

Value chains in renewable and sustainable food systems

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Abstract

Globalization of food trade in agricultural commodities is in some senses the antithesis of key concepts of sustainable agriculture. Global trade in food products distances the depletion of resources and environmental impacts of food production from the economic and social processes that drive consumption and increases the global risks from introduction of species that become pests. However, both supply and market value chains have emerged as major sub-systems in the larger global agro-food trade system that exert enormous importance over the potential for change in agricultural production at the farm level. This special issue presents studies of seven value chains that exhibit the breadth of research about value chains and their potential contributions to sustainable agriculture. They address value chains at different scales and dealing in various products. These studies contribute to the body of knowledge with a focus on lesser researched regions and products. Most important, they demonstrate the potential for value chains to enhance agricultural sustainability for rural populations and reduce food insecurity and inequities.

Key words: case study, environmental quality, food security, inequality, globalization, market chain, supply chain, sustainable agriculture, value chain

Strategies to enhance the sustainability of agriculture have emerged and grown more sophisticated over the past 20 years as the body of research and practice has expanded. Driven by the increased recognition of the environmental consequences of contemporary agricultural practice in both the industrial and developing world, early interventions focused largely on natural resource management and conservation. On-farm practices received the bulk of attention from researchers, change agents and farmers. While the social and economic aspects of sustainability were recognized, they were not the focus of early research or practice, nor did most research address the policies and traits of large-scale systems that constrain and facilitate sustainable agriculture. In fact, sustainable agriculture practices were and still are associated with the adoption of site-specific practices that rely to the degree possible on resources that are generated on-farm or at the local level.

Global Food Systems, Resource Use and Risk

At the same time, global commerce in food products, including fresh fruits and vegetables, animal products

and ornamental species has become a dominant feature of the food system. Globalization of food trade in agricultural commodities is in some senses the antithesis of key concepts of sustainable agriculture—particularly the emphases on local, typically smaller scale supply and marketing systems, reduced reliance on off-farm resources, and nourishing local ecosystems and economies. MacDonald *et al.* (2015) refer to this as the transformation of the geography of food systems, accounting for about 13% of worldwide cropland and pasture. While increasing global food trade offers opportunities to participate in lucrative markets to farmers, the ramifications of the scale of exchange extend far beyond the economic.

Global trade in food products distances the depletion of resources and environmental impacts of food production from the economic and social processes that drive consumption. Water use for export crop production provides an example of the environmental impacts of the distancing between demand and production. Schwarz and Mathijs (2017: 231) report that the burgeoning production for export in coastal Peru over the past two decades has increased income and employment, but uses five times more groundwater use than local crop production.

Two high-value crops for export, asparagus and grapes, account for over 50% of total groundwater extraction. Cotton exports in Uzbekistan account for 20.3 billion m³ of embedded water per year, accounting for 72% of the water embedded in all Uzbek exports and contributing greatly to the 20.7 billion m³ annual-water deficit in the country—a significant driver of the desiccation of the Aral Sea (Rudenko *et al.*, 2013). The impacts of virtual water export are not limited to emerging economies. The United States (US) is the largest virtual water exporter, exporting 621 m³ annually in maize, 2921 in soybean and 1359 in wheat based on the global hydrological model developed by Hanasaki *et al.* (2010). Total exports alone do not reveal the localized nature of the potential consequences of water export. The ratio of consumptive use of water to renewable supply in Illinois where maize and soybean production are concentrated is only 2%, whereas the California ratio is 34% (Mubako *et al.*, 2013). These examples highlight the importance of understanding how global agricultural trade affects local food production capacity and, over the intermediate to long term, the sustainability of the natural resource base on which agriculture depends. The separation of consumption and production makes understanding the linkages between producer and consumer critical.

Global food systems also generate increased risks to local ecologies through introduced organisms. The changing nature of intentional and unintentional species introductions provides an illustration of the complexities of relationships between global agricultural trade and local ecologies. Seebens *et al.* (2015) examined the global spread of plant species among 147 countries. While Europe was once the most important net exporter of naturalized plants, they show that socio-economic activities over the past 20 yr are the best predictor of current distributions. They project introduction trajectories for the coming 20 yr and find strong predicted increases in natural plant species in emerging economies in megadiverse regions.

Berger *et al.* (2013) established that linkages between fashion conscious purchases in high-income nations have driven land use changes in Central Asia because herders have increased goat production to take advantage of the multi-billion dollar cashmere market, reducing survivability for more than six endangered large mammals.

Paini and others (2016) examined the spread of pest and pathogen species, analyzing the threat of nearly 1300 agricultural invasive species to 124 nations. They explicitly examined the role of international trade flows in the movement of pests and pathogens between nations and took into account the likelihood of a species reaching a country and establishing itself as well as the potential economic impact of the pest. Their results show that sub-Saharan African nations are the most vulnerable to these pests because they are highly dependent on agriculture, even though others, generally wealthier nations have a higher potential for invasion

and establishment. The US and China were identified as the most important source countries because of their large and diverse volumes of trade and because they are hubs in the international network of agricultural trade.

