INITIATIVE ON Rethinking Food Markets
CGIAR
INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
IFPRI
IITA Transforming African Agriculture

INITIATIVE TECHNICAL PAPER JANUARY 2024

Outsource agrifood service MSMEs facilitating pivoting by fruits & vegetables farmers, wholesalers, and retailers

Thomas Reardon, Titus Awokuse, Lenis Saweda O. Liverpool-Tasie, Bart Minten, Geneviève Nguyen, Sara Qanti, Johan Swinnen, Rob Vos, and David Zilberman

Abstract

There is an important gap in the literature regarding evidence about the emergence of outsource agrifood services. We contend that there are few studies on outsource services for differentiated product value chains, particularly in developing countries. To some extent, also, there is a knowledge gap regarding the use and effectiveness of eco-certification and labeling compliance-assisting services in developed countries. The bulk of attention on outsource services is centered at the commodity phase (such as with bulk grains) and the modern stage, and less attention is being paid to the product differentiation phase. To fill these voids, we focus on three country illustrations, ranging in the product cycle phases from transitional to transitional-modern to modern, and from early differentiating case in Ethiopia (on basic quality) to intermediate differentiating case in Indonesia (on advanced quality and variety differentiation in mangoes), to advanced-differentiating case in France (on eco-labeling and certification). We focus on horticulture as it is rapidly growing, and rapidly differentiating both in developed and developing countries. We conclude that policies and public investments facilitating the formation of these services are important. Importantly, we found that without these emerging outsource services, farmers would not have been able to be resilient to the shocks of market requirements and climate change.

CONTENTS

1. INTRODUCTION

Agrifood value chains are transforming rapidly both in developing and developed regions (Barrett et al. 2022). On the one hand, value chains are transforming in stages from “traditional” to “transitional” to “modern”. In this sequence, value chains become spatially longer from traditional to transitional, and then again from transitional to modern. In the transitional stage, micro-, small- and medium-sized enterprises (MSMEs) tend to dominate, and because value chains are spatially long (due to the rise of the share of cities in total population), they are fragmented. In the modern stage, large enterprises tend to dominate, coinciding with concentration of segments and often disintermediation over the chain. In the modern stage, private standards of quality, safety, and other attributes such as environmental sustainability develop (Swinnen 2007).

On the other hand, a given value chain tends to move along phases of the Product Cycle (Reardon and Minten, 2021), from niche, to commodity, to differentiated products. In the commoditization phase, the product is a bulk good, with little differentiation into non-price traits, and competition is on cost. In the product differentiation phase, the product is differentiated by non-price traits such as quality (such as taste), safety, and non-price traits noted above (Porter 1986).

The food economy today is experiencing intense development of product differentiation (McCluskey and Winfree, 2022). As evidenced in our case studies in this paper, this trend of differentiation holds both in developed regions, such as in “advanced differentiation” of horticultural product environmental traits of low-pesticide use in France, as well as developing regions, as evidenced for example in cases below of “emerging differentiation” into non-traditional products and quality grades in vegetable value chains in Ethiopia and “intermediate differentiation” into different varieties with a range of taste, appearance, size, and timing traits in mango value chains in Indonesia.

Agrifood value chain participants, whether farmers or off-farm segment actors (what we call food industry here), experience “market shocks” as value chains transform along the above stages and product cycle phases. The market shocks can be inherent to the shift of stage or phase, such as going from the market not demanding a particular quality, to the market demanding higher quality. The latter change in requirements such as is often embodied in a new private standard, and that “translates” into a set of new practices and threshold investments that the farmers and other supply chain actors must undertake (Swinnen 2007). This is of course parallel to threshold investments that farmers must undertake to adopt any new technology (Feder et al. 1985). This undertaking can be onerous and major for the farmer or other actor, and if the farmer lacks the necessary levels and types of assets, or experiences “idiosyncratic market failure” to access the needed information or inputs, they can be excluded.

To “market shocks” have been added, over the many decades and increasingly intensely and in complex ways, non-market shocks which we will for simplicity (and because they link to our case study discussion) call “climate shocks.” But we place in the latter basket other shocks like human disease such as COVID-19, animal and crop disease, conflict, and so on. Controlling for market requirements, these further disrupt and challenge farms and other market actors and require an additional set of practices and investments to cope with or mitigate the shocks. Things are even worse, as is increasingly common, when these non-market shocks confluence (Zurek et al. 2022).

Two broad strands of literature exist on the mechanisms that enable farmers’ and other value chain actors’ “resilience” to market and climate/non-market shocks and making the needed changes in practice and being able to make threshold investments. The first strand roughly (as there are overlaps as we will note below) focuses on mechanisms or – in new institutional economics parlance – institutions, through which the food industry buyer helps the farmer (or any other supplier) overcome asset constraints and address idiosyncratic market failures via “resource provision contracts.”

This first strand has been rich in the modern-stage situations. For example, Austin (1992) noted that modern food industry firms in developing countries often must address shortfalls in the suppliers' capacities with technical assistance, credit, inputs, and so on. Gow and Swinnen (1998) and Dries and Swinnen (2004) emphasized this in the cases of sugar and dairy firms in Central and Eastern Europe. Key and Runsten (1998) made this point in Mexico for agro-exporting firms.

Sometimes, such as in Gow and Swinnen (1998), the studies in this strand point to third-party relations such as of banks and input companies that co-adapt and help the food industry firm supply "resources", such as credit and input to the farms or other suppliers. Reardon et al. (2007) studied this for the case of supermarkets and large processors procuring from farmers and enlisting in "symbiotic relationships" the participation of logistics companies and specialized wholesalers to provide both suppliers and buyers with services and assets they lack. Reardon and Swinnen (2020) and Reardon et al. (2021) note that during COVID-19 delivery intermediaries and other logistics services "co-pivoted" with e-commerce firms and supermarkets to allow retail to be resilient in the face of the lockdowns of the pandemic. This sub-strand of the first strand links to and presages the second strand below on outsource services helping farmers.

The first strand has also been important in transitional and even traditional stage situations. Bardhan (1980) and Eswaran and Kotwal (1985) analyze the needs of large farmers or landlords to use "tied" labor-land, labor-credit, and other means to provide tenant farmers with management, with land, and with credit that they lack, and in turn assure themselves of the tenant's labor on and produce from the land. The relational contracts literature (e.g., Macchiavello et al. 2022) is in the same vein, but applied to other actors in the supply chain, such as traders, that provide these mechanisms.

