brief 9). These regulations established a regulatory framework in Bangladesh equivalent to that existing in export markets.

Capacity building to participate in the international arena allows developing countries to engage in and influence the "rules of the game" governing food safety. Developing-country government officials need to be able to more effectively use existing trade rules and agreements and to argue for changes in them in a more powerful manner. In order to do this, they must have the capacity to participate effectively in the three international standard-setting organizations recognized by the WTO to ensure that internationally agreed-upon standards reflect production conditions particular to that developing country. Furthermore, they must have the capacity to negotiate market access (see Brief 11). Such negotiations will become more important between developing countries in the future as the high-value product trade among them expands (see Brief 14).

Provision of information by the public sector can make it easier for consumers or export buyers to identify and reward safer products. Certifying production conditions to satisfy domestic and export buyers (see Brief 10) is a well-established public role or function, and facilitation of private quality and safety certification is also becoming an important public role. As discussed in the Guatemala case (see Briefs 7 and 12), such facilitation includes establishing voluntary guidelines, authorizing testing agencies, and auditing producer group records. The case studies in this collection show that food safety concerns have significant impacts on traditional producers of high-value agricultural products in developing countries. These farmers need not only to produce safe food, but to assure buyers that their product is safe. Thus facilitating collective action among small producers for certification of food safety and quality is likely to be a critical part of agricultural policy in developing countries.

Direct public efforts to prevent and control hazards can be useful when hazard control is a public good. Public goods in developing countries include basic investments in sanitation infrastructure, particularly at key points in the food supply chain. In China (see Brief 13), the government has tried centralizing slaughter facilities in an attempt to improve meat hygiene. Additional examples include targeted infrastructure investments to facilitate better handling and processing, such as cold storage facilities in ports or clean water supplies in markets.

Investments in infrastructure and research are sometimes necessary as part of overall food system development. Investments to improve food safety include the development of rural sanitation and water supply infrastructure that support better hygiene at the beginning of the food supply chain as well as marketing infrastructure that improves the performance of the system in terms of timeliness, freshness, cleanliness, and quality. Investments in research targeted to food safety might lead to the discovery or adaptation of new methods of control for important hazards, such as the development of aflatoxin-resistant crop varieties. Applied research on pest control in order to reduce negative health effects resulting from pesticide application and residues on horticultural products is another example. These kinds of public sector investments in infrastructure and research are more likely to have positive benefits for food safety *within* developing countries, but also set the stage for better export market performance.

CONCLUDING COMMENTS

Food safety is no longer simply a public health issue. It is also a market development issue. The focus on food safety in international trade and in trade agreements has also made it a trade issue for many countries—developed and developing alike. The process of adaptation by the developing countries to standards and expectations originally set for developed country consumers could potentially yield benefits in developing countries. Looking to the future, the growth in demand within developing countries for highly valued products, such as meat, fish, and horticultural products, will increase the returns to improved food safety for both domestic producers and consumers. The perishable high-value food products that most often give rise to safety concerns will become important building blocks of South-South trade.

But the benefits from food safety improvement will only be captured if policymakers in developing countries understand both food safety risks and their impact on public health, and the synergies between development of the domestic food system and food export industries. In addition, developing countries must establish processes for food safety policy development that are inclusive, in that they take into account the interests of many different groups; transparent, in that they use verifiable information, relate decisions to evidence-based rationales, and communicate those rationales in a widely accessible manner and in a timely way; and competent, in that they are based on the best available information about the magnitude and distribution of benefits and losses. ■

For further reading see C. Delgado, M. Rosegrant, H. Steinfeld, S. Ehui, and C. Courbois, *Livestock to 2020: The Next Food Revolution*, 2020 Vision Discussion Paper 28 (Washington, DC: IFPRI, FAO, and ILRI, 1999); and L. J. Unnevehr and N. Hirschhorn, *Food Safety: Issues and Opportunities for the World Bank*, World Bank Technical Paper No. 469 (Washington, DC, May 2000).

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