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## **Food Safety and Developing Markets**

Research Findings and Research Gaps

**Laurian Unnevehr**

**Loraine Ronchi**

**Markets, Trade and Institutions Division**

## **INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE**

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## **AUTHORS**

**Laurian Unnevehr** ([lunnevehr.professional@gmail.com](mailto:lunnevehr.professional@gmail.com)) is professor emerita of Agricultural and Consumer Economics at the University of Illinois at Urbana.

**Loraine Ronchi** is a senior economist in the International Finance Corporation Division of the World Bank Group, Washington, DC.

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## ABSTRACT

To better inform donor support for public food safety interventions, this paper reviews the literature on the impact of more stringent food safety standards on developing-country markets. This literature has primarily focused on the market access and economic implications of higher standards in export markets rather than on the extensive debate around market failure and public health benefits that dominates the literature in developed countries. We find that the market access benefits from compliance with public and private food safety standards are clear, as is the market exclusion that results from noncompliance. These benefits are now well documented, with more recent evidence pointing to added benefits of poverty reduction and spillovers for health and productivity. Rigorous evidence is also found concerning the positive role of technical assistance and public or donor support. Most of the literature, however, has focused on the relatively small market for EU horticultural products, which will provide opportunities for only a fraction of developing-country producers. This narrow focus causes important gaps in the literature informing meaningful public roles in addressing food safety in developing countries. Future research should examine and rigorously evaluate alternative models for how best to support improved food safety management outside of the export channels that have been the focus of the literature thus far. Further, evaluating the impact of public–private approaches on reduction in enforcement costs and improving compliance through supporting industry-led efforts would better inform donor support for food safety reforms, as would research among developing-country consumers with respect to food safety reforms and public health.

**Keywords:** food safety standards, food safety compliance, supply chain, co-regulation

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## 1. INTRODUCTION

Food safety has been the subject of increased attention in public regulation, private supply chain coordination, and international trade for the past two decades. The emergence of new and more stringent food safety standards is the result of several factors, including the growth in trade of perishable and high-value products, advances in hazard detection and epidemiology, high-profile health scares, scientific and regulatory consensus on best approaches to risk management, and the recognition of global standards and approaches under the World Trade Organization (WTO). More stringent regulatory standards have emerged in high-income countries alongside more rigorous private requirements for food suppliers to high-income retail markets. Developing countries or producers within those countries have found that meeting such standards is a necessary requirement for market access.

This increased attention has been mirrored in an extensive research literature. Case studies and empirical research regarding food safety management identify a number of benefits to public, private, and public–private (simultaneous) approaches to food safety. A better evidence basis for the benefits of these approaches, and the conditions under which these benefits best accrue, is needed to inform donor support for these different approaches. Thus, we carried out a literature review to better inform public-sector food safety reform work.

The objective of this review is to summarize existing research findings related to the impact of public, private, and mixed public–private approaches to food safety reforms on key economic variables of interest in both developed and developing countries. At the sector or economywide level, these variables include investment, exports, import substitution, and employment. At the firm level, these impacts include market access, marketing channel choices, and technology choices of the firm. Insights from this literature review will assist with assessment of current donor-supported food safety activities and will help to identify empirical gaps in the literature with respect to the public and private approaches to food safety.

After a brief outline of methods used in Section 2, the paper proceeds in Section 3 to consider the evidence regarding market and economic impacts of food safety standards compliance, distinguishing among (1) public standards, (2) private standards, and (3) technical assistance, including public–private approaches. Section 4 briefly reviews the very cursory findings regarding domestic regulation in developing countries, before we draw implications and identify important research gaps in Section 5.

## 2. METHODS

Searches were conducted in *EconLit* using the term *food safety* in combination with each of the following: *regulation, standards, deregulation, co-regulation, and cost benefit*. The review covered only literature published since 1995. Duplicates, purely theoretical work, political studies with no economic content, and studies not published in peer-reviewed journals were eliminated. Relevant articles that did not appear in this search were added based on the authors' knowledge of the literature.

The review draws from 50 articles (see References). The articles in the tables are confined to those with robust empirical methods (including both case study approaches and econometric methods) related to specific developing countries and industries. Other articles are referenced that provide evidence from developed countries, international markets, or conceptual background and are discussed in the text as relevant to the primary focus about market access in developing countries. For these topics, the review is not exhaustive. In particular, the extensive literature on food safety as a barrier to multilateral trade is summarized below only as relevant background to the countries' industry-specific studies of public standards.<sup>1</sup>

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<sup>1</sup> A large number of studies have examined consumer demand for food safety, usually through hypothetical estimates of consumer willingness to pay, based on surveys or experiments. These were excluded from the review as they are not directly relevant to the questions of interest.

### 3. MAJOR THEMES IN THE FOOD SAFETY LITERATURE

The food safety literature in economics addresses questions that emerged following major regulatory and trade actions. New regulations in the United States and the EU in the 1990s prompted studies of industry impact in developed countries. Studies in developing countries came about in response to disruptions in the growth of high-value exports, such as the bans on fishery product exports to the EU in the late 1990s. The literature shifted in the new millennium to a focus on the impact of private standards, as these become de facto requirements for market access. In particular, the emergence of third-party certification for standards adopted by consortia of EU retailers for horticultural products have been the focus of a large number of studies during the past 5 to 10 years. Only very recently have a few published studies emerged that address the impact of domestic regulations within developing countries, as the enforcement of such regulations is relatively recent.