The second strand of literature focuses on the emergence of the supply of third-party "outsource" agrifood services that provide services and inputs to farms and other suppliers so that they can pivot if new market requirements (market shocks) are presented to them, or co-pivot with their food industry buyer if the latter needs to pivot to face some new requirement or non-market shock.

There is an important gap in the above literature on the emergence of these outsource services. We contend that there are few studies on outsource services for differentiated product value chains, particularly in developing countries. To some extent, also few studies exist about eco-certification and labeling compliance-assisting services in developed countries. The bulk of the existing literature on outsource services focuses on the commodity phase (such as with bulk grains) and the modern stage, while much less attention has been paid to the product differentiation phase.

To address these knowledge gaps, we will focus on three country illustrations, ranging from transitional to transitional-modern to modern, and from early-differentiating case in Ethiopia (on basic quality) to intermediate differentiating case in Indonesia (on advanced quality and variety differentiation in mangoes), to advanced-differentiating case in France (on eco-labeling and certification). We focus on horticulture; we need to focus because of space constraints, but horticulture (or animal products) as perishables, as rapidly growing, and rapidly differentiating in both developed and developing countries (but with different trait foci) allows us a rich set of illustrations.

The paper proceeds as follows. Section 2 provides a brief review of the literature of the outsource agrifood service firms (with an emphasis here on agricultural services rather than other supply chain services such as logistics, that we treat elsewhere) to put the illustrations in context. Section 2 then presents the three cases. In each case, we first discuss the shock, then the pivot farmers need to and are making, then we discuss the supply of outsource services by emerging enterprises, to end with an assessment of the role policies and institutions played in facilitating this symbiosis. We keep to the theme of "symbiotic resilience" when discussing the three cases, not only in terms of the triangular symbioses we observe (food industry, farmer, and outsource services firm) but also in terms of the types of resilience, both to market shocks, and to climate and environment shocks or challenges per se, as those are rife in the horticulture contexts of the three setting. Section 4 concludes summarizing and comparing the cases and presenting policy implications.

2. BACKGROUND: BRIEF REVIEW OF THE OUTSOURCE AGRIFOOD SERVICES ENTERPRISES LITERATURE STRAND

The theoretical literature on outsource agrifood services has appeared in several forms and times. A useful lens for our purposes is provided by Lu et al. (2016) who depict, essentially, the supply of these services as a function of a firm, like a large farm, having indivisible or lumpy assets (like a combine) that it cannot use to full capacity on its land; the excess over its own demand is sold as a service, like custom combining, to other farmers. The demand from the latter arises because they are asset constrained in some way, such as having land too small to justify their own purchase of a combine, or they do not have enough money to buy a combine, so they just hire the custom service when they need it.

The applied literature on outsource agrifood services has had three main axes: (1) ”commoditization versus product differentiation contexts”, which has tended to be (but not strictly) correlated with “grains versus non-grains”; (2) ”over time” and “over regions”, from early to later and from developed to developing countries; (3) “over technologies and organizational forms”, like labor teams plus simple machines to drones, from machines only to machines and chemical and biological applications.

The first sub-strand has been on outsource services for grain farming, such as custom reaper services in the 1800s on (Cochrane, 1979, and Olmstead and Rhode 1995). This work analyzed the diffusion of cross-state custom services, composed of a machine and a team of workers. There were subsequent waves of this sub-strand over countries as mechanization spread and adapted to local conditions. For example, Yang et al. (2013) and Zhang et al. (2017) analyzed cross-province rice combine outsource services in terms of supply from a cluster in Jiangsu. Subsequent studies analyzed the demand over farmers for these services and the effects on a range of outcome variables such as yields.

There was a variation on this theme in the work of Goldberg and others on “one stop shop” services of combines plus other services (such as input application and sales links) by firms like El Tejar in Argentina and Brazil. This was in the context of a commodity but one, soybeans, that also required differentiated traits such as oil and protein content (Goldberg and Allison, 2004).

The second sub-strand has been on outsource services for non-grains. This work mainly focuses on developed countries. Two studies illustrate this. One researches bee pollination services in the United States for orchards (Baylis et al., 2021). Another studies multi-service computer consulting services in California for horticulture (Putler and Zilberman, 1988).

While there has been some follow-on literature on outsource services in developing countries, such research has been rare so far. A possible reason for this could lie in the fact that the rapid development of non-grain food value chains, such as those for horticulture in developing Asia during the 1990s and Africa during the 2000s, remained for some time in the commoditization phase with supply chains depending mainly on local wholesalers and other traditional services and own labor. It has not been until the more recent product-differentiation phase, as for instance in the cases of Ethiopia and Indonesia discussed below, where high requirements on individual value chain actors have called forth these outsource services. Those requirements include high threshold investments and higher skill and input application needs at the farm level and new marketing requirements to connect to supermarkets and reach urban consumers in the downstream of the supply chain. More recently, exogenous shocks to these differentiated systems, such as climate shocks challenging differentiating horticulture and avian flu and other animal diseases challenging intensifying and differentiating animal production, have upped the needs for these services. We turn to examples of these next.

3. CASE STUDIES OF THE DEVELOPMENT OF OUTSOURCE AGRICULTURAL SERVICE FIRMS IN HORTICULTURE VALUE CHAINS CATEGORIZED BY DEGREE OF PRODUCT DIFFERENTIATION AND STAGE OF VALUE CHAIN TRANSFORMATION

3.1. Emerging product differentiation & transitional value chain transformation case: Ethiopia vegetable outsource service enterprises serving a vegetable farming cluster

3.1.1. Transformation of Ethiopia vegetables value chain and shock/challenge and opportunity for vegetable farmers

Vegetable demand has risen rapidly in Ethiopia over time due to three factors: urbanization, income increase, and Bennett's Law predicting that the share of non-staples rises disproportionately with incomes. In 1990, 13% of Ethiopian population was in cities (with the urban population 6 million); by 2022, the share has nearly doubled to 23%, and the urban population, nearly quintupling to 28 million (World Bank). GDP per capita (in current USD) increased 4-fold over the period.

