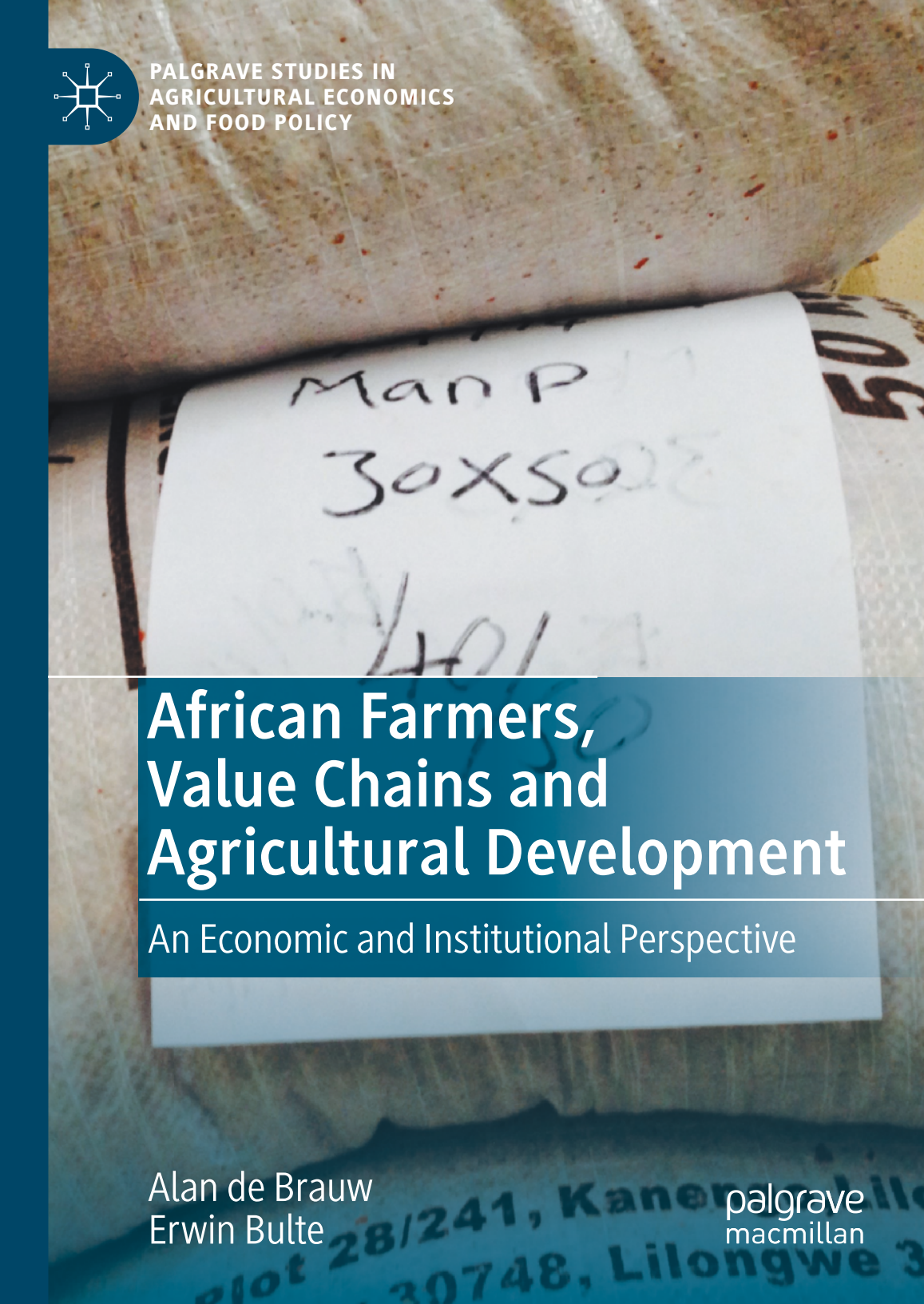
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African Farmers, Value Chains and Agricultural Development

An Economic and Institutional Perspective

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CHAPTER 1

African Smallholders and Their Market Environment

1.1 Introduction

African smallholders, like small and large farmers throughout the world, exchange their products on markets, linking them to the rest of the world. This book is about those exchange relations, and how outcomes from those exchange relations can be improved to reduce poverty and food insecurity. In most African countries, the majority of the farmers are smallholders and the bulk of agricultural production is produced by smallholders, so it makes sense to focus our analysis on them. Poverty in rural areas remains a persistent problem and production patterns are often unsustainable—depleting soils and destroying natural habitat. Transforming smallholder farming in Africa therefore has the potential to bring multiple sustainable development—goals (SDGs) within reach simultaneously—those related to poverty, food security, and sustainable use of natural resources.

This book aims to describe how smallholders manage their plots and then engage with markets to obtain inputs and sell outputs. Not surprisingly, issues involving farm management and market exchange are closely related. Efficient production typically requires the use of purchased

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inputs, and production incentives are at least partly based on expectations of prices that can be received on output markets. Helping farmers become more productive often requires fixing market imperfections, rather than transferring new knowledge or production techniques. We highlight the interdependencies between production and markets, paying special attention to the organization of agricultural value chains. Transforming African farming first and foremost requires improving agricultural value chain performance.

We start from the premise that smallholders may be poor and relatively unproductive, but they tend to be rational and operate efficiently in a difficult production context—a context riddled with market failures and policy failures. Smallholders have a deep understanding of local production conditions, and often have developed practices that carefully balance multiple objectives. Apparent deviations from economically efficient behavior make sense in light of missing markets for credit, insurance, labor, land, and/or food. For example, the majority of smallholders produce both for their own consumption and for the market, and their production decisions balance productivity and risk, while respecting labor constraints during peak periods in the season. These constraints yield outcomes sharply different from those based on the maximization of expected profits.

None of this argument implies that smallholders are necessarily satisfied with their occupation or livelihoods. Many are "entrepreneurs" by default rather than choice, and could certainly prefer to do something else. They may aspire for their children to become something other than a smallholder farmer, and their children may share those aspirations. Moreover, none of this argument implies the organization of African farming is efficient from a macro perspective, or that the overall allocation of production factors across African economies is somehow optimal. The agricultural sector offers employment to the majority of the African population, yet agricultural income as a share of total GDP is relatively low—the share of employment in agriculture is much higher than the share of value added derived from agriculture. In developing countries generally, value added per worker in the non-agricultural sector is more than twice as high as in agriculture (Gollin et al., 2014). This concept is known as the "agricultural productivity gap." Quite simply, if workers were reallocated from the agricultural to any non-agricultural sector, labor productivity would increase.

However, the ability of the manufacturing sector to absorb large numbers of rural workers appears limited. One important aim for policymakers should therefore be to increase productivity in African agriculture, rather than to abandon the enterprise. Large productivity gains are within reach if value chains were organized differently, and with the right set of supportive policies in place. Such gains would turn farming into a more remunerative activity and make the African countryside a more pleasant place to live.

This book details the relationship between smallholder farmers and agricultural value chains, and explores ways that agricultural markets can evolve to help catalyze structural economic transformation in Africa—a process we refer to as "Structural Transformation 2.0". Old school structural transformation, as occurred in developed countries and as currently happening in much of Asia, is unlikely to occur spontaneously in Africa. Instead, policies and markets should be reformed to ignite such a process. We regard transaction costs, broadly defined, as the main impediment to the development of African farming. However, reducing those transaction costs is not simple. Production must increase at the farm level (which is not the same as saying that farm size should increase), trading and transport costs need to be reduced, and governments should invest in the development of specific markets and information flows. A key lesson is that relaxing constraints in a piecemeal fashion, one-at-a-time, is unlikely to do a lot of good. Multiple constraints hold back smallholder farming and addressing them simultaneously is more to be effective at increasing productivity.

This book is not about the organization or impact of international value chains for high-value agricultural commodities such as cocoa, coffee, or horticultural crops (flowers, fruits, and vegetables). Such books exist. We focus on the great majority of African farmers who are currently *not* engaged in such high-value chains, and who produce food crops for their family and for domestic markets. However, the development of international high-value chains offers some valuable lessons and insights for reforming domestic markets. For that reason, we discuss them occasionally. While writing this book we imagined small farmers who, among other crops, trade surplus cereals on local markets. We hope and expect that many of the insights spill over to other domestic value chains.

1.2 Transaction Costs: The Elephant in the Room

Most African farmers use their own labor to cultivate the small plots they farm. They use little fertilizer, and hardly any herbicides or pesticides. Some farmers use improved seed varieties, but many use seeds of landrace varieties either saved from the previous year's crop or received from one of their neighbors. They lack access to credit from a bank or microfinance institution, and are not insured against the many perils that threaten their crops. They cannot write contracts with other parties that can be externally enforced. Economists define markets as (virtual) places where buyers and sellers meet, price discovery happens, and an infrastructure and set of institutions exists to facilitate the transfer of property rights from one person to another. By and large, such markets are expensive to access for African farmers.

If farmers struggle to access formal markets for production factors (e.g., labor and capital), inputs (fertilizer and seed) and their output (say, wheat and maize), then should we think of them as autonomous units operating under conditions of autarky? For the vast majority of farmers, the answer is "no." If formal markets fail—which will be made more precise below—then informal arrangements pop up. The main difference between formal markets and informal institutions governing the allocation of goods and services is whether the exchange is supported by third-party enforcement in case of non-compliance or not. The potential for enforcement affects the range of issues that can be agreed upon between seller and buyer ("completeness of the contract"). Compliance with informal arrangements is not due to the fear of punishment by a formal system, such as the judicial, in the case of transgression. Instead, compliance follows from fear of losing one's reputation or severing the relationship with the other party.

Social relationships are crucial for most humans, but they take on additional meaning in a context where markets fail. Farmers swap seeds with their neighbors because they cannot afford to buy seed at the agro-dealer (or input dealer). They informally pool their labor to take on particularly demanding or urgent tasks because hired labor is not available. Farmers promise to sell their crop, at a discount, to a specific trader in exchange for receiving an advance payment now, or perhaps access to a specific input. Uninsured farmers in village or family networks voluntarily "pool" their risk and share costs if disaster strikes for one or a subset of them. Informal

arrangements supported by reciprocity, reputations, or ongoing collaboration are vital for smallholders. But they typically accomplish less than what well-functioning markets could accomplish, and the cost of participating in these arrangements can be high. So, one might ask the question: Why don't markets take care of the allocation of goods and services in rural Africa?

Transaction costs are the most important reason why African agricultural markets fail. To explain how transaction costs affect markets, it is convenient to first imagine a textbook economic model of a market without transaction costs.[1] Markets bring together sellers and buyers of a specific good. Sellers and buyers each know how much they value the good, and so a market "price" will emerge at a value for the good at which every buyer who values it at or above that price will buy it, and an equal amount of the good will be sold by sellers willing to accept the price. The price then encompasses all this information, capturing the scarcity of the good being traded at present and potentially in the future (of course, the good could also be a service). Markets enable people to consume things they do not produce themselves, so they can specialize in the production of goods and services that they can efficiently produce. The opposite allocation mechanism is centralized planning, in which a planner decides how to allocate goods based on the relative scarcity of goods as measured or perceived by that planner. Every time central planning has been attempted, it has failed.

Yet economies cannot only rely on markets. An economic system attempting to do so fails to provide public goods, fails to price in negative or positive externalities associated with some goods, and fails to address issues of market power in specific markets that also reduce welfare. Economics textbooks argue in favor of government intervention to address these concerns. What is at stake in this book, however, is a simpler concept—transaction costs may cause markets to fail or be absent altogether. Economists distinguish between three types of transaction costs: (i) the cost of finding trading partners and learning about the (required) quality of products, or search costs; (ii) negotiation costs; and (iii) the cost of following up after the transaction occurs—delivery costs, and potentially enforcement costs. Trading is expensive if information is not available; farmers may not know the prices at which crops are

[1] We are also assuming away externalities here for the time being.

traded on other markets, and traders may not know what volumes might be available in specific places. Information can also be asymmetrically distributed; for example, product quality can depend upon characteristics not readily observed by the buyer. Moreover, in many contexts traders or other buyers may have market power on their side of the market, changing terms of trade for farmers. Crops are by definition bulky, and transport costs can be quite high if moving them from the farm to where they need to be sold has to take place on long, poorly built roads, if trade involves the risk of quality loss and spoilage, or if there is no recourse to independent arbiters to settle disputes between buyers and sellers. All these conditions are relevant for the context we consider in this book.

Transaction costs may, in fact, be so high that they exceed any potential gains from trade. Markets fail when economic actors cannot come together to make efficiency-enhancing trades. When an economy cannot access outside markets for a good, that good is a "nontradable" for that economy and the economy is "closed" for that good. Nontradability can occur at different levels: *nations* are closed economies if there is no international trade with other countries, *villages* are closed economies if there are no opportunities to exchange goods and services with the world beyond the village border, and *households* are closed economies if they cannot trade on (local) markets. Any of the transaction costs discussed above can lead to such market failures, as can issues related to seasonal liquidity constraints that hinder investment, or issues related to uninsurable risks that farmers might need to take for production.

Conceptually the outcome is identical across the three levels. When "open economies" exchange "tradables" with the outside world, prices reflect international or inter-village scarcity and are set exogenously. Local producers and consumers adjust their production and consumption decisions in light of given prices. Prices of nontradables are instead determined endogenously, reflecting the local economy's supply and demand. These prices vary from country to country or village to village. At the country (or even city) level, meals at restaurants and haircuts, for example, are more expensive in high income areas than they are in low income areas. When there is no trade between villages, goods and services that are scarce (and expensive) in one place could be abundant (and cheap) somewhere else. This outcome is inefficient: aggregate welfare would be greater if trade would occur and equalize prices, producers would produce at the same marginal cost and the marginal rate of substitution would be equal for consumers.

Nontradability is also relevant at the household level. If households do not trade a good, we say that households put a shadow price on the good. The shadow price reflects the value of the good for that household, which varies from one household to the next. Shadow prices must occur within a price band. They are lower than the market price plus transaction costs (else households would buy on the market), and higher than the market price minus transaction costs (else they would sell). Nontradables certainly exist at the household level, but presumably, most things that households produce—and certainly agricultural products—could be turned into tradables if transaction costs were lower. Alas, lowering transaction costs is no easy task.

Again turning to the textbook case, market prices set by demand and supply determine what buyers pay and sellers receive. But the costs for the buyer obtaining the good are higher than the market price, and gains for the seller of supplying the good are lower than the market price that she receives. Both parties also had to incur transaction costs to engage in the deal. Transaction costs drive a wedge between what buyers pay for accessing a good (or service) and what sellers receive. The market fails if this wedge is sufficiently wide—goods are nontradables and economies are "closed." This statement is made more precise in Fig. 1.1, for the case of a village.

The left panel of Fig. 1.1 introduces local supply (S_v) and demand (D_v) in a village. In the absence of trade with the outside world, an equilibrium price P_v and associated quantity level Q_1 emerge from trade. Suppose

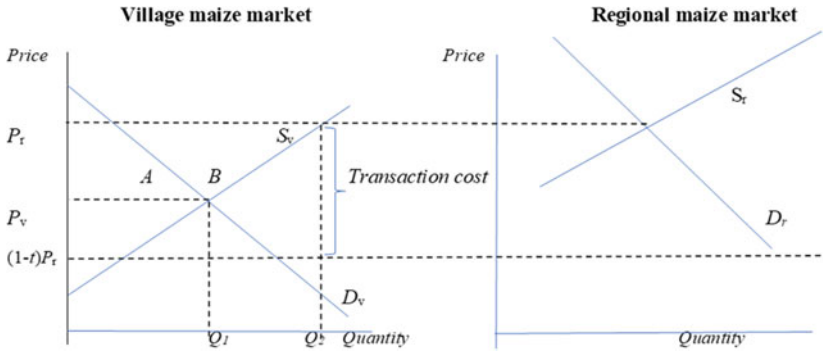

Fig. 1.1 Transaction costs and maize trading in a village

the existence of a nearby urban center where regionally produced maize is traded and sold at a price P_r ($>P_v$). If local producers could sell their maize at a price P_r they would increase their supply from Q_1 to Q_2, and producer supply would increase by the area A + B. Consumers would have to pay more for the maize they purchase, and lose consumer surplus, represented by the trapezoidal area A between P_v and P_r, and the demand curve D_v. The net welfare gain for the entire village from engaging in the regional maize market, summing the gains for producers Y and losses for consumers, is therefore given by area B.

We would tell a very similar story about how regional trade increases village-level welfare if the regional maize price were *below* the village-level price (not drawn). In that case, consumers would gain and producers would lose, but welfare at the aggregate level would also unambiguously go up. This is a deep truth—engaging in trade may have winners and losers, but there are net gains when aggregating over consumers and producers.

However, these potential gains from trade cannot be seized in the village economy depicted in Fig. 1.1. The transaction costs here could include costs associated with searching for a trading partner, negotiating between farmers and traders who may have good reason not to trust one another, and costs associated with hauling maize from the village to the urban center (or vice versa). The per-unit transaction costs are assumed to equal share t of the per-unit maize value, so transaction costs per unit of maize sold are tP_r and the per-unit net receipt for the maize farmer is only $(1-t)P_r$. As drawn in the figure, $(1-t)P_r < P_v$ so the farmer is better off selling his crop to a co-villager at the lower village price P_v. Obviously the co-villager is also better off by buying from his neighbor; if he would turn to the urban market instead he would have to pay the sum of the urban price P_r and the consumer-level transaction costs (not shown); as the regional price is already higher, it would clearly be more expensive to buy on the regional market than the local market. Consequently, the village is closed for maize and maize is a nontradable for the village economy.

1.3 The Weakest Shoulders and the Heaviest Burden

A fundamental insight that returns throughout this book is as follows. If the village-level price is higher than the regional price *minus* the per-unit

transaction costs for sellers, then sellers will prefer to trade locally. Similarly, if the household-level (shadow) price is higher than the village price minus the per-unit transaction costs for the farming household, then the household will prefer to not trade at all and focus on subsistence production instead. The set of feasible opportunities for win–win trading shrinks as transaction costs increase. As a result, we emphasize the importance of reducing transaction costs throughout the book—it is a pre-condition for welfare gains mediated through markets to emerge.

The implications of transaction costs for smallholder farmers extend beyond foregone static welfare gains. Farmers incur transaction costs when selling their output, but also when they try to sell their labor off-farm, or when buying farm inputs and goods to consume beyond food. For example, farmers may be wary of hiring laborers. Agriculture is a spatially dispersed production activity, so hired labor is thought to be more in need of monitoring than family labor (e.g., Binswanger & Rosenzweig, 1986).[2] And monitoring is a transaction cost. Another example, to which we return below, concerns fertilizer. Fertilizer is often more expensive in Africa than in other places, and perceived to be of low quality. Whatever the cause of that perception, for the farmer it means that purchasing fertilizer is a risky decision with uncertain returns. Therefore, farmers have to either incur additional screening costs or factor in a risk premium before deciding to purchase fertilizer.

Farmers cannot afford to be fully autarkic—cash is needed for school fees, medical expenses, some food items, and other things they cannot produce alone (for example, manufactured goods). But many farmers care first and foremost about subsistence production, and engage in relatively little trade. As a result, the shadow price of labor can vary from farm to farm, and many farming households do without productivity-enhancing inputs that could help them close the yield gap between their realized harvest levels and the harvests that are theoretically possible on their plots.

It is evident that the smallest farmers are affected disproportionally by transaction costs. Such costs are to some extent "fixed," and searching for a trading partner and negotiating a price is costly regardless of whether you sell a small or large quantity of maize. It is obviously more expensive to move 20 bags of maize to the market than to move 10 bags, but maybe not that much more expensive. There are economies of scale in transport,

[2] One way to deal with shirking among hired laborers is to pay by a piece rate, but that is only possible for some agricultural tasks.

regardless of whether goods are moved by motorbike, donkey cart, or truck. The presence of fixed costs or scale economies in transacting implies that trading small quantities is especially unattractive. Per-unit transaction costs decrease in the quantity that is traded. Consequently, an argument that surfaces regularly favors the consolidation of smallholder farms in larger production units, as such consolidation would reduce transaction costs. We return to this issue later in the book.

Finally, it is important to keep in mind that both trading parties incur transaction costs—not just the farmer. When a smallholder tries to secure a loan, he must find a bank (more likely a moneylender) and jump through all the administrative hoops. But the bank or moneylender would like to learn more about the credit history of the farmer and possibly monitor how the money is spent. In the case of a smallholder asking for a loan to purchase fertilizer and improved seed, the bank ideally would like to visit the village and observe whether they think the loan could be successfully used in production, and then visit again later to learn whether the money was actually used for production inputs, and not spent on consumption items. Small or even relatively large loans are made impossible because the overhead costs of due diligence and appropriate monitoring are simply prohibitive. As a result, formal institutions generally do not lend to smallholders. Transaction costs are the main reason why many microfinance institutions have adopted joint liability and group lending—doing so enables them to shift the costs of adverse selection and moral hazard to group members, who have every incentive to carefully select their fellow group members and scrutinize their actions.

1.4 Value Chain Development

There is no universally agreed definition of the term "value chain", but it normally refers to the range of goods and services necessary for an agricultural product to move from the farm to the final customer or consumer. Most analysts would agree that the concept is actually a bit broader, and also includes input provision, finance, extension, and perhaps even the overall enabling environment. Multiple actors are connected along a chain, to produce, process, and deliver goods to consumers through a sequence of activities. So-called agricultural value chain approaches are often used by donors seeking to help upgrade existing chains or to develop new ones. "Inclusive value chains" focus on approaches to incorporate smallholders in chains or enable them to extract greater value from

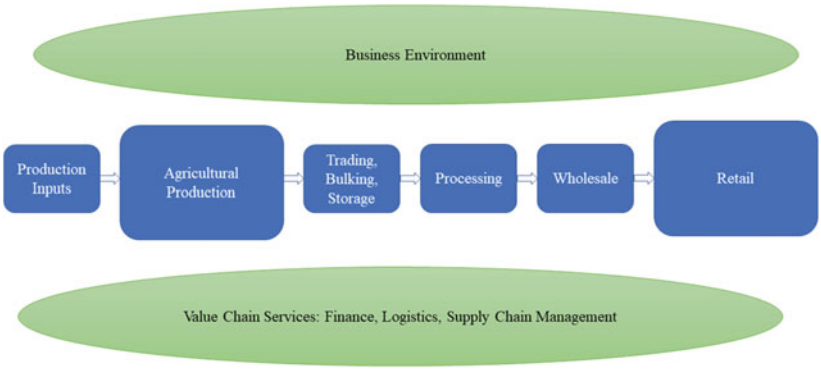

Fig. 1.2 Schematic of an agricultural value chain

chains (usually by increasing productivity and quality, or carrying out activities further along the chain). An illustration of a typical agricultural value chain is provided in Fig. 1.2.

Agricultural value chains vary greatly along many dimensions. They can be short and simple, or they can be long and complex. A useful dimension to consider is the degree of coordination. Value chains can be highly organized or even vertically integrated so that the major actor in the chain is in a command-and-control relationship with other actors. Examples include plantations or estates owned by large processing companies where smallholders have no role to play, other than as workers providing labor (sometimes instead of working on their own farms). Such plantations exist for high-value commodities such as tea, coffee, and flowers, and sometimes fruits and vegetables; many of these commodities are exported. Yet local fruit and vegetable chains can be quite simple; farmers simply bring their produce to a vendor in an urban market daily, with nothing in between. Value chains can also consist of a series of spot markets with hardly any formal coordination; this description fits many cereal markets for domestic consumption. Intermediary outcomes involve arrangements such as contract farming, where smallholders attempt to supply agreed quantities of a crop based on quality standards and delivery requirements of the purchaser. Prices are usually agreed in advance, and farmers may receive support from the purchaser in the form of input supply, extension advice, and transport services. For example, companies may source

fresh vegetables and fruits from smallholders on a contract basis, and beer companies may source specific grains suitable for brewing.

The relationship between smallholder productivity and value chains is complex and gives rise to questions that are of a "chicken-and-egg" nature. Are farmers more productive because they participate in a certain chain, or do they participate in a chain because they are more productive? Are high-quality farmers selected into more remunerative chains, or does participation in remunerating chains "transform" smallholder farms enabling them to produce better quality? Presumably, both are true. Assistance within coordinated chains will tend to boost productivity and raise quality. But the evolutionary dynamics of value chains are also determined by the productivity of the farmers that supply it.

For example, in follow-up chapters, we provide examples of situations where smallholders struggle to harvest enough so that they can sell part of their crop on nearby spot markets. In turn, if farmers supply small volumes then traders will aggregate and bulk whatever they are able to buy from many different farmers. If traders mix crops purchased from multiple farmers with production of varying quality, they will not reward farmers for the quality of their individual supply but base payments on quantity and average quality. Lacking incentives to produce high-quality output, every farmer supplies low-quality output. As a result, average quality and prices are both relatively low. Farmers end up trapped in a cycle of low returns to their (rain-fed) production, so by the time they need to purchase inputs that would help them improve productivity and average quality, they cannot afford to do so, and perhaps they do not have full incentives to do so either. A catch-22 situation emerges where low-quality smallholder supply "shapes" the value chain, and where the value chain "shapes" smallholder supply.

If farmers' productivity shapes value chains and vice versa, then complex dynamics can emerge with feedback effects. The evolution of value chains is an important theme in this book. It is tempting to think about value chain development as a linear process—from simple and local chains where little value is added to complex and long chains, involving many specialized actors adding considerable value as crops are moved along the chain. Such upgrading of value chains, from traditional to complex, obviously does occur. But not all chains change along a predictable path, nor at the same speed—some are stuck at a level that generates very little value for actors within the chain. In other cases, chains regress from more "advanced stages" to basic ones, as is evident from the

post-colonial era (discussed in Chapter 2). In such cases, we argue, transaction costs get in the way. For example, it may be costly for processors to prevent side-selling by smallholders operating on a contract farming basis. Smallholders may gratefully accept the support they are given, and sell part of their harvest to third parties offering higher prices on the spot market than the prices specified in the contract.

A long-term perspective, as sketched in Chapter 2, confirms that the formality, complexity, and "length" of African value chains has varied through the years, in response to policies and economic conditions. There is no natural trend toward more remunerative and complex chains. But with the right set of supportive policies, we argue, such movements can be initiated and fostered.

1.5 Policies and Interventions

Value chain development has been a popular concept in donor circles, particularly since the food price crisis of 2007 and 2008. Some of its popularity is based on the idea that it potentially offers a market-based approach to development. With private firms behind the steering wheel, what role is there for governments or NGOs to implement policies or interventions, respectively?

We argue that the case for public intervention is typically strong, especially in the early stages of economic development. Governments have to invest in the institutional and physical infrastructure to facilitate farmer and trader access to well-functioning markets—essentially beginning to reduce transaction costs. This book provides several examples of outside intervention—always well-intended, and sometimes helpful. The underlying reasons for intervention are well understood and often based on public good arguments, the presence of externalities, or simply preferences for redistribution and poverty reduction.[3] If farmers cannot be excluded from using rural roads or ICT infrastructure freely, then the market will typically not supply such infrastructure. When farmers learn

[3] Another common reason for government intervention is reducing market power and promoting competition. However, as argued in later chapters, the relation between market power and value chain performance is complex. Somewhat counterintuitively, under some circumstances farmers may benefit from engaging with traders who have market power. Market power fosters investment and value creation when formal institutions are weak, but also implies that the bulk of the value created through production and trade is obtained by the actor with market power.

about the benefits of new technologies by observing others, early adopters experimenting with new technologies provide a free service to their peers. Subsidizing the uptake of innovations may increase welfare. Governments may increase welfare if they invest part of their tax revenues (or aid flows) to build roads or (temporarily) subsidize inputs.

In the context of rural Africa, there are other reasons why governments should invest in agricultural development. Capital markets are absent or very imperfect, so many farmers and traders face tight liquidity constraints. Such farmers cannot afford to make investments, even if they would generate attractive returns. Governments can increase welfare by helping farmers to make such investments. Most importantly, perhaps, the long-term (dynamic) effects of public interventions with positive returns extend far beyond the static welfare gains depicted in Fig. 1.1. If interventions manage to reduce transaction costs, several outcomes are possible. Farmers may start searching for new trading partners, be able to specialize in certain crops, buy fertilizer and other inputs, and try out new farming practices—igniting a process of modernization, intensification, and innovation.

However, the track record of African governments in promoting the modernization of farming is chequered at best. As in much of the developing world, public policy took on an urban bias in many African countries after independence (e.g., Lipton, 1977). By urban bias, we broadly mean that policies were set to attempt to build a manufacturing and service sector in urban areas, and so at best policy was somewhat indifferent to agriculture, and at worst taxed agriculture either implicitly or explicitly to provide for investment capital. If policymakers thought about agriculture at all, it was as a source of cheap food for workers in urban areas (so that wages could be kept low—improving competitiveness). And many states lacked the capacity to effectively intervene in thinly populated areas or supply public goods, far from the capital city. These policies began to change after the structural adjustment period of the 1990s, and agricultural development and the role of value chains therein has received ample attention since the food price crisis of 2007 and 2008. In recent years, there have been massive investments in the agricultural sector by domestic governments and international organizations alike.

At the same time, it is clear that the evidence base for rural investment is thin. Adding to the confusion and uncertainty, international donors have their own priorities, which may or may not align with those of

African governments. As many African governments are quite dependent on overseas development assistance for a substantial portion of their budgets, these competing priorities may cause policy fragmentation. One important objective of this book is to take stock of the evidence to help prioritize future investments in rural areas and promote a process of structural transformation 2.0. We focus on transaction costs as an overarching principle and emphasize the importance of participatory approaches and competitive sectors—including industrial policy and temporary trade measures to protect fledgling industries that might serve domestic or regional markets. It is further evident that we are not in a position to speak the final word about this topic. While this book points to several promising new approaches, some uncertainty about the optimal mix of policies to transform smallholder farming in Africa remains.

1.6 What This Book Tries to Do (and Does not Do)

In this book we do not present the details of value chains for specific commodities in specific countries. While a lot of interesting things can be brought up about, for example, the teff value chain in Ethiopia or the dairy value chain in Kenya, we believe it is more instructive to present the key foundational principles and underlying insights that apply to rural markets in Africa. Even so, this book could have been much longer. Several important issues could have received more discussion and emphasis. One could argue that the following five topics deserve more attention.

First, throughout most of the text we gloss over heterogeneity. Africa is the second-largest continent in the world, both in terms of landmass and population. We gloss over the massive differences between farming in the Sahel, the highlands of the Great Rift Valley, the humid West Africa coast, and the other agroecological zones of sub-Saharan Africa. Heterogeneity exists at other levels as well. Some countries have a coastline and harbor, others are landlocked. As a result, trading costs can differ, the scope for export of manufacturing goods and agricultural commodities differs, and the intensity of competition on domestic markets varies. At the national level, there is also variation due to the colonial history and macro-level governance and institutions. Within countries, there is also substantial variation between villages due to agroecological conditions, population pressure, and the reach of the state. Within villages there is

social differentiation resulting in large and small farms, facing different sets of constraints. Within farms, agronomists emphasize heterogeneity in soil quality at the plot level. Compared to Asia, where access to irrigation is widespread, the vagaries of rain-fed agriculture further add to variation in productivity. A major implication is that "blanket recommendations" about fertilizer use or the timing of specific activities are unlikely to be very helpful. Context matters and our recommendations at the end of the book will work differently by context.

Second, one might argue we do not pay sufficient attention to gender. Gender equality is not only a sustainable development goal on its own (SDG 5), gender issues also matter for many of the other SDGs and activities discussed in this book—production, trading, and consumption. The role of women in Africa is quite heterogeneous. In west Africa, women often farm their own plots and may not even communicate with their husbands about production (Goldstein & Udry, 2008), whereas in matrilineal societies in southern Africa, access to land passes through the wife's family rather than the husband. Still, we can make some broadly true statements about female farmers relative to male farmers. Women are clearly disadvantaged along multiple dimensions. On average women have completed less schooling, own or command fewer resources (including land), have lower earnings and are less productive than men (e.g., Croppenstedt et al., 2013). Women may grow different crops than men, sometimes for a different purpose—homestead production is often for own consumption and contributes to dietary diversity and nutrition security of the household. If the purpose of a crop can change from a staple to a cash crop, sometimes men may become more interested in growing it and may come to dominate production (von Braun & Webb, 1989). Women also tend to be disadvantaged in terms of voice, both in their households and in broader society. Gender norms may preclude participation in certain activities, including accessing markets. Echoing the point above, though, heterogeneity matters. When running field experiments with wheat traders in Ethiopia, we worked with a sample dominated by men. When running similar experiments with cowpea traders in Benin, a week later, gender ratios were effectively reversed. Meaningful variation exists at the household, village and country level, and myths portraying women as either "victims or saviors" are unlikely to be productive (Doss et al., 2018).

Third, while we recognize that agricultural value chains are a key component of food systems, we focus our attention solely on value chains

and their performance rather than providing any analysis about their role in food systems or food systems transformation. The international community, as we write, is placing a great deal of attention on the concept of food systems in advance of the 2021 UN Food Systems Summit. We note that many of the solutions to improving outcomes of food systems are rooted in value chains, and as such the analysis we present may be useful from a food systems perspective. However, to limit our scope we do not cover, for example, the interaction between value chains and the food environment to which consumers are exposed.

Fourth, our focus on domestic food markets implies that we do not pay much attention to international trade. This choice reflects the fact that most African smallholders are not engaged in growing roses or green beans for European consumers. Instead, they grow staples for own consumption and regional trade—a decidedly less sexy and appealing activity, often by default rather than choice. The international dimension is nevertheless important because food commodities are regionally traded across borders, and in many African countries, domestic cereal producers compete with, for example, importers who ship in grains from abroad. This is certainly true in urban areas. The price of imported rice and wheat defines an upper limit for the price that domestic producers may expect to receive. This raises discussions about the possible role of trade policy to temporarily protect domestic smallholders from hyper-efficient producers elsewhere—at the expense of urban consumers.

This is associated with the fifth and final issue that we could have given more attention (in a longer book). The policy preferences of rural producers likely differ from the preferences of urban consumers. The interests of men almost certainly differ from those of women and, similarly, the interests of traders and farmers are unlikely to be perfectly aligned. While not many policy reforms are zero-sum games—where one person's gain is somebody else's loss—value chain interventions often have winners and losers. Since winners are unlikely to (fully) compensate losers, interventions to reform or build value chains are not neutral activities. They will be supported by certain social groups and resisted by others. Policymakers prefer inefficient policies with short-term gains for their constituency over efficient policies bringing long-term gains for all. Because of their key role in diets and "self-sufficiency" goals of countries to at least produce as much or more of the main staple as is consumed in a year, main staple crops often have particular political importance, including rice in West Africa and maize in East and Southern Africa.

Political economy motives also matter at the local level. During the recent implementation of an experiment with male wheat traders in Ethiopia mentioned above, we learned about this the hard way. The experiment involved quality grading and certification of individual smallholder supply by an independent third party. After grading and certification, wheat was put in special 50 kg bags that could be sealed. Traders were expected to purchase these bags from farmers, pay farmers a small premium for high-quality wheat, and benefit from selling a separate stream of certified high-quality wheat to downstream millers. However, this implied that traders could no longer use their own (biased) weighing scales. Heretofore this had provided them with a simple opportunity to cheat farmers—consistently under-reporting the weight of what was offered by a considerable margin. While traders appreciated the information value of the certification experiment, they strongly rejected the use of standard bags. Their resistance eventually derailed the intervention. When proposing value chain interventions, it is recommended to identify winners and losers ex ante and incentivize compliance.