Studies of the economics of new food safety requirements have asked distinctly different questions in developed and developing countries. In developed countries, new regulations can be expected to add to industry costs through requiring additional effort to meet food safety standards. These costs are justified in regulatory cost–benefit analysis by the public health benefits from reduced morbidity and mortality from foodborne illness. Thus, the literature from developed countries has focused on measuring costs, identifying the extent of market failure in food safety (that is, will private incentives provide adequate safety?), and evaluating trade-offs in meeting regulatory (public health) objectives. However, the literature in developing countries has focused almost exclusively on questions about how new standards in high-income markets influence exports and incomes. Thus, studies in developing countries have focused on whether market access benefits are greater than compliance costs and whether such costs exclude small farms or firms.

Below we distinguish between compliance efforts for public and private standards. Public standards are legal requirements for market entry, and thus governments can deny market access for exporting countries or firms that do not comply. Compliance may include requirements for public agencies in exporting countries as well as for private firms. Public standards must meet WTO requirements for transparency, have equal application to domestic and imported products, and be based on scientific risk assessment. Typically such standards change only infrequently. Private standards are set by buyers (or a consortia of firms) and include both safety and quality specifications for particular market channels. Although they may be de facto requirements for particular buyers, noncompliance will not preclude entry into an importing country. Private standards change over time as buyers manage risks and reputation, and thus compliance must also evolve.

Here we highlight some recurring research questions and findings in food safety economic research over the past two decades that are of particular relevance to this review.

***Economies of scale can lead to small firm or small farm exclusion.*** A frequent finding is that food safety management at the firm level requires high up-front (fixed) costs. These include the costs of setting up a management or quality control system (for example, Hazard Analysis Critical Control Point, or HACCP), training staff in new procedures, and investments in new equipment for reducing risks or monitoring outcomes. A high initial fixed investment can be a heavier burden on small firms or farms, as they will have higher per-unit costs of adoption than larger firms or farms. Thus, a major research question in the literature is, Do higher food safety standards exclude small firms and farms from markets or force them out of business? As discussed below, high fixed costs and exclusion effects are often observed, but empirically some examples do exist of successful adaptation of small firms and farms to higher standards, with resulting benefits of higher incomes and greater market access.

***Standards can be barriers or catalysts.*** Higher standards would seem to preclude some producers and some developing countries from participating in food export markets, particularly for products requiring a high degree of care in food safety management. Initially, researchers looked for evidence regarding the extent to which standards posed barriers to trade, through imposing higher direct costs of risk control and

safety verification. Jaffee and Henson (2004; also Henson and Jaffee 2008) reframed this research question to consider whether higher standards might serve as catalysts for improved management, higher value added, and greater efficiency in production and marketing. They found many examples of this positive dynamic, some of which have been validated in more rigorous empirical studies. Nevertheless, the literature provides examples and evidence that standards can be both barriers and catalysts, as discussed further below.

***Food safety is only one dimension of the growing demand for quality that requires greater vertical coordination in food supply chains.*** For high-value food products such as fresh produce, dairy, fish, and meats, increasingly stringent private standards reflect multifaceted quality demands in high-income markets. Thus, better and more reliable food safety is only one aspect of private standards. Other quality attributes addressed by standards include appearance, nutritional content, convenience, and credence goods such as sustainable production practices. Thus, the impact of food safety standards, per se, can be difficult to disentangle in the literature on increased vertical coordination in food supply chains. This review primarily focuses on studies that identified food safety standards as a key motivation for the research.

***Public-private partnerships (co-regulation) have untapped potential.*** Most recently, the difficulties with improving food safety through regulation have been recognized and different public-private approaches have been proposed (Martinez et al. 2007). Martinez et al. provide this general definition: “Co-regulation is an approach in which a mixture of instruments is brought to bear on a specific problem, in this case management of food safety, typically involving both primary legislation and self-regulation or, if not self-regulation, at least some form of direct participation of bodies representing stakeholders in the regulatory decision-making process” (Martinez et al. 2007, 302). In a developing-country context, co-regulation may offer the opportunity to achieve greater efficiency in moving to higher standards through adoption of approaches that are acceptable to the private sector and viable in practice. Co-regulation also has the potential to address weak enforcement capacity in developing countries through leveraging industry incentives. The empirical studies of co-regulation are few, but this might be an important alternative approach for improving the enabling environment for food safety management in developing countries. Below, we explore evidence found regarding public-sector activities that enable compliance with higher food safety standards.

## **The Impact of Public Food Safety Standards in Developed Countries on Developing-Country Exports**

Food safety regulation is long standing in high-income countries dating to the early 1900s. Recent reforms since the 1990s reflect better scientific understanding of foodborne risks and approaches to risk management. In the 1980s, the US National Academies issued a series of reports outlining a risk-based approach to food safety management and regulation. Advances in epidemiology along with better understanding of risk assessment informed this new approach. This paradigm was then reflected in the 1990s reform of US meat and seafood regulation. A cornerstone of new regulations is a focus on prevention of food safety hazards through the HACCP system (Unnevehr and Jensen 1999). Similar regulatory developments took place in other high-income countries, with major reforms of food safety regulation in Australia, France, and the United Kingdom, among others. Outside of the United States, the adoption of a risk assessment approach was accompanied by institutional reform to consolidate authority for food safety in one agency. In the EU, this new approach includes traceability as an important aspect of risk management.