Rapid urbanization and income growth have acted as strong pull factors for vegetable farming. Domestic vegetable production, and domestic value chains, met the great majority of demand as less than 1% of consumption or production is traded internationally. Consumer survey data show the increase in vegetable consumption. The fruit and vegetable share in consumption baskets doubled over 10 years, from 4.5% in 2006 to 9% in 2016. Consumption per capita increased 1.3-fold in urban areas and 1.4-fold in rural areas between 2011 and 2016. For the capital Addis Ababa, 19% of the food basket was going towards vegetables in 2020, significantly higher than national levels (Minten et al. 2020). Addis Ababa's population tripled from 1.7m in 1990 to 5.5 in 2022, which, along with rapid income growth, created a jump in the vegetable market represented by the capital. Overall vegetable output in tons in Ethiopia tripled from 1990 to 2020 and doubled from 2000 to 2020, based on FAOSTAT Food Balance Sheet data.

3.1.2. Pivots needed & undertaken by vegetable farmers

To respond to the opportunity of the overall growth in vegetable demand in Addis Ababa, a large "spontaneous cluster" emerged, that is, a cluster not founded by a company or the government or an NGO project, but just by farmers coming to a favorable area. The cluster is of vegetable farmers in a well-watered area of the Rift Valley around 3 hours by highway from Addis Ababa. The cluster emerged in the 2000s and grew quickly thereafter. The irrigated area of the cluster more than doubled over one decade. In a little more than a decade the cluster has grown to supply 60% of the vegetables consumed in Addis Ababa.

Almost 60% of the vegetable area is cultivated by medium-scale tenant farmers (who produce 70% of the output of the cluster) (Minten et al. 2020). The medium-sized farms specialize in vegetables higher on the "value ladder" and require more investment, such as tomatoes. Tomato cultivation also requires more labor expenditures than other crops. For example, tomato production requires 35% more labor than the cultivation of onions. Tomatoes are a non-traditional vegetable that formed 6% of vegetable output in tons in 2000, and 3% in 2020. By contrast, the share of onions in output went from 12% to 21% over the period.

The growers that entered vegetable production had to be able to address two cost challenges. On the one hand, vegetable farmers had to undertake a major "threshold investment" for putting in place a pump and irrigation system. This is needed for water control in the rainy season and access to water for a second season during the year to meet urban demand for pan-seasonal supply of vegetables. Irrigation investments are costly even though the area is well watered with lakes and rivers and an accessible water table.

On the other hand, vegetable producers in the cluster use intensive growing techniques, featuring purchase of seedlings, fertilizers, and pesticides. Non-labor costs for this are twice as high for medium-scale farmers compared to small farmers in the cluster. This is partly driven by the fact that medium-sized farms have a different crop mix than smallholders. Production costs are highest for tomato and onions, products that medium-sized farms specialize in, and lowest for Ethiopian kale (a leafy vegetable), which is mostly grown by smallholders. However, differences are also substantial when farmers are growing the same vegetables as medium-scale farms use more and better inputs. Tomato-producing medium-size farms spend on average d nearly 25% more than tomato-growing smallholders. Moreover, cluster vegetable farmers spend about 10 times more per hectare on non-labor costs than farmers growing basic grains (teff) (Bachewe and Minten 2021).

3.1.3. Co-pivoting by mobile outsource horticultural service firms

The clustered vegetable farmers face asset constraints (equipment and skills) to undertake the pivoting toward growing vegetables in general and toward climbing the "value ladder" from traditional green leafy vegetables to higher value tomatoes and onions more in particular. These constraints have induced demand for outsourcing of: (1) equipment and labor teams (managing migrant labor) for digging wells and ponds; (2) mechanized plowing; (3) planting seedlings; (4) applying chemicals; (5) harvesting; and (6) marketing. The firms did not offer these via digitalization or apps, nor did they provide credit.

The firms operate locally in the cluster, rather than across clusters or provinces (unlike the cases we present in the other countries). Moreover, their activity is highly seasonal, e.g., tractor services come for plowing, well diggers after the rainy season, and their activities in general are somewhat less intense in the rainy season when many grow cereals.

While other cases in this paper concern outsource services firms that are "one-stop shops," in the Rift Valley the service firms tend to be specialized and that specialization is correlated with firm size. The small firms tend to do labor-intensive simple tasks (e.g., digging wells). The medium-scale firms perform plowing services. The larger firms (but still "MSMEs") undertake seedling production in their own farms and planting on client farms, as well as vegetable wholesaling to markets in Addis Ababa.

The great majority of the users of these services are (as in the Indonesian case) are medium-scale farms. There is less demand from small-scale farms. The demand is correlated with the degree of 'technification' of the farm, and the requirements of labor, skills, and equipment to undertake the tasks.

3.1.4. Role played by government policies and institutions

The emergence of the outsourcing firms took place completely spontaneously, without any direct intervention of the government or NGOs. Moreover, the firms fully rely on domestic capital; no foreign direct investments are involved. However, the government of Ethiopia played two roles in the differentiation and intensification of vegetable farming and thus indirectly the formation of the spontaneous cluster and the outsource services.

On the one hand, the general development of vegetable farming and its supply chains was facilitated by the upgrading of the highway system serving Addis Ababa from the secondary cities near the vegetable

production areas in the 2000s and 2010s. It was also facilitated by the expansion and upgrading of produce wholesale markets in Addis coupled with national policies deregulating supply chains of agricultural products among Ethiopian provinces in the past two decades.

On the other hand, the government liberalized vegetable seed imports and imports of equipment and pesticides. This in turn encouraged SME input firms of chemicals and equipment to multiply in the cluster and link as well to the outsource firms.

3.2. Intermediate product-differentiation and transitional plus modern stage case: Indonesia mango sprayer traders as outsource service enterprises

3.2.1. Transformation of mango value chain and shock/challenge cum opportunity for mango farmers

Mango demand has risen rapidly over time due to three factors: urbanization, income increase, and Bennett's Law. In 1990, 31% of Indonesian population resided in cities (with the urban population totaling 56 million). By 2022, the share had nearly doubled to 58%, and the size of the urban population had tripled to 160 million (World Bank). Our analysis of the 2010 LSMS data for Indonesia shows that 75% of mango consumption is in cities and that the share of cities in mango consumption is higher than the share of cities in the national population (this is expected, given that urban consumers have higher incomes than rural consumers and since mango consumption is income elastic).