So what does the book do? We start by providing a brief historical overview of the long-term trends in African value chains. We revisit the days of colonial rule and discuss broad brush trends after independence (Chapter 2). After sketching the basic theory of value chain design (Chapter 3) we discuss the evolution of African value chains—distinguishing between traditional, transitional, and complex value chains (Chapter 4), and consider key features of each. In the following three chapters, we explain why it is difficult to move smallholder production from traditional value chains through to complex ones in Africa. We first consider the smallholder economic environment (Chapter 5), and then explain why developing markets for high-quality products is so challenging (Chapter 6). We follow those chapters by considering a temporal angle to market development (Chapter 7), exploring storage and the role effective storage can play in functioning markets. The final two chapters provide some potential solutions. First, we discuss what we consider "silver bullet" type of solutions that have been proposed to reduce transaction costs and lift African smallholders out of poverty (Chapter 8). Several of these solutions have been presented with some hyperbole, but ultimately they have failed to deliver upon their promise (or will fail in upcoming years). Finally, in Chapter 9 we take stock of lessons learned and cautiously formulate some recommendations of our own. Throughout the book, though, we argue the key impediment to the

development of smallholder farming and their inclusion in value chains is high transaction costs. Hence, our recommendations focus on creative solutions to reduce them.

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CHAPTER 2

African Agricultural Value Chains: A Brief Historical Overview

2.1 Introduction

In this chapter we sketch a broad overview of the history of African agricultural value chains. The idea is not to zoom in on specific countries or crops, but to provide a general background and context to the chapters that follow. The main aim is to illustrate that African agricultural value chains have gone through various more or less dramatic "transformations" in terms of their formality and international reach. African farming has repeatedly straddled the boundary between production for exchange and subsistence. In other words, farming patterns and the configuration of value chains are not fixed or written in stone—malleability and fluidity in response to evolving conditions are the rule. The implication is that policy reform may affect the shape of future agricultural value chains.

The next chapter discusses the formality of exchange in more detail. The key difference between formal and informal arrangements, in this book, is that the former is characterized by credible contracts. In the context of a market economy, with competing and cooperating private parties, formal contracts are typically supported by a third party—for example an independent judicial system. If one of the contracting parties does not seem to respect the terms of the agreement, the other party

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can take the dispute to an independent arbiter who verifies actions or outcomes in relation to the contract, and possibly punishes transgressions. Assuming away transaction costs, formal contracts can be complete and cover all contingencies—enabling contracting parties to benefit fully from cooperation and maximize the size of the pie to be distributed between them.

Informal contracts, in contrast, are not enforced by an independent third party. Either such a party does not exist, or that party cannot access the relevant information to enforce the contract at an affordable cost. The absence of third-party enforcement creates incentives for contracting parties to explore opportunities for cheating. This risk of defection limits the scope for reaching arrangements—parties will be reluctant to agree to an arrangement that exposes them to the risk of malfeasance by their partner. Instead, informal contracts are arrangements supported by the promise of future cooperation between the parties. That is, informal contracts are self-enforcing, because contracting parties perceive it in their own best interest to comply, and maintain the relationship with their partner. Because informal contracts have to meet several conditions to be viable, they are typically less complete than formal ones. Potentially profitable actions may not be undertaken because they are subject to the risk of hold-up problems. An obvious example is input provision to smallholders by traders. While the provision of hybrid seeds and fertilizers may be welfare-enhancing, traders may be reluctant to engage in this activity if farmers might fail to pay them back if they can sell their crop to another trader offering a slightly higher price after harvest.

One perspective on the long-run historical evolution of African agrifood value chains is that exchange modalities have morphed from less to more formal. A complementary perspective, elaborated in Chapter 4, is that value chains become increasingly complex over time. Initially, farmers grow multiple crops and exchanged any surplus harvest for other goods. Later, farmers may specialize in specific crops and monetize the full harvest, maybe on a contract basis and benefiting from assistance from the buyer. However, the transition from traditional to complex value chains is not a simple linear process. Shifts in policies implemented by the colonial and post-colonial state first pulled smallholders into more formalized modes of exchange, and subsequently pushed them back into the realm of informal contracting and surplus selling on spot markets. More

recent increases in urban income and efforts to promote vertical coordination in high-value chains, among other factors, have begun to cause the pendulum to swing back towards more formalism and complexity.

Similarly, the integration of some African smallholders in international value chains does not follow a simple trend. It received a boost during colonial times, when extraction for colonial markets was an important objective for European powers. Post-colonial policies motivated by urban bias—cheap food for urban consumers for political and economic reasons—dulled incentives of production for international markets, causing the tide of internationalism to ebb. Policy reform accompanied by reductions in transport and transaction costs are now pulling increasing numbers of farmers again in the direction of production for high-value markets abroad.

2.2 Precolonial Farming

We largely begin our historical discussion with the "scramble for Africa", or the rushed process at the end of the nineteenth century when European powers sliced and diced the African continent into colonies. European governments showed little regard for pre-existing ethnic ties and divisions during this process. As records of agri-food chains in precolonial times are sketchy (at best), we know little about agri-food chains in precolonial times. It is likely that most agricultural production was characterized by subsistence farming and informal local exchange of surpluses at the time, but we know there are important exceptions to that rule. Many examples of kingdoms and empires pre-date European colonization. These societies were hierarchically organized, and featured specialization into specific activities—there were classes of soldiers, administrators, traders, etc., all of which were supported with food produced by others. The historian John Tosh describes the situation as:

> "historians of pre-colonial trade have, until very recently, concentrated almost entirely on the scarce mineral resources (salt and iron) which generated regional trade, and on those items destined for the world market—especially ivory and slaves. Yet all this entrepreneurial activity depended on the production of a considerable food surplus to support specialist craftsmen and full-time elephant hunters, to supply the great offshore entrepot of Zanzibar, and above all to feed the trading caravans,

sometimes several thousands strong, which by the second half of the nineteenth century were covering every region of tropical Africa." It seems likely that this organization required extensive planning and coordination by central authorities. Especially in West Africa, the antiquity of markets testifies to the importance of food production for exchange in precolonial times.

However, large-scale integration in broader trade networks did not occur until European colonization. Even then, the potential gains from food production for markets did not come within reach for many farmers until well into the colonial era. Writing about the 1940s, a period when the urban population in Africa was growing rapidly, Tosh observes that "only then was the high cost of transporting food in bulk offset by a reliable and buoyant demand. Until that point, the production of staple foods for the market was an option which hardly existed for the African smallholder."

2.3 The Scramble for Africa

World trade expanded rapidly in the nineteenth century, a process derived by three main forces. First, transaction costs fell. A transport revolution lowered the costs of moving materials from one country to the next (steamships and railways). Second, there was substantial political support for liberal trade policies across industrial Europe (at least until the Long Depression, from 1873 until 1896, which was a period of protectionist policies in mainland Europe). Finally, world GDP and therefore individual incomes grew rapidly due to the Industrial Revolution.

The colonization of Africa occurred against this background and fits in a wider historical context of what is now commonly referred to as the "commercial transition"—a process during which a focus on slave exports from Africa was replaced by efforts to boost commodity exports. The abolition of the African slave trades and the transition to commodity exports stopped the drain on labor from the African continent, providing an impetus to develop land-extensive tropical agriculture.

Some crops found their way to coastal markets via indigenous trade routes and were subsequently traded with Europeans. Intercontinental trade between Africa and Europe during the nineteenth century was exclusively managed by Europeans, who owned the vessels and possessed

the human capital to navigate the oceans. Limited entry in the shipping business presumably implied that coastal markets were not very competitive. Informal arrangements in a near institutional void must have governed trade during those early days of international agricultural value chains.

The "Scramble for Africa" refers to the short period after the 1884 Berlin Conference during which the Europeans invaded, occupied, and divided Africa. While only 10% of Africa was under European control in 1870, this share increased sharply to 90% by 1914. Essentially, only present-day Liberia and Ethiopia remained independent. This transition implied European influence evolved from informal imperialism, based on military influence in strategically located areas and economic dominance, to colonies based on direct or indirect rule—governance via local chiefs and other leaders. This transition is often explained by a combination of religious zeal, national prestige, and rivalry between European countries. These factors are all undoubtedly relevant, but simple economics also goes some way towards explaining the heightened interest in Africa. While the link between colonialism and free-market capitalism remains contested, it seems more than likely that the lure of profits kindled an interest in Europeans to look south.

Frankema et al. (2018) study the decades prior to, and during, the Scramble for Africa. They document a sharp improvement in African terms of trade—mainly caused by falling trade costs (trade measures hardly existed in this period) and increased demand from Europe. Falling costs accounted for more than half of the trade boom during the scramble, and presumably more than that in earlier decades when transport costs fell even faster. Peripheral regions producing primary commodities, like Africa, saw the prices of imported manufactures decrease, and exported commodity prices increase. Especially products like gum and palm oil fetched high and increasing prices, but other crops such as cotton, rubber, cocoa, and tea were also in demand (not to mention copper, tin and diamonds). From the late eighteenth century to 1860 the improvement in terms of trade for Sub-Saharan Africa was nearly 1.5% per annum. Zooming in on the four decades from 1845–1849 to 1885–1889, the average growth rate of Sub-Saharan terms of trade was no less than 2.4% per annum. This did not go unnoticed.[1]

[1] East Africa integrated later in world markets of non-slave commodities than West Africa. In West Africa, this process took off during the nineteenth century, whereas in East

In earlier centuries, Europeans did not seem to care deeply about Africa. They typically did not dare to venture far inland out of fear of malaria and were more interested in gaining and maintaining control in Asia. For a long time, coastal trading posts in Africa were little more than stopovers for the long journey to Asia, some of which evolved into defense bases for growing navies and places from which the export of slaves was organized and implemented.[2] This does not imply that the impact on the economy was small or temporary. For example, Nunn (2008) shows that slave exports adversely affect *current* economic performance. Nunn and Wantchekon (2011) suggest that the eroding and persistent effect of the slave trade on trust may be one mechanism explaining this finding. Some impacts of the interaction between Europeans and Africans were likely positive. Europeans introduced crops from the New World, including cassava, maize, and potatoes. According to the Crosby-Curtin hypothesis, the arrival of these crops implied a productivity shock for local farming, which increased population densities in Africa. And increased population density likely facilitated and supported subsequent slave exports (Cherniwchan & Moreno-Cruz, 2019).

However, Europeans became more interested in the prospect of seizing control over extensive areas of land when they observed increasing prices of African commodities. The persistence of that price boom likely fuelled an optimistic assessment of the profitability of colonization. As the value of African primary production increased, so did the European desire to control that productive base.

The outcomes were predictable. Europeans dominated Africans in terms of military strength, and the increased availability of quinine reduced the hostility of the African disease environment, even if the life expectancy of Europeans across large parts of Africa remained dramatically short. A phase of invasion, occupancy, and partitioning followed, and the Berlin conference emerged as the landmark event in shaping the

Africa this was largely a twentieth century phenomenon (with the exception of ivory and spices like cloves). The difference in timing is presumably associated with the availability of slaves. West African slave exports ended around 1860 in many regions, but in East Africa the export of slaves did not stop until some three decades later. The production of agricultural commodities for world markets was partly based on internal slave mobilization, which was obviously facilitated by the retreat out of ocean-bound export of slaves.

[2] Gold and ivory were the other main commodities that were exported from Africa. Africans, in turn, were keen to import textiles, guns, and liquor, amongst others. Cotton textiles (from India at first, later from Europe) were the single biggest import.

future of sub-Saharan Africa. Foreign capital started to flow towards the colonies, not in the least to pay for the construction of physical infrastructure (e.g. roads and railways) to facilitate the extraction of resources and crops. Agricultural value chains would be reconfigured completely, as did the distribution of rents along these chains.

2.4 Extraction and Growth During Colonial Times

While the era of colonial rule lasted for a relatively short period in Africa, it had a profound effect on the continent's economic development. Africa was land abundant but human capital scarce, so it had a massive comparative advantage in agriculture and resource exploitation. For the discussion in this book, two effects stand out. First, agricultural value chains evolved quite a bit and became much more oriented towards the export of commercial crops. There is a volume effect for specific crops, but also a widening of the types of crops produced, from a few main crops in the nineteenth century to a broad array in colonial times.[3] Within Africa, commodity flows also grew to feed mining cities and export enclaves. For example, livestock (meat) from Botswana fed South African mines, maize, and wheat from Rhodesia supported the central African Copperbelt, etc. The extent of trade formalization also increased. In contrast to most modern value chains, however, enforcement of agreements was not delegated to an independent third party (the judiciary). Instead, this responsibility was taken up by the dominant contracting party—the colonial state, broadly defined. We can interpret this enforcement as an (extreme) effort to curbing transaction costs by the colonial state. Both search costs, negotiation costs, and the cost of following up on agreements are relatively low when one party has a monopoly on the use of violence (which does not mean that peasants could not try to resist production and exchange rules that were clearly to their disadvantage).

Second, the focus on agricultural production caused the gradual dismantling of proto-industrialized sectors. It has been argued that deindustrialization slowed down the process of structural transformation in

[3] These products included palm oil, gum, cotton, cocoa, coffee, tea, tobacco, rubber, flax and wine and wool from temperate South Africa.

post-colonial times, and contributed to the process where fledgling independent nation-states were locked into the role of exporter of primary products (Frankema & van Waijenburg, 2018). African farming evolved as a low-productivity employer of last resort, perhaps contributing to the perpetuation of poverty.

An important aim of the colonial enterprise was to provide resources and crops for European markets. Broadly speaking, colonial agriculture consisted of three types of farming. Plantation farming involved extensive areas under commercial crops, owned by the colonial state or absent landlords, managed by professionals, and worked by unskilled local (or "imported") laborers. Plantations benefitted from scale economies in production and the support of an authoritarian state. Settler farming involved commercial production for export markets by European farmers who had migrated to the colonies, combining their expertise and capital with land and labor acquired locally. Peasant farming refers to production modalities where indigenous farmers started to combine production for subsistence purposes with production for export markets. The great majority of African farmers were part of the colonial enterprise through this third type of farming.

Two narratives coexist on peasant farming in colonial times, and they may both the right. The so-called *vent for surplus* theory argues that, at least during the first decades, farmers benefitted from colonialism. Demand for primary products boomed, and prices remained relatively high. Moreover, new manufactures and cotton textiles were introduced and came within reach of many rural households. Farmers were keen to increase their income and often managed to increase farm size or take new farms in production. Moreover, labor could be locally mobilized to cultivate these extra acres. The colonial pax reduced the frequency and intensity of local aggression and raiding, so there was less need for a specialized class of "soldiers." Traditionally, women supplied the bulk of the agricultural labor, but in response to the surge in profitability men now put their arms aside and also started to farm. This is the story of forested areas, where new crops like coffee and cocoa could be fitted in existing farming styles traditionally relying on roots and tubers. In the process of commercialization, production of local food crops and commercial cash crops co-existed side by side—typically on the same farm.

The second perspective is less benign. As the historian John Tosh (1980) emphasizes, traditional farming is an activity where labor and skills, and possibly capital, are combined with nature. In other words,

ecology matters. The forest-based narrative does not travel well to savannah areas. Farmers who traditionally grew cereals were now expected to grow cash crops like peanuts and cotton. Savannah areas are characterized by seasonality in growing conditions. Rainfall is variable over time, and the rainy season is short. Some savannah areas have only one rainy season, so it is imperative that the food crop does not fail. While labor may be relatively abundant during parts of the year, it is very scarce during peak periods such as when land preparation or harvesting takes place. Predictably, labor demand peaks for cash crops coincided with labor peaks for food crops.

With cash and food crops competing for labor, it is no surprise that most peasants in savannah areas were reluctant to produce for export markets. To make sure they could feed their household, most peasants preferred to grow surplus food for local markets rather than cash crops. Production and trade of starchy staples generated few opportunities for rent extraction by the colonial state, and therefore received little support. Instead, the colonial state sought to promote cash crop production and trade through coercion. Forcing farmers from savannah areas to produce cash crops (and setting low prices for these same crops when purchasing them from farmers) caused a decline in standards of subsistence. For example, this process caused a dietary transition from cereals to cassava—a storable crop with flexible labor demand, but with inferior nutritional properties.

The essence of colonial agricultural value chains is simple. Commodities are locally sourced, transported to European markets (using railways and steamships), where they are processed and sold. To facilitate sourcing, the colonizer often implemented a trade monopsony, complemented with additional policy measures. Marketing boards were supposed to stabilize commodity prices and peasant income, but the margins between purchase prices and world market prices were large and growing over time—a major source of rent extraction. Additional policies included the introduction of coerced labor on plantations, not unlike the system of slavery that had just been officially abolished. Another approach to urge native farming populations to produce for the market, rather than practice subsistence farming, was the introduction of lump-sum taxes (e.g., a hut tax) payable in official currency. This tax forced farmers to sell at least some surplus in the market to obtain the money needed for paying taxes. For other crops, trade taxes enable the colonial state to generate revenues.

The effects of opening up the African interior were significant: between 1897 and 1913 the value of sub-Saharan African commodity exports rose by more than 150%, from about £71 million to about £184 million (Munro, 1976). Colonial occupation deepened African specialization in tropical commodity exports and accelerated the trend of commodity export growth. Rapid growth in value after the Berlin conference was mainly based on the growth of exported volumes, rather than increasing prices. Frankema et al. (2018) show that the terms of trade boom of tropical commodity exports turned into a prolonged bust after 1885, which continued until 1940. Under normal conditions, countries would seek to diversify and move out of sectors with deteriorating terms of trade, this did not happen in colonial Africa. Instead, as mentioned, de-industrialization was the outcome.

Rents from agriculture were to a large extent creamed off by the colonizer, and not channeled back into the development of local agriculture. The net effect of these policies, according to Tadei (2020), was extraction rates of 20–70%, reducing GDP growth by as much as 2% per year.[4] If correct, upon independence, incomes in West Africa would have been twice as high if a competitive trade system had been in place.

2.5 Taxing Farmers: African Agriculture After Decolonization

Decolonization in Africa took place between the mid-1950s and 1975. Newly-born sovereign states wanted to modernize, industrialize, and start occupying their rightful place on the global stage. The starting conditions for many states were unfavorable. They were ethically fragmented, a factor that is associated with a lower supply of public goods and slow growth (e.g., Alesina et al., 2003; Easterly & Levine, 1997). Institutional checks-and-balances were also weak in many post-colonial states. Independence left political power concentrated in the hands of a small urban elite that sometimes outlawed opposition parties or instituted military rule. Bates (2008) argues that these elites implemented policies that channeled resources to themselves—to the detriment of the rural agrarian

[4] Colonial extraction rates were computed using producer prices in a competitive market—calculated as the difference between world market prices and trading costs—as the counterfactual. Actual producer prices were very low, compared to market prices in France (correcting for transport cost, etc.).

population. Such policies often involved efforts to control international trade, banking, and currency, as well as policies that protected domestic industries owned by said elites.

Rural development was not a priority. A substantial amount of post-colonial thinking was inspired by development experiences elsewhere. In an effort to spur structural transformation, many countries sought to develop manufacturing sectors to supply domestic markets, and perhaps international markets as well. Some countries were inspired by an anti-imperialistic or anti-capitalist spirit and were anxious to leave behind the shackles of being a primary goods exporter—a position that held little hope for the future due to the prospect of ongoing resource-sparing technical change and the fear of deteriorating terms of trade for primary products.

The agricultural sector had a special position in these development plans. It was typically regarded as a source of (cheap) labor, foreign exchange, and cheap food. Cheap labor was necessary to do the work in the manufacturing industry. Exports were necessary to finance the import of intermediate goods and services for the manufacturing sector, and perhaps luxury consumption items for local elites. Cheap food was necessary to keep production costs in manufacturing in check. The latter point is illustrated by the fact that, since the 1950s, African imports of staple crops grew rapidly.[5] Cereal prices on world markets tend to be low (but volatile), and for many urban populations (close to the coast) it is cheaper to purchase imported cereals than to source them domestically, from the "hinterland," particularly in west Africa. This point, again, reflected transaction costs. Aggregation costs from dispersed producers and high transport costs along poor roads contributed to high costs (as did low productivity in farming).

A seminal World Bank report explores these patterns of exploitation of, and assistance to, the farming sector (Krueger et al., 1988, 1991). The report covers 17 low-income countries during the period 1960–1984. The report documents that, through various agricultural and non-agricultural policies, governments introduced distortions on markets. These distortions create a "gap" between a country's domestic prices and the prices of similar products at the country's border. Policies that increase domestic prices contribute to the protection of the agricultural

[5] This is especially true for "savannah commodities" like cereals, and not for "forest commodities" like yam, cassava, or plantains.

sector. In contrast, policies that reduce domestic prices act like a tax on production. The report documented the extensive and widespread use of price-distorting policies. On average, farmers in low-income countries faced prices that were 30% below free trade prices. This is indicative of a *negative rate of assistance* for farmers. Governments used a combination of policies to achieve this outcome.

Some of these policies were akin to colonial policies from the recent past. Agricultural exports were taxed to raise revenues. Export or import taxes are easier and cheaper to collect than, say, income taxes or profit taxes (for which administrative capacity is typically not available). Another approach that achieved the same result was the use of marketing (or commodity) boards, where farmers were obliged to sell their crop to the marketing board at an administratively set price, presumably well below the world price. Marketing boards therefore enjoyed considerable market power on sourcing markets. If smuggling could be contained, they acted as monopsonists. Boards targeting export crops buy cheap from farmers and sell dear on international markets, benefitting from the price margin. Other boards target staples and buy cheap in order to sell cheap to urban populations. Both types of boards keep food prices (and wages) low, in an effort to increase the competitiveness of the domestic industry. Regardless of the underlying considerations, forcing farmers to sell at artificially low prices is akin to forcing them to pay a tax.

The agricultural sector also suffered from overvalued currency exchange rates. An overvalued exchange rate makes imports artificially cheap, such as intermediary goods for the manufacturing sector. However, if an exchange rate is overvalued, exporters receive less local currency for the dollars they earn through trade. Overvalued exchange rates therefore harm agricultural producers targeting international markets. A more sophisticated variant of the overvalued exchange rate aims to target specific sectors. Under a so-called "dual exchange rate" regime, (agricultural) exporters have to sell (part of) their foreign currency to the government at an arbitrarily low rate.

These policies keep farmers poor, but they also destroy incentives for modernization of farming or the expansion of production. Why invest in new production techniques, modern inputs, or the intensification of production if economic returns are low? Similarly, low prices reduce opportunities to invest in the modernization of farming. Capital markets are thin or non-existent and access to agricultural loans is extremely limited (due to asymmetric information, uncertainty, and seasonality). In

such contexts, farmers rely on their own savings for profitable investments, but it is evident that low crop prices undermine the accumulation of savings.

The World Bank analysis by Krueger, Schiff, and Valdes was updated and expanded by Anderson (2010), who included more countries and more commodities, and also considered a long time period—from 1964 until 2007. This study confirms that the direct rate of assistance to farmers was negative during the period 1960–1984, and more so as countries were poorer. Adopting a global perspective, Anderson also observes that African farmers not only lost because of distortionary policies implemented by their own governments. Other countries' policies also mattered. Implementation of the Common Agricultural Policy (CAP) in Europe implied *positive assistance* (or protection) for farmers in high-income countries, which increased production and lowered international prices. Trade-restricting measures in high-income countries also make international markets "thinner" so that prices are much more volatile. Anderson estimates that instability in the early 1980s was three times greater than it would have been under free trade. Low and volatile prices harmed agricultural producers in low-income countries, contributing to increased poverty and global inequality.

The overall picture for the development of African agri-food value chains during the first decades after independence was therefore rather bleak. Negative assistance rates undermined incentives and opportunities for increasing production or improving quality. Many farmers therefore responded by re-allocating their effort away from production for markets. They may have sought off-farm employment, or settled for low-risk subsistence farming. As a result, agri-food value chains failed to develop or dwindled. From the perspective of comparative advantage, these policies amount to slaughtering the goose with golden eggs.

2.6 From Taxation to Protection

This situation started to change in the 1980s, a decade characterized by extensive policy reform. The change occurred partly in response, perhaps, to a lack of satisfaction with import-substitution policies, and partly in response, certainly, to pressure by multilateral lending organizations. Many low-income countries, including African states, were heavily indebted and struggled to repay their loans as interest rates soared. New loans were only made available if debtor countries also accepted the

package of policy advice that accompanied the money, a practice known as conditional lending. Experts from the IMF and World Bank believed they knew how to cure sick economies, using first principles from economics to turn them around. The result was a policy mix prioritizing liberalization, deregulation, and privatization.

The impact of (forced) policy reform has been extensively debated. It is evident that the short-term economic outcomes were not nearly as favorable as hoped for—the 1980s are widely known as the "lost decade" for Africa. But from the perspective of agri-food development the glass is at least half full. The liberalization and deregulation mantra forced governments to abandon some of the policies responsible for negative assistance rates. In other words, conditional lending promoted the phasing out of some policies with anti-agricultural and anti-trade biases. On the downside, fiscal stringency implied cutbacks in public research and support policies such as extension or veterinary vaccination programs. While private actors stepped in and took over the role heretofore played by the public sector, evidence suggests that this happened more successfully in some regions than others. Market access and regional development become important determinants of access to support, and groups of farmers in marginal areas lose access to supporting services and outlets to sell their output.

During the same period, albeit for different reasons, agricultural policies were reformed in high-income countries—including the European Union. This reform typically took the form of de-coupling payments from production, and cutting export subsidies. The result of both types of reform was, not surprisingly, international convergence of nominal rates of assistance. Assistance rates started moving towards zero. Low-income countries approached zero assistance from below, and high-income countries from above.

Overall, Anderson (2010) estimates that these developments imply a three-fifths move of the way towards free trade. Model simulations suggest that global economic welfare improved by some USD 230 bln per year, from which especially developing countries have benefited. The share of the world's primary agricultural exports rose from 43 to 55%, and farm output share rose from 58 to 62%. For developing countries as a group, net farm income is some 5% higher than it would have been without the trade reforms set in motion in the 1980s.

In recent years, the market-led incorporation of African farming in global value chains is transforming the economic landscape. Sometimes

this involves vertical integration of production in processing and trade networks, or formal contracting with smallholders. The food price crisis of 2007–2008 contributed to this process. The spike in food prices invited large-scale land acquisition in several African countries. FDI in African farming is increasing, as is contract farming via outgrower systems with foreign companies in the hub. African value chains are increasingly formalized and connected to global developments.

Interestingly, it appears as if African countries are not necessarily aiming for zero assistance rates and free trade, as advocated by most trade economists. Two observations are relevant. First, richer countries tend to provide greater assistance to their farmers. As incomes in low-income countries increase, protection rates there also seem to creep up. Some recent evidence suggests that import-competing agricultural producers in various African countries now also receive positive assistance from their governments. Such assistance typically does not take the form of subsidies, but of import measures (although Zambia and Malawi, among other countries, have implemented ambitious input subsidy programs—with mixed effects, as discussed in Chapter 8).[6]

Second, within Africa there is increasing talk about a pan-African trade union. Regional trading blocks already exist, but there is certainly scope to integrate them further. The outcome would be reduced trading costs internally, and a common policy towards the rest of the world.

From a static economic welfare perspective, these trends can be debated. Subsidies and trade measures are likely welfare-reducing, and trade diversion within an enlarged African market, rather than trade-creation, is unlikely to be first-best either. However, from a dynamic sector development perspective, these trends bode new opportunities for sustainable intensification and modernization of farming, and the development of new agricultural value chains.

[6] Such programs help to make modern inputs available to smallholders, and contribute to boosting productivity. However, the implementation of these policies have raised concerns about adverse effects on the private sector (input dealers), unsuccessful targeting of the poorest farmers who were deemed to receive subsidized inputs, and fiscal sustainability. Large-scale subsidy programs contribute to the accumulation of debt, or crowd out other expenditures from the public budget.

2.7 Conclusions

In colonial times Africa had a very large comparative advantage in primary product exports. Notwithstanding major breakthroughs in sectors like tourism, cinema, and banking, it is evident that this situation has persisted. Africa is still natural resource abundant and human capital scarce (even if population and schooling levels are increasing rapidly). In the words of Deaton (1999), "Africa is likely to have a comparative advantage in exports of primary commodities for many years to come. The volatility of export incomes makes life difficult for policymakers, but not by enough so that they should consider abandoning the enterprise."

One lesson of this chapter is that African farming is malleable. It has gone through episodes of more and less internationalization, and episodes of more and less formalized exchange. Farmers respond to incentives and are keen to explore opportunities to adjust their farming styles—if they can afford the investment and risk. Malleability is important because various developments imply African farming will be transformed as dramatically in the future as it was in the past, during the days of colonialism or structural adjustment. Some of these developments are positive, such as innovations in ICT or breeding, and the rapid growth of (domestic) markets. Other developments are likely to impose major challenges to large groups of farmers, such as trends in climate change and soil and water degradation.

Sustainable intensification will imply incorporating smallholders in value chains providing gainful employment and access to modern inputs under sufficiently attractive terms. History teaches us that this path requires reforming policies, institutions, and markets.

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CHAPTER 3

Economic Theory and Value Chain Governance

3.1 Introduction

As an agricultural commodity makes its way from the producing farmer to the final consumer, its path typically involves transport, aggregation, processing, and packaging. Agricultural commodities flow in one direction down an agricultural value chain, and information (and sometimes assistance and complementary inputs) flow in the opposite direction. But there exist differences between value chains, for example in the amount of planning and coordination that is involved. In this chapter we find that value chain organization is not a random outcome. Instead, the evolution of value chains reflects both simple and not-so simple economic principles, following from the economic and institutional context within which commodities are moved around. We take stock of the basic ideas underlying how value chains are organized and explore some of the implications for the generation of economic surplus.

Value chains are dynamic constructs. They evolve in response to changing conditions, often to secure the economic interests of dominant trading partners. New value chains, particularly those similar to existing ones, can evolve quickly due to such interests. Changes in demand or supply conditions may pull or push value chains from one type of governance to another. However, not all configurations are feasible. The

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institutional context in rural Africa—in particular, the extent to which economic agents can seek external enforcement of their contracts and agreements—imposes clear restrictions on the evolution of value chains over time.

The typical absence of third-party enforcement implies that agreements between trading partners in a value chain should be "self-enforcing". During all stages of a transaction, it should be in the best interest of all contracting parties to live up to their promises. As will become clear below, this requirement may result in paradoxical outcomes. The welfare effect of policies and projects implemented to make farmers better off may, in fact, make farmers worse off. An increase in the market power of farmers vis-à-vis traders on local spot markets, for example, may under some conditions do farmers more harm than good. The aim of this chapter is to illustrate the complex interaction between partners in value chains and their external environment.

3.2 How Value Chains Are Governed

An important question for firms is which activities and technologies should be kept "in-house" and which ones should be outsourced. If arm's-length relationships are possible, where should outsourced activities be located, and which agreements should be made with transacting partners for the best result?

Williamson (1975) used transaction cost economics to propose a binary view on the organization of production—his argument suggests production can either be organized through markets or within one firm. On spot markets, multiple buyers and sellers meet and transact with virtually no coordination. However, partners can only trade the quantities and qualities available on a specific spot market, at onepoint in time. In contrast, integrating multiple steps along the value chain under the authority of one economic agent implies greater opportunities for tailoring the supply of one agent to the specific needs of the next agent in the chain. This process requires planning and coordination—which is costly.

Intuitively, key considerations for the shape of value chains are the complexity of inter-firm relationships and the extent to which transaction-specific investments are necessary (or asset specificity). Asset specificity introduces the risk of dependency, or hold-up problems due to opportunistic behavior on the part of the other party. Market-based solutions

work well for standard products that are easily described and valued, and for which asset specificity is unimportant, as there are multiple buyers and sellers. An example is trade in cereals for local markets.

In contrast, the integration of activities within one (overarching) firm makes sense when customized products and services are involved. Such products and services likely involve transaction-specific investments and greater coordination costs. An agricultural example is producing horticultural products meeting strict phytosanitary standards for high-value export markets. Integration is also fostered by a high frequency of transactions. Greater frequency implies production at greater scale, hence enhanced opportunities for learning and reducing costs. As a result, large firms might keep several lawyers on staff, because those lawyers can learn about their specific business, while small firms are unlikely to have legal expertise in-house—the frequency with which this expertise is called upon is simply too low to make the investment pay off.

Of course, there are many organizational forms between one vertically integrated firm and all transactions taking place on spot markets. Within social networks, greater inter-firm division of activities may be feasible than expected by transaction cost economics. Conversely, the decision to integrate customized activities within the firm may be negated by difficulties in producing the good or service in question yourself (i.e., which depends on the necessary competencies and resources). For example, family farms may be able to mobilize labor (during peak demand periods) at much lower costs than commercial firms. As we explore in greater depth below, it is possible to control opportunistic behavior through a range of mechanisms, including reputation effects, social norms, and the promise of repeat transactions. In other cases, large firms may fear reputation costs when obtaining the land that is necessary for large-scale production activities—displacing small producers or converting wild habitat to cropland. Complex land rights institutions can also make it difficult to acquire land. If so, arm's-length production may be preferable.

Gereffi et al. (2005) develop a general theory of (global) value chain governance that is readily translated to agriculture. Their typology distinguishes between five analytical types of chain governance:

1. *Markets*. A characteristic is that the cost of switching to new partners is low. Market linkages may be transitory, as on spot markets, or there may be repeat transactions between parties—for convenience

or other reasons. Farmers are commodity suppliers, offering standard products. An example, as mentioned above, are smallholders offering their surplus maize or wheat to local traders, who aggregate the crop before selling it on to larger traders or millers.

2. *Modular value chains*. Suppliers make products according to client specifications, but typically serve multiple buyers and use flexible technology. Farmers are "turn-key suppliers" responsible for all parts of the production process, and may make capital outlays for key inputs on behalf of buyers. An example is the case of small-scale dairy farmers who produce fresh milk, using combinations of inputs and practices to reduce contamination with bacteria and increase the protein content, for one of multiple dairy processors (or local dairy cooperatives).
3. *Relational value chains*. In relational value chains, there are complex interactions between sellers and buyers, often characterized by mutual dependency and asset specificity. Relationships may be governed by trust and reputation effects, or by social punishment in social networks in case transgressions are observed. An example is the case where farmers gain access to key inputs, such as fertilizer and improved seed, via traders. In return, farmers sell their output at a reduced or specified price to the same trader.
4. *Captive value chains*. Small suppliers are dependent on large buyers for their transactions and face high switching costs when seeking to trade elsewhere. Captive value chains often involve monitoring and control by the lead party in the arrangement. An example are smallholders in so-called out-grower schemes, producing green beans or specific grains for beer brewing, according to specific instructions for a local estate or processor.
5. *Hierarchy*. Hierarchy implies vertical integration, in which one firm takes control over multiple stages of the value chain, and coordination takes place via managerial control rather than through prices or contracts. Investors not only take charge of bulking and processing, but also own or rent the land where production takes place. Examples include bioenergy plantations, such as large sugar cane estates, or large farms growing horticultural crops for export markets.

The typology is helpful to organize our thinking, but a good theory of value chain governance also explains why each type of governance might emerge within a specific context. According to Gereffi et al. (2005),

Table 3.1 Determinants of value chain governance

Governance type	*Complexity of transactions*	*Codifiability of information*	*Capability of supplier*	*Explicit coordination & power asymmetry*
Market	Low	High	High	Low
Modular	High	High	High	
Relational	High	Low	High	
Captive	High	High	Low	
Hierarchy	High	Low	Low	High

three factors determine which type of value chain governance emerges: (i) the *complexity* of transactions, (ii) the *codifiability* of information (about production and storage), and (iii) the *capability* of suppliers. The interaction of these three factors determines the transaction costs under alternative governance regimes, which in turn matters for how value chains are organized.