An international consensus emerged, and the risk-based approach to food safety regulation was outlined by the Codex Alimentarius (WHO and FAO 2007) as the best practice for food safety regulation. As Hoffmann and Harder (2010) state: “A consensus has emerged among nations about the basic components of an effective food safety system based on modern science and management practices. In shorthand, the vision is of a farm-to-fork, risk-based, scientifically supported safety control system.”

As new food safety regulations were implemented in the 1990s in high-income countries, concerns emerged about the impact of these standards on developing-country exporters. In concert with new regulations, the growth areas for high-value exports were in perishable products that posed more challenges for food safety management (Unnevehr 2000). Two kinds of studies were undertaken to evaluate the importance of food safety standards as barriers to high-value exports from developing countries.

In the first kind, studies examined the impact of differing standards between importers and exporters on bilateral trade flows. These studies consistently find that when importing countries have higher standards than exporters, traded quantities tend to reduce and also trade is diverted to other import markets with lower standards. This hypothesis has been tested using gravity models of trade for standards that are relatively easy to quantify and compare, such as maximum residue levels for pesticides, drug residues in meat, and maximum allowable aflatoxin levels (for example, Ferro, Wilson, and Otsuki 2013; Wilson 2007; Orden, Beghin, and Henry 2012). These international trade studies have also found evidence that the fixed costs of meeting standards tends to favor established exporters and leads to a greater reduction in developing-country exports relative to those in developed countries (for example, Anders and Caswell 2009). A frequent recommendation is to pursue harmonization to facilitate trade, although this does not consider whether such harmonization would be cost-effective for developing countries. These findings at a global level set the stage for empirical studies at the industry or firm level within exporting countries, by demonstrating that standards can hinder exports from developing countries.

The second kind of study has examined the impact of public standards in developed countries on specific export industries in developing countries. The EU imposed bans on imports of fishery products from Bangladesh in 1997, from Kenya in 1997–2000, and from Malaysia in 1998. The United States imposed a ban on raspberry imports from Guatemala in 1997–1998. These bans resulted in substantial losses for the industries involved, and four studies explored how each industry responded.<sup>2</sup> The primary information in the Bangladesh (Cato and Subasinge 2003), Kenya (Henson and Mitullah 2004), and Guatemala (Calvin et al. 2002) reports is the most extensive, and the Malaysia article (Alavi 2009) relies mainly on secondary data and earlier literature. In Bangladesh, Kenya, and Guatemala are several common themes from the evidence collected. The governments and donors provided support for compliance, particularly since some aspects required public investments; firm-level costs to upgrade facilities were substantial relative to revenue, and therefore a sizable number of firms went out of business; and the export market recovered but was not as large or profitable as before the ban.

Two studies of seafood exporters in the Philippines (Ragasa, Thornsby, and Joshi 2011) and in Brazil (Donovan et al. 2001) use survey data to examine the costs of compliance with export market requirements for HACCP. Neither of these countries experienced bans so were likely more successful in meeting food safety requirements than those above, but costs were still a barrier to market participation. In the United States, HACCP adoption has been demonstrated to lead to improved efficiency in processing, which can partially offset costs (Unnevehr and Jensen 2005). In Brazil, at the time of the Donovan et al. (2001) study, HACCP had been adopted only by exporting firms. Much as in the United States at that time, the principal costs included more intensive sanitation procedures, record keeping, and staff training. The benefits of adoption were seen in maintaining market access, rather than in higher prices or greater efficiency. In the Ragasa, Thornsby, and Joshi (2011) Philippine study, the compliance costs are estimated through a system of cost equations. The findings show that compliance costs have been underestimated, as HACCP leads to reduced flexibility and slower production processes and *crowds out* expenditures on other inputs. Taken together, these two studies show that HACCP in these cases did not lead to enhanced efficiency and that meeting this standard imposed costs and likely reduced production and exports at the margin.

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<sup>2</sup> We did not consider the literature on the impact of trade bans due to animal disease (for example, Foot and Mouth Disease or Highly Pathogenic Avian Influenza) but confined our review to bans related to food safety.

Whether high-income-country standards would have positive health benefits in developing countries is a question addressed in relatively few studies. Okello and Swinton (2010) looked at the imposition of developed-country pesticide standards in export production of vegetables in Kenya. Farmers who were monitored for compliance and provided with pesticide safety training tended to have fewer pesticide-related health problems and used safer chemicals. This is an important example of spillover benefits for domestic safety from higher standards in exports, and stands in contrast to the lack of spillovers for domestic seafood in Brazil found by Donovan et al. (2001).

In summary, exporter compliance with importing-country standards imposes costs and often leads to changes in industry structure. Compliance with public standards has not generally been as beneficial as compliance with private standards (the Kenya pesticide study is an exception), although the impacts may be similar, as discussed below. Since these standards are minimum requirements for market access and are not rewarded with price premiums or supported by private coordination efforts, it may be that adapting to public requirements can be more difficult for developing-country industries and for developing-country governments.