The tripling of the urban population thus gave a powerful demand push to mango farming. The increased demand was by and large met through domestic production and domestic value chains, as less than 1% of mango consumption is imported and less than 1% of output is exported. Consumer data confirm the increase in mango consumption. The Indonesia National Survey and Census of 2019 shows that domestic mango consumption increased by about 20% from 2007 to 2016 (0.37 kg/capita/year in 2007 and 0.65 kg/capita/year in 2016).

Through a rapid reconnaissance of downstream wholesale markets and supermarkets and both reconnaissance and surveys of upstream farms located in the mango production study areas (Western and Eastern Java), we found a rapid expansion of mango production during the 1990s and 2000s centered around the main mango variety (*harumanis*) and declining shares of a wide set of minor local "niche" varieties.

During the 2000s and 2010s, in turn, there was a rapid increase in plantings (hence of consumption as the mango economy is nearly "closed") of differentiated mango varieties, such as *gedong gincu*. These have been sweeter, more fragrant, and with more desired colors than the original commodity varieties and high in demand by consumers in urban markets. At the same time, with the differentiation of qualities and varieties prices for mangoes in urban markets also have become highly differentiated providing further demand signals to production areas.

3.2.2. Pivoting needed and undertaken by mango farmers

The overall growth in mango demand in urban areas, coupled with the product cycle from commoditization to product differentiation, acted as a "market requirement shock" on mango farmers in several ways. The farm results are drawn from Qanti et al. (2017) for the 2011 survey of 404 mango farmers in West and Eastern Java and hitherto unpublished results from a subsequent resurvey of 415 mango farmers in the two provinces in 2017.

First, farmers responded to the rapid growth in demand with a 4-fold increase in mango production, from 0.56 million tons in 1998 to 2.2 million tons in 2009. This growth mainly took place with the emergence of "spontaneous clusters" of mango farmers especially in a few areas of Java (selling to the huge city of Jakarta and others) and a few other islands.

Second, based on the 2019 farmer survey, mango farmers that had started as micro-sized farmers (less than 10 trees) rapidly planted mango trees from 2005-2009 (46% of mango farmers planted new mango trees in this period).

Third, farmers undertook product differentiation matching market demand. The survey showed that farmers in the traditional market channel (selling to local markets) tended to focus on commodity varieties (e.g., *harumanis*). Farms in the "modernizing channel" (selling to city wholesale markets and specialized wholesalers selling on to supermarkets) adopted the new high-value differentiated varieties (e.g., *gedong gincu* and *dermayu*). They also did a new practice of letting the fruit ripen on the trees to have a sweeter taste and fetch a higher price.

Fourth, farmers intensified mango production (shifting away from the former dominant method of "extensive" production using few inputs and even practices like pruning). They substantially increased their application of chemical fertilizer, pesticides, herbicides, and hormones (to induce flowering to extend the season to get better prices). By 2009 in the West Java and East Java samples (the main mango production zones), 70% of farmers used fertilizer (compost, manure, or foliar fertilizer), 40% of farmers used pesticides, and 28% applied growth hormones. The share of farmers who used these inputs is higher in the "modernized/urban market" channel than in the traditional market channel. The share of mango farmers who used these inputs was somewhat higher in 2017.

Fifth, there was a rapid rise of medium farmers and a decline in the share of the traditional micro farmers (called "backyard mango farmers" there). Most mango farmers are "backyard farmers" but the great majority of total volume of production by the mid-2010s came from non-backyard farmers, that is, those operating small- and medium-sized farms. Nationally, in the early 2000s, the backyard/marginal farms with 4-10 trees represented 80% of mango growers but farmed only 40% of the national stock of mango trees. The small-scale farmers, those with 11-99 trees, were 19% of the farms and yet had 40% of the trees. The medium-sized farms with more than 100 trees comprised 1% of the farmers but 20% of the trees. Non-backyard farmers grow 60% of the trees. Over the past two decades the share of medium farmers grew. For example, in the 2017 survey for West Java, the backyard/marginal and small-scale farms constituted 86% of mango farmers but only had 35% of the trees. The medium-scale farms comprised 14% of the farmers but had 65% of the trees. Medium-sized mango farms are much more specialized in farming in general and mango farming in particular compared with marginal and small-scale farms, many of which tend to engage in rice cultivation.

3.2.3. Co-pivoting by mobile outsource agrifood service firms ("sprayer traders")

Mango farmers faced many asset constraints (equipment and skills) to undertake the pivoting toward new varieties and use of intensification technologies. This induced demand for outsourcing of skilled pruning, mechanized spraying, harvesting and sorting, and differentiated quality marketing. The new demand induced the rise of "sprayer traders" providing these agricultural services.

a) Supply of sprayer-trader services

These findings are based on hitherto unpublished data from a survey of 145 of these enterprises in West Java and East Java in 2011. First, "sprayer-traders" mobile outsource-service enterprises rapidly emerged in the second half of the 2000s, increasing 26% in numbers during the 5 years before the survey in West and East Java. These enterprises are MSMEs, servicing about 10 clients on average, and for the larger firms, about 15 clients. The firms work with various scales of mango farming (from marginal to medium), mainly located within the same village as the sprayer-trader. The size of the firm and their client farm base tend to be correlated, with small sprayer-traders servicing mainly the marginal mango farmers and larger sprayer-traders servicing mainly small- and medium-sized farms.

Second, the sprayer-traders have a dual strategy in the product cycle: the survey found that about 70% of the trees they service are the commodity varieties, and 30% the new differentiated varieties. They serviced almost no traditional niche variety trees.

Third, the sprayer-trader enterprise is a “one-stop shop” for mango farmers, doing, as in the other case examples, “A-Z” services, including planting seedlings, preparing the soil, spraying many times over the season, bagging fruit on the tree (to reduce insect damage), harvesting, sorting, and marketing, mainly to wholesale markets and in some cases to supermarkets. They have a dual purpose: to increase productivity (via fertilizing and pesticide spraying), and differentiating the product (introducing varieties, spraying for cosmetic quality related to low blemishes, and harvesting later for sweetness), as well as inducing an earlier harvest than the regular harvest season via growth hormones and flower inducer application. The differentiation gives a higher selling price.