The complexity of transactions refers to the transfer of information needed to support a specific transaction. It may refer to product or process characteristics. Codifiability of information refers to the extent to which key production, storage and transport parameters can be "standardized" and captured in issues like standards and grades. Standards can be public or private, what matters is that product differentiation is accommodated by unambiguous and shared parameters. The key element is that information regarding differentiated products can be shared efficiently between trading partners and does not involve transaction-specific investments. Supplier capability refers to the ability of the supplier to respond effectively and efficiently to whatever is demanded by buyers, as captured in standards or as transaction-specific requirements.

If complexity, codifiability and capability are either "low" or "high", then 8 possible cases are possible. If we disregard the 3 cases that are unlikely to emerge,[1] then 5 types of governance modalities emerge as the most plausible outcomes. Table 3.1 illustrates which combinations of determinants map onto which governance type.

[1] For example, it is assumed that the combination "low complexity" and "low codifiability" does not exist.

Each governance type represents a different trade-off between the benefits and costs of outsourcing—depending on conditions. For example, when transactions can be easily codified and concern products with relatively simple requirements, and if suppliers are capable of effectively responding to incentives via relative prices, then value chain transactions are likely to be governed via markets—with very little explicit coordination.

If key product characteristics are perfectly observable and if differentiated products can be unambiguously codified (graded, certified), then modular value chains will emerge. Codification implies information can be exchanged without explicit coordination. Capable suppliers respond to opportunities provided by premium prices for specific outputs and undertake the necessary investments that enable them to produce such goods. So, market and modular governance are quite similar, in that there is little explicit coordination necessary, and there is not a clear power asymmetry between actors in the transaction.

The "standard" relational value chain story involves high levels of explicit coordination between specific buyers and highly capable, specialized sellers. If product requirements cannot easily be codified, but buyers demand specific products, then relational value chains are likely to flourish. Detailed information about production requirements is exchanged between sellers and buyers, which results in mutual dependencies.

When the complexity of transactions and ability to codify is high, but the capability of suppliers is low, then captive value chains are likely to emerge. Within agriculture, horticultural products grown for export are a great example. Perishable products have to meet high standards that many smallholders cannot meet in the absence of extensive assistance. If a value chain emerges, its governance will tend toward the captive type. A single (large) buyer provides inputs and instructions and is otherwise involved in the management of small farms. Farmers are monitored and sell their produce to the lead firm—often at pre-determined prices. To maintain control, the lead firm may try to "lock in" its suppliers by promoting investments in specific assets, with little value outside the relationship. For example, loans may be provided to facilitate investments in perennial crops.

Finally, there are cases where transactions are complex and cannot be easily codified due to tacit knowledge. If suppliers lack the capability to respond effectively to requests for customized products, then the lead

firm is likely to start producing these goods in-house. Hierarchy is also a typical outcome when the lead firm does not want to share its knowledge about production practices.

This analytical framework requires some adaptation to apply cleanly to much of what we observe in African agriculture. While complexity, codifiability and capability matter, so do specificities of the context and value chains being studied. As we discuss in particular in Chapter 5, African farming is dominated by smallholder production facing imperfect markets for both inputs and risk management tools. This characterization has several implications for value chain governance.

For example, relational value chains are common, but typically do not function as described above. Poor smallholders either lack the land to produce or cannot access the necessary inputs to produce in enough volume for bulk production (i.e., transactions with low complexity, involving easily codifiable products). So traders may help farmers to obtain inputs on credit to increase production, in return for repayment (sometimes in kind) after harvesting. The result is explicit coordination and an enduring relationship, but the face-to-face interaction does not necessarily extend to instructions about farm management or product specifics.

Similarly, value chains may take the "captive" form, not because smallholders make investments in specific assets with little value outside the relationship, but because the lead firm can more easily absorb the risk of price volatility than smallholders. The coordinating role played by the lead firm may be valued by smallholders because of the implicit insurance the firm provides against adverse price shocks; this insurance comes at an implicit transaction cost to the smallholder.

Economies of scale in production may also matter for certain crops. If small-scale production is inefficient, then the lead firm may be tempted to take matters into its own hands and invest in a large plantation—assuming it can accumulate the resources that are needed for such a project. The potential benefits of scale production should obviously be balanced against the costs of negotiating the complexities and sensitivities of land acquisition and securing the mobilization of labor; land may not be trivial to obtain, however, given that land tenure institutions are complex in most African countries (e.g., Feder & Noronha, 1987).

3.3 Development and Value Chains

How does value chain governance evolve as economies develop, become richer and more urbanized? Using the analytical typology above, this question is difficult to answer. Overall development processes affect both the demand and supply sides of the chain. As economic growth occurs, there is a shift in consumption toward processed and differentiated products, which makes transactions more complex. From Table 3.1, this tendency pushes the value chain toward more extensive coordination and power asymmetries—a transition toward captive chains and hierarchy. On the other hand, development is likely associated with increased education and improved access to key resources by farmers. If farmer capabilities improve, value chains are predicted to rely on more coordination via prices and markets, and less on power asymmetries. The effect of improvements in codifiability on coordination is theoretically ambiguous.

Nevertheless, it is possible to speculate about changes in value chain governance as economies develop. The reason is that the trends affecting governance in opposite directions are operating on different time scales. Specifically, demand for differentiated products in low-income countries—due to globalization, the domestic supermarket revolution, and the rise of an African middle class—has increased much more rapidly now that constraints on smallholder capabilities have been lifted. The increase in complexity has outpaced the improvement of capabilities.

Traditionally, smallholders consume part of their output and sell surpluses to local traders. For reasons we describe in detail later in the book, there is little or no premium for farmers delivering high-quality output. The output thus produced and bulked is unlikely to meet the standards set by domestic supermarkets or exporters. Markets for high-value products develop slowly, and exporters, processors and traders turn to governance modalities other than the market to secure supply. The result is a movement toward increased coordination, contracting, input supply and assistance—a movement toward hierarchy, and relational and captive value chains. This process is discussed in more detail in Chapter 4. In the long run, however, as farmer capabilities improve, the pendulum could swing back to a greater role for markets and anonymous transactions (for example via auctions).

3.4 Formal and Informal Governance of Value Chains

Most African agricultural value chains can be characterized as following the modular, relational, or captive types of governance described in Table 3.1. Traders may make arrangements with smallholders about crop quality, and help farmers to increase quality by providing inputs on credit. Similarly, processors or exporters bargain with smallholders about the terms of a captive relationship, involving far-reaching involvement, assistance, and technology transfer in return for future harvests. A key issue in these processes is the extent to which the agreements made can be "formalized." Formal contracting involves third-party enforcement of whatever is agreed. If transaction costs are not prohibitive, relatively complete contracts can be written that specify terms across the most common contingencies. Absent transaction costs, such complete contracts promise maximum efficiency so that first-best outcomes, where the net surplus is maximized, are within reach. The division of surplus varies with the bargaining position and ability of the contracting partners.

However, agreements in rural Africa are unlikely to be based on formal contracting backed by external enforcement. Authority to settle disputes can be ambiguous; traditional authorities and formal courts can have overlapping mandates. The formal legal system can also be dysfunctional and underfunded, and therefore difficult to access. And behavior of contracting parties cannot easily be verified by third parties, and it is often very difficult to gauge how contract terms were actually affected. For example, weather shocks affecting crop development can be difficult to confirm. Last but not least, transaction costs associated with third-party arbitrage may be substantial, and they can specifically derail formal contracting. Contract writing may be expensive, in particular, relative to contract values, and disputes may not be adjudicated in a timely manner. As a result, parties seeking to enter an agreement are typically forced to resort to informal (or relational) contracting. Informal contracts do not require third-party enforcement but, instead, should be self-enforcing. In other words, agreements must be designed so that it is in the best interest of all contracting parties to "stick to the deal."

A range of alternative informal governance mechanisms exists to support trade-facilitating agreements. There are two broad categories: mechanisms that change the trade-offs faced by agents (and hence their *incentive to renege*) and mechanisms enabling potential trading partners

to identify the nature of prospective partners—distinguishing between good and bad types (*signaling*). Within these broad categories, further subdivisions can be made. Some mechanisms govern the behavior of pairs of players (buyer–seller), others are based on the behavior of a broader community of traders within which transacting occurs. Mechanisms can rely on behavior of the transacting partners themselves, but also on the actions of "others." For example, others can foster information sharing or the enforcement of agreements (especially in later stages of development). An overview of mechanisms, based on Aoki (2001) is provided in Table 3.2.

Table 3.2 Informal value chain governance mechanisms

Governance mechanism	*Enforcement agent*	*Rules of the game*	*Domain characteristics*
Pairs of traders			
Relational contracting (incentives)	Trading partner with sunk cost	Termination of trade with dishonest trader, and beliefs about its consequences	Repeated bilateral trade, actions observable but not verifiable in court
Clientage (signalling)	Trading partner with sunk relation-building costs	Termination of relationship with dishonest trader	Ex ante anonymity, ex post repeatable trade opportunities
Groups of traders			
Traders' community norms (incentives)	Traders sharing communications network	Ostracism of dishonest traders from the community	Traders connected by communication network
Club norms (signalling)	Traders with sunk entry costs	Expulsion of dishonest member from the club	Ex ante anonymity, ex post repeatable trade opportunities
Third Party Involvement			
Third-party information dissemination	Third-party collects and shares information (e.g., certified authorities)	Information dissemination about dishonest traders	Anonymous traders
Coercive enforcement by a third party	Third party (ruler, but also "mafia")	Punishment of dishonest traders	Asymmetric distribution of coercive power, large gains from defection

Source Based on Aoki (2001)

In this context, relational contracting is based on the trust that the other party will behave honestly. Trust may be based on intimate knowledge about the good nature of the partner, or on the understanding that it is in the partner's best interest to live up to her promises (see below). If a trader is caught cheating, his partner will terminate the relationship and burn opportunities for future trading. Under some conditions, cheated traders can share information about dishonest behavior of their past partners with other traders in the market. This may result in ostracism, or being banned from future trades by everybody else—a hefty punishment incentivizing most forward-looking traders to honor their agreements. Strong traders' community norms refer to situations where honest trading is supported by shared beliefs about information sharing among traders in a network. Note this equilibrium may require second-order enforcement among traders. Honest traders should resist the temptation to engage in (potentially profitable) trade with people who behaved dishonestly in the past. If traders do not share information among each other, a third party can sometimes play the role of clearinghouse and inform traders about the trading history of prospective partners.

Next, consider the case of populations composed of a mix of (innate) honest and dishonest traders. How to tell the good ones from the bad ones, without running the risk of constantly being bamboozled? Honest traders wish to transact together. Dishonest traders have an incentive to mimic the honest ones, and subsequently cheat them. *Clientage* is a mechanism by which trustworthy trading partners can recognize one another. Under some conditions, they can signal their identity by investing in relationship building, at some cost. For example, signaling could involve (wasteful) gift-giving. The cost should be sufficiently large so that dishonest players do not wish to make the investment, but not so large as to swamp the discounted value of cooperation between honest traders. Observe that, if the signaling mechanism "works" for pairs of traders, it may be possible to replicate it at the group level. Honest traders can join an exclusive club of honest members, after paying the non-forfeitable "joining fee" (akin to the value of the gift exchanged in pairs). They then benefit from trading with all other club members. If dishonest members are expelled at once after behaving badly, and the fee is set at such a level that they cannot recoup their fee by cheating once, then an exclusive club helps to distinguish good traders from bad ones (a so-called *separating equilibrium*).

3.5 Relational Contracting in More Detail

Third-party enforcement of trading agreements is not very common in rural Africa, and concerns about side-selling and cheating are rife. Relational contracting (at the pair or group level) is an important mechanism to mitigate such concerns. In this section we examine relational contracting in more detail. We consider the case of traders and farmers investing in a relationship to their mutual advantage and show the space for viable agreements is more limited than with formal contracts. First-best outcomes that maximize the joint surplus are often not within reach.

Consider a simplified case in which traders can sell a certain type or variety of cereals at a premium price to a miller. Cereals are purchased from local smallholders, but to produce the required variety, an external input such as improved seed or fertilizer is needed that the farmer cannot obtain himself. Instead, it can be provided by the trader, on credit. Suppose the welfare-maximizing outcome is one in which the trader supplies the input, and the farmer agrees to sell the output at an agreed-upon price to the trader after harvesting (reflecting the cost of the input). Such an arrangement may seem workable but exposes the trader to hold-up risk. After all, the farmer may find another trader who is willing to pay more for (part of) her harvest—especially when spot market prices are higher than expected. If the farmer sells to the alternative trader, the original one may not recoup their investment.

Whether this situation occurs depends on several factors. The net benefits of cheating for the farmer include possible social costs of norm violation or reputation loss. However, if the spot market price is sufficiently high, then the farmer is tempted to side-sell and the trader would incur a loss. Anticipating this outcome, however, a rational trader should not provide the welfare-maximizing level of inputs. Instead, he provides zero or small quantities of inputs—never enough for the farmer to make a splash when selling to another trader.

It is easy to turn this example upside down. Suppose the farmer can produce the coveted variety or type at the expense of allocating additional effort during production or storage. The trader promises to compensate the farmer for his effort afterwards, but when it is time to collect the crop he only offers the standard market price for the crop. The farmers' efforts are effectively sunk costs and cannot be recovered, so now the farmer suffers from the hold-up problem. If he cannot turn to another

trader with his specialty crop, because these are not available or have no special use for premium quality, then the farmer has no option but to grind his teeth and sell cheap. Again, whether the trader will renege on the agreement, or not, depends on a comparison of the net benefits of the various strategies at his disposal. But anticipating that the trader may cheat him, the farmer probably rejects a welfare-maximizing contract on forehand. Returning to the material covered in Chapter 1, the problem at hand is driven by transaction costs—in this case the costs associated with enforcing an agreement, when the other party's actions can only be imperfectly monitored.

The common element in these examples, and many others, is that contracting requires one party to make an up-front investment. The investment exposes her to the risk of a hold-up problem because promises are cheap. In the absence of third-party enforcement, the party at risk is better off declining the agreement or only accepting a watered-down contract creating smaller overall benefits (and reduced incentives for the other party to cheat). The absence of a credible commitment strategy for the contracting partners may therefore lock them into inefficient production and trading modalities, perpetuating poverty.

It is possible to make these statements much more precise, with aid of some extra notation. In the Appendix to this chapter, we provide a stylized example that illustrates the main trade-offs involved in relational contracting.[2] The example is based on a risk-neutral trader and farmer that could create a surplus by cooperating—now and in the (infinite) future. In any period, the trader wants the farmer to undertake a specific combination of activities to improve the quality of his crop. She can offer a side payment or bonus to induce the farmer to make the effort. Payments are based on observable variables that depend on farmer activities.

Which contract will the trader offer to the farmer? In the presence of costless third-party enforcement of the contract, and if the trader is the first mover who makes the offer, then he will pick the effort vector that maximizes the joint surplus, and credibly promises payment to the farmer that will make him indifferent between accepting and rejecting (i.e., the trader promises the farmer's "reservation utility"). The rest of the rent goes to the trader. The situation is more complex if we consider informal contracting without third-party enforcement. Now the trader

[2] The example can be generalized in several directions, but the main insights would hold.

cannot promise to make the bonus payment to compensate the farmer for his up-front effort, so the farmer understands that he risks being exposed to a hold-up problem—his effort is sunk and cannot be reversed when the trader buys the crop. The trader "does not get away" with a contract that only stipulates this contingent payment. The farmer wants reassurance that the trader keeps his promise, else he will reject the contract. How would this situation work out?

Assume that if the trader reneges, the farmer will terminate the relationship, and inform all his peers about the cheating nature of the trader (the case of community norms, in Table 3.2). So a cheating trader would earn the stand-alone payoff in all future periods after defection. Now we have the building blocks in place to analyze the problem. The trader maximizes his profits (revenues minus fixed payment and bonus) subject to two types of constraints. First, the trader and farmer should both earn at least as much from the contract as from their stand-alone options. This defines two so-called *participation constraints*. Second, the trader should credibly commit to the promise to pay the bonus after the farmer has invested effort into high-quality production. This condition implies introducing a so-called *incentive compatibility constraint*. This constraint specifies the conditions where the payoffs from continued collaboration should exceed the one-time gains from defection. In other words, the discounted benefits of sustained cooperation should be greater than the discounted gains from defection—the sum of the discounted stand-alone returns and the one-time gains from defection (or the value of the unpaid bonus). The Appendix provides mathematical details.

Hence, relational contracting is only possible if contracting parties can credibly commit to "stick to the agreement" rather than free ride on the other's sunk investment. The credible commitment follows from a comparison of the current benefits from defection to the (discounted) long-term benefits from sustained collaboration. Three important predictions follow immediately from the model in the Appendix. First, sticking to the agreement is easier for agents who value the future more—who have a lower discount rate. Informal contracting is easier when agents are patient. Second, committing to cooperation is easier when the opportunity cost of honoring the contract is lower—if it is not too tempting to defect. The other part's sunk cost investment should not be too large, else grabbing the one-time rent is too attractive. Third, committing is easier when the fallback or stand-alone option after termination of the relationship is bad. If the benefits of being in a relationship, vis-à-vis going alone,

are large, that relationship must be very valuable, Cheating for short-term gains becomes less attractive then, and also less likely.

A related model can be written where the order of investment is reversed, or where the farmer may free ride on the trader. This case is relevant when, for example, the trader provides inputs "on credit". The trader has made a sunk investment and demands a contract where the farmer is better off not cheating. Such a contract can be designed using the same steps as above.

3.6 Policies, Projects, and Value Chain Performance: Competition and Insurance

Consider the earlier statement that "committing is easier when the fall-back or stand-alone option after termination of the relationship is bad." This results in a rather counter-intuitive insight about the impact of policy interventions that aim to "make poor smallholders better off." Interventions may actually have the opposite effect. By improving the stand-alone option of farmers, they can undermine the scope for relational contracting. As a result, farmers who are intended to benefit from the policy may actually be hurt. We return to this issue in the context of competitiveness of local spot markets in Chapter 5.

For now, consider efforts to promote agricultural insurance. Lack of access to insurance is a well-known problem for multiple reasons. Volatile income lowers welfare if farmers are risk-averse. Adverse shocks may invite distress sales of productive assets to ensure households can continue to eat—casting households in a poverty trap. Moreover, exposure to frequent weather shocks causes farmers to avoid and diversify risk, and opt for "low-return, low-risk" farming strategies over "high-return, high-risk" strategies supported by external inputs. Insurance may "crowd in" investments in modern technologies, and unlock increases in productivity (Karlan et al., 2014).[3]

Firms, governments, and NGOs have explored different approaches to increase the uptake of (index) insurance. This includes efforts to improve the quality of products (reducing basis risk), information campaigns, and subsidy programs. All of this makes sense if uninsured farming is an

[3] In practice, adoption rates have remained low (typically less than 10% of the target population). Important reasons for sluggish demand are basis risk (of index insurance), liquidity constraints, and low trust in insurance providers (e.g., Carter et al., 2017).

important cause of under-investment in farming. But it is not evident that providing access to insurance will improve outcomes. Bulte and Lensink (2021) study the case where relational contracts enable traders to make inputs available for farmers and to absorb part of their risk by shifting payments from "good years" to "bad years." Insurance enables farmers to stabilize their income themselves. The stand-alone option improves, relaxing the incentive compatibility constraint: side-selling becomes easier for farmers. In response to increased hold-up risk, however, traders cut back on the inputs they provide on credit. Hence, while insured farmers may seek to use modern inputs in greater quantities, the interaction between market imperfections on the supply side and imperfect contract enforcement may result in the opposite outcome—farmers will use smaller quantities of modern inputs, stalling rural development.[4]

3.7 Discussion and Conclusions

The configuration of value chains responds to economic and technological conditions, which shape transaction costs. Depending on the complexity of transactions, the codifiability of production standards, and the capabilities of suppliers among other things, a specific value chain governance modality occurs because it enables value chain actors to meet their objectives at the lowest cost. The extreme cases are spot market trading and complete vertical integration or hierarchy. Relational trading, with varying intensities of buyer involvement, represents an intermediate case.

The full range of value chain governance modalities can be observed in the African countryside. From small-scale wheat farmers selling surplus wheat in Ethiopia to local traders on the weekly wheat market to large-scale plantations that are at the supplying end of a vertically integrated chain. Intermediate forms include relationships between individual farmers and traders, in which traders provide access to key inputs on credit, and promises to purchase the harvest (perhaps at a pre-determined price). Another example, with more hands-on involvement of the buyer,

[4] One way to escape from this equilibrium is to address multiple imperfections *simultaneously*. In the case discussed there are multiple imperfections: contracts cannot be enforced, and farmers are uninsured and cannot access inputs. If institutions improve and farmers gain access to input markets, then lifting the remaining market imperfection (i.e., providing farmers with access to insurance) will necessarily increase welfare. The paradoxical outcomes under relational contracts emerge because of the "second best" nature of the market context.

is an out-grower scheme where farmers use their land and labor to grow pre-specified crops in a pre-specified manner. Relational and captive value chains rely on agreements between parties.

A key element of agreements governing agricultural value chains in Africa is that contracts are typically not enforced by independent third parties—these transaction costs would be too great. Instead, contracting parties have to seek out trustworthy partners, and design informal contracts to guarantee performance. We have shown that different types of informal arrangements exist to govern trade. In many of these arrangements, the promise of future rents is the disciplining force that keeps the contract together, as constant monitoring of the other party's behavior would be too costly. If the discounted value of cooperation outweighs the short-term benefits of reneging, it is said to be self-enforcing. Self-enforcing relational contracts facilitate flows of crops from producers in the direction of consumers, and flows of information and inputs in the opposite direction. The risk of being cheated by the other party limits the up-front investments parties are willing to make.

Constraints imposed by the principle of self-enforcement imply that many well-intending policy interventions, aiming to make farmers better off, may actually achieve the opposite. They may undermine relational contracting—and obstruct the flow of resources from traders to farmers—by mitigating the adverse consequences for the farmer of cheating his partner (and earn stand-alone profits afterward).

Appendix: A Formal Model of Relational Contracting Between a Trader and a Farmer

For simplicity, consider the case of a risk-neutral trader (T) and risk-neutral farmer (F) who lives forever and discount payoffs in the next period by the common discount factor $1/(1+r)$, where r is the discount rate. In any period the trader wants the farmer to undertake a specific combination of activities to improve the quality of his crop. Farmer effort is captured by the action vector $a \in A$ that generates net profit $\pi_T(a)$ for the trader and $\pi_F(a)$ the farmer. The trader can offer a side payment or bonus to induce the farmer to make the effort, defined as a payment schedule $b_x(a)$. Payments are based on observable variables that depend on a, for any possible action plan $a \in A$. Define a contract $a = x$ where, if the farmer accepts the contract, x is his preferred action. This means that $x = \arg\max_a \pi_F(a) + b_x(a)$. If the trader and farmer cannot agree on

a contract, they earn their stand-alone payoffs $\overline{\pi}_T$ and $\overline{\pi}_F$, respectively. Without an agreement, the total surplus is defined by $S = \overline{\pi}_T + \overline{\pi}_F$.

The sequence of events in the game is very simple. In stage 1, the trader offers a contract $a = x$ that specifies conditional payment $b_x(a)$ (and a possible fixed payment, R). If the farmer rejects, the game ends and both parties earn their stand-alone payoff. If the farmer accepts, the trader pays the up-front fixed sum R, and the game moves to the second stage. In stage 2, the farmer chooses an action plan a. In stage 3 the contract may be enforced and the trader may make the contingent payment $b_x(a)$. In the final stage the payoffs materialize: $\pi_T(a)$ and $\pi_F(a)$.

Which contract $a = x$ will be offered to the farmer? In the presence of costless third-party enforcement of the contract, and if the trader is the first mover who makes the offer, then he will pick an effort level maximizing joint surplus and credibly promises payment to the farmer that will make him indifferent between accepting and rejecting (i.e., the trader promises the farmer's "reservation utility"). The rest of the rent goes to the trader.

The situation is more complex if we consider contracting without third-party enforcement. The trader wants to pay as little as possible, so he offers a payment schedule $b_x(a) = \hat{\pi}_F(\hat{a}) - \pi_F(x)$ if the trader accepts and honors the contract, $a = x$, and zero otherwise. Here the term $\hat{\pi}_F(\hat{a})$ captures the point at which farmer payoffs are maximized in the absence of a contract (where $\hat{\pi}_F(\hat{a}) \geq \overline{\pi}_F$). The contingent payment from the trader to the farmer, therefore, compensates the farmer for the loss in payoffs when working according to the contract (but not more).

However, the trader "does not get away" with a contract that only stipulates this contingent payment. The reason is that the farmer is aware of the fact that he risks being exposed to a hold-up problem. In stage 3 of the game, his effort is sunk and cannot be reversed. This means the trader may renege on his promise to pay $b_x(a)$ and only pay the going market price for average quality (assuming that this is the price that the disappointed farmer would obtain when seeking another trader to buy his high-quality crop). The farmer wants reassurance that the trader keeps his promise, else he will reject the contract. If the trader reneges, the farmer will terminate the relationship, and inform all his peers about the cheating nature of the trader (the case of community norms, in Table 3.2). We therefore assume that the trader earns the stand-alone payoff in all future periods after defection.

The trader must therefore solve the following problem:

$$\max_{x \in A} \pi_T(x) - \left\{\hat{\pi}(\hat{a}) - \pi_F(x)\right\} - R. \tag{3.1}$$

The solution to this problem should respect several constraints. First, and obviously, both the trader and farmer should earn at least as much from the contract as from their stand-alone options. This defines two so-called *participation constraints*:

$$\pi_T(x) - \left\{\hat{\pi}_F(\hat{a}) - \pi_F(x)\right\} - R \geq \overline{\pi}_T \tag{3.2}$$

$$\pi_T(x) - \left\{\hat{\pi}_F(\hat{a}) - \pi_F(x)\right\} + R \geq \overline{\pi}_F \tag{3.3}$$

In addition, as mentioned, the trader should credibly commit to the promise to pay the bonus after the farmer has invested effort into high-quality production. This implies introducing a so-called *incentive compatibility constraint*, specifying that the payoffs from continued collaboration should exceed the one-time gains from defection:

$$\frac{1}{r}\left[\pi_T(x) - \left\{\hat{\pi}_F(\hat{a}) - \pi_F(x)\right\} - R\right] \geq \frac{1}{r}\overline{\pi}_T + \left\{\hat{\pi}_F(\hat{a}) - \pi_F(x)\right\}. \tag{3.4}$$

In Eq. (3.4), the left-hand side captures the discounted benefits of sustained cooperation. The right-hand side captures the discounted gains from defection: the sum of the discounted stand-alone returns and the one-time gains from defection (or the value of the unpaid bonus). If we solve Eq. (3.3) as equality for the lowest payment R that exactly meets the farmer's participation constraint, then we can rewrite the trader's participation and incentive compatibility constraints as follows:

$$\pi_T(x) + \pi_F(x) \geq S, \text{ and} \tag{3.2'}$$

$$\pi_T(x) + \pi_F(x) \geq S + r\left\{\hat{\pi}_F(\hat{a}) - \pi_F(x)\right\}. \tag{3.4'}$$

It is clear that Eq. (3.4') is a more restrictive constraint than Eq. (3.2'), so the latter can be dropped. It follows that the trader's maximization problem can be reduced to a quest for the informal effort contract a^I that satisfies Eq. (3.4') and maximizes constrained profits:

$$a^I = \arg\max_{x \in A} \pi_T(x) + \pi_F(x) - \overline{\pi}_F, \text{ subject to (3.4')}. \tag{3.5}$$

Relational contracting is possible if contracting parties can credibly commit to "stick to the agreement" rather than free ride on the other's sunk investment. The credible commitment follows from a scomparison of the current benefits from defection to the (discounted) long-term benefits from sustained collaboration.

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CHAPTER 4

The Evolution of Agricultural Value Chains in Africa

4.1 Introduction

As discussed in Chapter 2, value chains evolve and change over time, partly in response to changes in the economic and policy environments. In this chapter, we introduce the idea of value chain "types" rather than governance and discuss how agricultural value chains can evolve from being characterized as traditional to complex. We then discuss the factors that catalyze this transition and some implications of this transition. Throughout the chapter, we consider how consumers relate to different types of agricultural value chains. While the phrase "evolution of value chains" suggest movement in one direction, the process of evolution may be stalled or be non-linear (i.e., there may be periods of "regress"). While the overall trend is from short and simple to longer and more complex, value chains can become shorter and simpler if certain stages along the chain are no longer profitable, or if key actors opt out. Producers may supply multiple types of value chains simultaneously, or hop back and forth between different chains—there is no natural tendency toward complexity or modernity.

Our attention is largely on domestic value chains, as at present only a relatively small amount of food is traded across international borders within Africa (Songwe, 2019). So from either a producer perspective or a

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consumer perspective, domestic value chains play a more important role as a potential market for agricultural products or as consumer goods. There are two important caveats to this statement. First, export-oriented agricultural value chains may play an important macroeconomic role, in particular as a source of foreign exchange. Second, Africa is a net food importer, and there is some concern that if food imports continue to rise quickly, they will hinder overall economic growth (African Development Bank, 2016). Indeed, in some cities, a large share of food is imported. We discuss exports and imports briefly in this chapter.

4.2 Types of Value Chains

Just because most food flows through domestic markets does not mean all value chains within a country are at the same stage of development. In Table 4.1, we adapt a characterization of stages of value chain development from Barrett et al. (2020). We label the three types of value chains as traditional, transitional, and complex (or modern).

Traditional value chains are thought of as value chains that are short and localized. There are only one or two nodes to these value chains beyond the initial producer and the end consumer; there might be a

Table 4.1 The three stages of agricultural value chain transformation

	Traditional AVC	*Transitional AVC*	*Complex AVC*
Main enterprise type in			
Value chain length	Short, local	Long, rural–urban	Long, rural–urban, international
Technology	Labor-intensive	Labor-intensive	Capital-intensive
Product Differentiation	Little or none	Quality premia begin for attaining standards	Premia for attaining various standards
Wholesale	Brokers based in rural villages	Wholesaler based in urban markets	Off-market distribution companies
Processing	None (home-processing)	SMEs such as small mills	Large processors and food manufacturers
Retail	Home enterprise	SMEs, wet markets	Supermarkets

Note Adapted fromBarrett et al. (2020)

trader/wholesaler and a retailer, but no other major nodes. Retail, to the extent that it exists, is largely informal or in small, local wet markets. There is little to no product differentiation in these value chains, meaning that there is no reason for farmers to pay attention to different aspects of crop quality as they are producing. In fact, for grains households might just be selling excess production or selling after harvest and would then later purchase back grains during the production season if the household runs short. If wholesalers operate in these markets, the wholesalers locate themselves in rural villages.

In transitional value chains, more steps begin to evolve between farmers and retail outlets. Food may travel farther along value chains, which implies some level of aggregation before it fans back out from wholesalers to retail outlets. More opportunities for processing evolve; for example, entrepreneurs might start small mills for grains. Quality premia begin to evolve as well since consumers begin to demand foods with specific types of attributes; multiple markets might then evolve for what had been the same product type. We discuss methods of attaining quality premia in more detail in Chapter 6.

Complex value chains can be thought of as transitional value chains on steroids. Most international value chains can be thought of as complex, since differential quality standards are a rule rather than a rarity. Large companies often become involved in food distribution, processing, and marketing, and more intermediaries become involved, though they may be cross-support for transactions, rather than intermediaries. For example, large multinationals such as Cargill may buy the bulk of grain within a market directly from large farmers on contract; such transactions require support through other transport companies, banks, and purchasing contracts on future markets to reduce risk. Technologies also become more capital than labor-intensive, and retail tends to occur through supermarkets rather than through smaller vendors or wet markets.

For complex value chains to become the primary mode of agricultural exchange, we hypothesize that there must be a shift from the type of relational contracting described in the previous chapter to more formal contracting. In turn, the ability for governments to enforce contracts through courts, dispute resolution mechanisms, or other means quite generally is necessary to make this transition. While formal contracting never stipulates all conditions (Michler & Wu, 2020), it allows for both

larger firms to reduce the risk of market entry and can allow farmers better access to liquidity and technology (Deb & Suri, 2013; Macchiavello & Miquel-Florensa, 2019).

4.3 Value Chain Services

Another aspect of value chains that changes as they move from traditional to complex relates to what can be termed the provision of services. These services can work across different value chains, and relate to the way that actors within value chains deal with risk, liquidity, payments, and logistics (Table 4.2). In traditional value chains, the risk is largely dealt with through informal institutions, which differ by community and region but are meant to attempt to better distribute risk around communities (Bardhan & Udry, 1999). People tend to self-finance any investments, and payments are largely in cash. When value chains become transitional, and either risks grow or more parties may be exposed to specific risks, further contracts can result to help deal with risk and/or liquidity

Table 4.2 Further constraints that lead to changes in value chain services as agricultural value chains evolve

Specific constraints	*Traditional AVCs*	*Transitional AVCs*	*Complex AVCs*
Risk	Informal institutions/arrangements	Additional migration; some contracts	Largely contracts and through formal insurance and futures markets
Liquidity	Self-Financing of any inputs or liquidity needs	New institutions evolve for some financing (formal contracts or reputational contracts)	Bank Finance, Agricultural Value Chain Finance, Contracts
Payments	Cash	Mainly Cash, some invoicing	Invoicing dominant
Logistics	Ad hoc; specific to chain	Some cross-chain services (transport) but largely ad hoc	Third party companies enter market specifically for logistics

constraints, which could be either formal or relational contracts. Migration also tends to grow, which can help farmers deal with either risk or liquidity constraints, though it also reduces household agricultural labor (de Brauw, 2019).

Logistics services, related to transportation and matching farm products to buyers, may also begin to develop as transitional value chains evolve. In transitional value chains, these services may remain ad hoc, but some transportation companies may evolve just to move agricultural products. As value chains become more complex, third-party companies may enter the market to provide services that, for example, restaurants or other consumer service providers may need.

Therefore, it is not surprising that complex value chains can exist alongside transitional and even traditional value chains. The most likely candidates are high-value commodities grown for export, such as coffee, cocoa, cotton, and tobacco, to name a few. Many smaller countries in sub-Saharan Africa depend upon one of those commodities for a large share of their export earnings, and as such, the government may take particular interest in the organization and finance of those value chains. In those cases, the formalization may occur more rapidly as the government takes an interest in the commodity to ensure foreign currency is available to pay for imports while keeping exchange rates relatively stable.

In fact, as mentioned, it is certainly possible for smallholder farmers to produce for all three types of value chains. Consider, for example, some of the farm households surveyed by one of the authors for a randomized control trial conducted in central Malawi in 2016 (Table 4.3). Farmers in Malawi all grow maize for self-consumption and sell some excess production; the endline data collected suggest that 38% of farmers growing maize sold some of their crop, and almost all households sold it to a local trader. Farmers in the intervention began to grow groundnuts or soya, and intervention farmers would then sell the crop to NASFAM, who then lightly process the products, including sorting them, and sell them domestically through a marketing arm. The value chain can therefore be considered transitional; 73% of all farmers grew soya and of those, 91% sold at least some of their crop and about half reported selling to NASFAM.