### **The Impact of Private Food Safety Standards in Developed Countries on Developing-Country Markets**

Several factors have led to the increased importance of private standards for food safety during the past decade. Henson (2008), Henson and Humphrey (2010), and Fulponi (2006) discuss how these emerged from European retail chains as a response to concerns from consumers and civil society and to address a perceived vacuum in public regulation following high-profile food safety incidents, such as the emergence of *mad cow* disease. Market power exercised by multinational retailers allowed them to use such standards to establish brand identity and reputation, and to make the standards de facto mandatory requirements for market access. Several observers have noted this shift in “governance” of the supply chain from public to private. Henson (2008) notes that the proliferation of private standards initially increased transactions costs, leading to efforts to harmonize private standards, such as GlobalGAP. Henson, Masakure, and Cranfield (2010, 376) explain: “GlobalGAP is a collective private standard for the implementation of generally agreed principle of GAP [good agricultural practices] in primary production, initially in fruit and vegetables and now in a wide range of plant and animal products.”

The emergence of these standards as a requirement for market access, along with the costs of meeting varying requirements, has increased supply chain coordination in markets serving these buyers. In developed countries, studies have examined the extent of increased vertical coordination as well as how third-party certification supports compliance (for example, Hobbs, Kerr, and Phillips 2001; Henson and Hooker 2001). We turn now to the evidence regarding the impacts of modernizing markets on developing-country producers, as this sets the stage for the review of the impacts of private standards on developing-country exporters.

### **Smallholders in Modernizing Supply Chains**

Many studies have focused on the distribution of benefits from improved market access to modernizing supply chains serving export markets and domestic supermarkets. Studies of private food safety standards are a subset of a much larger literature on the impact of modernizing markets and globalization on smallholders. That literature has focused on testing hypotheses regarding the impact of multiple, simultaneous changes in markets, including integration with world markets, the transfer of new production technologies, the imposition of standards for quality (for example, uniform size of product), and the requirement for regularity of supply, among other things. Improved food safety is taken to be implicit in improved quality. In other words, these studies do not directly test hypotheses regarding food safety compliance. Some synthesis articles provide an overview of emerging findings regarding smallholders and modernizing markets, which we review briefly here.

Barrett et al. (2011) review experiences in five countries (Ghana, India, Madagascar, Mozambique, and Nicaragua) for smallholders in contract farming to meet private standards in modernizing supply chains. They find that farmers gain from reduced risk and increased efficiency, rather than from the price premium associated with certification, but they also state that the evidence is very thin. Because the studies they reviewed focus on firms that already participate in contract farming, selection bias is present in the findings. Also, the geographic determinants of desirable supply (higher yields, better roads) mean that most contract farming avoids the poorest farmers. But within favored regions where contract farming is concentrated, they assert less uncertainty now about whether or not benefits accrue to smallholders. They also find that farmer organizations tend to lower transactions costs of participation, a finding we return to in the next section.

Reardon et al. (2009) summarized several studies published in a special issue of *World Development* regarding smallholder participation in modernizing supply chains. They find mixed evidence regarding smallholder benefits, with many cases of smallholder inclusion when there are service-providing contracts, a finding reinforced below in many food safety studies. But they also find cases of smallholder exclusion due either to scale economies or to lack of access to nonland assets (for example, financing or technical support). A role for policy is seen in supporting these enabling services.

Dries et al. (2009) summarize the experience in dairy supply chains in several central and eastern European countries (including Albania, Bulgaria, Poland, Russia, and Slovakia) following the transition to a market economy and the resulting integration with Western markets. The process of restructuring following privatization led to fragmentation of farms into smaller units. But in spite of this, foreign direct investment and greater vertical coordination along the supply chain facilitated improved quality (including safety), adoption of modern technology, and enhanced productivity. The review concludes that modernization of supply chains provides substantial benefits to rural households in these countries.

These results from studies of smallholder participation in modernizing supply chains are generally echoed in our review below of the evidence from specific studies of food safety standards. There is strong evidence that participation in modernizing supply chains has benefited smallholders, but smallholder inclusion is shaped by external circumstances, such as market access and supporting institutions.

### ***Benefits and Costs of Compliance with Private Food Safety Standards***

In response to concerns about market exclusion arising from export bans and from findings that higher standards reduce trade, Jaffee and Henson (2004, 1) reframed the question of exclusion by posing that standards can serve as catalysts for capturing greater value through strategic adaptation: “Rising standards serve to accentuate underlying supply chain strengths and weaknesses and thus impact differently on the competitive position of individual countries and distinct market participants. Some countries and/or industries are even using high quality and safety standards to successfully (re-)position themselves in competitive global markets. This emphasizes the importance of considering the impacts of food safety and agricultural health measures within the context of wider capacity constraints and underlying supply chain trends and drivers. The key question for developing countries is how to exploit their strengths and overcome their weaknesses such that they are gainers rather than losers in the emerging commercial and regulatory context.” In 2004, they reviewed the emerging case study evidence to support their position, and their arguments provided a number of hypotheses that were tested in later studies.