Fourth, the survey showed that sprayer-trader MSMEs were formed mainly by two sets: (1) medium-sized mango farms with farmers and workers possessing the needed experience, skills, and equipment and with links to input suppliers (including access to credit to buy inputs); (2) mango traders, specifically mango collectors and wholesalers with a market network). Sprayer traders revealed through the survey that they started providing these services to increase the marketed volume and quality and earliness of harvest (by facilitating these among their clients the output of which the sprayer-trader then marketed), to shorten the marketing chain (thus integration with farmers) to compete as traders, and to earn money selling farm services.

Fifth, the survey showed that sprayer-traders made substantial investments in equipment (specifically sprayer and harvesting tools), vehicles, and links with the labor market (especially specialized labor for spraying). Some of these assets were already part of their own medium farm operation and some were bought or rented when the enterprise was started.

b) Demand for outsource services by farmers

In the study area of West Java, comparative surveys using the same farmer sample found that the share of farmers using sprayer-trader outsourcing firms doubled from 7% in 2009 to 15% in 2017. The new (relative to 2009) adoption of sprayer-trader services was mainly by medium farmers, and to a lesser extent small farmers. This was due to medium farmers having more intensive operations, aiming at the modernizing/urban market, and having rural nonfarm employment (hence higher opportunity cost of time).

In both the 2009 and 2017 surveys, medium-sized farms are more likely (than the smaller farms) to use outsource sprayer-trader services. In 2009, about 15% of medium mango farmers used outsourcing firms versus 30% in 2017. Regression analysis further showed that the adoption of sprayer-trader services is driven by farmers’ wealth and commercial orientation, the opportunity cost of farmers’ time (rural nonfarm employment), their social and physical capital, and the density of agricultural services and mango growers (hence, a cluster) in the area.

3.2.4. Role played by government policies and institutions

The government of Indonesia played two roles in the differentiation and intensification of mango farming which induced the derived demand for sprayer-trader services. On the one hand, the general development of mango farming and its supply chains was facilitated by the construction or upgrading in the 1990s and 2000s of broad highways from West and East Java to the huge urban market of Jakarta and conurbation cities (Greater Jakarta area was 34 million people by 2018, ranked as the second largest megacity worldwide, after Tokyo) (Rustiadi et al. 2021). It was also facilitated by the expansion and upgrading of produce wholesale markets in Jakarta coupled with national policies deregulating supply chains of agricultural products among provinces after the economic crisis of 1997-98 (Araki et al. 2006).

On the other hand, the Indonesian Tropical Fruits Research Institute (ITFRI) was instrumental in the breeding and initial introduction of new mango varieties on Java and other islands (Mansyah and Sutanto, 2020), including in the West Java and Central Java study areas. After that, substantial private sector development (through SME development of seedling nurseries) led to the diffusion of the new varieties (Qanti et al. 2020).

3.3. Advanced product differentiation and modern value chain transformation stage case: France vegetable outsource service enterprises serving large vegetable companies selling to supermarkets and exports

3.3.1. Transformation of vegetables value chain and shock/challenge cum opportunity for vegetable farmers

In contrast to the other two cases, where the product market was growing quickly and, in some cases, differentiating, the case of France and Europe is one of a market close to being saturated on the supply side but changing rapidly in terms of product differentiation and labeling. The latter is not for quality or safety, as those were earlier stages in product differentiation of the product cycle, but rather to facilitate the rise of both private and public eco-labeling by large supermarket chains.

First, on the demand side, French consumers increasingly perceive fruits and vegetables (FV) as healthy. This perception has been reinforced by a government campaign launched in 2001. This led to a reversal of a medium-term decline in fruit and vegetables consumption, with demand increasing again starting in 2010. In particular, consumer demand for eco-labeled, low-pollution FV, and, more recently, "locally" produced FV has expanded rapidly. A national survey in 2016 found that 51% of consumers preferred these traits in FV. But consumers also noted that they do not want to pay price premiums for such products. Modern retail (hypermarkets and supermarkets) dominates produce retail and has been signaling "eco" traits with labels.

Second, on the supply side, farmers have received signals of the demand for "eco" traits. Modern retail chain labeling is transmitted as trait requirements to farmers. European directives recommend reduction of pesticide use in agriculture. The French government has a medium-term plan to promote the reduction of pesticides and has put in place subsidies to promote the adoption of "green" practices and use of precision equipment to reduce chemical application.

3.3.2. Pivots needed and undertaken by vegetable farmers

First, there has been rapid consolidation of French agriculture, in the long term, but also in the recent past. From 2000-2016, the number of small and medium family farms dropped 37%, and large corporate farms increased 23%.

Second, large corporate farms (and their outgrowers) are the main type of farms implementing private standards called GAPs (good agricultural practices) to be certified with eco-labels for supermarkets. Several cases of very large farms (in the context of French horticulture) have done so recently at a scale and speed that has rapidly increased the supply of eco-labeled FV (Purseigle and Mazenc, 2021).

A first example is Fermes Larrère (www.fermes-larrere.fr) based in the Southwest of France with operations in France and Portugal. The farming company has 16 separate farms (owned by members of the family) on about 2400 hectares with 400 permanent employees. It produces 20 different varieties of vegetables carrying their own brand "panier bio" (bio-market basket). Their vegetables also have the label "zero pesticide residues", which is a private standard guaranteeing a level of chemicals less than 10^{-5} grams per kilo. It is a member of the consortium of certified horticulture firms called "Nouveaux Champs" (New Fields), discussed below.

A second example is Planète Végétale (www.planetevegetal.com), the leading independent French grower of carrots and leeks, also located in the Southwest of France and in Portugal. The firm produces 35,000 tons per year and has 200 employees. It sells to wholesalers and modern retail chains in a number of countries in Europe. Since 2004, the company has various certifications, including GlobalGAP, Agriculture Biologique, HVE (High Environmental Value public label), and the Zero Pesticide Residues certification from Nouveaux Champs. It is a founding member of the consortium "Demain la Terre" (Tomorrow the Earth), discussed below.

Firms like the two cited above have sought to scale up production quickly due to rising consumption and due to the demand by large modern retail chains in France. Those firms (and other large farms with hub and spoke sourcing systems producing eco-labeled vegetables in France) are adopting precision eco agriculture.