Tobacco is a key export commodity for Malawi, and smallholder farmers participating in the tobacco value chain typically produce burley tobacco. Contracts between smallholders or groups of smallholders and

Table 4.3 Example of farmers participating in traditional, transitional, and complex value chains, Central Malawi, 2016

Type of value chain	*Crop*	*Percent of households growing crop (%)*	*Percent of farmers selling at least part of Crop (%)*	*Typically sold to*
Traditional	Maize	99	38	Local Trader
Transitional	Soya	73	91	NASFAM or local trader (50/50)
Complex	Tobacco	46	95	Private Company or Local Trader (50/50)

Source Fomento Project Data (2016); see Ambler et al. (2019) for a more complete description

buyers are common, and at the time of the survey, the crop was typically graded and then sold at an auction floor at Kanengo near Lilongwe (e.g., Prowse & Moyer-Lee, 2014), typically to international buyers. The organization of this value chain is much closer to a complex value chain than a transitional one. And by induction above, some farmers are clearly involved in all three types of value chains.

Because some value chains serve different consumers, there might be an interdependency between chains. As farmers produce for different types of chains, they can learn from the product being produced for a transitional or complex value chain and transfer those skills or techniques to other chains. For example, Minten et al. (2009) show that farmers participating in vegetable contract farming schemes in Madagascar improve their resource management skills learned producing crops under contract to their rice, and as a result, they are more productive than other farmers after participation. Farmers may also "divert" certain key inputs, such as fertilizer, from crops produced for modern chains to other crops, produced for traditional chains or self-consumption.

4.4 Factors Shaping the Transition from Traditional to Complex Value Chains

Factors external to value chains play an important role in driving the change from traditional to complex value chains. In sub-Saharan Africa, there have been factors on both the supply side and demand side

catalyzing these changes. On the supply side, decisions made by agribusinesses are certainly shaped by changing relative prices for different types of agricultural products. But government policy also plays an important role in creating those opportunities. In the 1980s and 1990s, several sub-Saharan African countries liberalized agricultural markets by privatizing parastatal agribusinesses (Kherallah et al., 2002). Liberalization led to opportunities for small and medium enterprises to develop around specific agricultural products.

On the demand side, relative prices faced by consumers matter, but the growth of incomes in end-product markets likely played a more important role for creating agricultural value chain opportunities. As incomes grow, the demand for calories does not grow as quickly (e.g. Colen et al., 2018). In economic terms, this statement implies the income elasticity of demand for total calories is below 1. A meta-analysis for Africa shows that higher value, perishable foods have higher elasticities; demand will rise, at least in relative terms, for more perishable food groups including dairy, meat and eggs, and fruits and vegetables. De Brauw and Herskowitz (2021) further show that in Nigeria, income elasticities for more highly processed foods are higher than those for unprocessed foods. So as incomes among a class of individuals rise, we can expect to observe changes in demand toward perishables and more processed foods.

Still, it is worth recalling at this point that value chain development is predicated on increasing production. As Africa's population has grown rapidly, production has been increasing. But according to Jayne and Sanchez (2021), production increases are largely due to area expansion rather than productivity increases. If production growth does not continue, the transition from traditional to modern value chains also stagnates. In other words, if producers do not have surplus production to sell (over what they need to consume), markets will not develop.

Population growth and income growth imply that food demand has broadly been rising along the lines described above. Moreover, from the perspective of agricultural value chains, people with rising incomes will demand more perishable and processed foods. A rise in inequality implies that a group of relatively well-off consumers have rapidly rising incomes. A growing class of better-off consumers in sub-Saharan Africa implies that, at least among that group, demand for perishable and processed foods should be rising. Therefore opportunities for transitional and complex value chains to evolve exist.

A related driver of value chain evolution is urbanization. Sub-Saharan Africa has urbanized rapidly since the turn of the century (de Brauw et al., 2014). Urban population growth has been faster than rural population growth in most countries, implying ongoing movement from rural to urban areas (even if fertility rates were equally high, which they are not). Urbanization in sub-Saharan Africa is a bit different from earlier experiences in North America, Europe, and Asia as it has not followed increased manufacturing. Still, new market opportunities have arisen through emerging and growing urban markets. Urbanization often accompanies rising incomes, though in Africa the two seem less correlated than in other regions (e.g., Fox & Gaal, 2008). Urbanization causes changes in the way food must be distributed, from rural to urban areas, and catalyzes the need for at least transitional value chains. Urban consumers do not produce food but must purchase it and are wholly dependent on markets for food security.

Finally, the intersection between Africa's demographic composition and technology may lead to new opportunities for actors within agricultural value chains. Younger people more quickly begin to use new technologies, and as a result the food preferences of African youth will likely be influenced by those of young people elsewhere in Africa and the rest of the world. So long as smart phone penetration and internet penetration continues to rise, the patterns of food demand among the youth may change relatively quickly, not limited by the rural–urban dichotomy as much as by the quality of internet coverage.

4.4.1 Consequences of Income Growth, Inequality, and Urbanization

As incomes have grown and inequality and urbanization rates have risen, the food environment faced by consumers has begun to change. The food environment refers to the affordability, accessibility, convenience, and desirability of foods available to consumers (Herforth & Ahmed, 2015). In turn, there are changes to either agricultural value chains or opportunities for change that arise. We want to highlight three linked changes to the food environment that have occurred because of these drivers. First, there has been a growing presence of supermarkets. Second, consumers in urban areas tend to eat more food away from home. Third, there has been a rising presence of processed foods in African food markets, some of which are domestically produced, but others imported; the extent to

which products are imported can provide an opportunity for domestic producers within sub-Saharan Africa.

Supermarkets arise both because urbanized, high-income consumers appreciate doing all their food shopping with (perceived) reliable and safe food available in one place, and because corporations that run supermarkets perceive profitable expansion opportunities. Most transactions in sub-Saharan Africa still take place through less formal markets, but in some countries, the rate of supermarket growth has exceeded 25% per annum since 2002 (Angola, Madagascar, Nigeria). Their share in transactions is growing rapidly in some places (Reardon et al., 2021).

Supermarkets require value chains to provide them with reliably-sourced, relatively safe, and attractive produce to attract buyers to pay premia for them. To attempt to build that reliability, supermarkets often set up specific value chains that may include specialized traders or distribution centers, and often use preferred suppliers that can meet their quality requirements (Reardon et al., 2008). Farmers or farms that can meet those requirements are often larger, have better access to transportation of their own, and are better educated than others (Rao & Qaim, 2011). A question is whether smallholder farmers benefit from participating in such schemes. In Kenya, Andersson et al. (2015) study this question and find that farmers supplying to supermarkets tend to be better off in the first place, but also experience large income gains over time. The main reason for farmers not to participate is a lack of their own transportation (e.g., a motorbike, car, or truck). So the supermarket revolution may lead to higher inequality within rural areas in sub-Saharan Africa.

A second trend relates to food consumed away from home. As more people move to urban markets, food stalls and convenience foods become available to meet the new demand. We know from survey data that food away from home is growing as a share of the food budget in several countries (e.g. Reardon et al., 2021). Cockx et al. (2018) show an ongoing shift among consumers from traditional staples to high sugar, convenient foods in Tanzania.

These two trends, in combination, suggest the consumption of processed foods is also rising, and that trend has implications for agricultural value chains. Some processing is "light"; e.g., where households might have pounded maize in the past to make maize meal, companies arise to provide maize meal through growing urban market channels (e.g., Snyder et al., 2015). Similarly, Minten et al. (2016) describe the evolution of new injera bakeries in Addis Ababa. Some local businesses also arise to

manufacture ultra-processed foods and drinks, demand for which are also growing in Africa (e.g. Vandevijvere et al., 2019).,

These processed foods can also be found in the informal markets from which most consumers purchase their foods. For example, an inventory of retail shops in Accra, Ghana found that processed products from local firms were available in all types of retail shops. In a study spanning several countries, Tschirley et al. (2015) claim that demand for processed foods begins at relatively low incomes, and is not constrained to urban areas. So processed foods have become part of the food environment; the implication is that more agricultural products are being purchased by companies to process them. As some companies continue to grow, a pattern similar to that found in Latin America and Asia, in which larger companies enter markets, is likely to follow (e.g. Reardon, 2015). These changes will have implications for employment, but also the health status of consumers—obesity is becoming increasingly common in Africa.

4.5 Contract Farming

Before we move to explanations of why transaction costs are so high, it is worth discussing contract farming in more detail. Contract farming arises when buyers need a specific amount of agricultural product of a certain quality and might require smallholders to produce all or some of that product (Minot & Sawyer, 2016). Examples include having enough green beans to make money exporting them to Europe (e.g., Ashraf et al., 2009), or having a steady flow of products for processing (e.g., Ambler et al., 2018). The farmers who could potentially supply them lack capital and might not take the risk to grow new crops needed for those buyers without the provision of inputs or potentially the guaranteed market. In an idealized arrangement, farmers enter more formal contract farming arrangements to be able to obtain inputs to grow specific crops, and receive a pre-arranged price for their product assuming it meets quality standards. In exchange, the buyer receives the product at harvest and can sell on or process to add value. As a result, one would expect farmers to make more money through (voluntarily) moving to higher value crops through these arrangements, and for buyers to also profit from the inputs for their processing (or to supply to export markets).

As part of these arrangements, farmers are often provided with extension to teach them to meet product standards. The difference between this more formal contracting and the relational contracting described in the previous chapter is that the formal contract often relates to captive value chains in that the buyer is in need of the crops to fulfill their own contracts or to process.

Box 4.1. Supporting Women's Involvement in Value Chains

Kate Ambler, Kelly Jones, and Mike O'Sullivan

In smallholder households engaged in production for commercial value chains, women may perform production-related physical labor but are not involved in management and marketing. Thus, men usually manage the revenues from these activities, which represent a significant component of household income. The Farm and Family Balance project sought to mitigate this issue by encouraging households that contract to sell sugarcane to a large company near Jinja, Uganda to involve women in market facing work by registering a sugarcane block in her name (Ambler et al., 2021). By registering the block in the woman's name, she receives access to payments and profits associated with the block. Among households offered this option, take-up was high; 72% of households chose to participate.

The project found lower measures of household gender norms, and socioeconomic status, were associated with refusal to participate. A randomly selected set of households were further offered a couples' workshop that sought to create a more balanced household; participation in the workshop further increased take-up of the contract intervention by 7 percentage points. The workshop increased take-up among households with low indicators for household gender norms, but not among those with lower socioeconomic status.

The project then analyzed the quality of blocks transferred to women relative to the quality of men's blocks. Women's blocks are smaller and closer to home than blocks registered to men, which may be indicators of intent to give women lower work loads. Though they are smaller, they are also younger than men's blocks,

making them more valuable, as sugarcane blocks have multiple harvests. In an examination of self-reported block quality, only 12% of women's blocks are the household's lowest quality block, with all other being the best, in the middle, or equal to other blocks. Households did not systematically assign low quality blocks to women. Households also report that women do manage the blocks registered in their name, suggesting the project lead to meaningful changes in women's involvement.

Two major questions related to contract farming are worth discussing here, in considering the transition between traditional and complex value chains. First, it is important to understand whether there are benefits to participation or not. It could be, as critics suggest, that contract farming is a way for large companies or rich entrepreneurs to exploit poor farmers (e.g. Singh, 2002). Second, it is worth understanding what type of farmers engage in contract farming. If farmers are already better off when they begin to participate, then impact analyses should control for this (so as not to conflate impact estimates with a selection effect). It also speaks to the question of whether contract farming is "inclusive", or merely magnifies local inequalities.

Several recent papers have summarized impacts of contract farming schemes in developing countries, including Africa. One of the key insights is that farmers initially selected for contract farming are better off than average farmers, or that the poor are left out of contract farming schemes (Ton et al., 2018). Smaller farmers also do not necessarily continue in contract farming arrangements after entering; Barrett et al. (2012) show that in both Ghana and Mozambique there is a substantial exit from contract farming arrangements for export-oriented crops. From the buyers' perspective, it is less costly to transact with a small number of larger farmers than many smaller farmers. So perhaps it is not surprising that some contract schemes gravitate toward larger farmers (Minot & Sawyer, 2016). Contract farming arrangements should be thought of as dynamic in nature, rather than as a one-time either/or decision.

Does contract farming increase welfare among participants? There is some disagreement in the literature reviewing contract farming, in part because of addressing (self-)selection bias is not easy. As participants in contract farming are, on average, better off than non-participants, it is

quite difficult to attribute welfare differences to the contracting itself (Bellemare & Bloem, 2018). Heterogeneity, both in terms of the type of contract farming, crops, end markets, and among farmers makes the identification of welfare benefits difficult (Otsuka et al., 2016). Ton et al. (2018) also suggest that contract farming leads to income gains between 23 and 55%. On the other hand, Meemken and Bellemare (2020) study nationally representative data from six countries, including Cote D'Ivoire, Nigeria, Tanzania, Mozambique, and Uganda, and find that contract farming is associated with higher incomes in Mozambique and Uganda, but not in the other four countries. However, they do find higher labor demand among households participating in contract farming, suggesting that benefits may spread beyond participating households to landless laborers. Further, Bellemare et al. (2021) find that contract farming participation can partially insure farmers against general risk due to price guarantees. This proposition is seemingly confirmed in an RCT in Benin; farmers receiving contracts for rice at a guaranteed price made other investments, since the price risk they faced had been minimized (Arouna et al., 2021).

It is therefore useful to think about contract farming as a vehicle that helps develop agricultural value chains; it appears to have benefits for participants, whether in terms of welfare, partial insurance, or market access. Some of those benefits may flow through to other community members through increased labor opportunities. However, the poorest farmers are likely to be left out of these arrangements, which means that encouraging contract farming from a policy perspective is not a panacea; other policies would still be necessary to help the poorest. And it is important to recall that contract farming as it exists in Africa today relates more to value chains under captive governance than anything; smallholders in these arrangements are typically beholden to specific buyers without whom they would not be able to sell their crops.

4.6 Value Chain Finance

Another development that has arisen to address transaction costs is value chain finance. Several value chain services link broadly to finance or the lack thereof—specifically, risk, liquidity, and even payments. The majority of farmers in sub-Saharan Africa lack any kind of bank account, and small and medium-size enterprise operators along the value chain likely also lack access to more formal sources of finance. This problem is particularly

acute among women; according to the Global Findex 2017 data, women only have equal access to bank accounts in Lesotho and South Africa; they are less likely to have a bank account in all other African countries (Demirguc-Kunt et al., 2018).

A potential solution to this lack of access is for formal lenders (banks) to give a larger loan to enterprises who count on either farmers or other value chain actors to provide them with raw materials for processing. In turn, the enterprises can lend on to their suppliers, using the relationship (whether formally contractual or not) as a form of collateral to ensure repayment. The bank then lowers its transaction costs of lending by only lending to the larger enterprise, while the enterprise uses reputation effects among its suppliers to reduce its risk in lending on cash or inputs directly. This type of value chain finance was particularly popular among milk processors in Eastern and Central Europe post-transition, to help farmers make investments and to reach quality standards demanded by the Western European market (Dries et al., 2009). Whereas value chain finance has arisen as a response to transaction costs related to access to finance, it has transaction costs of its own, and is only likely to help reduce them in general under specific conditions (de Brauw & Swinnen, 2021).

Two nice examples of expansionary value chain finance schemes in Africa have recently evolved. Van Campenhout et al. (2019) show that in recent years milk production for both domestic and export markets has expanded rapidly in Uganda. Recently established milk collection centers often provide credit, hygiene trainings, and aluminium milk cans to their clients (farmers). In most cases, credit flows from banks or Village Savings and Loan Associations to farmers, rather than directly from the cooperative established alongside the milk collection center. In this context, there is clear increased value to farmers (and traders, who often participate in the chain between farmer and the center) in participating in value chains centered around milk. The rapid expansion of such centers that has occurred provides the competition necessary to keep any one actor from dominating returns.

Second, Casaburi and Willis (2018) describe a value chain finance scheme around agricultural insurance. They offer insurance as part of a package within an existing contractual relationship between sugarcane farmers and a processor in Kenya. The innovation is that insurance was offered to a randomized group of farmers at actuarially fair prices to be deducted from the payment for their harvest, if yields fell below 90% of average yields. They find the change in timing of payment for insurance to harvest season increased demand from 5 to 72% of farmers, relative to farmers paying for insurance up-front in the planting season. To expand

this scheme, a third-party insurer would likely be necessary to reduce risk to the processor.

4.7 The Role of Imported Food in African Markets

Africa appears to have a comparative advantage in the production of primary products, so it may be surprising to learn that Africa imports food in the aggregate. Indeed, African policymakers are increasingly concerned about the role played by food imports in the food system, and whether food imports are rising. The concern extends beyond obvious foreign exchange issues and can be stated as follows: If cheap imports dominate African food markets, then African producers will be hard-pressed to compete with those cheap imports, whether those producers be smallholder farmers or processors. If imports are rising, the implication is that markets for national producers are stagnating or potentially shrinking.

African food imports in general rose at the beginning of the 2000s, but appear to have plateaued. As discussed by Fox and Jayne (2020), food imports grew rapidly between 2000 and 2011, but have been relatively stable since then in value terms (Fig. 4.1). In index terms, the real value of imports by African countries only grew by about 3% between

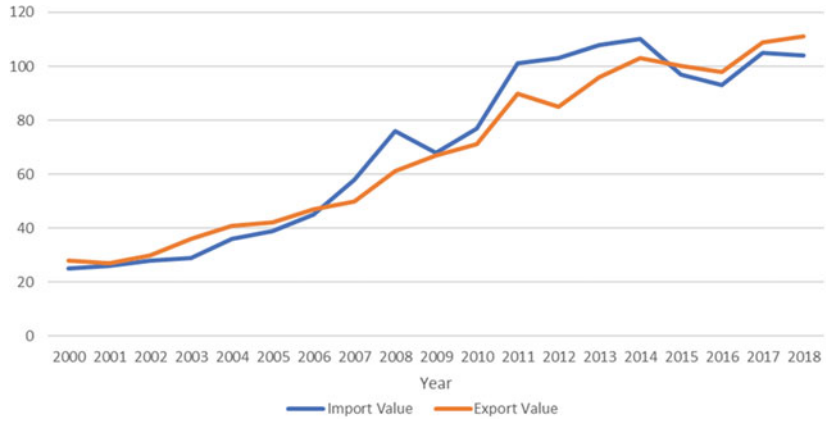

Fig. 4.1 Aggregate indexed value of agricultural imports and exports, African countries, 2000–2018 (2014–2016 = 100)

2011 and 2018. The trade balance may be improving on net, since the figure also shows the value of African exports has been growing over the same period. Notably, the majority of this trade is interregional; the value of official intra-African trade is relatively limited. But as described by Bouët et al. (2020), there is a substantial amount of informal cross-border trade missed by official statistics; it may in some cases be twice as large as official trade. Finally, Fox and Jayne (2020) show that net imports are concentrated among resource-rich countries; specifically, Angola, the Congo Republic, Mauritania, Nigeria, and Zambia all have large net food import deficits that are offset by oil or mineral exports.

What is imported by African countries? While the top 20 agricultural products only represent 56% of all imports (Odjo & Zaki, 2020), products that reflect a substantial share of those imports include wheat and wheat flour, palm oil, soy products, sugar, and milk and cream. Some of those imports are necessary if they are to be consumed. For example, it is difficult to produce wheat in many African countries due to the relatively large number of hours of daylight required to grow wheat effectively (only Ethiopia and South Africa plant 500,000 or more hectares of wheat). Many imports are raw materials for processing done within Africa; soy products and palm oil are used at least partially as inputs to other production processes (chicken rearing and food processing, respectively). In sum, some of the main imports are either products that would be difficult to produce in Africa or are inputs to food processing industries within African countries.

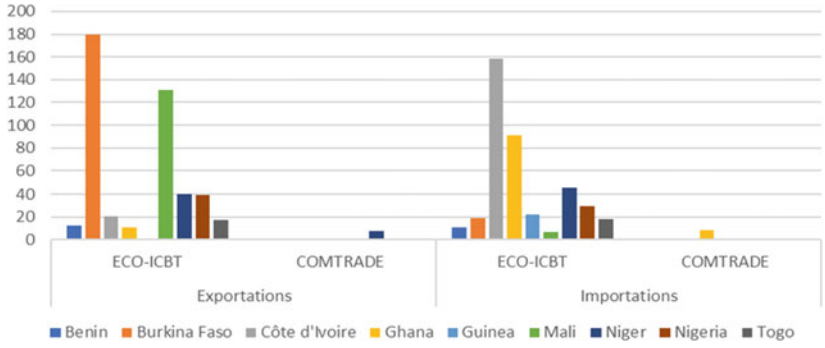

Fig. 4.2 Comparison between COMTRADE data and CILSS data of intraregional trade of 70 agricultural products—US$ mlns

Box 4.2 Informal Trade in Africa

Fousseini Traoré and Antoine Bouët

Informal cross border trade (ICBT) is a widespread phenomenon in Africa. Formal data collection systems in Africa are weak for several reasons, including under-declaration, misclassification, lack of incentives for customs agents due to exoneration of customs duties. As a result, data on cross-border trade misses ICBT and there is a widely shared consensus that official are relatively low quality.

Informal trade flows are determined by complex interactions. First, historical and cultural determinants matter, as trade in Africa has traditionally taken place between people of the same ethnicity located on either side of a common border. Second, trade policy plays a key role: tariffs, export taxes, prohibitions, sanitary and phytosanitary measures, and inefficiency of customs procedures all play a role in leading to ICBT. And third, IBCT can provide additional income for relatively poor smallholders or pastoralists.

The magnitude of ICBT in Africa is becoming more apparent, particularly in West Africa. For example, the ECO-ICBT database (www.eco-icbt.org), coordinated by the Comité inter-États de lutte contre la sécheresse au Sahel (CILSS) and IFPRI, collects data in collaboration with the private sector and makes real-time information on shipments available for traders. The two-way information flows represent a unique mechanism for monitoring the cross-border flows of agro-pastoral products in West Africa. The ECO-IBCT database covers intraregional exports and imports of 70 agricultural products by nine West-African countries shows official statistics systematically and substantially underestimate trade flows of agricultural products in the region (Fig. 4.2). In comparison with the United Nations COMTRADE database, the reference database used by trade economists and international institutions, the ECO-IBCT database suggests that in 2018, COMTRADE missed 98.1% of all agricultural trade. The data collection is operated in collaboration with the private sector, and the initiative maintains a platform with real-time information on shipments, which benefits the traders and makes the initiative sustainable.

Finally, as a share of the total size of agricultural markets, the aggregate agricultural trade in Africa is relatively limited in value terms, both on the export side and the import side. According to Odjo and Zaki (2020), Africa has a "trivial" share of world agricultural exports relative to other regions; and the share of agricultural exports in GDP falls far below the average share of agricultural production in GDP. For example, Africa, as a whole, imports about 20 million MT of maize each year, but produces 750 million MT, so only 2.7% of total maize is imported (and some of that figure double counts official intra-African trade).[1] While imports certainly compete with domestically produced products in some markets, for the typical African smallholder (to the extent that such a concept exists), domestic value chains are likely to be more important to them than export-oriented value chains.

An alternative way to look at trade integration is that imports (and exports) should stabilize prices, or at least ensure that farmers face world prices (rather than local prices) for heavily imported goods. If price expectations are easier to formulate, then farmers or processors can better choose which markets to enter.

4.8 Closing Words

This chapter moved beyond value chain governance and provided a typology of agricultural value chains, from traditional on through transitional and then complex chains. Transaction costs hinder value chain development, as does a general lack of formal contracting, as well as the lack of a third-party method of adjudicating formal contractual disputes. Relational contracting occurs as a consequence of high transaction costs, and as a result, most farmers are producing for traditional or transitioning value chains. Assuming smallholders can reap higher returns to their land and labor endowments by producing for transitional and complex value chains, it is important to reduce transaction costs so that they can move their crop sales into more transitional and complex value chains.

Therefore, it is important to understand these transaction costs in more detail. Our goal in the following three chapters is to more fully describe some of the fundamental challenges that African smallholders face in beginning to participate in more transitional and complex value

[1] Figures here are from Odjo and Zaki (2020) and the World Development Indicators (2021).

chains. In the next chapter, we examine the way that input markets work or do not work, for smallholders in Africa. In Chapter 6, we examine conditions necessary for product differentiation to occur, which typically occurs through a certification method. Chapter 7 studies how storage and related institutions can arise to smooth agricultural markets over time. As such, storage can play an important role in reducing transaction costs. In this discussion, we also cover post-harvest losses, which further reduce smallholder returns to farming.

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CHAPTER 5

Smallholders and Markets

5.1 Introduction

Many of the stereotypical pictures of rural Africa are either wrong or misleading. One stereotype casts African farmers as backward individuals. Another one describes the traders with whom farmers try to do business as greedy parasites. It is certainly true that many African smallholders use production technologies that strike the Western eye as quaint and traditional and they could produce higher yields on their land. It is also true that traders try to earn an income by maximizing the wedge between the prices at which they buy and sell. However, these facts do not imply the stereotype is true.

This book focuses on African agricultural value chains, and all nodes in the chain are equally important for successful trading. However, a chain is only as strong as its weakest link, so for this chapter, we zoom in on one particular node in the chain—the smallholder farmer. Smallholder production is the most contested bottleneck in the chain, and a natural leverage point for interventions by policymakers and NGOs seeking to improve food security, alleviate poverty, or promote environmental sustainability.

Smallholder production in Africa is typically challenged along dimensions of both quantity and quality. Yields (production per unit of land)

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are typically low, and only slowly creeping upward in most places. The so-called yield gap is the difference between potential and actual yields (for a given crop variety and climatic conditions), which for most of Africa is large (Van Ittersum et al., 2016). Important reasons for the gap are nutrient limitations and biotic stresses. It is common for smallholders to produce only one or two tons of cereals per hectare (and sometimes much less than that), while production under optimal management could be three or four times as high. Producing larger volumes not only helps reduce hunger—by raising income for producers and lowering prices for consumers—but also facilitates trading (by lowering per-unit transaction costs).

Producing larger quantities tackles only part of the problem. Smallholder production also tends to be of low and variable quality. Most of the more remunerative trading options are therefore not available for their crops. Producing for export markets or domestic supermarkets implies (constantly) meeting high-quality standards. If this does not happen, crops are traded on local markets, typically aggregated by local traders. Herein lies the risk of a vicious cycle. Farmers producing low quality sell at low prices to local traders, who mix and bulk the output (for local processing, say). But mixing and bulking imply that traders base the prices they pay on *average* quality, rather than individual quality. As a result, the incentives for farmers to improve their own quality in the future are dampened. The absence of individual quality grading at local markets creates an example of the classic "market for lemons"—a context within which farmers trade off quality for quantity as much as they can (e.g., Akerlof, 1970; Bernard et al., 2017). This issue is taken up again in Chapter 6.

How to move forward? The smallholder problem is one of small landholdings and unproductive technologies—and these factors are obviously interconnected. Notwithstanding ongoing urbanization in many African countries, further land fragmentation is still a concern, for example, because parents sub-divide their land endowment among multiple children. In some regions the pressure on land resources is very high, and perhaps not coincidentally these also tend to be regions scarred by conflict (e.g., Rwanda, Burundi, eastern DRC—see for example André & Platteau, 1998). The solutions proposed in the literature for the smallholder problem can be grouped, broadly, under two headings.

The traditional solution, strongly favored by the international community, is to invest in programs and policies that strive to improve smallholder farming. Sustainable intensification strategies seek to increase the

adoption of external inputs and new practices to increase land and labor productivity. These investments are supposed to result in greater tradable surpluses and higher incomes in the countryside, while ideally also respecting environmental boundaries.

This approach has been challenged by some observers as romantic and naïve and destined to fail. An alternative way forward is based on farm consolidation and commercialization. Larger farms are more likely to invest in new technologies and will outperform smallholders because of economies of scale in producing and transacting. While such firms could be the basis for remunerative wage employment for landless laborers, they are also consistent with freeing up labor for productive sectors elsewhere in the economy. Perhaps this explains why the international community and domestic policymakers have typically shied away from this path. How to deal with a large rural population "pushed" out of rural areas with few prospects elsewhere, at least in the short run? This problem is compounded by high population growth in most African countries, leading to the challenge for governments to provide more employment—especially for the youth.

In this chapter, we consider some of the evidence for and against the dominant paradigm that the future of African farming rests upon smallholders and evaluate the economic constraints that have limited the success of rural development strategies based on this premise. As a result, we focus on both market and policy failures. For sustainable intensification to thrive as a market-mediated, bottom-up development strategy, smart government intervention is necessary, presumably simultaneously on multiple fronts. We revisit the alternative approach to rural development based on consolidation and commercialization in Chapters 8 and 9.

5.2 Factor Markets

Agricultural production involves the combination of the three well-known production factors: labor, land, and (other) capital. Capital can be used to acquire external inputs such as improved seed and fertilizer. However, both factor markets and input markets in the African countryside are a far cry from the economics textbook case, which affects the way smallholder production can occur. In this section, we sketch several more or less informal approaches to mobilize production factors. There are large differences in land-labor ratios across the African continent. Land is scarce in countries like Rwanda and Burundi, and institutions

emerge that govern access to (and control of) land, and that are geared toward maximizing land productivity. Labor is scarce in other places, like eastern Sierra Leone, and in such places, wealth and power are traditionally reflected in the number of one's dependents, followers, or other social ties and affiliations—this determines one's ability to mobilize labor ("people as a resource"). Anthropologists refer to this as "wealth in people" (Bledsoe, 1980).[1] Depending on local population densities, informal institutions develop that mitigate or negotiate local scarcities. As a result, there is considerable variation in institutions and arrangements, depending on local factor ratios. Nevertheless, some common features can be distinguished.

Most African smallholders do not own the land they cultivate. Land often belongs to the government, and in some cases to the community or the (extended) family, such as in the uplands of eastern Sierra Leone where families come together and allocate plots to individual households for the upcoming cropping season. Most economists believe that the lack of secure and tradable property rights hamper investments in agricultural productivity. Farmers are less likely to invest in soil productivity-enhancing practices or tree planting if they are unsure that they will be cropping that same plot again in the future. The lack of individual property rights also implies that land cannot be used as collateral, so it is more difficult to obtain loans. Finally, lack of individual tradeable rights prevents land from gravitating toward the most productive farmers. In a normal market, more productive farmers can "outbid" less productive ones, so the land will eventually be cultivated by the best farmers. There is no such guarantee if land markets do not develop.

To remedy these perceived shortcomings, many African countries have implemented land reform policies. Often these reforms are supported by external parties, such as the World Bank, and programs were developed to provide farmers with certificates of individual (or household) plot ownership. In some cases, these certificates indicated ownership of the full bundle of rights, and in others, it merely reflected long-term lease contracts. Restrictions on trade remained in place in some places, and were lifted in others. Overall, the impact of such interventions was mixed. While certificates increased investment in land in some places (Beekman & Bulte, 2012), the productivity-enhancing effect in other places was so

[1] The labor of dependents generates material wealth, which can be used to attach further dependents—an alternative mode of accumulation.

modest that the costs of the certification program were not earned back (Jacoby & Minten, 2007).[2] Among other things, this reflects differences in the quality of the customary land rights system that was replaced by the certification scheme. If farmers are rather certain about their tenure even in the absence of a legal title, the gain from providing them with such a title will be modest—especially if there are other reasons why credit markets fail to develop so that loans are not forthcoming, even in the presence of collateral.

Indeed, there are many such reasons. Smallholders seeking loans are typically not served by commercial banks. Smallholders require relatively small loans, which implies relatively high transaction costs for the banks when dealing with them. But there are other reasons as well. Because farmers are scattered across the landscape, it is impossible for banks to keep track of the activities of individual borrowers. Asymmetric information between formal lenders and farmers exposes the former to the well-known risks of moral hazard (hidden action) and adverse selection (hidden type). An example of the former is that farmers grow risky crops in case of limited liability—in case of failure, costs are for the bank, and in case of success, the spoils are for the farmer. An example of the latter is that untrustworthy farmers, who never intend to repay, manage to obtain a loan. Raising the interest rate to capture these risks may be counterproductive, as doing so only invite more risk seeking behavior and crowd the few remaining honest farmers out of the credit market.

Instead, African farmers tend to rely either on microfinance by microfinance organizations—sometimes NGOs—or informal credit. In many countries, inspired by the perceived success of the Grameen bank, microfinance organizations tried to push down the costs associated with transacting with farmers. This was accomplished by introducing a system of *joint liability*. Individual farmers are asked to form groups and are made jointly liable for each other's loans. If one farmer defaults on her loan, then group members will also be excluded from future loans. To avoid such outcomes, farmers will self-select into groups with only

[2] Another concern is that a system of individually tradable land rights introduces the risk that certain families are forced to sell their land endowment after an adverse shock. This would result in a rural proletariat. While such a (market-mediated) consolidation strategy may be favored by some, it would have adverse social consequences—typically the displacement of landless rural families to urban shanty towns.

trustworthy colleagues (mitigating adverse selection concerns), and scrutinize each other's spending behavior (mitigating moral hazard). Indeed, in exceptional cases group members may even pay back the loan of a colleague who is unable to do that himself. It is perhaps no surprise that repayment rates under joint liability are typically very high.[3]

Notwithstanding greater access to microfinance, many smallholders continue to rely on informal finance to deal with their capital needs. Informal moneylenders in villages know their clientele and have access to a range of methods to enforce repayment. The interest they charge is typically high, often exceeding 100% on an annual basis. While such loans may be helpful to cope with consumption shocks, they are problematic for farmers who seek credit for productive investments. Loans for improved seed and fertilizer can only be paid back after the cropping season—several months later. The costs of such loans may nullify the gains from having access to modern inputs. Where informal credit is available for smallholders it often takes the form of interlinked transactions, where the market for capital becomes connected with the market for crops. As argued in Chapter 3, traders may be willing to provide loans for input, in exchange for the promise that they will receive the crop after harvest—at an agreed price.

The discussion of land and capital suggests that factor markets in rural Africa are complex, and at least partly informal. The same applies to the case of labor. If land distribution is unequal, or if some landowners have more land than they can cultivate themselves, they have several options at their disposal to "bring labor to the land." Some are outright exotic. For example, Mokuwa et al. (2011) describe how landowning families in rural Sierra Leone try to appropriate the labor of landless individuals by

[3] Joint liability seems to have lost part of its appeal in recent years. Microfinance institutions are increasingly moving away from this system, and individual liability systems are becoming more popular. The transition is presumably related to a process of mission drift for many microfinance institutions. While the ambition to target the poorest of the poor was an integral part of the initial mission of microfinance institutions, in recent years many organizations apply a more commercial model and aim to be financially sustainable (i.e., do not rely on subsidies). This involves targeting other clients, for whom individual liability is a better fit. (Individual liability systems are more attractive for borrowers as they involve less risk and lower transaction costs—e.g., fewer group meetings.) Joint liability also involves a risk known as the "bandwagon effect." If one member fails to pay back his loan, defaulting may be optimal for other group members as well, even if they could pay back their loans. Why pay back now if you will be excluded from future loans anyway?

leveraging the local judicial system. Big men in polygamous communities—the descendants of slave-owning families—control much of the land and women, and use these women as a "honey trap" to lure unmarried young men into extramarital sexual relations. These men are "caught" having sex with women and girls for whom they paid no bride price, and brought to the local court. The charge is "woman damage," reflecting that something of value is lost due to the extramarital relations. Justice is administered by the same rural elite that owns most of the land. To compensate the patriarch for the "damage" inflicted on one of his women, the perpetrator is typically convicted to pay a cash fine he cannot afford. To repay his debt, instead, he works for next to nothing on the patriarch's land. There exists a strong correlation between the number of women damage convictions in local courts and the demand for labor dictated by the agricultural calendar.