In addition to the *catalyst hypothesis*, two recent articles outline the theory behind distribution of welfare effects from higher standards. These articles demonstrate why results may vary widely but also show that smallholders tend to benefit. Xiang et al. (2012) outline the general equilibrium conditions under which smallholders may benefit from rising standards and find that smallholders benefit from higher export prices for improved quality, but the extent of benefit depends on the growth in domestic market for quality, whether the production of quality attributes is labor-intensive, and credit availability for smallholders. Swinnen and Vandeplass (2011) explore the conditions under which price premiums will be paid to smallholders participating in high-value export markets. They predict that an efficiency

premium will be paid to smallholders and that buyers will have incentives to upgrade their suppliers' technology levels. Below we find much evidence that accords with these predictions, although given the complex determinants of benefits, it is not surprising that we also found mixed evidence regarding benefits.

Table 3.1 summarizes 12 studies on the impacts of private standards in horticultural supply chains, usually exported to the EU. This reflects the emergence of a unified standard, GlobalGAP, for produce among EU retail chains, which primarily addresses pesticide residues. Three of the studies are from Kenya, and another includes Kenya among the countries surveyed, providing rich evidence specific to that country context.

**Table 3.1 Impact of compliance with private food safety standards for EU horticultural product markets**

Country	Study	Impacts of compliance	
		On benefits and costs	On smallholder inclusion
Peru	Schuster and Maertens 2013		Costs of certification lead to reduced processor purchases from smallholders over 19-year period.
Madagascar	Subervie and Vagneron 2013	Certified producers sell larger quantities at higher prices than those not certified.	Market access determined by proximity to processing plant, not scale of production.
Thailand	Kersting and Wollni 2012	Farmers' perceived benefits include improved quality, reduced pesticide risks, better market access.	One hectare increase in farm size associated with only 2% increase in likelihood of compliance.
Chile	Handschuch, Wollni, and Villalobos 2013	Certified producers have higher yields, quality, prices received and net incomes; also higher fertilizer and pesticide costs.	Scale impacts are modest; certification costs 11% of gross income per hectare, making public support critical.
Peru	Lemeilleur 2013		Contracts, technical support, and payment of certification costs by exporter firms are critical for smallholder certification.
Kenya	Kairuki, Loy, and Herzfeld 2012	Certification leads to prices 4.2% to 9.5% higher	
10 African countries south of the Sahara	Henson, Masakure, and Cranfield 2011	Certification leads to higher sales revenue (2.6 million euros higher per firm).	About one-third of exporting firms' purchases are from smallholders.
Madagascar	Minten, Randrianarison, and Swinnen 2009	Compliance led to greater income stability and shorter lean periods; adoption of improved technology; better resource management with spillovers for the productivity of the staple crop.	Smallholders were able to meet quality requirements.
Senegal	Maertens and Swinnen 2009	Compliance led to sharp growth in exports; higher rural incomes and poverty reduction.	A shift from smallholder contract farming to integrated estate production. Poor households benefited through labor markets.
Kenya	Asfaw, Mithöfer, and Waibel 2009	Compliance led to use of safer pesticides and a positive and significant impact on farm revenues.	
Kenya	Ashraf, Giné, and Karlan 2009	Farmers switching to (compliant) export crops had significantly higher income.	The switch was not sustained when new certification requirements were not supported.
India	Roy and Thorat 2008	Compliance increases successful export market participation and higher net profits for farmers.	Smallholders participate through group marketing arrangements and receive assistance through cooperatives.

Source: Authors, per studies noted above.

Compliance with private food safety standards is found to lead to higher export sales or prices, revenues, and incomes in 10 studies of high-value horticultural exports in at least 10 different countries (Table 3.1). Many studies show other benefits, such as adoption of improved technology with spillover benefits for staple crops (Minten, Randrianarison, and Swinnen 2009), higher or more stable labor income (Maertens and Swinnen 2008; Minten, Randrianarison, and Swinnen 2009), and improved health through reduced on-farm exposure to pesticides (Kersting and Wollni 2012; Asfaw, Mithöfer, and Waibel 2009; Okello and Swinton 2009).

Costs of compliance include both nonrecurring and recurring costs. Examples of nonrecurring costs include establishment of new procedures, training, and physical upgrades to facilities. Recurring costs include audits for annual recertification, management oversight, tests, and record keeping, as well as any additional physical inputs required. The nonrecurring costs are an important barrier to smallholder participation, but recurring costs can also prevent sustained participation (Kersting and Wollni 2012). Both kinds of costs are often shared by exporters to facilitate farmer compliance (Kersting and Wollni 2012; Handschuch, Wollni, and Villalobos 2013; Leimeilleur 2013; Subervie and Vagneron 2013; Henson, Masakure, and Boselie 2005). For example, in Thailand, exporters and donors pay for more than 90 percent of all costs of GlobalGAP certification (Kersting and Wollni 2012).

Changes in production practices or greater efficiency as a result of standards were found in Chile (Handschuch, Wollni, and Villalobos 2013), Madagascar (Minten, Randrianarison, and Swinnen 2009), and Kenya (Asfaw, Mithöfer, and Waibel 2009). As these are more difficult to measure, it is notable that they have been identified. Certified farmers in Chile produced products of higher quality, which enhanced revenues even without a price premium for certification per se. In Madagascar, improved production methods introduced for the export crop were also adopted for the alternate season's domestic food crop, leading to efficiency spillovers. In Kenya, safer pesticides were used as a result of certification (aligning with results discussed above regarding health).