To facilitate the above pivot, groups of these large firms have developed two competing consortiums: Demain la Terre (www.demainlaterre.org) and Nouveaux Champs (www.nouveaux-champs.fr). These two consortiums produce large volumes comprising around 30% of total French fruit and vegetable production. The consortiums have their own labels signaling "zero pesticide residues" and "no detectable pesticides." In turn they have reached agreements with large modern retail chains to retail and to feature (with promotional sections) their labeled products.

The consortiums have brought in other members (medium-scale farms) and include the farms serving as outgrowers for the half dozen or so large corporate farms forming the core of each consortium. The consortiums do two things, one in-house and one outsourced, to help members comply with their standards. The in-house actions include the consortiums' using their own teams of experts to help members to scale-up and pivot and to run lobbying actions to gain recognition by consumers, supermarkets, and policymakers.

The outsourcing actions are undertaken because the agricultural technology and organizational changes required by the certifications require specific skills and assets lacking even in the large farms and their outgrowers. These farms have turned to outsource service firms to develop strategic outsourcing. This way they transfer investment costs to third parties.

3.3.3. Co-pivoting by mobile outsource crop service firms in France

The above outsourcing strategy is not specific to the two large consortiums. According to the 2020 Agricultural Census, 30% of French fruit and vegetable farms outsource one or more operations. Use of full range "A-to-Z" outsourcing firms is, however, still limited to 6% of corporate horticulture farms, while only 1% of family horticultural farms use the full range. However, given the huge size of the corporate operations and their numerous outgrowers, the total demand for the A-Z services is large. Consequently, the outsourcing services market is growing rapidly. The number of farmers (all types of production) who outsource has increased by 53% since 2000. There has also been a rapid increase in the number and diversity of outsourcing companies. The number of employees of various types of outsourcing companies increased from 76,500 in 2002 to 227,000 in 2016. The market for outsourcing services reached 5 billion euros in 2016, up by 17% since 2005. Finally, there has been a co-evolution of the outsourcing market, the labor market, the agro-equipment market, and the input supply markets (Nguyen et al., 2022).

These firms have expanded along different pathways. First, some outsource firms were created by large farms, as, for example, "Fermes Larrère" and "Fermes Hartmann" (https://www.ferme-hartmann.fr/fruits-legumes/) for their own operations and their outgrowers. Second, other outsource firms (of diverse sizes) are independent, operating with "excess capacity", including individual farmers or units of cooperatives (Lu et al. 2016).

Most of the outsource firms are "one-stop shops", however, providing "A-Z services", including: (1) individual plant fertilization; (2) sensor-equipped spraying; (3) drone monitoring; (4) labor teams for harvesting and other cropping operations. These A-Z service firms had about 150,000 employees in 2016. Rates of employment growth over the past decade varied, raning from 7% to 213%, depending on the type of employee (Nguyen et al., 2022). To manage investment risks, stay at the cutting edge of innovation, and stand out from competitors, some service firms collaborate with equipment and input suppliers and provide a package of additional services (such as transport and marketing. Examples in France of firms that offer that package include "Fermes Hartmann" and "Ets Mennesson" for the production of onions (https://travauxagricolesmennesson.fr/index.php).

There has also been an increasing number of temporary work agencies, foreign migrant workers providers, and employers' alliances. These not only provide teams of workers but also manage them in diverse operations (such as planting and harvesting) and provide skilled equipment operators able to operate sophisticated precision machines (Laurent and Nguyen, 2022).

Over the past two years, with rising food price inflation, consumers have been turning away from organic FV in favor of FV with lower standard eco-labels, such as those based on precision farming practices (public labels like HVE, private labels like ZRP). At the same time, the booming market for digital and robotic agricultural technologies, driven in part by public authorities, is creating favorable conditions for the emergence of new outsourcing arrangements. In the grain and wine sectors, we have seen unprecedented strategic alliances between outsourcing firms and input & agro-equipment firms for new types of A-to-Z offers (for examples (1) "Hamon enterprise", member of the Cleo network that collaborates with Yara to promote the Yara N'Sensor technology - http://www.hamon-entreprise.com/agronomie-precision/; (2) the concept of "healthy fields" by Xarvio Digital Farming Solutions powered by BASF - https://xarvio-itl02.basf.com/fr/fr/products/healthy-fields.html; (3) the concept "Robot as a service" powered by Naïo Technologies - https://www.naio-technologies.com/). Although census statistics suggest that farms specializing in fruit and vegetables make less use of outsourcing than grain or wine farms, the situation can evolve quickly.

3.3.4. Role played by government policies and institutions in France

The role of the government in a direct sense has been quite limited given that the "enabling environment" has been advanced and stable for many years, in terms of hard and soft infrastructure and regulations facilitating business formation and intellectual property rights.

The government has played a more indirect role, as noted at the start of this section, through the sustainable agricultural regulations put in place by the EU and the French government. The private standards and labels of supermarkets were formed above and beyond those public standards and have been both disruptive to the supply chain and providing new opportunities for many value chain actors, as discussed above.

4. CONCLUSIONS AND IMPLICATIONS

This paper addressed a gap in the literature on the emergence of outsource agrifood services, in particular for differentiated product value chains in developing countries and for eco-certification and labeling compliance-assisting services in developed countries. We have tried to fill some of this void through three country illustrations, ranging in the product cycle phases from transitional to transitional-modern to modern, and from early-differentiating case in Ethiopia (on basic quality) to intermediate differentiating case in Indonesia (on advanced quality and variety differentiation in mangoes), and to advanced-differentiating case in France (on eco-labeling and certification). We focused on horticulture as it is a rapidly growing food market segment and horticulture value chains are rapidly differentiating in both developed and developing countries.

We presented and used the notion of "symbiotic resilience," in which actors in value chains are in symbiotic relationships to assist each other to adapt – to pivot and co-pivot – in the face of market disruptions, such as market requirement changes, and non-market shocks, such as climate shocks. These symbioses foster resilience to these shocks in the value chains. The outsource agrifood services discussed in tis paper refer to third-party actors in these symbioses. They provide services and inputs that help farmers meet food industry market requirements, and to help both weather and other non-market shocks. Importantly, we found that without these emerging outsource services, farmers would not have been able to be resilient to the shocks related to changing market requirements and climate change.

