AGRICULTURE

Research Principles for Developing Country Food Value Chains

From farm to table, multidisciplinary research is needed to improve the economic benefit of food production in the developing world.

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Food value chains (FVCs) comprise all activities required to bring farm products to consumers, including agricultural production, processing, storage, marketing, distribution, and consumption. FVCs are changing rapidly in developing countries (DCs), because of population and income growth; urbanization; and the expansion, globally and domestically, of modern food retailing, distribution, and wholesaling firms (*1*, *2*). One such change is that consumers and regulators increasingly demand product-specific characteristics beyond price—including nutrient content; food safety certification; and indicators of impacts on natural resources, greenhouse gas emissions, and farmworkers. To accommodate these multidimensional demands, regulators and firms are developing new multiattribute product labeling and production standards. We outline below ways in which scientists must integrate existing disciplinary evidence into rigorous models and must develop measures and methods to evaluate the multidimensional performance of FVCs.

Principles for Advancing FVC Research

These labeling and production initiatives affect those who participate in DC FVCs as growers, workers, or consumers. Under which conditions do poor people benefit from these trends? Which consumer behaviors, public policies, and decisions by private-firm and civil society organizations are likely to promote the emergence of poverty-reducing, environmentally sustainable FVCs? By addressing these challenges, scientists can help identify good FVC practices that can help poor people and protect the environment. Toward that end, we offer six principles to guide scholars in advancing that research agenda in this rapidly changing landscape.

1. *Focus on opportunities available in domestic markets.* FVCs in DCs are primarily oriented toward domestic markets. DC food exports account for only 1.9% and 8.4% of domestic production in raw tonnage and value, respectively (*3*). Global supermarket chains are expanding into DCs where in-country retail sales of domestically produced food are three to four times the sales of their food exports (*4*). Global retailers are setting food quality and safety standards for domestic products in DCs that are similar to standards in developed countries (*5*). This trend toward increasing supermarket sales is primarily driven by higher incomes and changing diets among urbanizing populations (e.g., increased consumption of meats and processed foods). International markets exhibit higher producer price risk because of fluctuating exchange rates, trade barriers, and more stringent food safety standards. For example, stricter standards for aflatoxin (a liver toxin produced by the fungus *Aspergillus*) in Europe further restrict food imports from Africa (*6*). Moreover, developed countries' higher import tariffs for processed foods than for raw commodities (*7*) impede value-addition in export FVCs. Although export-oriented FVCs also offer opportunities for smallholder farmers (*8*) and farmworkers, linking them to domestic markets may generate greater economic gains through follow-on multiplier effects that help reduce poverty (e.g., employment created by local spending by supermarket employees). Research should focus more on identifying what public policies, private-firm decisions, and FVC innovations can improve the functioning of domestic FVCs, not just on export channels.

2. *Pay attention to indirect effects, not only to increased sales from smallholders.* Although opportunities exist in domestic markets, it is often difficult to influence production decisions and to induce increased FVC participation among poor farmers (as sellers) and traders (as intermediaries). These individuals are often harder to reach and lack the assets and skills of their better-off counterparts (*9*). But because smallholder farm households derive a large share of income from off-farm employment and are commonly net food buyers, the greatest poverty implications of FVCs likely do not arise directly through purchases from poor farmers. Instead, these effects often occur indirectly through lower cost, more nutritious and safer foods for poor consumers, and increased employment of and safer working conditions for unskilled workers in commercial agriculture and post-harvest processing (*10*). Researchers too often focus just on the profitability of direct FVC participation. We must not overlook the crucial indirect effects FVCs have on rural and urban poverty.

3. *Enhance marketing channel efficiency.* Poor people in rural and urban areas participate in FVCs not only as farmers but also

Bulls for sale at the zebu market, Antemoro, Madagascar.

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as consumers (*9*). Only by reducing the difference between retail price and price when sold by the farm can FVCs simultaneously decrease food costs for poor consumers and increase earnings for poor farmers and farmworkers via increased demand and employment. This requires cost-efficient market intermediation, including product aggregation, storage, processing, and distribution. It is otherwise difficult to avoid the "food price dilemma" that higher prices help and incentivize net-seller farmers but also hurt consumers, especially poor people (*11*). For example, investments in infrastructure that reduce the significant marketing costs Kenyan smallholder farmers incur delivering crop to buyers—estimated at equivalent to a 15% sales tax—can increase earnings without driving up food prices (*12*). Research is needed on how to reduce market intermediation costs in an equitable and environmentally sustainable manner.