While most studies found positive benefits from standards compliance, one study stands out for negative findings. In Kenya, a nongovernmental organization (NGO) carried out interventions to facilitate smallholder production of export crops (Ashraf, Giné, and Karlan 2009). The focus of the study was to determine which packages of support services were most effective in promoting the switch to export crops and higher incomes. The NGO efforts initially succeeded. However, the NGO failed to support certification to the EU standard, and following the period of study, exporters no longer purchased from these farmers. This cautionary tale shows how difficult it can be for an outside organization to be an effective broker in private markets. We return to this point below when considering the sustainability of technical assistance efforts.

### ***Smallholder Inclusion and Vertical Coordination***

Many studies were also concerned about smallholder exclusion effects, and these results were more mixed. A study of changes in export supply chains over 19 years in Peru found that stringent standards led to greater vertical integration and exclusion of smallholders (Shuster and Maertens 2013), although the authors note that this might not be expected in other country contexts. In another case, restrictions due to export quotas in Madagascar limited the benefits of certification to farmers with size and location advantages (Subervie and Vagneron 2013). In contrast, studies in Zimbabwe, Chile, Thailand, and India found that smallholders were able to successfully adapt, scale effects were modest, and transaction costs in supply chains declined over time (Henson, Masakure, and Boselie 2005; Handschuch, Wollni, and Villalobos 2013; Kersting and Wollni 2012; Roy and Thorat 2008). In Senegal, a shift to estate production excluded smallholders, but these households then benefited from wage labor opportunities that led to higher incomes (Maertens and Swinnen 2009). Low-income workers in exporting firms also benefited in Senegal from higher wages and longer employment periods (Colen, Maertens, and Swinnen 2012).

Three studies, in Thailand, Chile, and Peru, identified the characteristics of farmers that are associated with successful compliance and certification. These include education, male gender (Chile), experience, membership in a farmer association, and access to technical support (Kersting and Wollni 2012; Handschuch, Wollni, and Villalobos 2013; Lemeilleur 2013). These results suggest that not all smallholders will be equally able to comply with standards.

Many of these studies provide detailed analysis of how vertical coordination can lead to successful standards compliance. In particular, intensive farmer monitoring, training, and pre-planting contracts with inputs provided on credit were all found to facilitate compliance in Zimbabwe (Henson, Masakure, and Boselie 2005), Kenya (Okello and Swinton 2007), and Peru (Lemeilleur 2013) and for the smallholders still operating in Senegal (Maertens and Swinnen 2009). In Kenya and India, farmer groups play an important role in facilitating compliance, through extension efforts and group monitoring (Roy and Thorat 2008; Okello and Swinton 2007).

### ***Summary of Impacts of Private Standards***

In general, these studies show the benefits of adopting private standards to gain access to high-value markets, primarily through exports. Adoption of food safety standards is found to lead to higher export sales, revenues, and incomes. In some cases, it is found to lead to adoption of improved technology, greater efficiency in production or marketing, higher labor income, or improved health through reduced on-farm exposure to hazards. Most studies were concerned about smallholder exclusion effects, and while these were found, they were also modest in impact.

Thus, one summary view of the studies in Table 3.1 is that they generally support the “standards as catalysts” model posed by Jaffee and Henson (2004). That is, standards tend to serve as catalysts for improved processes and products, leading to capture of greater value added for successful export industries. Support for this finding is strongest in more recent studies based on extensive surveys and using careful econometrics to control for selection bias.

However, it may be useful to consider the caveats to this rosy interpretation, especially since they stand in contrast to the findings in the studies of public standards. First, most of the positive findings were found in a fairly narrow sector of global food trade—specialty horticultural products for the EU market. It is not clear that these findings would extend to other products and high-income markets. Second, all of the studies focused on adoption of certification noted that the rates of certification are not universal, in spite of efforts to promote and support such certification, indicating that costs and barriers remain significant. Finally, it should be noted that many studies of both public and private standards compliance report that noncertified or banned products found alternative channels or markets. That is, lack of compliance may not always pose an absolute barrier to market participation, although it likely leads to lower returns.

### **Technical Assistance and Public–Private Food Safety Approaches**

The roles played by governments and donor institutions vary in the many case studies discussed above. With public standards, a frequent requirement from the importer is to see equivalent regulation and inspection procedures, and thus governments must rapidly adopt unfamiliar standards, upgrade laboratory facilities, and train staff. A further role for government is suggested where needed improvements are beyond the scope of individual firms, for example in upgrading landing facilities on Lake Victoria. These would be public infrastructure investments, which might be supported by World Bank loans, for example.

Henson and Mitullah (2004, 74) make this observation in their study of Kenya fish exports:

The prominent role of the “competent authority” in implementing and maintaining standards that are at least equivalent to those in the EU creates a mutual dependency between exporters and public regulatory authorities. Although it reduces the risks of rejection associated with border inspection in export markets, it also requires considerable capacity on the part of regulatory authorities in developing countries, which is often lacking and costly to implement. Indeed, a number of countries, not only developing but also industrial states, have struggled to comply with EU requirements, some of which have still been unable to secure market access.

None of the studies of the impact of public standards’ compliance tested hypotheses specifically related to government interventions. Thus, the impact of adoption of standards in an exporting country is not well understood in terms of whether benefits exceed costs.