Some anthropologists argue that "women damage" is one of the reasons for the civil war in Sierra Leone in the 1990s. Nevertheless, women damage as a labor-mobilizing strategy has survived the war––Mokuwa et al. (2011) estimate that no less than one-third of the local court cases in the first decade of this century deal with it. Local landowners have access to additional approaches to mobilizing scarce labor. For example, it is customary that the bride price is partly paid in kind—a respectful groom works on the land of his father-in-law if circumstances so dictate. In the past, before slavery was abolished, fathers-in-law could even pawn the labor of their son-in-law in case of a debt they could not otherwise settle.

Other approaches to bring together land and labor are more conventional. First, landowners may hire workers and pay a fixed wage for their time. This has the disadvantage that workers have an incentive to shirk. To make sure workers supply enough effort, the landowner should invest in monitoring, but this comes at a cost (and who monitors the monitors?). An alternative approach is to rent the land out to households who lack enough land and charge a fixed rent. While land rental provides workers with a strong incentive to provide effort and produce, it has the disadvantage that the risk of a bad harvest is carried solely by the party in the partnership that is least able to absorb it—the landless worker. He runs the risk of accumulating debts he can never pay back.

A compromise solution is sharecropping Eswaran and Kotwal (1985). Landless workers cultivate the plot in return for a fixed share of the harvest—typically 50%. Sharecropping implies the landowner and worker

share the risk, and preserves incentives for supplying effort by the tenant (who receives half of what is preserved). Sometimes the landowner chips in and provides additional inputs, such as fertilizer. While sharecropping was practiced in colonial times, for example in South Africa, it is uncommon in Africa today. The reason, presumably, is that land distribution is relatively equal in many places, so most households and extended families are able to cultivate their own plots. Where seasonal migration opportunities are available, sometimes (male) family members leave the farm for extended periods when labor demands are relatively low. Some of this seasonal migration extends beyond international borders, but most of it does not and simply involves rural–urban or rural-rural migration. Seasonal workers return home during labor peaks, to harvest the crop or clear the fields.

5.3 Input Markets

"Fixing" African factor markets will not be enough to set in motion a process of sustainable intensification. Farmers should also be able to access and use the modern inputs that promise to raise their land and labor productivity. However, several problems cripple the performance of such input markets. We distinguish a Big Five of challenges to accessing input markets—all of them raising transaction costs associated with purchasing inputs.

First, low population densities and bad roads imply that farmers must often incur *high transport costs* when acquiring modern inputs. Input dealers may be few and far between, which raises costs and also creates conditions for market power on local markets (further raising the effective prices that farmers have to pay).

Second, farmers may lack *information* about either the availability of certain inputs or how to use them if they were to acquire them. Traditional extension approaches have by and large failed to reach the majority of African farmers, and information diffusion through social networks is often incomplete and slow. The assumption that extension agents can target and inform key farmers, and that information will then spread autonomously and automatically via informal contacts, has proven way too optimistic. Farmers may have strategic reasons not to inform their peers (unless there are strategic complementarities in production) or be unwilling to incur the effort cost associated with sharing knowledge. If information sharing involves cost and resembles an investment choice,

then it is no surprise that incentives matter. Farmers respond strongly to material and symbolic incentives when deciding whether to share knowledge with other farmers (Ben-Yishay & Mobarak, 2019; Shikuku et al., 2019). The importance of incentives is also evident from the recent finding that input dealers do a better job in diffusing knowledge to farmers than government officials (Dar et al., 2021). They stand to gain directly from additional sales. However, it is also evident that input dealers cannot be a panacea for information diffusion as they will only spread information from which they expect to gain—such as the fertilizer that they are selling.

The third key bottleneck impeding the uptake of modern inputs is a *lack of liquidity*. Reflecting on the earlier discussion about the imperfect capital market, many farmers may be unable to secure the cash that is needed to pay for fertilizer or modern seed or be scared off by the hefty (perhaps in-kind) interest rate that they would face. Yet, the presence of liquidity constraints is somewhat puzzling. If modern inputs are divisible so that they can be acquired in small quantities, why don't farmers "start small" and scale up over time as their level of savings increases—slowly converging to the optimal level of modern inputs? The apparent inability of many households to save has attracted quite some attention in recent years. It is evident that there are many pressing demands on any amount of savings in the context that we study, so lack of commitment may be an issue. This could point to explanations rooted in behavioral economics—perhaps a combination of time-inconsistent preferences (and, hence, a tendency for procrastination) and naivete (an inability to learn about one's own behavioral anomalies; e.g., Kremer et al., 2019). It may also be the case that social pressures for redistribution within extended families ("the family tax") prevent households from following their preferred savings path (Di Falco & Bulte, 2013).

A fourth reason why the adoption of modern inputs fails to take off could be the *low or variable quality* of these inputs. Some authors argue that modern inputs are counterfeited on a large scale so that farmers seeking to buy fertilizer or modern seed with local input dealers run the risk of receiving "fake fertilizer" or "fake seed". Bold et al. (2017) argue that the market share of counterfeit inputs is kept at a level where it is difficult for farmers to learn about the true identity of their inputs (so it is difficult for agro-dealers to earn the reputation of being trustworthy). Yields vary from year to year, depending on many uncontrollable factors, including the weather. The issue of counterfeit inputs, however, is contested in the literature. Other research suggests this issue to be of

minor importance. Producing a product that resembles fertilizer is likely at least as expensive as producing fertilizer itself, if not more, so counterfeiting fertilizer would be expensive. Instead, modern inputs are easily mishandled during transport or storage, which may explain why quality varies (Michelson et al., 2021).

To the smallholder who considers whether to buy an input or not, much of this discussion is moot. Regardless of whether the inputs are possibly fake or spoiled, they represent a risky investment. Not only will she buy less of these inputs (or maybe not at all), she will also re-optimize farm management along other dimensions. For example, realizing the risk of having bought low-quality fertilizer, the farmer also applies less effort (Bulte et al., 2014). The result is lower yields and reduced margins for investment in future farming.

The final impediment of the Big Five of African farming is the widespread presence of *uninsured risk*. Here we don't mean the risk of buying low-quality inputs, but production risk due to pest infestations or adverse weather shocks. The presence of uninsured risk may induce farmers to opt for "low-yield, low-risk" farming options instead of "high-yield, high-risk" farming. Mitigating production risk may thus be an effective way to crowd-in the use of modern inputs. The two main approaches to mitigating production risk are the development of robust crop varieties—tolerant to drought or flood conditions (e.g., Emerick et al., 2016)—and the introduction of formal insurance products. Insuring risks may do more for the adoption of modern inputs than relaxing liquidity constraints (Karlan et al., 2014). However, traditional indemnity-based insurance is not suitable to absorb production risk for smallholders due to transaction costs and asymmetric information (moral hazard, adverse selection). Moreover, weather shocks are covariate shocks, and reinsurance is difficult without objective, quantifiable measurement supported by risk models.

Box 5.1 Picture Based Insurance

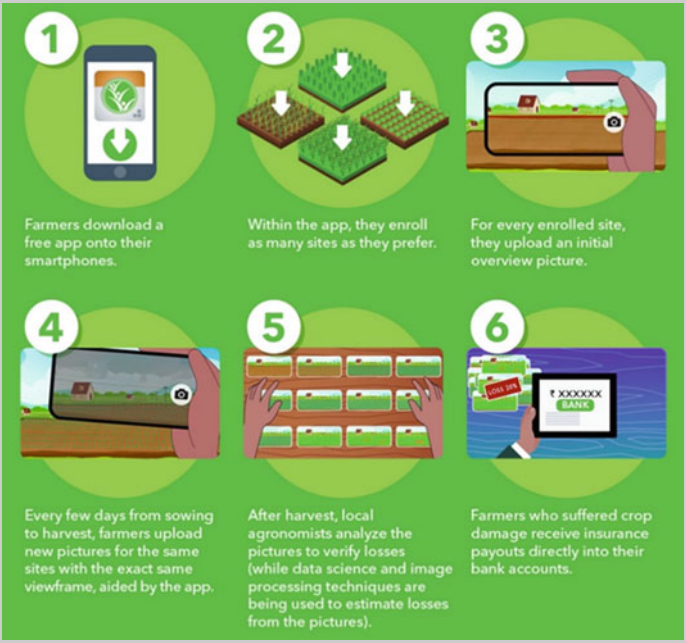
Berber Kramer

Climate extremes such as droughts, floods and cyclones pose a serious threat to livelihoods among millions of smallholder farmers in Africa. These farmers lack access to affordable, high-quality

insurance to manage climate extremes. Their farms are often too small and remote for insurers to visit fields and economically verify damage. CGIAR researchers, working with the private sector and international development community, have searched for alternative types of insurance that do not require insurance companies to verify damage through in-person visits. The growing use of technology in developing countries offers a potentially efficient solution.

The Picture-Based Insurance (PBI) project, launched in 2015, tests whether smartphone cameras can help make insurance products more attractive for smallholder farmers. By relying on visible crop characteristics observed in pictures farmers take of their crops, PBI aims to minimize the costs of loss verification and detect damage at the plot level without relying on in-person visits by insurance agents. This process is also more engaging, comprehensible, and accessible to small farmers.

The PBI project has since expanded to cover a wide range of crops in India, Kenya, and Ethiopia. It works as follows:



Initial proof-of-concept studies have shown PBI to be feasible and sustainable. Insurance experts can process claims for sites where farmers report crop damage remotely and in a short period of time, talking to the feasibility of such an approach at a large scale. Machine learning algorithms have also been trained to partially automate image processing and damage classification, further supporting claims settlement. Increased access to affordable high-quality insurance could help promote small African farmers' investments in agriculture, including seeds of stress-tolerant varieties that can help farmers further minimize their exposure to climate risks. Randomized trials to evaluate impacts on investments, technology adoption, productivity, and women's empowerment are ongoing.

In recent years, a range of innovative insurance products has been peddled to smallholders. The most prominent one is index insurance, where payouts are not based on individual assessments of damage but on local weather outcomes (correlated with these damages, hopefully). For example, if satellite data or weather stations indicate that rainfall in a certain locality was below a critical threshold during the growing season, then a payout to all local policy holders is triggered. Since rainfall is independent of the actions of local farmers, asymmetric information is no longer a concern. If the probability distributions of local rainfall is known, then actuarially fair premiums can be set, and reinsurance on international insurance markets is possible.

Expectations with respect to index insurance were high but proved to be too optimistic. The uptake of insurance, much like the uptake of modern agronomic inputs, remains very low—typically hovering below ten percent of the target population. Among the possible culprits are low trust in the product, and the reasons listed above—lack of information and liquidity, and low quality of the product that is traded. In particular, the quality of most index insurance products is undermined by something called "basis risk." Basis risk concerns the imperfect correlation between actual farmer damages and payouts based on the nearby production conditions. Farmers can lose their crops due to drought but still not receive a payout because it rained at the local weather station. Then they are worse off than in the case without insurance because they paid the premium. This prospect will scare off risk-averse smallholders.

This section paints a gloomy and complex picture, but the reality is perhaps gloomier and certainly more complicated. Heterogeneity in agronomic conditions among smallholders is a huge challenge and poses a greater challenge in rain-fed African production systems than in (relatively uniform) systems elsewhere based on irrigation. This implies that, notwithstanding the simple blanket recommendations that accompany the use of most modern inputs, the application of inputs should be tailored to local conditions (Suri, 2011). Moreover, the returns to adoption vary a lot from farmer to farmer. For example, the returns to fertilizer use vary with the quantity and timing of application, in relation to realized rainfall (Beaman et al., 2013).

Worse than that, the economic rationale for adopting some of the "recommended" inputs and practices seems flimsy, or absent. Many of the agricultural innovations promoted in the African countryside are the result of technology push driven systems, based on the linear invention-trial-extension-adoption model. However, if insufficient attention is paid to local preferences, conditions, or constraints, then smallholders may rationally reject these innovations. More complex non-linear innovation systems or platforms, where intended beneficiaries are involved in the design and trial stage are potentially more promising in this respect, and discussed in more detail in Chapter 8.

5.4 Output Markets

Most smallholders growing food crops consume part of their harvest and sell the rest locally. Some farmers engage in relational contracting and may be visited on their farm by their trading partner who collects the harvest and pays the agreed price. Others carry their produce to a local spot market and sell it to one of the resident traders. The price they receive depends on the intensity of competition between traders. Imperfect competition on such local commodity markets is often seen as a leading cause of small margins for producers. Buyers (traders) with market power will demand small quantities and offer low prices to farmers who cannot turn elsewhere with their bags of wheat, maize, or cowpeas.

The nature of the bargaining process, and the division of the surplus, depends on the market structure. Potential candidate models to explain the outcomes of bargaining between traders and farmers are *Bertrand competition between traders* (where traders compete by setting prices, and where traders freely enter in local markets), *Cournot competition between*

traders (where traders compete by choosing quantities to purchase), *bilateral bargaining with lock-in* (where farmer and traders are matched and can only trade with each other, and the equilibrium price solves the generalized Nash bargaining solution), and models with *search frictions*. Search costs create "segmented" markets where traders have some market power. The same happens if farmers incur costs associated with switching from one trader to the next, perhaps because of trust built up in the specific relationship (or perhaps because hauling a bag of wheat to another place is costly).

The market structure that eventuates depends on the completeness of information flows, trader entry costs, and whether traders can collude and maximize a measure of joint surplus—rather than compete with each other, bidding up prices. As a result, there is not one appropriate model of market structure and competition, but rather market structure is dictated by circumstances. For example, imperfect competition due to search frictions can be easily sustained if there are natural or man-made barriers to entry in the trade sector, which is easier to imagine in remote and thinly populated areas than in thriving producer areas.

Evidence about the competitiveness of food crop markets is rather mixed. Casaburi et al. (2013) study how a road improvement program affects local market prices in rural Sierra Leone, and conclude that the search friction model predict their data best. This means traders have some market power, but farmers are not completely "locked in" either. To what extent does this result spill over to other contexts? Unobserved trader costs and services complicate the assessment of this issue, and the evidence is rather scant. Dillon and Dambro (2017) review the evidence for African crop markets and conclude that these markets are fairly competitive. Their conclusion follows from analyses based on commodity prices and trader profits, market concentration ratios, and barriers to entry and exit markets. This is consistent with evidence for the cocoa sector, characterized by interlinked transactions (i.e., traders providing both loans before harvesting and purchasing beans later). Experimental subsidies provided to traders are at least partially passed through to farmers in the form of relaxed credit constraints for farmers (Casaburi & Reed, 2019), pointing points to the type of interlinked transactions as discussed earlier. However, outcomes vary from context to context. Bergquist and Dinerstein (2020) find that maize markets in Kenya are not competitive. Windfall benefits are incompletely passed through to producers, and traders collude to retain the bulk of the surplus created through trade.

The consequences of imperfect competition are complex and numerous. Adopting a simple static perspective, competition determines the distribution of the surplus between trader and farmer. For the case of bilateral bargaining, it is easy to demonstrate this point. Assume a farmer produces one unit of output. If he is unable to sell his unit to the trader on the spot market the crop has a default value v to the farmer. If the unit of output is sold, the trader transports it at fixed cost τ to a processor or final consumers in a nearby city. The unit price on the final market is given and equals P. Farmers and traders are randomly matched on a local spot market and bargain over the surplus created by trade, or the unit price p that is paid to the farmer. The Nash bargaining solution for the match between a trader and farmer i therefore solves:

$$P^N = \arg\max_p \left\{ (P - \tau - p)^{\alpha} (p - \upsilon)^{1-\alpha} \right\} \tag{5.1}$$

where α is a measure of the bargaining power of the trader. It is reasonable to assume that the trader's bargaining power varies with the intensity of competition in the local market. Under the further assumption that trader bargaining power declines as there are more traders within a market, the solution of Eq. (5.1) implies:

$$p^N = (1 - \alpha)[P - \tau] + \alpha\upsilon \tag{5.2}$$

If trading is efficient, so that the surplus of a traded unit exceeds the default value ($P - \tau > \upsilon$), then it follows directly that smallholders receive higher prices on more competitive local agricultural markets; e.g., $\partial p^N / \partial \alpha < 0$. This finding is a direct consequence of the assumption that individual traders have more bargaining power vis-à-vis framers when competition is less intense between traders.

However, the impact of competition extends beyond how a pie of given size is distributed between the farmer and the trader. It also affects the size of the pie. Low farmer income may limit his ability to invest in productivity-enhancing inputs, which directly limits the next period's output. Market power affects both the farmer's *ability* and *incentives* to invest. This is evident from a simple model extension where the farmer can increase output quality by allocating extra effort to production. Assume that prices on the final market reflect these quality differentials due to farmer effort; $P(e)$ with $P' > 0$, $P'' < 0$. Allocating (additional) effort e to production involves a cost $c(e)$ for the farmer. Farmers choose the

optimal effort level by maximizing the following objective function;

$$\pi_{F,i} = (1-\alpha)[P(e_i - \tau)] + \alpha v_i - c(e_i) \tag{5.3}$$

Denote the farmer's optimal effort level by $\hat{e}$, which is implicitly defined by $(1-\alpha)P' = c'$. If the farmer had full bargaining power ($\alpha = 0$), he or she would choose the efficient level of effort and capture all the (extra) value that is created. However, for $\alpha > 0$, the farmer chooses an inefficient level of effort (from society's perspective) because part of the benefits of producing quality is taken by the trader. For $\alpha = 1$ the farmer allocates no effort at all, as gains from additional effort are zero. Effort levels are decreasing in the bargaining power of the trader:

$$\frac{\mathrm{d}\hat{e}}{\mathrm{d}\alpha} = \frac{P'}{(1-\alpha)P'' - c''} < 0. \tag{5.4}$$

If the benefits of investments in quality-enhancing inputs and practices are taken by traders with market power, then farmers will respond by adopting low levels of modern inputs and practices (such as safe storage).

The discussion until now is relatively straightforward: reducing trader market power increases product quality and increases farmer income. However, from Chapter 3 we may remember that reality may be more complex. The welfare effects of more intense competition vary with the institutional context, and in particular with the contract environment. We next turn to this point.

Imagine a setting in which farmers cannot access key production inputs for any of the reasons discussed in the previous section. Perhaps traders can provide these inputs instead? When (costless) third-party enforcement of contracts is possible, farmers and traders will maximize the value of production and bargain over how to divide the gains.

In a more realistic world without costless third-party enforcement of (formal) contracts, partners may turn to relational contracting as a second-best solution. As discussed in Chapter 3, such contracts are enforced by the promise of future rents, which depend on the gains from being in a relationship vis-à-vis the gains from trading on the spot market. The latter gains depend on the intensity of competition on spot markets. If spot markets are more competitive, then the gains from spot market trading for farmers increase. In other words, it becomes more tempting for farmers to renege on agreements (side-selling part of their

crop) because being in a relationship is less valuable relative to the stand-alone position of trading on spot markets. However, doing so erodes the gains from relational contracting. Anissa et al. (2021) demonstrate that the value of the relational contract is reduced in equilibrium because the trader now anticipates that the farmer may renege. He therefore supplies smaller quantities of inputs. The paradoxical result is that increasing the intensity of competition on local markets is not necessarily in the farmer's interest if he or she needs traders to supply her with inputs. Resources flow easier in captive relationships. Promoting competition may enable farmers to obtain a larger share of a smaller pie, and it is not evident that they are better off.

Some empirical evidence is consistent with these ideas. Anissa et al. (2021) study the association between the intensity of competition on local wheat markets in Ethiopia and the quality of wheat that is supplied. They distinguish between spot market farmers and farmers in a relational contract. Consistent with the reasoning above, they find that the spot market farmers supply wheat of higher quality on "competitive markets" than on markets with little competition between traders. However, the reverse is true for farmers with a relational contract; they supply wheat of lower quality if local spot markets are more competitive. Moreover, farmers are less likely to be in a relationship when traders have less market power.

Macchiavello and Morjaria (2021) study relational contracting between coffee growers and a monopsonistic miller in Rwanda and find much the same. Entry by a competing mill *lowers* the quantity and quality of beans supplied by smallholders. Competition between mills makes relational contracting more difficult as the presence of another buyer facilitates side-selling by farmers. The competition increases the risk of investments in the provision of complementary inputs and services by the miller. In this case, the increased competition reduces overall productivity and performance.

Much more can be said about local output markets and their impact on the performance of local value chains. Some of these issues will resurface in later chapters. For example, high transaction costs cause fragmented markets, which imply volatile prices with strong seasonal influences. This provides an incentive to invest in storage to prevent scenarios where farmers "sell low" (after harvest, when prices are at their lowest) and "buy high" later in the season. This issue is addressed in Chapter 7.

5.5 Smallholder Households

Farming households in Africa typically face an incomplete set of imperfect factor markets, input markets, and output markets. Within this complex institutional context, they try to maximize a measure of aggregate household welfare. Challenging the stereotype of backward producers, the mainstream economic view is that smallholders are rational agents operating under adverse conditions. Farmers are best conceived of as expert experimentalists for their plots. They lack the knowledge and tools to observe, say, microlevel processes in the soil and do not experiment in a textbook way, but they do learn and accumulate locally relevant knowledge.

Different typologies of smallholder household models are available. One key distinction is between separable versus non-separable household models—hinging on the presence or absence of a full set of markets. Another one emphasizes the difference between unitary versus collective models. This classification zooms in on decision-making within the household and introduces an important group of gender-related issues.

Consider the former typology first. The economist's dream world is characterized by a complete set of current and future markets where farmers take prices as given, and economic decision-making is relatively easy. The conventional farm household model reduces households' simultaneous production and consumption decisions into a recursive form, so that production and consumption become "separable problems". In other words, we can treat households as first maximizing their income, and subsequently allocating their income to the consumption bundle that maximizes their utility. Production decisions are independent of the preferences of household members.[4]

In light of the discussions earlier in this chapter about the many ways in which rural markets can "fail" in Africa, it is reasonable to expect that the separable household model is not a very useful guide to understand real-life decision-making for smallholders. If markets are not perfect, production and consumption problems are not separable but should be solved *jointly*—decisions in one domain have repercussions for the other

[4] While some literature did not reject these assumptions (e.g., Benjamin, 1992), later work casts doubts on them. LaFave and Thomas (2016) study demand for farm labor in rural Indonesia, and reject the model prediction that labor demand is unrelated to the demographic composition of the household.

one. De Janvry et al. (1991) demonstrate this might produce behavioral responses that appear "sluggish" or even paradoxical and perverse. Failures in the market for labor or food constrain farmers' abilities to respond to shocks (such as price incentives) and induce them to shift the burden of adjustment on the nontraded product which the household controls. In essence, income and substitution effects associated with changes in external prices will change the shadow price of nontraded products or factors.

For example, de Janvry et al. (1991) consider the stylized case of a household producing cash crops and purchasing manufactures. It also consumes food, but there is no market for food crops so these have to be produced on-farm. There is also no market for labor, and household allocates their available time between growing cash and food crops and leisure. Ultimately, the household's welfare depends on the consumption of manufactures, food, and leisure. Consider the case where the price of cash crops increases. A separable model would predict that households increased their supply of cash crops. Predictions of a non-separable model are not so simple. In addition to substitution effects, the price shock creates an income effect. If the household gets richer, it wishes to increase its consumption of food, manufactures, and leisure. But consumption of food and leisure comes at the expense of cash crop production, due to the reallocation of land and labor. This means that the household's response to an increase in cash crop prices in terms of extra cash crop supply will be attenuated. The household appears "sluggish" because it cannot freely mobilize land and labor for cash crop production (else it goes hungry, or becomes overworked).

There are more examples of complex interlinkages or feedback loops between production and consumption. Increasing the price of manufactures induces the household to produce fewer cash crops and instead consume more food and leisure. An increase in productivity in food production will invite an increase in cash crop production, as production factors are freed up and re-allocated. Some of the predictions of non-separable household models therefore run counter to what separable household models would predict. Non-separability of consumption and production decisions implies that forecasting production responses and welfare effects of policies and interventions are complex.

The portfolio of activities of smallholder households is designed to meet and balance multiple (conflicting) objectives. Overall outcomes are *rational* in the sense that the household make the best of a difficult

situation, motivated by an understanding of local constraints. However, outcomes could be improved if certain market restrictions were lifted. Examples of the careful balancing act of rural households abound and pervade all aspects of life. Classic trade-offs exist in the domain of increasing income levels and reducing income variability (if capital and insurance markets fail). As a result, households do not specialize in their most productive activity, but instead pursue a portfolio of activities—including off-farm employment and the cultivation of multiple crops to spread risk. Spreading labor demand throughout the year and avoiding labor peaks that cannot be met by the household are other obvious outcomes.

Crop diversity in the plot can also be motivated by a desire for dietary diversity (when food markets are thin and incomplete), or by a (cultural) desire for specific crop varieties for specific uses. In other contexts, multi-cropping can be motivated by a desire to keep diseases and pest pressure under control, if there is no market for herbicides and pesticides. Similarly, shifting cultivation can be one approach to achieve sustainable land use and restore soil fertility in the absence of fertilizer. Own fertility choices are also affected by the completeness of the set of markets. Children can serve multiple purposes in addition to the universal ones, including on-farm labor and care for the elderly. Parents may prefer to have fewer children and invest in their future productivity, or have more of them, depending on (market) circumstances. The list goes on.

Yet the view of consumption we just described is also unrealistic. It assumes what we refer to as a unitary model of the household, which means the household is treated as a single unit with uniform preferences over what to consume as if the household is a black box. The implicit assumption is that one, typically male, decision-maker maximizes the joint welfare of all household members. Collective models, in contrast, recognize the potentially conflicting preferences of individual household members within that black box and try to understand household-level decisions as a compromise between what different members want. Evidence suggests that the preferences of husbands and their wives tend to diverge in systematic ways. For example, it is often argued that women's preferences are more closely aligned with those of their children, and more geared toward human capital accumulation (e.g., investments in health and schooling). Collective models are more realistic, but also more complex, and often involve models of cooperative or non-cooperative bargaining between spouses.

The distributional implications—who gets what?—are evident. But the issue of collective models may also be relevant for agricultural value chains, depending on the market context. As mentioned, production and consumption decisions can be treated as recursive problems if markets are complete. Any gap between what husbands and wives want is confined to the consumption domain. Production decisions are optimal, including choices with respect to marketing modalities and contracts. In contrast, incomplete markets imply that choices about consumption and production are jointly determined. Intrahousehold bargaining over consumption bundles may affect both production choices and overall economic efficiency.

Indeed, the importance of gender extends beyond differences in consumption preferences. Consider the context of several African countries, where men and women sometimes manage separate plots (and own the ensuing stream of benefits). African women make up some 40% of the agricultural labor force, yet face several constraints in effectively tending their fields. According to a report by the World Bank, the gender gap in terms of agricultural productivity ranges from 23% in Tanzania to 66% in Niger. This gap is due to differential access to inputs, intrahousehold issues, and the sometimes difficult relationship between women farmers and male extension agents. Within the household, key issues concern who cultivates which crop (low-value food crops versus cash crops), but also how productive inputs are allocated. Udry (1996) demonstrated that the overall household income of farming households in Burkina Faso could increase if some productive resources were redistributed from men to women. Female-headed households also tend to have weaker tenure rights to the plots they farm than male-headed households—they are less likely to hold powerful positions in local political hierarchies and invest less in soil productivity. For example, they fallow their plots for a shorter period (because tenure is most likely to be contested during fallow periods) so the soil fertility of their plots is reduced (Goldstein & Udry, 2008).

Household responsibilities and cultural norms may prevent women from meeting with (male) extension agents. Research by IFPRI demonstrates that the performance of women farmers can be improved by increasing the number of female extension agents (van Campenhout et al., 2021). Research by the Gender Innovation Lab of the World Bank suggests that the performance of women farmers can improve by making

the design of training material more gender-inclusive, and offering trainings to couples rather than the male household head (World Bank, 2020). Moreover, women can be shifted into higher-value farming activities by nudging husbands, or providing cash grants to couples through community livelihoods programs. Gender roles are strong, but malleable, and interventions in this domain can affect both the quantity and type of agricultural commodities produced by households. And since the quantity of production can be affected, it can affect the surplus that smallholders have to sell into value chains.

5.6 Discussion and Conclusions

In this chapter, we focused on a key node in agricultural value chains—the smallholder household. Production decisions and performance at this level shape the organization of value chains and determines global progress toward SDG goals related to food security and poverty alleviation. SDGs related to sustainable resource use and gender are also closely related to smallholder farming.

We explored the institutional context within which smallholders operate, in particular, the factor, input, and output markets that they face. These markets are typically incomplete. Market failures frequently give rise to informal institutional arrangements as substitutes. Kinship systems, labor exchange, relational contracting, sharecropping, and informal solidarity systems are examples of surrogates for what markets do not provide. Many of the key arrangements that govern the functioning of African food value chains have emerged in response to imperfect markets.

As argued by de Janvry et al. (1991), such informal systems may suffer from unclear property rights and imperfect information, and therefore produce inefficient outcomes. For example, relational contracting can only support informal agreements that satisfy the incentive compatibility constraint of the party with the possibility to renege. Such contracts are incomplete, and not all efficiency-enhancing collaboration can be included in the agreement. Profitable opportunities for exchange remain untapped. They are also of a local nature, so potential economies of scale are foregone. Finally, it is evident that earnings may be unequally distributed among agents in value chains, reflecting local political or market power positions. For example, the first mover in relational contracts can design a contract that exactly satisfies the other party's constraints (i.e., offer the other party's reservation value) and keeps the

rest of the rents for herself. Traders need to give up only part of the rent to farmers and can secure the rest for themselves. This may be only a small amount, reflecting the incompleteness of the relational contract—most traders are not wealthy individuals.

To empower smallholders and increase efficiency, we argue interventions should be prioritized that reduce transaction costs and eliminate or attenuate market failures. We return to several such options in follow-up chapters in this book.

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CHAPTER 6

Product Quality and Certification

As argued in the previous chapter, a key consequence of transaction costs in agricultural value chains is the dampening of incentives to increase product quality. In this chapter, we consider quality in more detail. After all, even crops that appear to be quite standard agricultural products can have a lot of different qualities, especially once we start to think about different varieties of the same crop. Some such qualities can lead to several new value chain opportunities. For example, consumers may be particularly interested in certain aspects of products, such as whether or not they were grown organically or sustainably. Processors or other buyers might be interested in specific product aspects beyond growing practices as well: specific varieties of agricultural products might be more appropriate for certain types of processing, or processors might be concerned about the specific product content in advance of processing (e.g. water). Processors in fact might need specific crops or varieties to make processing efficient or even profitable in the first place. Not surprisingly, economic issues arise quickly when we think about simple models of improving agricultural product quality, both in contexts when contracts are formal and informal, since contracts cannot easily control for unobservable attributes.

First, we provide a simple framework from which to think about how quality issues might arise, and the types of transaction cost issues that

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arise. Second, we consider ways that certification can and is used in affirming certain qualities of crops. In the "real world," many types of product certification that are actually used at the farmer level relate to the growing process, rather than the quality of agricultural products. Third, we consider the impacts that participating in certification schemes may have on farmer livelihoods.

6.1 Producers, Purchases, and Certifying Quality

It is valuable to consider a simple model relating producers, buyers, and the potential need to certify quality, to think carefully about the types of issues that can come up in value chains as product quality or attributes become important.

First, let's consider a producer with a fixed amount of land, and they grow a crop we can label crop A. In a specific season, they might expect to produce Q_a on that land. They might consider growing either another crop or the same one with specific (new) attributes; we can call this option crop B. In expectation, they would grow Q_b of that crop. There are costs associated with changing from A to B, so let's call the increase in costs C_b. A risk neutral farmer would switch to B if the increase in returns to B relative to A are positive, so it would require that $p_bQ_b - p_aQ_a > C_b$, where p_b is the average price expected to be received for B and p_a is the same for A. If the yield is roughly the same for A and B, or $Q_a = Q_b$, we may divide through by the quantity to obtain $p_b - p_a > c_b$ (where c_b now represents the per-unit cost of switching to B).

Note that we have made an extreme simplification here to illustrate principles; every crop or even variety of a specific crop has multiple attributes that could matter to potential buyers. This setup, though, refers to both a maize producer deciding whether to grow blue maize to the same producer thinking about switching at least part of their land to growing cucumbers. And the "crop" could also be an animal source product, such as milk.

Let's next consider the buyer of the crop. To start, again for simplicity, let's assume there are multiple buyers who can costlessly buy from the farmer. We assume they are willing to pay p_b for product B and p_a for product A, where $p_b > p_a$. If they can costlessly verify attribute B exists in the crop, the problem is simple; the producer will produce crop B and the buyer will purchase it from her, and everyone will benefit. Let's

further assume the trader would also make a small profit by selling the product at a higher unit price P_b, so they also achieve some gain from participating in this trade.

Unfortunately, the world often does not follow the simple model we have sketched out so far. It obviously holds if the buyer is purchasing cucumbers instead of maize, but it is less obvious when attributes are unobservable. Without verification (particularly if we are talking about one crop or product), the buyer and seller face an asymmetric information problem. The farmer knows about the crop's attributes or the product he is trying to sell, whereas the buyer does not. A simple example is the moisture content of maize; maize that is not as dry will weigh more and be more susceptible to molds in storage. So in this case the farmer has information about the crop, whereas the buyer does not. Meanwhile, the seller may know more about the market conditions than the farmer does; for example, they may have a good idea about how large P_b is, and may try to increase margins by cheating the farmer. There are several different ways that asymmetric information can exist in this context.

If the crop attribute cannot be observed costlessly, the buyer could pay some per-unit cost to test for attribute *B*. That cost, however, both lowers profits for the trader (or, if passed through to the farmer, for the farmer); it may create a second potential information asymmetry, if the buyer has access to the test result and the farmer does not. In this case, the buyer can declare whether the attribute exists in the product; if not, he offers a lower price to the farmer. As a result, as discussed in Chapter 3 reputation becomes important. If the farmer does not trust the buyer's declaration, her incentive to grow the crop with attribute *B* in the future becomes weaker. Note that it is not always possible to test for these attributes, as we will discuss later.

A second, related problem emerges if these unobservable attributes exist in an environment of relational contracting, and from the farmer's perspective it is costly to find a new buyer ("search costs"). As discussed earlier, there is a risk to the farmer that the buyer tries to renege on the agreement—"hold up risk." The threat of hold-up risk may lead the farmer to hesitate in producing the crop with attribute *B*.

The buyer may also be a monopsonist, either locally or more broadly. This situation is actually quite common, as specialty crops or varieties often only have one purchaser for local processing. As agricultural products are bulky the incentives for farmers to transport them long distances and find another buyer themselves are low. It is perhaps best to think

of this situation as giving the buyer pricing power; they can choose a price that maximizes their profits from purchasing the product rather than paying the competitive price. Again, the farmer's gain from switching to the crop with attribute B declines relative to the simple, initial equilibrium.

Let's consider a final variation, which is a situation in which consumers might not value the attribute, but there is some positive externality to consuming food with that attribute. In this case, $p_B = p_A$, since the market does not value the attribute, and therefore farmers would not grow the crop with attribute B, even though it is quite possible that the overall social benefit to consumers purchasing and consuming B is much higher than A. We will return to this concept with a precise example.

As one might guess, these market disruptions tend to be the norm in low and middle-income countries quite generally, and also in sub-Saharan Africa. There are two main consequences. First, smallholders typically do not pay much attention to the quality of their products, which can both reduce yields and the price per unit (since anything sold would be considered low quality). Second, based on the small and varying quality of output, traders and/or cooperatives will likely just aggregate whatever product they receive, rather than separating it by quality, due to the small gains relative to costs of separating higher quality products for different value chains (e.g. Abate et al., 2021). Consequently, value chains that require specific qualities of products will only emerge with difficulty, as farmers and traders are simply responding to their individual incentives. We discuss this point in more detail below.