The cases presented showed that outsource agrifood services emerged rapidly in horticultural product differentiation contexts as diverse as Ethiopia, Indonesia, and France. Most of them provide "A-Z services" as a "one-stop shop" for farmers, preparing the soil, setting up irrigation, pruning and weeding, spraying chemicals, harvesting with a differentiation of quality grades, and marketing. Some of them, as in France, helped farmers to comply with low or no pesticide use protocols and quickly adapt their operations to the demanding processes required for eco-labeling for major supermarket chains.

In all the cases we found that governments and NGOs and even food industry firms played no direct role in founding these enterprises. Instead, these emerged spontaneously, often in "spontaneous clusters" of actors, including farmers and operators in other segments of the value chain. Yet, in most of the cases the government played an important indirect role, especially in the developing countries, through the creation of basic enabling conditions in the form of physical and market infrastructure (e.g., roads and wholesale markets) and more flexible market regulation which aided actors adjust to the changing organizational structure of the supply chain.

More research on these outsource services is needed, however, especially regarding the role of outsource services in improving supply-chain resilience to non-market shocks, such as climate variability. This potential role was evident in Ethiopia where the services prioritized the creation of irrigation systems, and, in Indonesia, where the service firms provided spraying regimes to deal with the plethora of pests attacking mangoes grown in hotter and wetter conditions. The services in France directly aimed at helping farms adjust to more sustainable production regimes and regulations.

ABOUT THE AUTHORS

Thomas Reardon is a Professor with the Department of Agricultural Food, and Resource Economics at Michigan State University (MSU) and a Non-Resident Senior Research Fellow with the International Food Policy Research Institute (IFPRI).

Titus Awokuse is a Professor with the Department of Agricultural Food, and Resource Economics at MSU.

Lenis Saweda O. Liverpool-Tasie is a Professor with the Department of Agricultural Food, and Resource Economics at MSU, and a Visiting Scientist at International Institute of Tropical Agriculture (IITA).

Geneviève Nguyen is a Senior Lecturer at the Department of Education, Economic, Social and Management Sciences and the Research Laboratory with L'UMR AGIR, INRA in Toulouse, France.

Sara Qanti is a Professor with the Department of Agricultural Economics and Social Sciences, Faculty of Agriculture at Universitas Padjadjaran, Bandung, Indonesia.

Johan Swinnen is the Director General, Rob Vos is the Director of Markets, Trade, and Institutions Unit, and Bart Minten is a Senior Research Fellow with IFPRI.

David Zilberman is a Professor with the Department of Agricultural and Resource Economics at the University of California, Berkeley.

ACKNOWLEDGMENTS

This work is part of the CGIAR Research Initiative on Rethinking Food Markets and Value Chains for Inclusion and Sustainability. Launched in January 2022, the Rethinking Food Markets initiative is a collaborative effort of seven CGIAR centers, including the International Food Policy Research Institute (IFPRI), the Alliance of Bioversity International and the International Center for Tropical Agriculture (Alliance Bioversity-CIAT), the International Institute of Tropical Agriculture (IITA), the International Maize

and Wheat Improvement Center (CIMMYT), the International Center for Agricultural Research in the Dry Areas (ICARDA), International Water Management Institute (IWMI), and WorldFish. The initiative further collaborates with national and international partners to leverage innovations and policies that improve the functioning of food markets and value chains in order to address food insecurity and malnutrition, reduce poverty and income inequality, and minimize food systems' ecological footprint.

The initiative is currently undertaking research testing the effectiveness and scalability of market and value chain innovations in seven countries in Africa, Asia, and Latin America. In partnership with the ISEAL Alliance, the initiative has further launched the Knowledge Platform for Inclusive and Sustainable Food Markets and Value Chains (KISM) to help farmer organizations, food businesses, governments, and practitioners make better-informed investment and policy decisions on inclusive and sustainable food value chains. The Initiative's leadership thanks all funders for supporting this research through their contributions to the CGIAR Trust Fund, and in particular also the Bill and Melinda Gates Foundation for designated funds received.

REFERENCES

Araki, T., Koyama, T., Sagara, Y., & Tambunan, A. 2006. Market Capacity Model for the Supply Chain of Fruit and Vegetables in Indonesia-A Case Study on the Kramat Jati Central Wholesale Market in Jakarta. In 13th World Congress of Food Science & Technology 2006 (pp. 797-797).

Austin, J. E. 1992. Agroindustrial project analysis: critical design factors. The World Bank.

Bachewe, F.N., Minten B. 2023. Towards understanding vegetable and fruit markets for improved consumption and nutrition: The case of Ethiopia. *Food Security*. 1-17. https://doi.org/10.1007/s12571-023-01367-3

Bardhan, P. K. 1980. Interlocking factor markets and agrarian development: A review of issues. *Oxford Economic Papers* 32(1): 82-98.

Barrett, C.B., Reardon, T., Swinnen, J., Zilberman, D. 2022. Agri-food Value Chain Revolutions in Low- and Middle-Income Countries. *Journal of Economic Literature* 60(4): 1316-1377. https://doi.org/10.1257/jel.20201539

Baylis, K., Lichtenberg, E.M., and Lichtenberg, E. 2021. Economics of pollination. *Annual review of Resource Economics* 13: 335-354. https://doi.org/10.1146/annurev-resource-101420-110406

Cochrane, W.W. 1979. *The Development of American Agriculture: A Historical Analysis*. Minneapolis: University of Minnesota Press.

Dries, L., Swinnen, J. F. 2004. Foreign direct investment, vertical integration, and local suppliers: Evidence from the Polish dairy sector. *World Development* 32(9): 1525-1544.

Eswaran, M., Kotwal, A. 1985. A theory of contractual structure in agriculture. *The American Economic Review* 75(3): 352-367.

Feder, G., Just, R. E., Zilberman, D. 1985. Adoption of agricultural innovations in developing countries: A survey. *Economic Development and Cultural Change* 33(2): 255-298.

Goldberg, R., Allison, K. 2004. The global farmer and the future of soybean production. *Harvard Business School Case* 9-904.

Gow, H. R., Swinnen, J. F. 1998. Up-and downstream restructuring, foreign direct investment, and hold-up problems in agricultural transition. *European Review of Agricultural Economics* 25(3): 331-350.