More donor efforts were focused on specific efforts for smallholders as compliance with private standards came to the fore in the first few years of the new millennium. The role of the public sector and donors was specifically identified in seven of the studies in Table 3.1, and these findings are summarized in Table 3.2. To support new income opportunities for smallholders in agriculture, governments and donor institutions have assisted standards compliance through training and capacity building, providing direct financial support for the costs of certification, and fostering farmer organizations or cooperatives to reduce transaction costs in marketing and certification (Table 3.2). While private market returns have clearly motivated compliance in many cases, technical assistance seeks to overcome barriers to entry that might prevent full participation. In addition, such assistance may have spillover benefits, such as reduced pesticide exposure or improved farm management.

**Table 3.2 Impact of technical assistance to food safety standards’ compliance in developing countries**

Country	Study	Technical Assistance	Impact of Assistance
Madagascar	Subervie and Vagneron 2013	Donor support for GlobalGAP certification	Certified producers have better access to markets and higher prices.
Chile	Handschuch, Wollni, and Villalobos 2013	Public support for compliance with export standards	Assistance is critical to smallholder participation in markets.
Thailand	Kersting and Wollni 2012	Donor support for group certification of small farmers	Support by donors and exporters enabled farmers’ compliance.
Africa south of the Sahara	Henson, Masakure, and Cranfield 2011	Compliance support for EU Pesticide Initiative Program (PIP)	Firms more likely to be certified if they have received PIP technical assistance.
Senegal	Jaud and Cadot 2012	EU PIP support for food safety management practices.	PIP had a positive effect on horticulture exports to the EU but not on total horticulture exports.
Kenya	Ashraf, Giné, and Karlan 2009	Nongovernmental organization assistance to smallholder participation in export markets	Support for market services was effective in supporting farmers’ shift to export crops. Exports did not continue when support ended.
India	Roy and Thorat 2008	Government support for farmer cooperatives	Cooperatives result in higher net profits for farmer members and facilitate smallholder inclusion.

Source: Authors, per studies noted above.

Six studies that tested explicitly for the impact of technical assistance found positive impacts, at least in the short run, in facilitating standards compliance, market participation, and higher incomes (Table 3.2). Technical assistance, subsidies for initial certification costs, and managerial support were effective in Chile and Thailand in promoting market participation of smallholders (Handsouch, Wollni, and Villalobos 2013; Kersting and Wollni 2012). In Chile, the public sector plays a very active role in supporting certification. It subsidizes a trade association that adapts international standards for Chile and obtains benchmarking and recognition from foreign buyers. To assist smallholders, the government has supported a program to conduct audits, create farm-specific plans, provide credit, and cover the cost of certification for the first few years. In Thailand (Kersting and Wollni 2012), GlobalGAP group certification was found to reduce transactions and encourage smallholder compliance with standards. Donor and exporter support were found to be critical in assisting farmer compliance, and the study recommends public–private partnerships to support compliance as likely the most sustainable in the long run. In India (Roy and Thorat 2008) government-supported cooperatives have facilitated compliance with higher standards by providing technical assistance (for easier adoption of standards) and market access (through ensuring certification and regularity of supply).

The EU Pesticide Initiative Program (PIP) addressed pesticide standards compliance in countries exporting to the EU through training and technical assistance to firms, and support for public-sector laboratories and extension efforts. In 10 African countries south of the Sahara (SSA), receipt of PIP assistance was a positive and significant determinant of whether or not an exporting firm was certified to GlobalGAP (Henson, Masakure, and Cranfield 2011), which in turn led to higher revenues. In Senegal, it had a positive effect on exports to the EU, but not on total horticultural exports (Jaud and Cadot 2012).

Interventions are not sustainable with changes in market conditions or a lack of follow-through from donors. A shrinking export market in Madagascar reduced the scope for market participation (Subervie and Vagneron 2013). In Kenya, an NGO failed to support the certification desired by buyers, so that efforts to promote export crops failed after the study (Ashraf, Giné, and Karlan 2009). The need to connect with buyers who have a continued economic motivation to support farmer compliance was emphasized by Kersting and Wollni (2012) in studying such efforts in Thailand, as well as in a case study review of such efforts in SSA (Jaffee, Henson, and Rios 2011).

These studies of donor or public assistance are part of a growing literature on co-regulation or public–private approaches to food safety. Martinez et al. (2007) reviews the co-regulation concept, its promise, and selected examples from high-income countries. They outline the continuum of regulatory activities, from no intervention to direct regulation. Between these alternatives, the public sector can support voluntary codes of practice, provide information to producers and consumers about risk management, or create market incentives for improved risk management. Examples include the input provided to regulatory standards in both the United Kingdom and the United States, flexibility in application of process standards, and industry cooperation with enforcement efforts.

Narrodd et al. (2009) explore how public–private approaches in developing-country markets can facilitate standards' compliance, using case study examples from India and Kenya (which draw on articles published elsewhere and discussed above—Roy and Thorat 2008; Okello and Swinton 2007). Public-sector support for farmer organizations has supported compliance with private standards for beans in Kenya and grapes in India. Such support may be explicit, as when funding is provided for organization staff, or more oblique, as when government regulations are modified so as not to preclude collection action. Narrodd et al. (2009, 8) propose that “public–private partnerships can play a key role in creating farm to fork linkages that can satisfy market demands for food safety, while retaining smallholders in the supply chain. Furthermore, organized producer groups monitoring their own food safety standards through collective action often become attractive to buyers who are looking for ways to ensure traceability and reduce transaction costs.”