6.1.1 The Role of Trust in the Value Chain

Let's move back and consider how trust can affect outcomes for both farmers and traders, particularly how trust can potentially be built up or broken down. First, farmer trust in traders may break down if traders either have informational advantages about markets, have some monopsonistic power, or both. Disagreements can arise about crop quality, within the context of a crop that can be graded and priced based on its observable qualities.[1] Disagreement can also arise between farmers and

[1] Grading is easy when attributes are observable, in which case no third party is necessary. For example, consider two 50 kilogram bags of maize that a farmer is trying to sell. The first, if one opens it, has evidence of insect damage (e.g. from weevils); e.g. it is

traders about how agricultural products should be graded. Traders have an informational advantage as they will know what qualities their buyers look for. Farmers, though, likely have a grade in mind when selling their crops, based on their knowledge of the grading process and their own estimate of product quality (e.g. Anissa et al., 2021). Traders may use this process to their advantage, by purchasing certain crops at a low price claiming a low grade while then planning to sell at a higher grade, adding to their profit margin and detracting from the trust that farmers have in them. They might also bring scales to weigh crops that systematically underweigh crops or use other methods to trick farmers about the value of their produce.

Clearly, a result is distrust among farmers for traders. (Local) market power can play a second role, as farmers may perceive that the price wedge between what they are receiving and what the trader receives is too large. (Farmers may have a hard time understanding the various costs that traders incur—accentuating their tendency to regard traders with suspicion.) Market power can also keep farmers from having any recourse for grading issues, as they have no outside options for sales. These problems are particularly acute for perishables.

Traders have good reasons not to trust farmers, either. Farmers may provide low quality goods, especially if they feel prices do not reflect the quality of their output. For example, they may hide the part of their crop that looks bad in the middle of their bags or may add stones or dirt to increase weight. Bernard et al. (2017) study an expected change in pricing of onions in Senegal, which went from a volume to a weight measure; farmers invested more in inputs when they knew their crops would be weighed fairly.

An important question is what mechanisms can be put into place to improve trust in transactions between smallholders and traders. Without trust, contracts only occur with difficulty, as actors expect the other to renege. This point is where third-party certification enters. A third party—which can be the government or another private firm—can come in and certify quality standards, scales, or can audit bags of crops to assure uniform quality. The most common use of certification, though, relates to

observably product A. The second does not (e.g. product B). The trader likely offers a lower price for the insect-damaged maize, since it will be harder to sell on. With such an observable flaw, farmers would likely agree with the point that their product is less valuable.

process standards, which we explain in more detail below. Under the right circumstances, the potential for third-party verification can increase trust between farmers and buyers (Saenger et al., 2014). However, a challenge here is how third-party certification is paid for, as they create transaction costs; as a result, third-party quality checks often require high-value crops so the costs can be absorbed.

Even if a certification mechanism is in place, a further issue is whether farmers or traders would trust the certification mechanism itself. Farmers might consider the standard to be too related to business; few farmers actually participate in governance structures of most global standards (Bennett, 2017). If they produce more than the standard setter can absorb, farmers also may not be able to sell all their products into the certified value chain.

The incentive structure for contractors to follow the larger standards also likely matters. If monitoring of workers certifying standards are met is loose, the monitors may be susceptible to accepting payoffs to continue to certify products even if standards have slipped. In that case, certification may also fail to actually certify products (e.g. Laffont, 2005). This problem can cause certification mechanisms to break down, as farmers, traders, and consumers may all lose trust in those mechanisms.

6.2 Types of Certification

There are three types of crop attributes that might be certified before they are purchased. First, consider observable product attributes. The World Food Program (WFP) has moved substantially toward local and regional procurement for their food purchases, but they require crops they purchase to meet specific observable standards; if smallholder farmers cannot meet those standards, they cannot participate in those markets. As a result the WFP only buys a small proportion of their total purchasing from smallholder farmers; they often source from smallholders indirectly through traders who can ensure that quality standards are first met. As a second example, any type of food processing requires specific standards to be met; food safety protocols for instance need to be met before processing can occur. Again, smallholder farmers who do not know how to meet standards or separate out, for example, broken beans before selling, are destined to just produce low quality products and be excluded

from these markets. In both cases, large farms are naturally more cost-effective partners, because the transaction costs of buying from larger farms will be lower.

Second, unobservable product attributes that might require certification can be either negative or positive. A relevant negative example is aflatoxins, which are substances produced by largely unobservable types of molds found on grains and legumes in many developing countries. They have substantial negative health effects, including increasing stunting among very young children (Hoffmann et al., 2018). Aflatoxins are unobservable and it is costly to test for their presence, so it is a safe assumption that grains or legumes purchased on a local market in Africa have elevated levels of aflatoxins. There are also several ways to mitigate aflatoxins, but none are costless. Such treated grains or legumes are unlikely to find a market without a price premium.

There are also unobservable positive attributes. For example, HarvestPlus is developing high iron varieties of beans and pearl millet, and high zinc varieties of rice, wheat, and maize (e.g. HarvestPlus, 2020).[2] Whereas the additional micronutrient intake from high iron or zinc varieties is beneficial to health, one cannot tell a high iron bean from a "normal" one; they look the same. As with aflatoxin-free grains, to be able to demand a price premium for food products with unobservable benefits, the value chain must be kept completely separate and consumers have to be willing to pay a premium for such products.

Third, a different type of standard is a process attribute, which fits many standards that are called "sustainability standards" (e.g. Meemken et al., 2019). These standards are broadly met if farmers perform specific practices while growing crops; for example, organic production has specific standards, as does Global G.A.P. (Good Agricultural Practices); these standards relate to soil management, input application, labor use (specifically, not using child labor) and can even apply to post-harvest handling of crops. While there are literally hundreds of standards bodies acting worldwide, they cover only a very small share of total agricultural land. However, for certain crops or products, they are quite important; for example, for coffee, about 30% of the global sown area is covered

[2] Some other HarvestPlus crops, such as orange maize and vitamin A cassava, are observably different from standard products, and as such they tend to have a separate value chain.

by one of five certification standards (Meemken et al., 2019).[3] Meeting any of these standards requires farmers to be certified by a third party. As a result of associated costs, smallholders often participate as members of cooperatives (Meemken et al., 2019).

6.2.1 Quality Certification of Grains

As the majority of smallholders in Africa produce at least one major grain crop, it is worth further considering why in most cases markets for grains are not separated by quality. In a recent paper, Abate et al. (2021) develop a model that lays out four conditions for higher quality grain markets to develop. First, downstream actors (e.g. traders, processors) must be willing to pay a premium for higher quality grains. Second, there must be enough competition among traders to pass part of the quality premium through to farmers. Third, certification must be cost effective; it cannot cost more on a per-unit basis than the quality premium. And fourth, farmers must have or be able to build the capacity to produce certified goods. Without these four conditions being met, the prospects for certification are bleak.

When considering unobservable traits about grains, we could be talking about the absence of negative traits or the presence of positive traits. It is perhaps easiest to first consider a negative attribute, such as aflatoxins in maize and groundnuts. As mentioned above, aflatoxins are both costly to test for and they are avoidable, but at a cost. There are at least three ways to substantially reduce the presence of aflatoxins. These include spreading tarps for drying crops in the field, hermetic storage bags, and a product called Aflasafe that is spread in the field as crops are growing and inhibits aflatoxin growth. Treurniet et al. (2020) studies a randomized trial that encouraged the adoption of Aflasafe in Kenya, and finds that when farmers purchase Aflasafe, they actually prefer to consume the safe maize than sell it. Few farmer groups in the trial were able to aggregate enough aflatoxin-free maize to sell at the promised premium. This finding is consistent with willingness to pay studies (e.g. De Groote et al., 2016) and further suggests there is latent demand for safe food.

Evidence on whether pass-through occurs is mixed, and appears to vary by crop and context. Abate et al. (2021) describes an expert survey

[3] Those standards were the 4C Association, Fairtrade, Organic, Rainforest Alliance, and UTZ. Rainforest Alliance and UTZ have since merged.

across twenty countries in sub-Saharan Africa about five staple commodities (maize, sorghum, cassava, millet, and rice), and find that sometimes experts suggested a quality certified market could or did exist, while in other contexts it did or could not. Bergquist and Dinerstein (2020) test whether a randomly generated subsidy given to maize traders passes through to farmers and find less than 100% passes through as would be expected in a competitive market.

The third issue of cost effectiveness is perhaps the most challenging. Abate et al. (2021) note that while public certification systems typically exist in sub-Saharan Africa for grains, they do not reach smallholders for a couple of reasons. First, their availability is often limited to specific locations, so the cost of transporting grain to be certified would be prohibitively high. Second, they tend to be too expensive to use for smallholders. Abate and Bernard (2017) study this issue in Ethiopia, and find that farmers would need to produce 25 metric tons of wheat before the certification available becomes cost effective. Hence, it is really only available for large farms.

Box 6.1. Third-Party Grain Certification

Tanguy Bernard

As discussed in the body of this chapter, third-party certification schemes related to grains are rare for smallholder African farmers. In a diagnostic study covering 20 countries, Abate et al. (2021) find that while official grades and standards and related quality certification bodies exist in most countries, they are overwhelmingly not accessible to smallholders either due to information constraints, high costs relative to product volume, or limited geographic coverage of certification bodies. Thus, the question raised whether independent quality measurement and certification bodies for smallholders are viable.

In a recent study, Anissa et al. (2021) assess wheat farmers' willingness to pay for independent quality certification through real stakes experiments in Ethiopia. 70% of farmers exert a positive willingness to pay (WTP) for certification in the surprise market day visit. This figure increases to 92% when farmers are informed two weeks in advance, enabling them to adjust upward the quality of

their market supply, largely through improved sorting (Fig. 6.1). Hypothetical questions regarding one year forward WTP further show increased WTP, with farmers better able to adjust some of their production means and practices toward higher quality. The study also finds clear evidence of a positive correlation between levels of WTP and farmers' output quality, suggesting farmers are broadly aware of their product quality, but need certification to be able to signal it to the market.

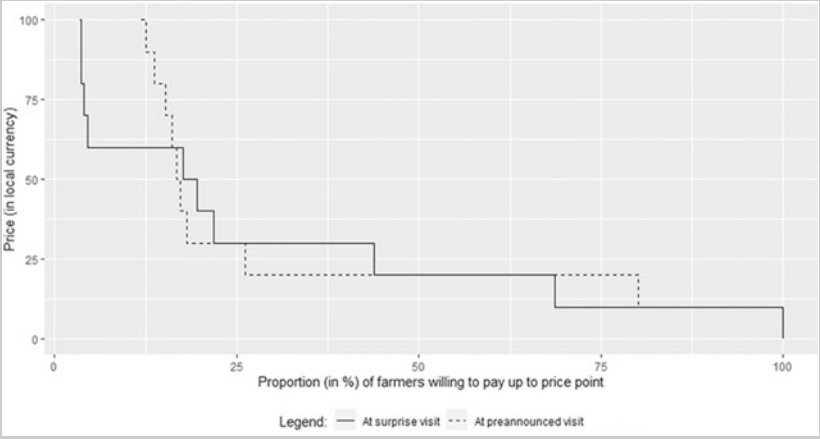

Fig. 6.1 Positive correlation between price of certification and willingness to pay, Ethiopian wheat farmers

Using a price of 50 Ehiopian Birr, at which about 17% of the farmers are willing to certify their wheat, the study further runs a cost-benefit and financial viability analysis of quality certification shops on rural Ethiopian markets. Results point to viable certification schemes in scenarios where 4500 farmers or more use the services of a certification shop. Given local market size and their operation one day per week, mobile certification shops operating on several markets are the most promising avenue.

This issue is worth further discussion because some value chains require, for example, aflatoxin-free grains. Consider the quite pertinent example of chicken feed manufacturers in Africa, who blend maize and soy to make chicken feed. Sanou et al. (2021) study this issue in a choice experiment in Nigeria, and find that traders are willing to pay higher prices for aflatoxin-free maize if they are selling on to large feed or food companies. If individual consumers are unaware of aflatoxins, which is the typical situation, they will not be willing to pay anything different for aflatoxin-free maize, groundnuts, or other crops.[4] Given producers do not want to pay higher costs, standard maize will not be aflatoxin-free; rather, one must assume that any crops purchased have at least some contamination. And as smallholders cannot pay the costs of ensuring their grain is aflatoxin-free, these manufacturers become more likely to turn to buying directly from larger farmers who can guarantee aflatoxin-free maize instead of on spot markets, even if they must pay a premium to do so. Further, if consumer-producers learn about ways to reduce aflatoxins in their maize, then they may hold onto their "safe" maize rather than selling it into the market. So the premia need to be large enough to attract producers to sell into the market, and transaction costs to find such producers may be quite high. As a result, if readily available some processors will prefer to purchase imported products which have already been certified as aflatoxin-free.

The final condition discussed by Abate et al. (2021) is whether farmers can produce higher quality products to attain standards. They argue that simple, cheap to use technologies to improve quality appear to exist, at least in some cases. Swinnen and Kuijpers (2019) find that a lack of appropriate technology does not appear to be a binding constraint against further value chain participation.[5] However, this question may merit further study, as it is likely that some technologies are too expensive or complex for smallholders to easily adopt (especially if there are

[4] As we note below, if consumers have information about aflatoxins or aflatoxin-free grains, they are willing to pay a premium for it in willingness to pay studies (e.g. De Groote et al., 2016). Yet these markets appear to be rare to the extent they exist at all.

[5] For example, in a randomized control trial in Ghana, Magnan et al. (2021) find the tarps to be effective at reducing aflatoxin growth; Pretari et al. (2019) find the tarps to be at least as effective as hermetic bags and cheaper. Still, both technologies cost at least some money to implement, which means that producing low aflatoxin maize is more costly than producing maize without regards to aflatoxins.

fixed costs associated with adoption, so that per-unit treatment costs are high when small volumes are produced).

6.2.2 *Potential Unintended Consequences of Certification*

Let's go back to the example of aflatoxins for a moment, and assume that an aflatoxin-free value chain did develop. Invariably some maize will be rejected for that value chain due to high levels of aflatoxins. An important question is what happens to the contaminated maize. Unless it is purchased by an entity with social welfare in mind, it will be consumed by someone. So the end result of any changes in value chains that start to separate out safer products for one chain almost certainly will lead to more concentration of aflatoxins in another chain—supplying food for the poor who cannot afford to obtain products from the safer value chain. The diet quality of the poor would be worse off as a result, which raises important ethical and distributional issues. Similarly, contaminated maize may be used as feed for animals, and could negatively affect food safety of animal sourced products. An information intervention could help in disseminating information about negatives like aflatoxins, but it is unlikely to completely eliminate a market for products with a concentration of the negative trait. In this context, one should worry about the potential for negative health externalities.

Similarly, if the unobserved trait is positive, separating the market for the positive attribute will likely lead to higher prices for the crop with the attribute. Relatively poor consumers would likely consume the version without the positive trait. Using the example of high iron beans in Rwanda, a recent newspaper report suggests that prices for high iron beans are double those of regular beans.[6] If the idea of disseminating high iron beans to farmers was to reduce iron deficiency anemia (e.g. De Moura et al., 2014; Vaiknoras et al., 2019), one might be concerned that to the extent it exists, the high iron bean value chain misses poorer consumers, since they must purchase their beans on the market. As the poor consumers are the ones more likely to have iron deficient diets, by driving a price wedge between high iron and normal beans the consequence of this market, at least in the short term, would be fewer targeted consumers being able to consume high iron beans.

[6] See https://allafrica.com/stories/202106010072.html.

6.3 Impacts of Certification on Smallholder Livelihoods

Before we begin to discuss the measurement of the impacts of certification on smallholder livelihoods, it is worth considering measurement challenges. The preferred way to estimate the impacts of certification would be through a randomized control trial, so that we compare outcomes among a group of producers who are exposed to certification with a theoretically similar group of producers. The challenge is how to expose producers to certification. As smallholders typically join certification schemes through farmer groups, it would not be possible to randomize in that case at the individual level. Moreover, if certification schemes were to work within villages, a concern would be that non-participants could sell crops to participants, to sell on at higher prices as "certified." As a result, the offer of joining certification schemes would need to be done at a farmer group or village level (if farmer groups exist), and a relatively large sample would be necessary for a cluster randomized control trial (e.g. Glennerster & Takavarasha, 2013) to be able to attempt to demonstrate impacts on those outcomes.

Just deciding how to expose farmers to certification is part of the problem. Consider a farmer group that is offered some type of certification program. The farmers would have to agree to comply with any requirements of the certification and might require training for that compliance to occur. Some farmers might decide not to participate, or some groups might decide not to participate. In either case, a problem would be that we might expect somewhat low compliance in the certification group, which would imply an even larger sample would need to be used to find expected impacts, especially on-farm income, which can be particularly noisy. Moreover, the effects of certification alone can be bundled in with the effects of training, for example, and it becomes difficult to ascertain which factor is most important in affecting outcomes like farm revenues and income.

Perhaps not surprisingly, then, much if not all the evidence on the impacts of certification in Africa come from non-randomized trials, either through the use of difference-in-difference methods, matching methods, or a combination thereof. As a result, we should read these results with some healthy skepticism due to the risk of selection bias. If using matching, for example, the farmers participating in certification schemes may not be comparable to those in control groups used for evaluation

in terms of important unobservables. Moreover, if farmers drop out of groups that are participating in certification schemes, the same type of dropout would not have occurred in the control group; resulting estimates of income effects, for example, would then be biased upward. These issues are quite similar to the ones discussed earlier, when we talked about evaluating the impact of participating in contract farming.

A final issue is that this literature concentrates on sustainability type standards rather than quality standards—which are rare, for reasons discussed above. There are several systematic reviews on the impacts of certification, looking at sustainability type standards. For example, DeFries et al. (2017) focus on impacts of voluntary standards on growers of commodity crops; they find the majority of standards increased revenues, but less than a quarter increased income. Their review mostly turned up papers on coffee standards. A further literature review and meta-analysis was conducted by Oya et al. (2018); they find that most studies of certification schemes have been conducted in Latin America, though Africa had the second most. In their meta-analysis, they find an increase in prices received and income from selling certified products, but again they do not find an increase in overall household income. Meemken (2020) also conducts a systematic review of and a meta-analysis of the global literature on sustainability standards, and finds that it increases household incomes of participating farmers by 16–22%. She finds farmers receive prices that are 20–30% higher for their products, suggesting that many farmers can overcome increased costs to producing under those standards. However, she also finds the returns are quite heterogenous, so some portion of farmers experience negative returns to following sustainability standards. As a result, there is a clear selection in terms of which farmers can follow the standards profitably and which ones do not.

A few other papers on sustainability standards in Africa are worth further discussion. Kleemann et al. (2014) study organic and Global GAP standards for pineapple farming in Ghana, and find a larger return on investment in organic farming (to a standard). Similarly, Akoyi and Maertens (2018) study the triple UTZ-Rainforest Allieance-4C certification against a Fair Trade-Organic certification among Ugandan coffee farmers; they find the former increases incomes while the latter does not. Others find little impact; for example, Minten et al. (2018) study coffee farming in Ethiopia, and examine Fairtrade and organic certifications as having the highest premia; they find that farmer income would increase by a maximum of $22/year; they note that since other standards have

lower premia, most such standards with only have small effects on farmer incomes. Van Rijsbergen et al. (2016) study a small panel sample of coffee farmers in Kenya, and find a small income effect, but most importantly they find a further constraint; impacts are limited because of what they call "over-certification"; farmers produced more certified product than the value chain could handle, and so some of the product following standards was sold on regular markets.

Some papers have gone beyond studying the impacts of certification on household incomes. First, Meemken et al. (2019) study the impacts of Fairtrade certification on wages earned by agricultural workers. They find certification helps workers employed cooperatives in the cocoa sector in Cote D'Ivoire receive higher wages, but does not help workers on individual farms, in part because monitoring is costly, and therefore easier to do within cooperatives than on individual farms. Second, Meemken and Qaim (2018) use gender-disaggregated data, at least at the household head level, to suggest that participation in certification standards tends to lead to increased wealth among both male and female-headed households. Participation also leads to more jointly owned assets among male-headed households relative to non-participants.

In sum, there is hardly any literature on the impact of product quality certification, and the literature on sustainability certifications suggests that there may be positive impacts on the income from those products. However, there is substantial heterogeneity in returns, and even participating farmers may lack the assurance their products can be sold on those markets. There is no evidence on impacts on poverty; it could be that relatively poor farmers cannot invest enough to participate in standards, or bear costs associated with them. Finally, there may be some relatively positive intrahousehold distributional impacts of participation in these types of certification, with women gaining more control over household assets.

6.3.1 Vertical Integration and Outcomes

There have been several efforts set up to vertically integrate farms for certified products for export markets in Africa, such as cut flowers and vegetables (Swinnen & Kuijpers, 2020). Countries with clearly vertically integrated farms explicitly managed for export markets include Senegal, Kenya, and Ethiopia. When these farms grow labor-intensive crops, they can employ relatively large numbers of people. Vegetable and cut flower

production and harvests are often labor intensive; the Ethiopian horticulture industry employs nearly 200,000 people. In Senegal, Van den Broeck et al. (2017) provide suggestive evidence that employment generated by large farms targeting exports had substantially positive effects on incomes and poverty status among the poor. Moreover, these enterprises tend to hire women (Maertens & Swinnen, 2012), and the additional control of household income among women can lead to better household outcomes as well as improved outcomes for women themselves (e.g. Doss, 2013).

6.4 Summary

In this chapter, we have examined what conditions are necessary for separate value chains to develop that signal higher (or specific) quality products. For many agricultural products, the incentives for smallholders and traders alike tend to push toward markets that do not reward quality with higher prices, and perhaps not surprisingly as a result the vast majority of products in African agriculture end up being sold in those markets. A few value chains that are specifically export-oriented tend to be certified by one standard or another (e.g. coffee, cocoa), but even though standards might exist for other crops they tend not to be used much. The transaction costs to expanding their use are simply too high to overcome, particularly for smallholders.

A question is whether certification could be encouraged in another way through policy, assuming that there is an additional social value to higher quality production.[7] It is not clear that government standards would enhance incentives. After all, for government standards to change behavior, both farmers and traders would need to trust government actors in this context. If left to the private sector, the markets for higher quality grains are likely to be captured by larger farmers, since it is easier to overcome fixed costs and adhering to such standards leads to higher profits for them. Governments could try to find ways to reduce the cost of third-party certification. A potentially positive role to play would be in trying to drive down costs of specific tests (moisture, aflatoxins, etc.) through research and development.

[7] One way that additional quality might lead to higher social value, here through additional returns to farmers and traders, is that the types of processes that farmers would need to follow to increase production quality may also increase yields; hence, they would produce more, leading to higher total value of trade.

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CHAPTER 7

Storage and Post-harvest Losses

7.1 Introduction

The storage of food after it is produced and the post-harvest losses that eventuate are inextricably linked. If food is not properly stored by the farmer or as it makes its way through value chains to retail outlets, then it can be attacked by pests, rot, spill, or otherwise lose value. Effective storage is therefore one method of reducing post-harvest losses. And these concepts are inherently interesting from the agricultural value chain perspective; if smallholders lack effective storage, they may both face post-harvest losses or they may have to sell crops when they are most abundant (and local prices at their lowest).

Yet both storage and post-harvest losses are interesting topics on their own. Storage, particularly for staple crops, is necessary to ensure enough calories can be consumed throughout the year. As a result, it is a key consideration in grain policy for many African countries. Furthermore, prices can vary widely during a year, and storage can be used for temporal arbitrage—storing grain when prices are low and selling it when prices are higher.[1] Moreover, done properly, storage can create additional value

[1] Throughout the chapter, we largely limit our discussion to food crops, rather than discussing storable non-food crops such as cotton and tobacco.

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for staples, since public storage facilities can offer receipts which may be used as collateral for loans. Issues related to storage differ somewhat when related to perishables, such as fruits, vegetables, animal source foods, and seafood. We cover these at the end of the section on storage.

Until recently, very little was known about the magnitude of post-harvest losses. By post-harvest losses, we mean losses that take place after the crop is harvested, and does not include production that is lost due to pests and/or diseases while the crop is growing in the field. Post-harvest losses can be a result of poor storage, though they need not always be. After discussing storage, we discuss post-harvest losses by initially focusing on their measurement, since solutions to post-harvest losses will depend upon the magnitude and the point along the value chain at which losses occur. Second, we talk about potential interventions that can be designed to address those losses. Again, we discuss perishable crops separately from non-perishables, as interventions may differ.

We conclude the chapter by turning back to storage, both as a potential way to reduce post-harvest losses, but also in terms of its potential to improve outcomes.

7.2 Food Storage in Africa

A set of basic facts can inform our discussion of food storage. First, it is worthwhile to differentiate three levels of potential storage—at the household, community, and regional or national level. Agricultural products can be stored at the household level privately, they can be stored at the community level in community warehouses or storage facilities, or they can be stored more regionally in larger warehouses. As storage gets more organized beyond the farm, the ownership of stored crops becomes the basis for exchange, rather than the physical crops themselves. The ability to trade stored crops, or the promise of delivery, adds value through the potential creation of additional markets, including futures markets. Therefore, even improved forms of private storage can be thought of as inefficient relative to other forms of storage.[2] We return to this idea later in the chapter.

Second, staple crop production is typically rainfed in Africa, which implies that without storage, there is a time when staples are abundant

[2] Farmers may not have access to the best technologies for private storage either, so they may face higher losses when storing privately.

(directly after harvest) and there is a time when staples are relatively scarce. If food could be perfectly moved across space to deal with shortages (or imported in the aggregate), prices for major grains should reflect relative global scarcity at any given point in time. If grains can also be stored with minimal losses, then there should not be global seasonal patterns to prices. Traders would use both spatial and temporal arbitrage to move grains to places where or times at which prices are higher. On the other hand, in places where transporting grains is costly and storage is imperfect, then prices will be low right after harvest, and high just before harvest.

On average, this pattern indeed shows up in price data from markets in Africa (Fig. 7.1). We use white maize retail price data from 42 markets in Chad, Nigeria, Somalia, and Zimbabwe, collected monthly between 2005 and 2017. We deflate the data using country specific deflators, and normalize the month after the start of the harvest(s) to 100 in each country (month one, on the left). Prices decrease, on average, to roughly 95% of that price, and ramp up to a level that is on average 15%

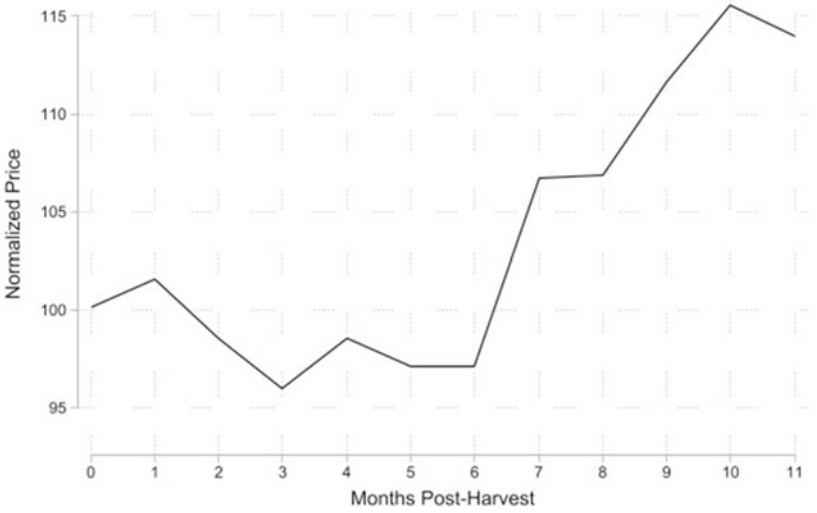

Fig. 7.1 Monthly price patterns from the month of primary harvest, selected African markets, 2005–2017

higher in the last months prior to harvest.[3] Such price volatility creates strong incentives for (private) storage, which in theory should smooth prices. Farmers have incentives to store excess produce to sell when prices recover. As a result of withholding current supply, market prices should go up immediately. This is apparently not what happens.

Two questions result from this pattern. First, why do farmers not store excess product to sell when prices are higher? Second, in the absence of on-farm storage, why traders do not buy up crops at harvest to sell later? If traders did so efficiently, then prices should not vary as much systematically over time, as traders would simply buy or release products until price differentials disappear. Alternatively, one might wonder why as prices rise crops do not come in from other nearby markets; e.g. if the prices are systematically higher in Kigali at one time of the year than in Kampala, one would expect traders to buy crops in Kampala and sell them in Kigali.

From a farmers perspective, there are two potential reasons why he or she might not store excess products with the expectation prices will rise. First, they may face credit constraints that imply they cannot borrow against their production. Relatedly, they may be liquidity-constrained; if households depend upon grain sales for much of their income, and have no access to credit, they may simply need to sell grain to pay for basic goods they cannot produce once a source of cash becomes available (and to repay any outstanding loans). Relatedly, they may engage in relational contracting to obtain inputs at the beginning of the production season, and pay back the loan through a portion of the harvest when it occurs. Second, they may lack access to effective storage; the post-harvest losses they might expect to face by storing grain (through pests or potentially rot) might mean it is profitable to sell immediately. We cover the second case more thoroughly in the section on losses.

In the first case, there is strong evidence that credit constraints hinder farmers immediately after harvest. A recent randomized trial in Kenya shows there could be returns to increased storage (Burke et al., 2019). The authors offer loans to randomly selected households at harvest and further randomize the intensity of loan offers made at the village level. Participating farmers realize a 29% return on investment. They further use the density of offers to show the credit intervention reduces seasonal

[3] The data used are from FEWSNET (2021), and we use the FAO harvest calendar.

price fluctuations in villages with more loans. Therefore, there is both a potential and social return to additional credit, but that private return is shaped by local market conditions.

While on average storage has positive returns, those returns may be quite variable. Evidence suggests the expected seasonal price fluctuations do not always occur. Cardell and Michelson (2020) compile data from 787 markets in Africa over 20 years and show that the peak price prior to harvest does not exceed the harvest season price more than one quarter of the time. In other words, the loans studied by Burke et al. (2019) actually carried hidden risk; in the absence of an experimental pilot project, farmers or traders might not have wanted to take on that risk for fear of losses. Unexpected policy interventions can also affect the returns to storage. Channa et al. (2018) found negligible returns to an improved storage product, as the government placed an export ban on maize during the experiment, and prices fell after the ban. It is worth recognizing that storage is yet another risky endeavor the African smallholder might have to consider, even if it pays off on average.

An alternative way for markets to clear is through spatial arbitrage. If prices are low in a first market, so long as transaction costs are low enough, traders will buy the good and sell it in the second market where prices are higher. Quite simply, we can write that trade will occur between two markets a and b until $|p_a - p_b| \leq t$, where t represents the transaction cost per-unit good—mainly transport cost associated with carrying food from one place to another.

This simple model can help us think about ways that prices should equilibrate between markets by thinking about how transaction costs may differ. First, if there are economies of scale to moving agricultural products between two markets, then the unit transaction costs decline. As a result, prices become more similar between the two markets. Second, if roads are particularly bad, then transaction costs will be higher; similarly, if the cost of crossing borders is high due to administrative costs (or the cost of avoiding administrative costs), then transaction costs will also be higher. Third, if information flows between markets are bad, then prices may be quite different; improving those information flows can make prices equilibrate between markets.[4]

[4] See Jensen (2007) for an excellent example of this principle applied to Indian fisheries; as cell phone towers were erected, fishermen could learn prices between markets as they came to shore and prices between markets equilibrated.

In a related point, since markets are interconnected, even remote grain markets are exposed to national and even international markets. Figure 7.2 shows maize prices in three remote markets in Zambézia, Mozambique, along with the city of Quelimane, between 2006 and 2008, which covers the period of a rapid increase in world maize prices through 2007 and 2008, and then a fall in 2008 as the world fell into recession following the near collapse of the world financial system. Prices in these four markets relatively closely track the world price—they increase more rapidly in the remote markets in early 2008, but that corresponds to the growing period in Zambézia, as does the decrease in April–May 2008 (harvest) in all four markets. But prices quickly rise again, before falling a bit after the world prices collapse. This graph represents suggestive evidence that even remote markets in Africa are affected by changes in world prices.

Nevertheless, the above discussion and Fig. 7.1 suggest that prices often exhibit a seasonal pattern consistent with suboptimal storage, and even remote markets can reflect large changes in world prices. As a result, governments may think of storage and pricing or trade policies in combination with one another. Gouel (2013) considers this question from a policy modeling perspective, examining whether a private storage subsidy

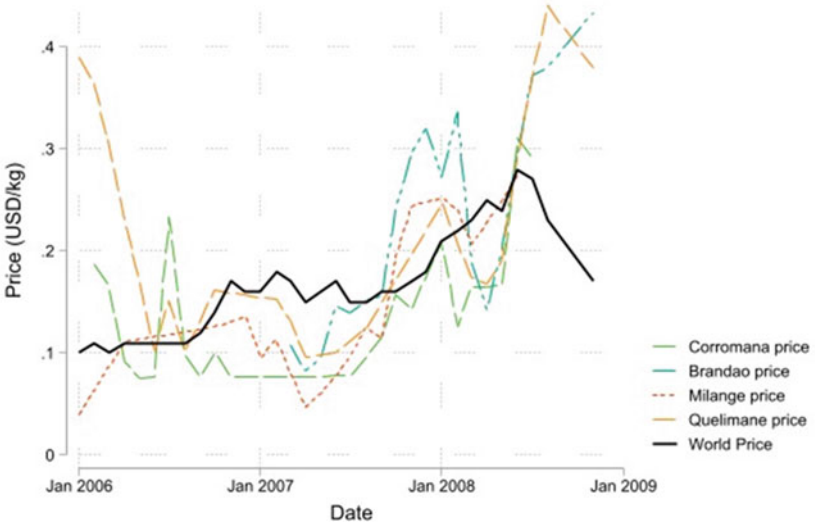

Fig. 7.2 Maize prices in four markets in Zambézia, Mozambique, 2006–2008

or a price band improves welfare more for risk averse consumers lacking access to insurance markets, meant to represent consumers in a developing economy. Building on a model from Williams and Wright (1991), he finds the storage subsidy is better able to improve welfare. In a follow-up paper, Gouel and Jean (2015) find that a combination of domestic storage and trade policies can stabilize domestic prices. The optimal trade policy involves subsidizing imports when availability of staples is low, while taxing exports when local availability and/or world prices are high. They find the policy combination reduces price volatility, but is redistributive from consumers to producers. Moreover, in a multilateral trade sense, export restrictions are discouraged, as they can destabilize agreements (Mitra & Josling, 2009). Gouel and Jean (2015) argue that this internal pressure for export restrictions should be recognized in multilateral trade negotiations.

7.2.1 Storing Perishables

Perishables, including fruits, vegetables, and animal products, can only be stored for very short periods at ambient temperatures without wilting or spoiling. Although many such products can be dried, preserved, or cured, doing so is time consuming and sometimes requires technologies that are not readily available. Drying some agricultural products using technologies often available in rural areas of Africa can in fact cause micronutrient losses (e.g. Bechoff et al., 2009). If perishable food is not dried, then it typically must be kept cold to reduce the rate of spoilage.

In Africa, there is actually very little food that moves through cold chains. Cold storage typically requires reliable electricity, which is often not present in Africa. Cold chains also require refrigerator trucks, which require substantial private investment. So long as the returns to such investments hinge on the reliability of public infrastructure, including roads and electricity, they are somewhat less likely. Moreover, with little demand equilibrium prices for cold chain infrastructure are likely to remain high. Innovations such as using solar power to power cold rooms (e.g. Sadi & Arabkoohsar, 2020) or technologies such as CoolBot (e.g. Dubey & Raman, 2016) can reduce these costs, but they are not widely available in Africa yet.