4. *Pay attention to post-harvest losses, both in volume and quality.* Post-harvest losses, estimated at 15 to 50% in DCs (*13*), disproportionately burden poor people who often lack capacity for food preservation and safe storage. Such losses cause market inefficiencies and have negative environmental effects because of inefficient land and water use. Associated food quality problems, in turn, impede poor growers' participation in FVCs and pose food safety risks for consumers. For example, mycotoxins and microbial hazards contaminate significant proportions of food supplies in tropical, low-income communities (*14*). Successful remedies include improved preharvest management and small-scale post-harvest storage and energy-saving technologies, as well as increased food-processing opportunities to prevent spoilage (*15*). Micronutrient fortification of staple foods and preservation of fruits and vegetables can improve the quality of diets (*16*). Increased research on post-harvest technologies can help reduce unnecessary losses and thereby reduce pressure on land and water and improve food safety and dietary quality.

5. *On-farm natural resources conservation can enable, and benefit from, smallholder FVC participation.* The increased output required to meet growing food demand can be sustained only with increased labor, energy, land, and water productivity. Historically, agricultural productivity growth reduces poverty through higher profits for net producers, increased employment and/or real wages for workers, and lower prices for consumers (*17*). Productivity growth has also slowed conversion into cropland or pasture of more environmentally sensitive lands on the agricultural frontier (*18*). FVCs can induce participating farmers to invest in water, soil, and energy conservation measures, and such investments enable new farmers to participate in FVCs. For example, solar-powered drip irrigation systems in the West African Sahel improved productivity, increased smallholder farmer income and nutrient intake, and cost less than traditional production systems (*19*). Farm practices that enable soil carbon sequestration can improve soil quality, eco-efficiency, and profitability (*20*). Too little is known about how to scale resource-conserving, productivity-boosting innovations and about how to capture consumer valuation of "green" farming innovations.

6. *Certification appears necessary, but not sufficient.* Certification (i.e., attestation of compliance with product standards) assures consumers about key product qualities, often eliciting a price premium for desired attributes such as fair trade, organic, or sustainable practices. In other cases, certification is necessary to show FVC compliance with standards set by regulators. But certification is costly because of the infrastructure required to sustain the scheme and may inadvertently exclude smallholder farmers from high-value markets (*21*). For example, the costs of Fair Trade certification—a system that identifies products with specific labor, environmental, and developmental standards—may prevent participation of small groups of farmers. In coffee, the certification cost for ~10,000 farmers is 2.4% of retail price; for ~1000 farmers it is 6.2% of retail price; and it is higher for smaller groups (table S1). It is clear that certification and credible product labeling can tap consumer demand for desirable attributes and is thus necessary to elicit the premium prices needed to pay for those attributes. However, it remains unclear whether certification facilitates smallholder entry into higher-return markets, promotes adoption of sustainable farming practices, or fosters farm-level innovation.

Agenda for the Future

The preceding six principles carry two important implications for scientists, donors, policy-makers, and private decision-makers. First, we need to be humble about how little we know about complex FVCs and their effects on poverty and the environment and cautious in our policy prescriptions on FVCs.

Second, scientists must begin developing a transdisciplinary, multidimensional conceptual framework to study DC FVCs in order to establish good FVC practices to benefit the poor, protect the environment, and help smallholder farmers meet growing consumer demand for sustainability attributes. This conceptual framework should include indicators to explicitly identify links among the multiple dimensions of FVC performance—such as economic costs, distributional equity, environmental impacts, energy use, and consumer and farmworker health and safety. Within such a conceptual framework, scientists can then construct rigorous models and conduct empirical research to test their validity. Appropriate foci include measurement of the tradeoffs and complementarities between specific FVC attributes (e.g., under what conditions are economic efficiency and environmental conservation practices complementary?) and comparative studies of FVC performance to establish what attributes are most strongly associated with desirable outcomes in multiple dimensions (e.g., under what conditions and in what dimensions do local FVCs outperform transnational ones?). Finally, we must use existing methods (e.g., models of consumer behavior and political decision-making) to communicate multidimensional food attributes to consumers and policy-makers so as to promote informed decisions by all parties. This can increase the demand for and supply of foods with economically, socially, and environmentally desirable attributes.

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Supporting Online Material

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