#### 4. DOMESTIC FOOD SAFETY REGULATION IN DEVELOPING COUNTRIES

The literature on domestic food safety regulation in high-income countries is extensive, much of which has been concerned with how industry costs balance against public health benefits (for example, Crutchfield et al. 1997) or with how well private incentives motivate food safety improvement, thus reducing the need for direct regulation (for example, Segerson 1999). In contrast, studies of developing-country regulation impacts are very few, in part because these efforts are very new. Schreinemachers et al. (2012) studied the impact of new Thai pesticide regulation, including the promotion of public Good Agricultural Practice (GAP) standards and pesticide residue testing. They found that producers certified under the public GAP standard do not differ in their pesticide use from other farmers and that the program did not pay sufficient attention to training farmers in the underlying rationale for pesticide safety. This finding contrasts with the Asfaw, Mithöfer, and Waibel (2009) findings above regarding Kenya. The results suggest the importance of both training and rigorous monitoring in achieving changes in practices.

A number of studies are emerging regarding food safety in China, as its domestic market has experienced high-profile food safety scares and a growing consumer middle class is demanding improved safety. China is unique for several reasons. On the one hand, the market structure is still dominated by many small suppliers with little vertical coordination or imposition of standards (Huang et al. 2008). On the other hand, the strong public-sector role in shaping development of the sector differs from other developing countries. One study from China (Mo et al. 2012) provides insights into the extensive market interventions to address recent food safety scandals in dairy. The government-promoted switch to housing dairy cows in centralized facilities (cow hotels) is reshaping industry structure, since primarily larger farmers are using these new facilities. It is not clear from this study whether the benefits in terms of public health or sustained supply outweigh the costs to the government of providing services and price supports. Another intervention in China, the government promotion of cooperatives, has increased vertical coordination and access to modern supply chains for some products but has not yet resulted in widespread compliance with food safety standards (Jia et al. 2012). Only about one-third of cooperatives market through modern channels, and only about half of these comply with any food safety requirements. The rapidly evolving institutions and responses to domestic demands for quality and safety in China should provide interesting future evidence about alternative models for public interventions in food safety.

## 5. IMPLICATIONS AND RESEARCH NEEDS

The market access benefits from compliance with public and private food safety standards are clear, as is the market exclusion that results from noncompliance. These benefits are now well documented, with more recent evidence pointing to added benefits of poverty reduction and spillovers for health and productivity. Rigorous evidence is also found concerning the positive role of technical assistance and public or donor support. Most of the literature, however, has focused on the relatively small market for EU horticultural products, which will provide opportunities for only a fraction of developing-country producers. This narrow focus means that important gaps are in the literature that informs meaningful public roles in addressing food safety in developing countries. More needs to be known about the potential market growth in meeting quality and safety demands in middle-income countries, regional trade, and South–South trade (Jaffee, Henson, and Rios 2011), as well as the nature of those demands among developing-country consumers with respect to public health.

What are the implications for research that could support developing countries as they look to improve food safety management in markets other than EU exports? As discussed above, public–private approaches may have the potential to reduce enforcement and compliance costs through supporting industry-led efforts. More and more examples of such partnerships are emerging in pilot projects, such as those addressing aflatoxin risks in markets for commercial feed in Africa (IITA 2013), where the public sector is supporting an initial price premium to encourage adoption of aflatoxin control technology. Internationally accepted certifiers are working to adapt standards to local markets in developing countries (for example, LocalGAP), providing further opportunities to explore public–private partnerships for addressing growing domestic demand for safety. The accession of central and eastern European nations to the EU, and resulting adoption of EU public food safety regulations, provides another opportunity to explore how public–private partnerships can reduce the costs of food safety improvements.

A key motivation for co-regulation is to reduce the costs of regulation for the government and of compliance for producers. That is, co-regulation holds hope for the public sector, which has limited resources to set, monitor, and enforce standards, or in the regulated industry, which would like to avoid costly regulatory burdens. This proposition has not been tested directly, so future research should examine and rigorously evaluate the constraints and net benefits of public–private efforts, to provide models for how best to support improved food safety management outside of the export channels that have been the focus of the literature thus far.

While it has not been the focus of this literature review, the ultimate goal of food safety standards or management is improved public health. Addressing this goal in developing countries is still aspirational. The health spillover effects from adoption of high-income market standards are modest at best, with conflicting evidence found in the literature (positive spillovers for pesticides in Kenya contrast with no spillovers for seafood in Brazil). The limited literature on domestic food safety regulation in developing countries shows that we do not yet have good models for standards and approaches that can address food safety where risks are pervasive, costs of compliance are high, and enforcement capacity is weak. Aflatoxins are a prime example of this gap (Grace and Unnevehr 2013). Thus, addressing domestic public health will require further research to determine the best public health targets (through risk assessment) and models for intervention (through testing alternative approaches).

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2033 K Street, NW  
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Tel.: +1-202-862-5600  
Fax: +1-202-467-4439  
Email: [ifpri@cgiar.org](mailto:ifpri@cgiar.org)