These examples illustrate the complex interactions between social, economic and environmental factors that create both opportunities and threats to agriculture and the environment mediated by global trade in agro-food products. Greater understanding of value chains is important to understanding how these interactions develop at the local, regional and global scale, and particularly understanding how the assessment that local decision-makers (*i.e.*, consumers and producers) influence the development of trade networks at multiple scales.

Value Chains as Critical Sub-Systems for Renewable Agriculture

Both supply and market value chains have emerged as major sub-systems in the larger global agro-food trade system that exert enormous importance over the potential for change in agricultural production at the farm level. This special issue presents studies of seven value chains that exhibit the breadth of research about value chains and their potential contributions to sustainable agriculture. They address value chains at different scales and dealing in various products. These studies contribute to the body of knowledge with a focus on lesser researched regions and products, and address three opportunities to address renewable and sustainable agriculture through value chain development.

The adoption of transdisciplinary and multidisciplinary views to value chain research is needed in order to capture with more precision the diversity, complexity and dynamics of processes involved (Hirsch *et al.*, 2006; Lang *et al.*, 2012). Integrative agricultural and food value chain analysis requires understanding the exchanges among human, environmental, social-cultural, institutional and technological dimensions of value chain processes. The application of novel and holistic methodologies advances the development and assessment of strategies for building sustainable value chains in agricultural and food production. Successful integrative strategies facilitate economic goal maximization while promoting agrobiodiversity conservation, protecting the environmental and renewable resources, and growing socio-cultural capital. The studies include a variety of approaches and perspectives to value chain analyses and demonstrate the value of multidisciplinary and transdisciplinary research.

It is also important to use multidisciplinary and synergistic approaches to incorporate various stakeholders' views, needs and opportunities, in order to use value chain development to create a more symmetric interaction and equitable distribution of resources, trade-offs and risks among actors in the value chain system, including individuals and households, economic entities,

governmental agencies, non-profits and communities, among others (Hirsch Hadorn et al., 2006; Pagell and Shevchenko, 2014). Research on agricultural and food system value chain that focuses on disadvantaged stakeholders in the value chain is of particular importance. The representation of these actors and understanding their roles in value chain research may permit the development of more equitable value chains, such as gender-sensitive value chain development, and may provide greater insights into ways to formulate socially conscious strategies with positive externalities for bottom-line economic growth *coupled with* environmental conservation (Barrientos, Dolan and Tallontire, 2003; Rubin, Manfre and Barrett, 2009; Coles and Mitchell, 2011; FAO, 2016). In addition, inclusionary approaches to value chain research illuminate emerging and non-traditional structures and dynamics in agricultural and food systems, for instance, value chain intermediaries connecting local value chain to global value chains (Ilbery and Maye, 2006; Pearson and Bailey, 2012). Including these emerging actors and dynamics in agricultural and food value chain research can help bridge the gap between theory and practice.

Finally, the focus of value chain research and development may need to move beyond sustainability to focus on renewability and resilience in the face of growing global threats associated with loss of biodiversity, climate change, diminishing resources for human sustenance, and increasing poverty and food insecurity for much of the world's population. The scope of sustainable value chain should not be confined to reducing social, economic or environmental harm (Zhu and Sarkis, 2004; Pagell and Shevchenko, 2014). Rather, sustainable approaches to value chain development should target regenerative social, environmental and economic impact. Continuing research on agricultural and food production value chains provide opportunities to formulate viable and innovative value chain strategies that can address renewability as well as sustainability.

Seven Case Examples

Blare and Donovan (2016) provide a case study of the development of value chains for indigenous crops, a strategy promoted by both non-governmental and governmental organizations to reduce poverty in rural areas in developing nations. Their work explored the case of camu-camu, a fruit crop native to Amazonia still in the process of domestication, using interviews with key informants and farm household-level data. Their data suggest that camu-camu has increased farm income without creating detrimental effects on other livelihood activities or environmental quality. However, they warn that building value chains to commercialize lesser known crops will require more than working with local farmers. They found that limitations in services and inputs, the business

environment and little coordination among actors in the nascent chains limited potential benefits. Blare and Donovan suggest that stronger institutions and growth in local markets for high-value products will be keys to success for this strategy.

Tobin et al. (2016) also examined value chain development in Peru, but their research focuses on the potato rather than an emerging domesticate. They address the relationship between value chain development and agro-biodiversity conservation, another strategy pursued by both public and private institutions and organizations. As the center of biodiversity of native potato varieties, the Andean highlands provide a particularly rich opportunity to explore the hypothesized potential for increased biodiversity conservation through value chain development. They found that value chains do provide households with economic value, at least for some varieties, but argue that value chains *per se* are likely to have relatively small effects on agro-biodiversity conservation because conservation and production for market are separate livelihood activities in the household. Further, households with greater resource endowments are best able to take advantage of both activities, conservation to fulfill cultural values and marketing of native varieties to secure economic benefits. They conclude that value chain development alone is insufficient to ensure agro-biodiversity conservation and that other measures will be necessary.