Key, N., Runsten, D., 1999. Contract farming, smallholders, and rural development in Latin America: the organization of agroprocessing firms and the scale of outgrower production. *World Development* 27(2): 381-401.

Laurent, C., Nguyen, G., 2022. Innovation in labour organisation and social conditionality: implications for farm advisory services. *EuroChoices* 21(1): 56-62.

Lu, L., Reardon, T., Zilberman, D. 2016. Supply Chain Design and Adoption of Indivisible Technology. *American Journal of Agricultural Economics 98*(5): 1419–1431. https://doi.org/10.1093/ajae/aaw076

Macchiavello, R., T. Reardon, T. Richards. 2022. Empirical Industrial Organization Economics to Analyze Developing Country Food Value Chains. *Annual Review of Resource Economics* 14 (October): 193-220. https://doi.org/10.1146/annurev-resource-101721-023554

Mansyah, E., A. Sutanto, 2020. Tropical Fruit Research and Development Programs of Indonesian Tropical Fruits Research Institute (ITFRI). *IOP Conference Series: Earth and Environmental Science*. 583. 012013. 10.1088/1755-1315/583/1/012013.

McCluskey, J. J., & Winfree, J. A. 2022. Product differentiation in food. Cheltenham: Edward Elgar Publishing Limited. (Pp. 47-61.)

Minten, B., Mohammed, B., Tamru, S. 2020. Emerging Medium-Scale Tenant Farming, Gig Economies, and the COVID-19 Disruption: The Case of Commercial Vegetable Clusters in Ethiopia. *The European Journal of Development Research* 32: 1402-1429.

Nguyen, G., Purseigle, F., Brailly, J., Marre, M. 2022. Agricultural Outsourcing in France: A Statistical Perspective on an Emerging Phenomenon. *Econ. et Stat*. 532(1): 91-113.

Olmstead, A.L., P.W. Rhode. 1995. Beyond the Threshold: An Analysis of the Characteristics and Behavior of Early Reaper Adopters. *The Journal of Economic History* 55 (1): 27–57.

Porter, M. 1986. *Competition in global industrie*s. Harvard Business School Press.

Purseigle, F., Mazenc, L., 2021. Crops under pressure. Rationalizations of large farms. *L'Année sociologique* 71: 127-161.

Putler, D.S., Zilberman, D..1988. Computer use in agriculture: Evidence from Tulare County, California. *American Journal of Agricultural Economics*. 70(4): 790-802. https://doi-org.ifpri.idm.oclc.org/10.2307/1241920

Qanti, S.R., Reardon, T., Iswariyadi, A. 2017. Triangle of linkages among modernizing markets, sprayer traders, and mango-farming intensification in Indonesia*. Bulletin of Indonesian Economic Studies* 53(2): 187-208. http://dx.doi.org/10.1080/00074918.2017.1299923

Qanti, S., Hardiyanto, Puspitasari, Reardon, T., Randy, S. 2020. Mango Seedling Sector in West Java Indonesia. IndoHort Working Paper 17. Bogor: Indonesian Center for Horticulture Research and Development.

Reardon, T., Henson, S., Berdegué, J.. 2007. 'Proactive Fast-Tracking' Diffusion of Supermarkets in Developing Countries: Implications for Market Institutions and Trade. *Journal of Economic Geography* 7(4): 1-33.

Reardon, T., Heiman, A., Lu, L., Nuthalapati, C.S.R, Vos, R., Zilberman, D. 2021. "Pivoting" by food industry firms to cope with COVID-19 in developing regions: e-commerce and "co-pivoting" delivery-intermediaries. *Agricultural Economics*. 52(3), June. https://doi.org/10.1111/agec.12631

Reardon, T., Minten, B.. 2021. Food value chain transformation in developing regions. Chapter 12 in Otsuka, K., Fan, S. (editors). *Agricultural Development: New perspectives in a changing world*. Washington, D.C.: International Food Policy Research Institute. Pp. 397-43. https://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/134131/filename/134325.pdf

Reardon, T, Swinnen, J. 2020. "COVID-19 and resilience innovations in food supply chains." Chapter 30 in Swinnen, J., McDermott, J. (eds.). *COVID-19 & Global Food Security*. e-book; Washington, D.C.: IFPRI. Pp. 132-136. https://doi.org/10.2499/p15738coll2.133762_30 https://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/133762/filename/133971.pdf

Rustiadi, E., Emma, A.E.P., Yudi, Y.S., Ardy, S.P.M., Didit, D.O.P., Tsutsumida, N.T. 2021. Impact of continuous Jakarta megacity urban expansion on the formation of the Jakarta-Bandung conurbation over the rice farm regions. *Cities*. 111 (April): 103000.

Swinnen, J.F.M. (editor). 2007. *Global supply chains, standards, and the poor: How the globalization of food systems and standards affects rural development and poverty*. CABI.

Yang, J., Huang, Z., Zhang, X., Reardon, T. 2013. The Rapid Rise of Cross-Regional Agricultural Mechanization Services in China. *American Journal of Agricultural Economics* 95(5): 1245-1251.

Zhang, X., Yang, J., Reardon, T. 2017. Mechanization outsourcing clusters and division of labor in Chinese agriculture. *China Economic Review*. 43: 84–195. http://dx.doi.org/10.1016/j.chieco. 2017.01.012

Zurek, M., J. Ingram, A. Sanderson Bellamy, C. Goold, C. Lyon, P. Alexander, A. Barnes, D.P. Bebber, T.D. Breeze, A. Bruce, L.M. Collins, J. Davies, B. Doherty, J. Ensor, S.C. Franco, A. Gatto, T. Hess, C. Lamprinopoulou, L. Liu, M. Merkle, L. Norton, T. Oliver, J. Ollerton, S. Potts, M.S. Reed, C. Sutcliffe, P.J.A. Withers. 2022. Food System Resilience: Concepts, Issues, and Challenges. *Annual Review of Environment and Resources* 47: 511-34. https://doi.org/10.1146/annurev-environ-112320-050744

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

A world free of hunger and malnutrition

IFPRI is a CGIAR Research Center

1201 Eye Street, NW, Washington, DC 20005 USA | T. +1-202-862-5600 | F. +1-202-862-5606 | Email: ifpri@cgiar.org | www.ifpri.org | www.ifpri.info