Returning to our simple model of spatial arbitrage and applying it to perishable products, the transaction costs per unit are substantially higher for perishables than for grains and legumes. As a result, markets are more

likely to be fragmented, and prices may substantially differ between cities, or particularly cities and rural areas. A stark example is when farmers have one or two fruit trees but lack the capacity to sell many of their fruits; they might sell some on the side of the road when they are ripe, and eat what they can, but the rest may rot because transaction costs of getting them to market are too high. Fruit and vegetable production for markets is likely to be concentrated near cities to reduce these price differentials. If improved cold chains were possible, one would expect markets to better equilibrate prices, though other constraints also may come into play.

7.3 Post-Harvest Losses

Since a High Level Panel of Experts (HLPE) meeting in 2010, post-harvest losses have become far more prominent on the development agenda (FAO, 2011). At that meeting, it was estimated that total food loss and waste encompasses 33% of all food produced. According to Delgado et al. (2021a), this estimate was largely derived from the difference between FAO production statistics and food balance sheets. This estimate suggests a compelling argument for the reduction of food loss and waste. By reducing loss and waste more food could be consumed without any pressure to produce more. As food production and distribution both put substantial pressure on the environment, through greenhouse gas emissions, there is also a strong environmental argument for reducing food loss and waste. The argument of reducing greenhouse gas emissions has catalyzed substantial recent research on post-harvest losses and methods to reduce them (e.g. Cattaneo et al., 2021).

Yet it is clear both through UN documents and from academic literature that it is challenging to even define food loss, food waste, or post-harvest losses (e.g. Bellemare et al., 2017; Delgado et al., 2021a; FAO, 2014). The UN now defines "food loss" as unintentional reductions in food quantity or quality before consumption (e.g. FAO, 2014; HLPE, 2014) and "food waste" can be defined as food that is deliberately discarded even though it otherwise could have been consumed (Delgado et al., 2021a). Food waste occurs either at the retail level with food that is unsold before it spoils, or at the consumer level.

Keeping with the theme of value chains in this book, we focus here on post-harvest losses, which slightly differ from food loss. Post-harvest losses include all losses in quality and quantity occurring between harvest and retail of a specific agricultural product. They can be measured

either using macro evidence, meaning that measures look for disappearance between production and consumption estimates, or through micro evidence, based on surveys which can be quite expensive to implement (Delgado et al., 2021a). Almost all writings on the magnitude of post-harvest losses are based on weak evidence (e.g. Affognon et al., 2015).[5] Many estimates do not differentiate between quantity and quality losses (Sheahan & Barrett, 2017). Despite these definitional challenges, the FAO (2019) updated their estimate of post-harvest losses, and now suggests that quality-adjusted post-harvest losses average 14%. However, that estimate still incorporates a substantial number of rough estimates, including those coming from macro evidence or expert consultations within countries.

Indeed, survey-based estimates suggest that post-harvest losses within value chains are relatively small.An early estimate from a household survey came from Kaminski and Christiaensen (2014), who used specific questions in some LSMS surveys to measure post-harvest losses on the farm in Malawi, Tanzania, and Uganda, showing that losses did not exceed 4%. Abdoulaye et al. (2016) conduct estimates on maize in seven countries and grain legumes in six countries, again focusing on the farm before food enters the value chain. They also find losses that vary between a low of 1.3% and a high of 7.3%; it is somewhat unclear how the authors asked about post-harvest losses in their write-up. Bachewe et al. (2020) use questions about storage in two surveys to estimate how loss from storage among over 12,000 households in Ethiopia, among all major grains grown there, and estimate a loss of 1.9% on average. Finally, Chegere et al. (2021) measure post-harvest losses pre-intervention of 12% in maize, in a relatively small sample in the Kilosa district of Tanzania (Table 7.1).

A more rigorous method is developed by IFPRI researchers through the Policies, Institutions, and Markets CGIAR research program (Delgado et al., 2017). The goals of developing this method were to refine estimates of post-harvest losses, to include both quantity and quality losses, and to determine at what point on the value chain losses occur. The result, then would be to help us understand what types of interventions could be cost effective in reducing post-harvest losses, and

[5] In fact, a system called the Africa Post-Harvest Loss Information System (APHLIS) was set up to compile evidence on post-harvest losses in Africa; it also demonstrates that much of the evidence is of poor quality.

Table 7.1 Examples of survey-based measures of post-harvest losses in Africa

Authors (year)	*Method*	*Country*	*Year(s) of estimate*	*Crop*	*Estimate (%)*
Abdoulaye et al. (2016)	Household surveys	Ghana	2015	Maize	6.0
		Benin	2015		6.2
		Burkina Faso	2015		1.9
		Nigeria	2015		4.7
		Ethiopia	2015		4.7
		Uganda	2015		3.7
		Tanzania	2015		6.9
Abdoulaye et al. (2016)	Household surveys	Ghana	2015	Grain legumes	5.7
		Burkina Faso			1.3
		Nigeria			4.9
		Ethiopia			4.1
		Uganda			3.7
		Tanzania			7.3
Kaminski and Christiaensen (2014)	One question, LSMS surveys	Malawi, Tanzania Uganda	2008–2010	Maize	1.9–3.9
Bachewe et al. (2020)	Survey, focus on household storage	Ethiopia	2013 and 2015	All major grains	1.9
Chegere et al. (2021)	Household Surveys	Tanzania	2015	Maize	12

Table 7.2 Examples of more detailed measures of post-harvest losses in Africa, PIM methodology

Authors (year)	*Method*	*Country*	*Year of estimate*	*Crop*	*Estimate (%)*
Delgado et al. (2021b)	PIM	Ethiopia	2016	Teff	6.3–8.9
Ambler et al. (2018)	PIM, only farm	Malawi	2016	Maize	2%
Ambler et al. (2018)	PIM, only farm	Malawi	2016	Soya beans	3
Ambler et al. (2018)	PIM, only farm	Malawi	2016	Peanuts	5
Minten et al. (2021)	Similar to PIM	Ethiopia	2018	Teff	2.2–3.3
Minten et al. (2021)	Similar to PIM	Ethiopia	2018	Pasteurized Milk	3.8–4.3

whether those losses are substantially related to total losses or quality losses. While the PIM method is based on self-reports, it is a rigorous method of measuring post-harvest losses especially relative to the methods described above.

The PIM method, or variants on it, has been used to study post-harvest losses at the farmer, trader, and processor level in seven different countries, including Ethiopia in Africa (Delgado et al., 2021b).[6] They tend to find slightly higher losses than other studies once quality is considered. Post-harvest losses tend to be concentrated on the farm with lower losses once crops enter the value chain. Several papers have estimated losses for various crops in different settings (Table 7.2). Largely following the same method but limited to the farm level in central Malawi, Ambler et al. (2018) show that losses range between 2 and 5% for maize, soybeans, and peanuts. The latter two crops were purchased from farmers by NASFAM, who anecdotally reported quite low quality-adjusted losses after purchase. So their evidence is much in line with the other studies noted above. Minten et al. (2021) use a similar method, studying the tef and pasteurized milk value chains in Ethiopia, and also find low post-harvest losses, between 2.2 and 4.3%.

[6] Here we name it after the Policies, Institutions, and Markets CGIAR Research Program which provided funding for the research.

Box 7.1. Food Losses in Sub-Saharan Africa

Luciana Delgado

In 2019, FAO revised its estimates of food losses, estimating that on average 13.8% of the food produced was lost. In sub-Saharan Africa (SSA), food losses averaged 14% (FAO, 2019). Roots, tubers, and oil-bearing crops report the highest level of loss, followed by fruits and vegetables. The latter is not surprising, given their highly perishable nature. In SSA, the majority of losses among cereals and pulses where at on-farm, post-harvest and at storage, while for fruits and vegetables losses primarily occur on-farm and post-harvest.

Within value chains, most losses occur at the farm level. Recent work studies causes of pre-harvest, harvest, and post-harvest food losses across four crops in four countries (Fig. 7.1). Pre-harvest, farmers most likely report pest infestation, diseases, and drought as causes of losses. Among crops left in the field, the main reasons were a lack of labor, inadequate harvesting techniques, and weather. Finally, at post-harvest, plagues, rodents, and animals, and damage to crops by workers during harvesting or sorting were the major identified causes identified (Fig. 7.3).

A recent study systematically reviewed loss reduction interventions for 22 crops across 57 countries in sub-Saharan Africa (Stathers et al., 2020). It found most interventions relate to storage technologies (79% of the studies). This clearly shows that the other causes of losses have not yet been addressed; there is a clear need for studies of interventions that go beyond storage technologies related to pests and diseases, handling practices, and weather resistant varieties.

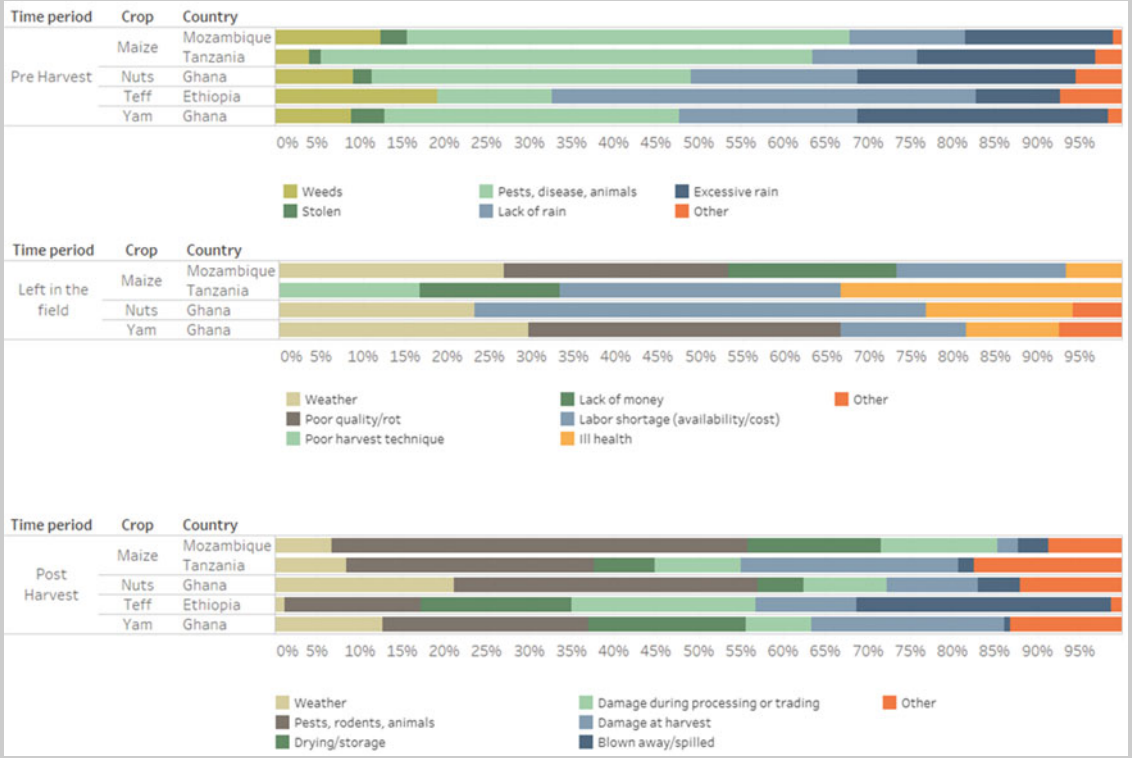

Fig. 7.3 Causes of food losses across the value chain

Although these measurements represent a very small fraction of crop-country combinations that could be of concern in Africa, they suggest a few points that are worthwhile to consider. First, post-harvest losses, particularly for different types of grains, are relatively low. Maybe this should not come as a surprise—smallholder farmers and local traders are generally poor and do their utmost to prevent outcomes that further reduce their income. If one wants to reduce post-harvest losses for those products, it would be important that those solutions are relatively cheap, else they might cost more than the gains, and would not be adopted. Second, we observe that the papers broadly show that the small losses that do occur mainly occur at the farm level, rather than further along the value chain. The implication is that low-cost innovations, targeted at the farm, would be the best way to attempt to reduce what might already be considered low post-harvest losses.

7.3.1 Post-Harvest Losses in Perishables

Note that losses may be higher for fruits and vegetables (Table 7.3). There are painfully few rigorous estimates of post-harvest losses in fruits and vegetables in Africa. Beye and Komarek (2020) study post-harvest losses on-farm in Senegal for onions, tomatoes, and peppers; they find much higher losses than described earlier for grains, of between 28 and 32%. They did break up losses by type (in storage, during transport) in their survey, rather than just asking one question. Gatere et al. (2020) adapt

Table 7.3 Survey-based estimates of post-harvest losses in vegetables

Authors (year)	*Method*	*Country*	*Year of estimate*	*Crop*	*Estimate (%)*
Beye and Komarek (2020)	Survey, on-farm	Senegal	2017	Onions	32.1
Beye and Komarek (2020)	Survey, on-farm	Senegal	2017	Tomatoes	28.6
Beye and Komarek (2020)	Survey, on-farm	Senegal	2017	Peppers	29.8
Gatere et al. (2020)	Similar to PIM	Kenya	2019	Tomatoes	28

the PIM method to find a 28% overall loss through the value chain among tomatoes grown in Laikipia, Kenya. Interestingly, losses are concentrated either at the farm level, or at the retail level. At the farm level, a major reason for losses is uneven ripening of tomatoes on the vine; as a result, when the majority of tomatoes are ripe, some are unripe and some are spoiled, and have to be thrown out. Given what are often large differences in wholesale and retail prices, interventions to reduce retail losses could also have important impacts on vegetable prices. Still, these estimates are at the very least suggestive that more evidence is needed about perishable losses from household and value chain surveys.

7.3.2 Hidden Challenges: Aflatoxins

We discussed aflatoxins as a specific quality challenge in the previous chapter. They can also be a pernicious source of quality problems and therefore post-harvest losses in grains. While proper drying prior to storage can reduce aflatoxin growth in maize, groundnuts, and other susceptible crops, similarly proper grain or crop storage can reduce the probability of contamination through aflatoxins. Therefore relevant to this section are storage interventions that have been piloted and evaluated, in part to see whether the interventions can cost effectively reduce contamination by aflatoxins.

Recall that without costly testing, aflatoxins are unobservable, so theoretically it is unlikely a priori that farmers would demand storage technologies to reduce aflatoxin growth, given their additional cost (Fafchamps et al., 2008). Although Purdue Improved Crop Storage (PICS) bags or hermetic bags can reduce or eliminate the growth of aflatoxins, they are costly relative to normal bags used for grains. As with any technology, hermetic bags are only effective if people know about it and can weigh its benefits against the costs of using it.

Without training, there appears to be little evidence that simply providing hermetic bags to smallholders is sufficient to reduce the growth of aflatoxins. Bauchet et al. (2020) use a randomized control trial in Senegal among maize farmers to distribute training along with a drying technology (a tarp) to one group versus another that received both tarps and a hermetic bag. They find the addition of storage limits aflatoxins levels by 30% relative to the control about 4 months after the bags were distributed. However, Leavens et al. (2021) return to the same villages two years later and find no remaining effects from the hermetic bags.

They surmise that two years later there is a weak supply chain for hermetic bags, so farmers simply cannot replace them. The effect they find is consistent with evidence in Pretari et al. (2019), who use another randomized control trial to study a package offered to Kenyan maize farmers including the option to use a grain drying service and a hermetic bag. They find in their context suggestive evidence the reduction in aflatoxins they find is not due to the hermetic bag, but rather due to the grain drying service.

Instead, drying interventions appear to work better or be more cost effective, and this result appears to hold in several countries and among both maize and groundnuts. Hoffmann and Jones (2018) find plastic tarps distributed randomly to some villages at subsidy would be cost effective at reducing aflatoxins in the maize supply if publicly subsidized. Similarly, Magnan et al. (2021) find that the distribution of plastic tarps are effective at reducing aflatoxins in groundnuts in Ghana, and Leavens et al. (2021) actually find reduced aflatoxins attributable to tarps in Senegal two years after the intervention they study. So while hermetic bags are quite effective at reducing pest contamination and therefore storage or post-harvest losses, they do not appear to also cost effectively reduce aflatoxins. Given that they tend to be quite a bit more costly than normal bags, it is not clear that any of these initiatives have a positive cost–benefit ratio for farmers. As a result, hermetic bags could be considered an example of a donor-driven initiative with little commercial viability among the smallholders they are meant to help.

7.4 How Can Improved Storage Work for the Poor?

A substantial body of research does show that improved private storage can benefit smallholders. There are several ways that households could improve their private storage of food. Improved private storage for grains can include improved silos or alternatively using hermetic bags once crops are appropriately dried. It is important to focus here on the word improved—one only knows the increased value of changing storage technology if we are considering the appropriate counterfactual. Farmers might have sold their entire crop immediately, but they could partially stored crops with an inferior technology or used chemicals on crops to reduce the probability of pest infestation, the latter of which could cause further health problems as the crop is consumed if consumers do not wash the crop before consuming it.

While we are not aware of any randomized trials conducted in Africa around improved silos, Gitonga et al. (2013) use matching methods and find that households in Kenya that adopt metal silos are able to eliminate pest damage and can hold onto their maize for an additional 1.5 to 2 months. There is a bit more rigorous evidence from randomized control trials on the ability to store maize longer using hermetic bags. Omotilewa et al. (2018) show distributing one hermetic bag to farmers in Tanzania extends storage by 3 weeks; Aggarwal et al. (2018) find clubs receiving hermetic bags in Kenya also increases the amount that clubs can store. Brander et al. (2021) tie the distribution of hermetic bags to food insecurity in a randomized trial; they find distribution in Tanzania reduces severe food insecurity among households receiving bags relative to the control group. So by improving their own storage, poor farmers may be able to extend the time they can hold crops, or improve their food security (either by receiving higher prices for their crop, or by having more own food to eat).

The use of hermetic bags can also have further impacts on-farm household outcomes. The aforementioned Omotilewa et al. (2018) found that two seasons after bag distribution, recipient households were 10 percentage points more likely to plant high yielding varieties of maize. Channa et al. (2018) combine the distribution of hermetic bags with credit provision to the same farmers, and find farmers receiving both credit and bags store 29% more maize than the control group; however, they do not find additional storage among a group only receiving hermetic bags. A third paper, Huss et al. (2021), discusses a randomized trial on storage in western Kenya when the COVID-19 pandemic began, along with associated policies to limit its spread. Farmers who received hermetic bags in late 2019 were less likely to experience food insecurity than the control group, according to a text message survey.

So hermetic bags or other improved storage at the farm level can help farmers sell their crops later if they can hold their products for a longer period of time and can potentially have positive impacts on food security. The papers on food security claim the channel is through reduced post-harvest losses, but given the earlier evidence on actual post-harvest losses on average, it is difficult to put much stock in this mechanism. An alternative explanation for this result is that farmers might know they lack the capacity to store their crops safely for a long period of time, so they sell early to eliminate the potential of those losses. It is plausible that farmers

become more resilient to shocks, as Huss et al. (2021) find. Nevertheless, these private storage mechanisms do leave some potential value of crops on the farm, rather than potentially extending it to further markets through warehouse storage.

7.4.1 Warehouse Receipts

Improved availability of warehouse storage in Africa would have a potential benefit beyond just improved storage and lower loss levels. When farmers deliver crops in a warehouse, whether at the community or at a regional level, the crop can potentially be graded and farmers can be given a receipt for that crop. The warehouse receipts then can be used as financial assets. Until the crop is sold, the receipt becomes a financial asset; since there is an "asset" behind the receipt, banks can then consider that asset as collateral (Coulter & Onumah, 2002). Alternatively, farmers could sell the receipt itself. So the difference between warehouse storage and private storage is subtle here, but it is theoretically much easier for a bank to take collateral from a community or regional warehouse than from private storage in the case of a failed loan.

From a smallholder perspective, warehouse credit has been tested in a few randomized trials in sub-Saharan Africa with mixed success. Casaburi et al. (2014) test warehouse credit for palm oil; they find few farmers take up the offer, potentially because good private storage was available and because they mistrust the financial institution (or do not see the need for credit). Delavallade and Godlonton (2020) study an offer to first warehouse crops locally and then cross-randomize credit offers among farmers who take up the offer to warehouse crops; in their case, the financial institution offering credit was better known than in the previous example. They find demand for storage but less demand for credit, and in general find benefits to farmers. Moreover, communal warehouses are relatively well-known and used in French West Africa.

That said, if it is costly to get crops into warehouses, farmers may not be willing to pay those costs given uncertain private benefits. Nindi et al. (2021) conduct a randomized control trial in Malawi in which they offer a hermetic bag to one set of households to store grain legumes, offer the bag and community storage to a second set of households, and a bag plus centralized warehouse storage to a third set of households. All recipient households experience gains in storage after harvest, but the warehouse storage experienced low take-up, in part because of the distance to the

centralized warehouses and the cost associated with getting the grains there. So even though in this case using centralized warehouses that can easily link into the financial system would appear to provide the most value, once real world transaction costs are taken into account, it may not be the optimal outcome for farmers.

7.4.2 Storage and Commodity Exchanges

The existence of some type of warehouse receipts system (whether regional or national) can be thought of as a necessary condition for the development of commodity exchanges. Commodity exchanges are legal entities upon which standardized contracts for crop delivery are traded, and establish a known price for a crop of a specific grade. As warehouse receipts represent actual crops, they can be traded on commodity exchanges, with transfer of receipts also transferring ownership of the warehoused crop. If suppliers can guarantee crop delivery to warehouses in the future, futures markets can develop, which represents the ability to buy or sell crops that might only be delivered several months in the future, after harvest. The purchase of futures can act as a hedge against positive price shocks, whereas the sale of futures at specific prices (or options on those futures) can help insure against negative price shocks. In places where commodity exchanges exist, in effect anyone can find out the price of a crop on that market and that price establishes a price band for trading that crop at the same quality level in more distant markets, based on the transaction costs of getting the crop to a warehouse associated with the commodity exchange.

Commodity exchanges exist in several countries in sub-Saharan Africa and have even existed regionally in East and Southern Africa. However, the exchanges do not appear to be as successful in providing the benefits noted above as one might hope (e.g. Thunde & Baulch, 2020). Volumes traded on exchanges have tended to be thin, so market manipulation remains a concern (Sitko & Jayne, 2012). Exchanges, in fact, are not generally developing enough trading to become self-sufficient through the small trading fees charged, implying they either need national government or international donor subsidies to continue to conduct businesses (e.g. Baulch et al, 2018). Unfortunately, without substantial volume, the advantage of price formulation through centralized markets is weak, and as a result the advantage of selling crops through these markets for smaller farmers becomes questionable.

One exchange that has had relatively high and consistent volume, at least for sesame and coffee, has been the Ethiopia Commodity Exchange (ECX). The ECX was established in 2008 with support from international donors, and was successful at communicating its initial success at generating trade volume (Gebre-Madhin, 2012; Hernandez et al., 2017). However, the establishment of the ECX was accompanied by mandated changes in specific commodity markets (Hernandez et al., 2017), and such mandates likely acted to make what had been informal contracts more formalized. For example, coffee farmers were required to sell their coffee through specific depots, and only certified buyers can then purchase those crops. By running the entire market through the exchange, it is not immediately clear whether the exchange itself or the rules around marketing affect prices received by producers. Hernandez et al. (2017), in fact, conclude it is largely factors other than the ECX affecting price determination in the coffee market in Ethiopia.

Consistent with the reasoning in Chapter 3, Meijerink et al. (2014) suggest that relational contracting in heretofore informal Ethiopian sesame markets has been affected by the introduction of the Ethiopian Commodity Exchange (ECX). Some "crowding out" of informal arrangements has taken place. Traders have broadened their trading network, rely more frequently on farmers with whom they do not have social relations, and provide less credit to farmers. They also have lower levels of trust in the intentions and capabilities of their trading partners, and attach less weight to trust.

However, it appears as if the expansion of commodity exchanges was too rapid. If a system of warehouse receipts were to precede it, and farmers could build up trust and potentially see use value in it (so long as transport costs were not too high), the development of commodity exchanges might follow. These systems, of course, take time to build up and might follow naturally from the value chain development process; as value chains become transitional, so long as economies continue to grow, there is pressure for them to become more complex, and that complexity might then naturally lead toward successful commodity exchanges.

7.5 Conclusion

From several perspectives, there are potentially high returns to improved grain storage in Africa, both in terms of income and food security, as the data suggest prices for grain products follow seasonal availability

patterns. There are potential additional benefits to increased commodity storage with warehouse receipts systems, but it is important to realize such systems might not help increase storage (or exchange) unless farmers are able to overcome the costs of participating in such storage. The cost of new types of storage, however, might be prohibitive.

Storage can also help reduce post-harvest losses; however, most estimates for grains and grain legumes in Africa suggest that post-harvest losses are already fairly low, and they concentrated on the farm. Therefore, technologies that would be employed to reduce post-harvest losses in grains or grain legumes would have to be cheap for them to be used by farmers. Theoretically, there is a parallel to quality control as discussed in the previous chapter; without an obvious and not very risky return to farmers, they will not adopt out of self-interest. Further, the yield gap is larger in most places than the magnitude of post-harvest losses; addressing the yield gap might have a larger impact on food availability than trying to reduce post-harvest losses for the same amount of money, especially if interventions are effective.

On the other hand, the scarce literature that exists suggests there are large post-harvest losses in fruits and/or vegetables, which appear to be concentrated on the farm or at the retail level. There could be large returns to developing cold chains into even smaller urban areas, where incomes tend to support higher fruit and vegetable consumption. As innovations are taking place in that space, they could potentially be used with new technologies to link producers to retailers in need. However, to ensure new fruit and/or vegetable farmers can see the benefits before participating, contracts with buyers, extension to teach growing techniques, or both may be needed to ensure returns to such investments can be realized.

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CHAPTER 8

Silver Bullets?

African agri-food value chains are diverse, their "type" ranging from formalized export chains for high-value commodities to informal and short food chains supported by small-scale production of low-quality output. As we have described in the previous chapters, there are several reasons why smallholder transaction costs, on a per-unit basis, are relatively high. These costs limit the adoption of market-mediated solutions. If transacting involves fixed costs, small volumes imply high per-unit trading costs—potentially so high that farmers or traders cannot profitably engage in exchange. As a result, many farmers do not invest in modern inputs, and cannot hire or sell labor. The informal arrangements that spring up to substitute for markets can be clever and helpful, but ultimately remain what economists call "second best" solutions.

Over the years, several solutions have been proposed to transform informal value chains into formal ones, connecting farmers to traders or markets that value high-quality output. Some of these solutions address the challenge of high transaction costs directly—for example by increasing the scale of production, or by joining farmers in collectives that pursue joint interests. Other solutions are based on the premise that (transaction) costs can be reduced through improved coordination, or through elaborate subsidy schemes. In this chapter we introduce and critically discuss

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several solutions that have either attracted a lot of traction in policy circles, or that have emerged as the private sector's response to perceived problems. While each solution has a certain appeal, they also tend to be subject to a great deal of exaggeration and hyperbole. We argue that none of them will have transformative power when applied in isolation.

8.1 Foreign Direct Investment and Farm Consolidation

We have documented that land fragmentation and more generally limited land holdings, quite present in many African countries, limit potential farm income. Since smallholders did not choose to be farmers, the argument goes as follows. If better farmers could "buy out" poorer and more disinterested farmers, then yield gaps would be reduced and these larger farms would reduce transaction costs in organizing production and processing (e.g. Christiaensen & Vandercasteelen, 2019). If we want to take this argument to an extreme, one could consider consolidating land into megafarms, as found in the Brazilian *cerrado* or the plains of Ukraine and much of the rest of Eastern Europe, where megafarms are typically defined as farms of 50,000 hectares or more.

A potential advantage of megafarms is that they might be better able to invest in processing capability than clusters of small farms, allowing them to become vertically integrated. Governments might hope they become important sources of employment for the rural poor. Assuming labor-intensive production dominated these farms, they could potentially employ more people than smallholder farmers, and as a result they could lead to reduced poverty. By internalizing all the economic externalities related to aggregation within value chains, these hypothetical, integrated companies could become important, welfare-enhancing entities for countries attracting the investment. Further, to the extent they exist, these large farms can also reap returns to scale.

At the beginning of the 2010s, there appeared to be some movement toward megafarms in Africa. Deininger et al. (2011) report that after the commodity price spike that occurred in 2008, interest in African land also spiked. Of 56 million hectares that foreign investors considered for investment, 29 million were in Africa. Countries such as Mozambique and Ethiopia struck several deals with local and foreign investors to create large farms, and other countries (Zambia and Sudan) have land that is both suitable for agriculture and relatively uncultivated.

Some experts are worried that customary systems enable large-scale "land grabs." The leases for large land tracts discussed by Deininger and Byerlee (2012) were not bid competitively but negotiated with leaders––offering substantial scope for corruption (Collier & Dercon, 2014). Indeed, there are examples of outright land grabbing, where the land was managed by smallholders who were displaced without due compensation, or where the compensation was provided in such a way that it never reached the intended beneficiaries (e.g. payments were made to local leaders who were supposed to take care of the local redistribution). However, customary systems are less "legible" to outsiders than conventional ones based on private property rights. This creates a complex trade-off for foreign investors—while land may be cheap under customary rights, the transaction costs (including enforcement of agreements) may be very high.

Christensen et al. (2021) study a natural experiment in Liberia where parallel private and customary property rights systems co-exist according to Liberian Law: the County Area with Western-style privately owned land titles along the coast and the "hinterland" governed by customary law elsewhere. Exploiting this institutional boundary, they find a larger increase in land clearing where private property rights prevailed, with such clearing related to more concession activity. Most foreign investors prefer to engage with transparent private property systems rather than opaque customary tenure systems, attenuating some of the fears of land grabbing.

However, some problems, or at least dilemmas, remain. First, such large farms would almost certainly have monopsony power over input purchases and some market power in output sales, which would present a distortion relative to smallholder (or even smaller farm) production (Collier & Dercon, 2014). Monopsony power in the labor market would mean lower wages at least locally, which could potentially both reduce already difficult to monitor effort, and potential welfare effects. (On the other hand, as argued elsewhere in the book, monopsony power has some advantages in informal transacting, as it enables more extensive relational contracting and investment.) Another form of market failure concerns the risk that megafarms likely do not internalize environmental costs; this problem has been particularly apparent in OECD countries where expansive livestock operations often generate substantial pollution.

Even without these problems, Ma et al. (2021) model a transition from staple production conducted by small to larger farms, assuming that small farms face credit constraints, but their labor is modestly more productive

than labor on large farms (due to monitoring problems). They find total welfare increases, but it shifts from rural to urban households through lower prices; meanwhile, there are no clear positive impacts on labor use. These findings are relatively consistent with further evidence about land deals for large land tracts. In Mozambique, Deininger and Xia (2016) find some positive spillovers on input use near larger farms, as well as some employment, but they find that farmers living near large farms actually perceive themselves as worse off after the farms began operation. Ali et al. (2019) find no evidence of additional job creation among rural households near large farms in Ethiopia.

Finally, it is not clear that so many of the deals announced soon after the commodity price boom faded came to fruition. Many of these "deals" stayed in the planning stage, and potential investors may have decided not to invest after a due diligence period (Deininger et al., 2011). According to the Land Matrix, of the 465 total land deals that were negotiated after 2008 in Africa, only 246 of them are in operation. Of land deals greater than 50,000 hectares, only 37 are in operation. And of those, more than half are related to forestry.[1] Finally, a study by Khadjavi et al. (2021) suggests that even when larger amounts of land were contracted in Zambia, companies may be using a small fraction of the land they could use. As a result, the largest boom in the potential creation of megafarms only ended up creating a handful of megafarms in Africa.

None of this argument is to say there is not a role for medium size or larger farms in African agriculture and value chains, as argued by Collier and Dercon (2014) and Christaensen and Vandercasteelen (2019). Rather, it is to say that if governments do make deals with foreign investors, it is important to ensure that they are competitively bid in a transparent process, they do not impinge on the rights of smallholders, and that potential environmental costs are internalized.

8.2 Input Subsidy Programs

Since the early 2000s, several African governments have set up extensive programs to subsidize improved inputs for smallholders (so-called input subsidy programs, or ISPs). From a farming perspective, the impetus behind providing these subsidies was that it would help smallholders

[1] Data is from the Land Matrix (www.landmatrix.org). Many of the forestry investments are in the Democratic Republic of Congo.

bridge the yield gap; e.g., it would make them more productive per unit of land. As a consequence of higher productivity, smallholder farmers would have higher incomes.

There are several reasons that fertilizer and improved seed subsidies re-emerged as a key component of agricultural policy in several African countries, but perhaps the most salient was a promising example set by Malawi. After a particularly poor harvest in 2005, Malawi's government implemented the Fertilizer Input Subsidy Programme (FISP), which distributed fertilizer and maize seed coupons to targeted farmers. The FISP claimed quite positive immediate results; the harvest in 2005, of just over 1 million MT, was followed by bumper crops of maize in 2006 and 2007 (over 3 million MT), after FISP was introduced (e.g. Denning et al., 2009). The Alliance for a Green Revolution in Africa (AGRA) reported that Malawi was "a model of success showing the rest of the African governments the way towards a sustainable version of the African green revolution" (Alliance for a Green Revolution in Africa (AGRA), 2009).

The apparent success of FISP in Malawi was followed by nine further African governments starting similar input subsidy programs, some of which are universal and some of which are targeted, meaning targeted toward "the poor."[2] According to Jayne et al. (2018), between $600 million and $1 billion are spent by African governments each year subsidizing inputs, largely fertilizer. These ISPs can be thought of as a second wave of input subsidy programs in Africa, following the strong involvement of parastatals in the economies prior to restructuring that took place in the 1990s (Kherallah et al., 2002). Rather than cornering the market and hindering the development of a private sector, the new round of subsidies was designed to work through the private sector. So called "smart subsidies" also were meant to target farmers who could find it profitable to use more fertilizer and promoting competition, rather than hindering input market development (Jayne & Rashid, 2013).

From the perspective of this book, there are a few reasons why we might be interested in ISPs. First, if production really does increase as a result of subsidies, then value chains are necessary to distribute the

[2] These countries include Zambia, Kenya, Tanzania, Nigeria, Ghana, Senegal, Burkina Faso, Mali, and Ethiopia. Ethiopia does not consider its program an input subsidy program, but it subsidizes the operation of farmer organizations and then provides them with fertilizer below the market price in neighboring countries.

additional production. In fact, an indirect consequence could be further evolution of value chains for staples; for example, from traditional to transitional. Second, if smallholder incomes increase, they could also lead to further demand from other value chains; if not, then one might call into question why subsidies persist, since costs are clearly so high. Third, it is important to understand why these programs have continued to flourish, since in the countries that have ISPs, they command a substantial proportion of the agriculture budget, and they crowd out other programs that could presumably also provide help to smallholders.