In their study emerging changes in supermarket sourcing, Bogomolova et al. (2016) examined the role of consumer preferences for local foods supermarket purchasing strategies. They studied one regional supermarket chain, collecting actual purchase data. They identified the drivers of high local food purchases with a sample of consumers and attempted to tie these value-based behaviors relating to the perceived health, economic and community benefits of purchasing local food to the supermarket setting. They found few opportunities to apply the drivers of purchasing behaviors among patrons of local venues, such as farmers markets, to supermarkets. They did, however, identify potential opportunities for developing local value chains between regional suppliers and supermarkets. They explicitly address the potential for using such strategies to address socio-economic and equity issues associated with the dominance of global value chains in the US food system.

Schulze-Ehlers and Anders (2017) also address the impact of consumer preferences on supply chains, focusing on pork sourcing in Australia. The study examines the example of Meat Standards Australia's (MSA) whole-of-chain, value-based grading system for beef, which provides insights into the requirements of a successful strategy for consumer-driven meat marketing. They examine the reasons for pork remaining focused on mass production and mass markets, paying little attention to the potential for development of lucrative niche markets based on intrinsic quality of the product, specifically taste. Their work brings together the frameworks of hedonic pricing and transaction-cost economics with

evaluation how to employ sensory qualities of the product to provide consumers with clues to the potential quality of an eating experience. They build on the existing body of knowledge about the importance of the eating experience in consumer choices to identify potential opportunities to develop value chains that would offset the declining demands for pork in major markets in Europe. Their assessment of the potential for pork supply chain development highlights the important differences between beef and pork supply chains in Europe that may limit the incorporation of sensory quality in pork chains. They warn that this approach to the development of alternative value chains may apply only to rather small niche markets.

Michelson *et al.* (2017) also address the relationship between the local and global value chains. They examined the emerging retail-led markets emerging as supermarkets in China shift from fresh fruit and vegetable procurement through wholesale markets to direct contracting with farm communities as they seek to eliminate intermediaries and gain better control over the quality, availability and safety of fresh produce they sell. The authors' comprehensive study used the 198 fresh fruit and vegetable supply chain intermediaries that worked with Walmart in 2014. They found that these intermediaries are playing an increasingly important role in steering land, labor and production decision-making through direct contracts. The intermediaries play important role in determining how farm households, mostly small farms, participate in and benefit from these new value chains. Their findings illustrate both how vertical coordination of the agricultural sector in China is occurring and provide insights into the rapid pace of agricultural modernization in the country. While Walmart provided a single case, Walmart is a major innovator in procurement strategies in China often serving as a model for other large supermarket chains whose supply chain strategies are believed to be similar to those of Walmart, or likely to become so. Their results also shed light on the important issues of food safety and quality that the commercial food sector must address.

In contrast, McRoberts *et al.* (2017) studied a critical value chain in Vietnam that supplies cattle manure for crop production, including pepper, coffee, dragon fruit and rubber farmers. Farmers with cattle must elect between using the manure on their own farms and sales, which in turn affects nutrient flows and incomes for both buyer and seller. The manure value chain include numerous actors that include small-scale manure collectors, traders and purchasers as manure moves from the lowlands of south-central Vietnam to the central highlands and south-east coast. Value-added activities included drying, bagging, collection and composting the manure. Net flows were outward from higher density animal regions to regions with lower density and to regions with higher value crops. Manure sales supplemented farmer incomes, but were a primary livelihood activity for traders. This case study provides important insights into how locally

generated value chains can provide important services that are more typically provided through large-scale international input supply chains and offers insights into ways to improve such value chains and ways to better evaluate their evolution and resilience.

The final study examines how contracting affects gender equity, drawing on the case of organic spice certification in Tanzania. The example of organic certification tied to moving product into the international market provided Bullock *et al.* (2017) with an opportunity to understand the complex interactions between value chain development and market participation, comparing households that sell through conventional and organic market chains. The authors explored intra-household and inter-household decision-making with regard to resources and marketing, access to benefits of contracting and labor distribution in the two types of market chains. The analysis was extended to the community and district. Contracting did reduce transaction costs compared to the conventional spot market trading, but the findings suggest that contracting does not provide significant opportunities for women in married households to participate in and benefit from contract marketing because they have limited access to training needed and limited roles in decision-making. On the contrary, divorced women and widows gain access to contract employment opportunities. This study provides critical insights into the need to understand complex gender relations in the household and in the community to develop gender equitable value chain strategies and contracting schemes.

Together, these seven studies highlight three critical contributions that value chain research can make to renewable and sustainable agriculture. First, they provide examples of the kinds of integrative frameworks and methodologies that are needed to advance understanding of how these complex systems function, especially to understand the impacts of value chains on social, economic and environmental outcomes. Secondly, these selected studies illustrate the importance of better identifying and more exploration of emerging dynamics and roles of various stakeholders and participants in the value chain, including analyses of differential benefits from value chain development. Thirdly, they draw attention to the need to develop enhanced, efficient and pragmatic approaches to value chain development strategies that will help ensure that such development supports agricultural sustainability and renewability in the face of rapid environmental, social and economic change.

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