For production to increase, the additional fertilizer being applied to crops must increase production, which could occur either through increases in yields or increases in land area sown in targeted crops (usually maize). As discussed in Jayne et al. (2018), yield responses for fertilizer are much higher and less variable when land is irrigated; in Africa, little irrigation exists. Nonetheless, ISPs are generally associated with positive effects on yields, but those effects are attenuated by poor or degraded soils. For example, Burke et al. (2017) show that average fertilizer response rates depend upon soil acidity in Zambia; fertilizer has less of a yield impact when soils are quite acidic. Soil organic matter and sandy soils can also reduce yield impacts, both of which are present in countries with ISPs (e.g. Marenya & Barrett, 2009; Joint Research Centre (European Commission) et al., 2013). Finally, the timing of fertilizer application affects the yield response; if fertilizer is delivered too late, then it will not have the same impact. Some ISPs have had trouble delivering fertilizer on time into areas in need, again reducing potential impacts (e.g. Namonje-Kapembwa et al., 2015). And ISPs almost certainly crowd out some market fertilizer purchases, further reducing their impacts on total use (Jayne et al., 2013). Finally, even if farmers do use more fertilizer as a result of an ISP, if it is not obviously profitable they might not use as much again. In fact, Beaman et al. (2013) find these other factors matter more for profitability than fertilizer use, making it difficult to ascertain fertilizer profitability. And given market fertilizer purchases are reduced, there are further negative impacts on fertilizer dealers, who experience lower sales. So whereas there is evidence in the literature of yield increases as a consequence of ISPs, those increases are not always as large as expected, and may be short lived if ISPs were to be removed.

The other way that production could increase is through area expansion. Studies exist related to the Malawi, Kenya, and Zambia ISPs; in Kenya, there appears to be no change in area planted (Mason et al.,

2017), whereas in land abundant Zambia, there does appear to be maize expansion (e.g. Mason et al., 2013). In Malawi, there may have been an intensification of maize into smaller area shares, though not large enough to nullify yield increases (Chibwana et al., 2012). So in general, we can conclude that there do appear to be production impacts, but they are not as large as one might expect.

Even without considering general equilibrium effects, the (private) income benefits to ISPs appear to be relatively low, and there are opportunity costs to running ISPs, as they preclude other investments that could be made with public money. Yet they continue to be supported by governments, although at times programs have been scaled back due to a lack of resources (Jayne et al., 2018). Political economy forces likely continue to make these programs popular. First, several programs are targeted through community leaders; evidence from Malawi, Tanzania, Nigeria, and Zambia all suggest there is at least some elite capture, as social or familial linkages to leaders lead to higher probabilities of receiving subsidy vouchers. Second, given the success of President Bingu wa Mutharika in the 2009 Malawi election following the introduction of FISP and immediate maize surpluses, there may be a perception among elected office holders that maintaining ISPs is good for them electorally, and reducing them would be politically harmful. So there is at least a perception that ISPs are good politically; unless that perception were to change, it is more likely that such programs might be reformed than discontinued.

Given that in some form ISPs are likely to continue, a remaining question is what these programs can mean for value chain development. It is worth considering this question from two perspectives; from the perspective of current programs, and from the perspective of ways that ISPs can be reformed. The first is relatively simple, even though one might be concerned that ISPs could lead to substantial surplus in value chains at least in the first year that cannot work through the system. Only Sibande et al. (2017) have studied the marketed surplus from an ISP, finding that Malawian farmers indeed increased their marketed surplus as a result of FISP participation. Since in general price effects of ISPs have been limited (Jayne & Rashid, 2013; Jayne et al., 2018), they do not seem to have affected value chains for maize very much; as the countries that have been studied most carefully (Malawi, Zambia, Tanzania, Kenya) all consider maize as the primary staple, this finding may reflect infrastructure that

already existed for maize storage. Had there not been such infrastructure available, then maize prices may have dropped due to ISPs, further affecting returns.

Second, we might think about how ISP evolution could potentially evolve in the future, given that they are unlikely to go away politically. An option discussed by Jayne et al. (2018) would be to improve targeting through, for example, a proxy means test. Proxy means tests, though, are expensive to administer. And as Brown et al. (2018) show, proxy means tests also tend to exclude a substantial proportion of the poor, just as community leader targeting does. They suggest using either a simple demographic scorecard, which could be collected via listing, or a basic income grant, which would drop the subsidies and simply provide a cash grant to everyone.

A basic income grant would likely be perceived as a politically popular replacement of an ISP. A challenge is that it would shift political power within government, since the Ministry of Agriculture would typically administer the ISP, whereas a different Ministry would almost certainly administer a basic income grant. Jayne et al. (2018) instead suggest adjusting subsidies by agroecology or making them more flexible; for example, to subsidize purchases of lime where soils are acidic as well as fertilizer. However, such conditionalities would add complexity to programs, increasing transaction costs to getting out subsidies. On the other hand, if some type of basic income grant was used as a replacement, then it would be important to also consider how those changes might affect production, so that adequate storage or capacity was available within value chains to deal with it.

8.3 Innovation Platforms

The traditional innovation approach in agriculture is based on a linear model with three distinct phases where each actor has its own specific role: research-extension-farmer uptake. Researchers focus on creating new solutions to relax (technological) production constraints, extension experts transfer these innovations to smallholders, who either adopt or reject them. Since the late 1980s innovation experts have questioned the underlying assumptions of this model. It was argued that meaningful change can only occur in networks, when multiple actors

change their behavior simultaneously. Moreover, most innovations are not simply adopted and implemented. If smallholders adopt, they typically also adapt—adjusting innovations to fit local preferences and constraints. Often farmers experiment with innovations on their own plots, to find out which modifications work best.

Knowledge is not always handed down through a vertical chain, but it tends to be co-created by multiple actors. In response to this insight, the supply-push innovation model was replaced by agricultural innovation system (AIS) thinking—probably more in theory than in practice. Multiple actors are encouraged to work together in a complex system with multiple feedback loops to generate, diffuse and use knowledge. The AIS approach emphasizes that innovations are not merely a technical matter—valuable innovations typically combine technological elements with institutional and organizational advances. For example, after providing farmers with improved seed, their production relationships with other input suppliers and output traders will likely change. Farmers may also start demanding insurance, improved infrastructure, and storage, or supporting policies.

AIS thinking has produced a novel approach to promote agricultural development which has gained a lot of traction in policy and research circles—the so-called innovation platform (IP). IPs are institutional innovations in themselves, and are spaces for communication, learning, and negotiation. Typically organized around a specific commodity or value chains, IPs try to bring together the relevant stakeholders with their different expertise and interests, and to initiate a process of joint diagnosis (of bottlenecks) and discovery (of solutions). Depending on the problem, IPs can be at the local level or a higher level of aggregation—the district, the country, or even involving international actors (in the context of international value chains, for example). IPs can also be vertically "linked" at different levels, for example, to promote the upscaling and outscaling of innovations.[3] Possible stakeholders can be farmers and traders, input and service suppliers, credit organizations, processors, consumers, and government representatives. Researchers can also be part of IPs (and

[3] Outscaling refers to horizontal diffusion of innovations (from one district to the next), and upscaling refers to embedding innovations at higher levels (e.g. institutionalizing in new policies. Embedding of IPs is imperfect, in practice.

many platforms have been initiated by international research organizations). This would facilitate integration of local and scientific knowledge. To help make platforms operate effectively, the challenge is to identify and recruit "champions" that effectively represent their constituency, and who can rally support for platform solutions to facilitate implementation of proposed changes (Klerkx et al., 2013).

Box 8.1 Innovation Platforms: No Panacea for All Development Challenges

Marc Schut, Murat Surtas, and Cees Leeuwis

Innovation platforms are fast becoming part of the mantra of agricultural research and development projects and programs, including those with a focus on agricultural value chain development. Their basic tenet is that value chain actors depend on one another to achieve their objectives, and hence need a space where they can experiment, learn, negotiate, and coordinate to overcome challenges and capitalize on opportunities through a facilitated innovation process (Schut et al., 2019).

However, research and development funding and implementation agencies need to think critically about when, how, and in what form innovation platforms can contribute meaningfully to agricultural development. Innovation platforms are not a cure to all value chain problems, nor do all constraints require the initiation of new innovation platforms, as there are often existing self-sustained networks and collaborations that can be built upon and should not be undermined (Sartas et al., 2018). Social network analysis can support mapping existing stakeholder networks and explore whether and how a platform approach can add value (Fig. 8.1).

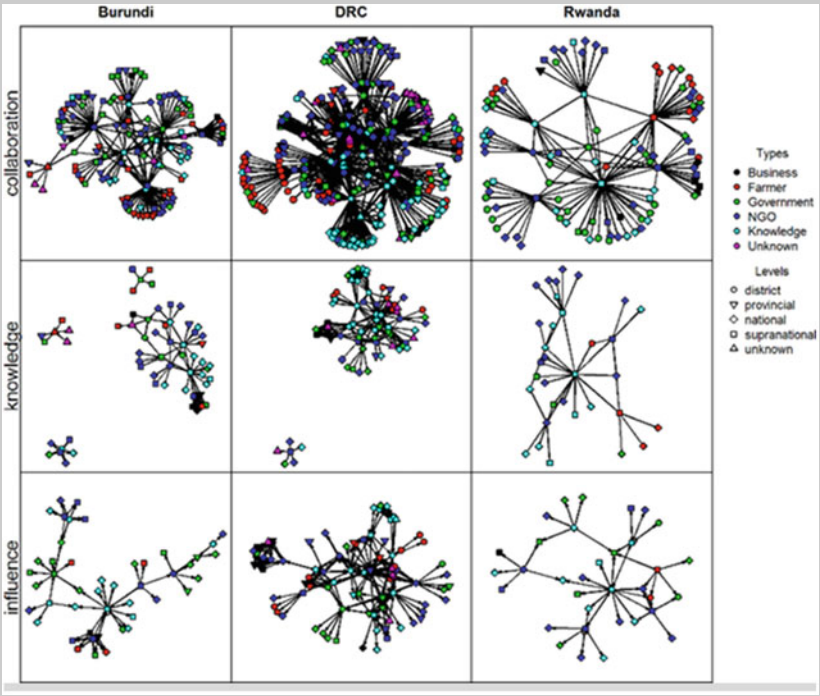

Fig. 8.1 Social network analysis of stakeholder influence, knowledge exchange and collaborative networks in Burundi, Rwanda, and DR Congo informing whether innovation platforms can add value (Hermans et al., 2017)

Innovation platforms should be seen as a specific type of multi-stakeholder intervention to tackle value chain and broader development challenges. Similar to other intervention approaches, innovation platforms have their advantages and disadvantages. For example, innovation platforms require financial and human resource investment, which may not always be at hand or sustainable. Furthermore, addressing some value chain problems may benefit from more strategic bilateral stakeholder engagement, rather than from a platform approach (Lamers et al., 2017).

To enable the scaling of innovations, platforms must be embedded in agricultural innovation systems to reach populations beyond its original scope (Schut et al., 2018). Specific value chain innovation platform interventions should be complemented by interventions that aim at triggering broader system transformation in order to contribute to addressing development challenges at scale (Seifu et al., 2020; Totin et al., 2020).

IPs seek to propose, co-develop and diffuse innovations, and relax binding constraints for systemic change. It rests on several important but plausible assumptions. First, by engaging all stakeholders in demand-driven and participatory deliberations, they leverage local knowledge about constraints and priorities. Outcomes are therefore likely to be technologically sound, locally adapted, feasible for smallholders, and socially and culturally acceptable. Second, the participatory nature of IPs may create trust between stakeholders, greater awareness of mutual interdependencies, and a feeling of "ownership" for outcomes—translating into greater willingness to collaborate and implement the proposals. Third, they should provide "institutional space" to leverage the outcomes of IP deliberations, and affect the lives of relevant actors who are not present at the platform table themselves—scaling out and scaling up (Schut et al., 2016). Fourth, and perhaps most importantly, IPs are based on the assumption that coordination challenges are the key bottlenecks for unleashing agricultural development. By bringing together the stakeholders and initiate conversation and negotiation among them, these bottlenecks can be modified and mitigated, and perhaps even eliminated.

However, the evidence base on the IP impact is thin. Perhaps this is no surprise. An econometric assessment of the impact of platforms would be based on the data of many platforms, each with its own stakeholders, dynamics, and priorities. Moreover, if the aim is to deliver *systemic* change, then it is not evident what the counterfactual should look like (as comparison groups are also affected by changing institutions and policies). Nevertheless, there is some empirical work on the impact of platforms in Africa. This literature provides mild support for the claim that IPs can be a force for good. Pamuk et al (2014) use experimental data from 8 African countries, and compare household-level outcomes for farmers in a region with an IP with outcomes for a matched control group of

farmers from another region (in the same country). They document that, on average, IPs promote the uptake of new technologies and practices. Focusing on a subsample of three Central African countries, Pamuk et al. (2015) find that the IP approach manages to reduce the average level of poverty among IP beneficiaries, relative to a comparison group.

However, these two impact studies also document a lot of heterogeneity in outcomes. While some platforms are successful in generating and diffusing knowledge, others failed and had no impact at all. The authors suggest that variation in IP performance is determined by the extent to which the IPs were implemented as truly demand-driven and participatory spaces for deliberation and negotiation—rather than top-down vehicles to push a pre-conceived development agenda (by the international research community initiating and facilitating these platforms). This concern resonates with claims from qualitative research, which also emphasizes the risk of IPs being hijacked by vested interests with sunk investments and narrow mandates—"old wine in a new bottle" (e.g. Schut et al., 2016). Many platforms fail to produce "out of the box" innovations, and instead re-produce existing technologies such as intercropping or approaches to improve soil and water management.[4]

There are other reasons why IPs may fail to deliver the promised results. Leadership qualities of platform facilitators, and their legitimacy, are important factors determining overall performance. Some externally supported platforms appear to be regarded primarily as an opportunity for resource extraction by members—for example as a source of *per diems*. Expertise in IPs may be skewed toward technological issues, and members often lack the capacity to address institutional constraints—even if these are relevant for improving system performance. Members may also fail to reach an agreement about which constraints should be addressed first. This issue speaks to the important issue of power relations. When the aim is to initiate systemic change, existing power relationships are typically challenged. This creates situations where the interests of platform members are opposed, impeding joint progress on the path forward.

A similar lack of consensus emerges when negotiating involves a *zero-sum game*, where one person's gain implies another person's loss.

[4] There are also doubts about the potential for IPs to achieve impact at scale, through out—and upscaling. Schut et al. (2019) found pockets of success and impact, but these were rarely achieved at scale. They question the use of IPs as a mechanism if the goal is to improve the livelihoods of many farmers in developing countries.

Zero-sum games are less likely when a dynamic perspective is adopted, if IP solutions manage to expand the size of the "economic pie" that can be redistributed among platform members. However, complex problems associated with a lack of dynamic consistency may emerge if agents move and "invest" sequentially. In the absence of formal contracts, early investors are exposed to the risk of hold up—earlier discussed in the context of relational contracting (Chapter 3). For example, farmers investing in the quality of their crop may be short-changed by traders refusing to pay the full premium later. Input suppliers who pre-finance inputs have to deal with side-selling farmers after harvesting. Coordination failure likely causes systemic underperformance, but it is optimistic to expect that coordination failure can always be addressed by merely creating space for negotiation—additional tools, in particular so-called commitment devices, may be needed to overcome it.[5]

In short, IPs are not a panacea for all problems in the agricultural sector. They are also costly—transaction costs can be large for participants. IPs consume resources to bring people together, and the participatory and interactive nature of IPs implies that members should seriously engage with each other, and so spend considerable amounts of time. Full-fledged cost–benefit analyses balancing the full costs and benefits of IPs are still missing. Schut et al. (2018) review the evidence and conclude that if there are simpler and cheaper alternatives than the creation of IPs, then they should be considered first.

8.4 Producer Organizations

There are a wide variety of producer organizations (POs) in Africa, encompassing farmer groups, cooperatives, associations of farmer groups (such as NASFAM in Malawi), or even umbrella organizations which are associations of those farmer associations (such as KENAFF in Kenya and

[5] The existing literature on innovation platforms emphasizes the importance of "flexibility," arguing that platforms members should be ready to change their behavior and expectations in light of the dynamic and unpredictable context within which they operate. However, increased flexibility is at odds with commitment to specific behaviors (think of the well-known dilemma between rules versus discretion, in economics).

FONGS in Senegal).[6] All these POs can be considered collective institutions intended to support the economic, social, and cultural interests of (voluntary) members. At the heart of many producer organizations is a jointly owned and democratically controlled enterprise which engages with other businesses in markets.

Even small POs can serve multiple functions for smallholders. POs help smallholders access extension services and markets for inputs and credit and also act as vehicles for joint storage and marketing output. Some of the larger POs, in fact, have marketing arms and act as a buyer and marketer of crops produced by members. Some larger organizations—especially in Francophone Africa—also engage in lobbying and policy advocacy, identity-building, and so on. The collective nature of these activities implies that transaction costs per unit of input purchased or output can come down, so smallholders can access markets at lower costs (and trade on a broader range of markets). Only if the benefits of these activities exceed membership costs (e.g. membership fees, share contributions, delayed payments, specific investments to meet quality standards, coordination costs), then smallholders are expected to voluntarily join these organizations. Farmers will consider that potential benefits from joining may be diluted if some of their peers shirk, side-sell, or otherwise avoid their obligations.

POs most commonly provide services related to output to their members. They often provide marketing services, such shared storage and transport. While large POs may act as an output market for farmer-members, others often help connect and bargain with buyers. In the latter case, POs can offer more output (in bulk) than individual farmers can, which improves bargaining power vis-à-vis trading partners—in other words, POs can bargain for higher prices or more favorable trading conditions than individual farmers. In doing so, the total revenues increase over what they would be if each farmer traded on their own, enabling all participants to increase their income. Some POs also process the joint output, from farm products into intermediate or consumer products, before selling it. Mwambi et al. (2020) refer to such organizations, which typically own capital assets in the form of processing equipment, as processing

[6] NASFAM stands for the National Smallholder Farmers Association of Malawi; KENAFF for the Kenya National Farmers Foundation; and FONGS stands for the Fédération de ONG de Sénégal.

POs. They should be distinguished from bargaining POs, which collectively sell unprocessed output. The second and third most common service provided by POs is provision of market information (prices) and access to extension services and trainings, respectively (Bizikova et al., 2020).

POs have emerged as a very popular institution in policy circles, and, indeed, as a "core element of rural development, agricultural productivity and anti-poverty policies" (Bizikova et al., 2020). For example, the 2008 World Development Report devoted to agricultural development argues that the creation of such organizations is an important approach to fostering links between smallholders and markets (World Bank, 2008). Bijman and Wijers (2019) write that "cooperatives are considered as a cost-effective tool for implementing poverty-reduction strategies and channeling external benefits to target groups." Many governments and international organizations have invested heavily in efforts to build and strengthen producer organizations for smallholders. In some contexts this involves building on existing institutions, in others it meant that such organizations had to be built from scratch. An impetus for international organizations and donors to try to build POs has been to more cost effectively deliver agricultural extension messages than delivering them to individual farmers.

In theory, the economic rationale for building and strengthening producer organizations is sound. Bizikova et al. (2020) review the impacts of PO membership and find the benefits of membership indeed tend to dominate potential costs. For example, the majority of impact studies finds that membership increases smallholder income. In particular, a positive correlation exists between the provision of marketing services and price information, and farmer income gains. These income gains are not simply the result of higher prices and reduced (transaction) costs. PO members also tend to have higher yields and produce output of higher quality. These findings presumably reflect superior access to extension services, farmer trainings and perhaps modern inputs.[7] Some of

[7] However, existing impact studies are not based on randomized controlled trials (for example based on a random encouragement design), and therefore it remains an open question to what extent these correlations reflect pre-existing differences between farmers (i.e. a selection effect) and to what extent differences between members and non-members is caused by membership.

the quality improvements that are observed between members and non-members likely reflect sharper incentives to produce high-quality output (if the PO manages to access high-value, niche markets). For example, many POs establish relationships with specific buyers and some make a transition toward organic farming.

Overall, the verdict on POs as a vehicle to transform agri-food value chains in Africa is at least moderately positive. But POs are not a panacea, and the literature has identified several challenges that deserve additional scrutiny and discussion. For example, while POs reduce transaction costs associated with accessing extension, input, and output markets, effective participation in an organization *also* involves transaction costs. Effectively participating in group meetings, PO activities and events, or scrutinizing the actions of management takes time—which not all households can spare. This is likely especially true in case of remote regions with bad infrastructure—exactly the regions where POs are most needed because regular spot markets for smallholders are likely to be thin.

A small literature has probed the issues of leadership and management of POs. Not surprisingly, there is a great deal of heterogeneity in management quality. Francesconi and Wouterse (2019) write that "agricultural cooperatives in Africa tend to be community-based organizations defined by principles of inclusion, voluntarism, democracy, equity, autonomy, mutuality and solidarity." Unfortunately this is no guarantee that governance is of sufficient quality. Governance could suffer due to bad leadership, dominated by corrupt or predatory elites, or it may simply reflect a lack of managerial ability or training. Bad leadership can be contained through effective monitoring and enforcement of rules, which raises questions about who will guard the guards, and who will volunteer to supply this second-order public good? (Kahsay & Bulte, 2021). The lack of managerial capital can be redressed by management trainings. Francesconi and Wouterse (2019) find that if leaders participate in such training sessions, then revenues for group members tend to be higher.

These challenges can lead to substantial heterogeneity within larger POs. Whereas a farmer group really has one level of management and leadership, an association of farmer associations has at least three—at the farmer group level, at the level of associated farmer groups, and then at the level of the umbrella organization. If there are differences in the quality of management and/or leadership at the associated farmer group level, even if the umbrella organization is run quite well, there could be substantial heterogeneity in performance (or effectiveness), however, one

might want to measure it. If, on the other hand, the umbrella organization is poorly run, then well-run associated farmer groups might either leave or side-step the umbrella organization. Because of the need for both management and leadership skills, the larger a PO, the more likely that some heterogeneity in performance exists.

Governance challenges are not restricted to PO leadership. Individual members have to cooperate for the PO to be successful, which implies meeting membership obligations. Members should sell their output via the organization—an important source of income for these organizations, who pass on most of these revenues to their members but typically retain a small share to cover fixed costs. Member should resist the temptation to side-sell their output to others, who may occasionally offer higher prices or more immediate payment. The presence of a PO improves the bargaining position of farmers on local spot markets and raises the prices paid to smallholders who sell individually. The reason is that the *possibility* of trading via the PO enhances their default option. Trading via the PO is therefore akin to contributing to a (local) public good for farmers—inviting well-known collective action problems. Farmers prefer their neighbors to sell via the PO, to maintain its viability, but are tempted to pursue individual trading strategies themselves. A shared sense of ownership (or social capital) is therefore necessary to turn POs into a successful enterprise. This condition is easier satisfied in smaller and coherent communities.

Another issue that has attracted some attention in the literature is the "inclusivity" of POs. For which types of smallholders do the benefits of membership exceed the costs? While many POs may be based on principles of "inclusion, voluntarism, democracy, equity, autonomy, mutuality and solidarity," it turns out that the level of inclusion varies from one type of PO to the next. While most community-based POs typically have the interests of the entire community at heart, and focus on the provision of a broad range of services for all community members, several production organizations have a more narrowly focused mandate. When operating in competitive markets (and in the absence of subsidies), POs may exclude smallholders who cannot meet specific buyer requirements. Open membership implies heterogeneity in quality, which is at odds with efficiency and successful pursuit of market-based strategies. Many POs therefore opt for "closed membership," and refuse poor and marginal smallholders who struggle to meet production criteria. Bijman and Wijers (2019) distinguish between POs with a community-orientation and POs

with a market-orientation—arguing that the former is much more inclusive than the latter (and typically require external financial support to survive).

Additional subdivisions between types of POs are possible. As mentioned, Mwambi et al. (2020) distinguish between bargaining POs and processing POs. Bargaining POs aggregate and collectively sell member output, while processing POs also process them in intermediate or final products. Since processing requires capital assets, processing POs often ask their members to contribute to PO equity or buy "shares"—which many poor households cannot afford. This may be another channel for exclusion. The combination of quality (and sometimes volume) requirements and compulsory capital contributions effectively excludes the poorest smallholders from joining certain POs. As a result, an inverted U-shaped relationship is found between PO membership and farmer land size (e.g. Bernard & Spielman, 2009). The poorest smallholders cannot join, and the richest are better off trading individually.[8]

In sum, there are positives and negatives with POs. They appear to, on average, help farmers make more money farming, and increase their bargaining power relative to the counterfactual. But outcomes are heterogeneous and depend on management and leadership skills that are often lacking. And they are likely not inclusive of the poor. Yet it is important to stress that an important harbinger of failure for a PO is one that is not formed endogenously, by the farmers themselves. There are plenty of examples in which governments and (international) development agencies have designed and implemented a development strategy aiming to "roll out the producer organization agenda." Evidence suggests that it is not easy to create viable organizations in a top-down fashion. The outcome of "exogenous" PO design often results in weak organizations, characterized by the limited commitment of members, low trust, and bad governance (Wanyama et al., 2009). Such organizations provide very few benefits for their members. Another challenge emerges in contexts with strong and authoritarian states, such as Rwanda and Ethiopia. Here, POs often resemble grassroots level organizations of the central government, rather than autonomous organizations that focus on the well-being

[8] Mwambi et al. (2020) distinguish between inclusion in terms of membership, and inclusion in terms of participation in decision-making in the organization. They find that inclusion in membership is not sufficient for inclusion in participation. Poor households, and female-headed households, are under-represented in PO decision-making.

of its members. The most successful POs have endogenously formed, in response to shared concerns and inspiring local leadership. Alas, this formation process cannot easily be copied and scaled.

8.5 ICT and Mobile Phones

As we have discussed in previous chapters, the coverage and adoption of ICTs in Africa have dramatically increased in recent years, in both urban and rural areas (Box 8.2). In recent years, the diffusion of mobile phones across the countryside is a particularly noteworthy development, as the adoption of ICTs may benefit smallholders by reducing the cost of accessing information and improving access to financial services. In contexts with dispersed markets and poor infrastructure, farmers and traders incur opportunity and transport costs each time they go out and seek new information. The same is true for extension workers who visit farms to bring information. ICTs promise to provide access to different sorts of information at much lower costs.[9]

Box 8.2 Using ICT to Improve Government Accountability

Katrina Kosec

Developments in ICT can help reduce transaction costs in indirect ways as well. A recent paper provides useful insights into how access to information can improve rural service delivery and promote development (Kosec & Wantchekon, 2020). Rapidly increasing availability of ICT in low and middle-income countries can help two way flows of information between citizens and governments (Fig. 8.2). Providing information to governments may help overcome information asymmetries between service users and providers, which can result in inefficient or misdirected expenditures, or it may help the central government induce effort from

[9] The potential gains of improved access to information were established in an early study by Svensson and Yanagizawa (2009), which focused on distribution of timely and reliable price information via radio. Access to this information depended on radio reception, or exogenous factors in the terrain (uncorrelated with productivity). Farmers who received the information could bargain higher prices for their crop and sold more maize—as a result they experienced a 55% increase in crop revenues.

lower tiers. Providing information to individuals may help them better monitor and thus reward or sanction service providers, incentivizing high-quality public investments.

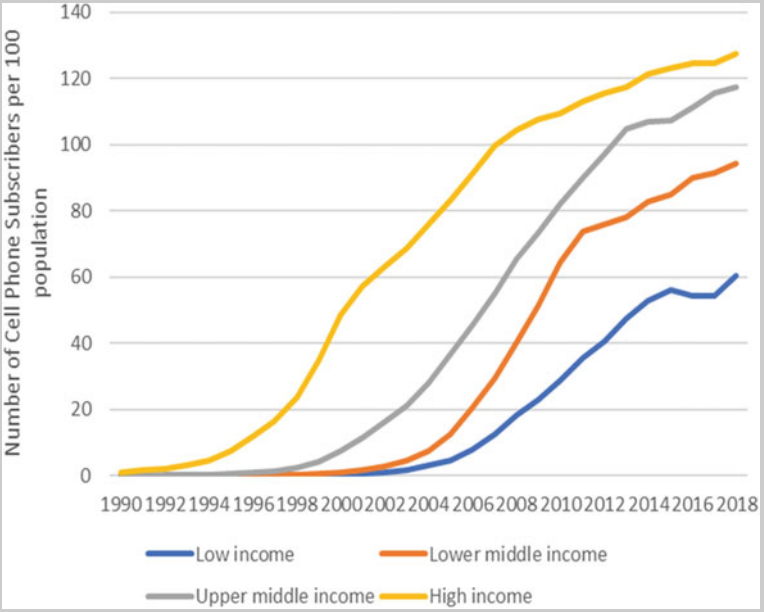

Fig. 8.2 Number of cell phone subscribers per 100 population, by income category, 1990–2018

Despite its promise, however, information often fails to improve governance and service delivery. The authors present a framework arguing that information alone is insufficient. To be influential, information must be relevant to the recipient, meaning it is salient and has a high perceived signal-to-noise ratio. Recipients must then have both the power and incentives to act on the information. Bringing all three conditions together is challenging in any setting, but especially in rural areas, where the capacity to receive, understand, and act on information is relatively low.

This interpretation is broadly supported by their systematic literature review. There were no cases of positive impacts of information on governance and service delivery when any of the three conditions (relevance, power, or incentives) were missing—consistent with these conditions being necessary for information to improve service delivery. From the perspective of agriculture, understanding information asymmetries at play and mapping incentives and capabilities of relevant actors is critical to understanding whether and where additional information can improve outcomes.

ICTs have evolved considerably. Radio messages have by-and-large been replaced by text messages for mobile phones, mobile voice-based advisory services, and apps and websites for smartphones and computers. Services provides range from one-way sending of generic information via radio or videos to interactive initiatives aiming to provide customized advice on farming and marketing. Such two-way communication requires call-in centers, hotlines, or interactive voice recognition. Hybrid extension forms have developed where experts armed with smartphones visit farms to collect data, for example on soil properties, and access a reference library to produce locally relevant recommendations on the spot, in real time.[10]

8.5.1 The Benefits of ICT

Aker et al. (2016) distinguish between three types of information flows.[11] First, mobile phones can leverage the gains from *existing social networks* by facilitating the circulation of information within these networks. New information about prices, for example, can be shared quickly within a

[10] Farm visits obviously negate most of the cost-saving properties of ICT and, in the absence of other means of collecting farm-level data, introduces an important trade-off between the specificity of information that can be provided and the ease with which services can be scaled up and out.

[11] In addition to the benefits discussed in the main text, ICTs may also help to source feedback from intended beneficiaries (to increase accountability in public service delivery, say), and it could play a role in reducing adulteration and counterfeiting of modern agricultural inputs.

peer network, enabling farmers (and traders) to exploit arbitrage opportunities. Information may also improve the bargaining position of farmers vis-à-vis traders. These gains vary with the size of one's network. In many contexts, ICTs are not particularly helpful tools for farmers seeking to expand their network. Face to face communication likely remains more important for that.

Second, ICTs can improve *access to* (*semi-*)*public information*. Traditionally, this involved the provision of (weekly or daily) prices via radio. In more recent times it involves regular text messages about market prices for specific crops, weather predictions, pests, and technical agricultural information ("digital extension"). Possibly farmers can access websites via smartphones or internet kiosks to learn about these same issues. Technical information can be timely reminders of specific activities and behavioral nudges to motivate certain actions.

Third, mobile phones can *improve coordination of input and output value chains*. Farmers can search for trading partners and easily compare different offers from input suppliers and output buyers. In addition to reaching out to potential trading partners within the social network, ICTs may reduce the cost of establishing new links. In some contexts, intermediated services are available—platforms or directories linking potential buyers and sellers. Low-cost communication can also foster coordination and prevent uncertainty about problems elsewhere in the value chain, such as stock-outs. This should reduce delays and wasted trips.

In addition to improving access to low-cost information, ICTs can *facilitate access to financial services*. Mobile phones provide a platform for safe and rapid electronic money transfers, which facilitates trade and regular payment of insurance premiums, and enables risk sharing within social networks to cope with shocks (e.g. Jack & Suri, 2014). Improved opportunities for consumption smoothing may, indirectly, affect farm management and productivity by enabling farmers to expose themselves to more risk—moving from "low-yield, low-risk" to "higher-yield, higher-risk" activities on the margin. Mobile money is also used to implement public transfer programs at very low cost—for example by sending e-vouchers for subsidized inputs to farmers. Insurance payouts can be sent in the form of mobile money, economizing on cost and time, and making insurance programs more valuable to farmers. Another innovation is digital credit, even if this is mainly available for consumption smoothing and ill-suited to respond to realities of seasonal agricultural production.

Finally, we note it is easy to see why new technologies have enthralled public and private parties, and tempted them to invest in this sector. Today, the (large) majority of African farmers nowadays have access to a mobile phone, even if for the majority this still is a so-called "feature phone" rather than a smartphone. In Kenya, virtually everyone uses mobile money, and the popularity of this service in other countries is increasing. Numerous information campaigns via text service have been "rolled out"—aiming to help rural households with issues from agricultural production to improved nutrition and health care. Without a doubt, the ICT revolution has reached the African countryside.

8.5.2 The Impacts of ICTs on Rural Africa

The question therefore begs: How has the ICT revolution contributed to transforming the countryside? Did it help farmers to intensify production and achieve productivity gains? Has it fostered agricultural specialization and market integration, and did it contribute to structural transformation processes by helping off-farm businesses grow? Unfortunately, the evidence seems rather checkered and incomplete, sometimes even contradictory. Aker et al. (2016) conclude that "the impact of [ICT] services on agricultural adoption, behavior and welfare is mixed."

The effect of ICTs on agricultural performance varies with the information needs and the presence or absence of other market imperfections. In other words, it depends on whether ITCs relax a binding constraint, or not. In many cases *other* constraints bind as well—poor infrastructure that inflates price bands, limited opportunities to reduce risk exposure, or a monopsonistic market context. For example, consider a context where farmers cannot access credit through banks or microfinance institutions, and instead rely on interlinked transactions with traders to obtain access to credit and inputs. Gaining access to extra information about prices elsewhere through ICT is unlikely to help these farmers because their bargaining position is still weak. Similarly, receiving information about weather and pests is unlikely to matter much for farmers who lack the capacity to effectively respond to threats and opportunities—for example because they cannot obtain the necessary inputs. The ability to respond to information may also be affected by cultural norms, so effects of ICT are typically heterogeneous and vary along gender, ethnicity, and caste dimensions.

Some examples are instructive. Both Jensen (2007) and Aker and Fafchamps (2015) find that (increased) access to mobile phone coverage improves the efficiency of local agricultural markets. Jensen (2007) documents a reduction in the dispersion of fish prices in India, and Aker and Fafchamps (2015) find the same for agricultural crops in Niger. However, the distribution of welfare gains varies across contexts. While fishermen benefit not only from more stable but also from higher average prices, the same is not true for farmers in Niger, whose farmgate prices did not increase. Another example is Esoko, a large mobile phone-based platform based in Ghana shares market prices with farmers. In one region, evidence suggests access to Esoko led to farmers receiving higher prices for maize and groundnuts (Courtois & Subervie, 2015), but in another region the same platform had no discernible effect on the same prices (Hildebrandt et al., 2015).[12]

Given that impacts on prices received by farmers armed with more information are limited, it is perhaps not surprising that many ICT-based measures of agricultural extension impacts are also limited. A meta-analysis of several experiments evaluating different modes of "mobile extension" produced an average impact of 4% on yields, which seems underwhelming (Fabregas et al., 2019).[13] It is therefore not surprising that the adoption of ICT-based information systems, especially of the type that provides access to (semi) public information and extension services, remains limited. Traditional market failure considerations also enter. Information is non-rival and non-excludable, and information asymmetries enter by definition in the context of information transfer. Farmers receiving information may (costlessly) share this with their neighbors, so that the social impact of ICT may extend beyond the target group in the experiment. This curbs demand, so market-based solutions for mobile extension service, with subscriptions to cover costs, have typically failed. Farmers only seem to adopt when the service is free of charge, and adoption and usage of ICT services fall after subsidies are removed. Public

[12] Somewhat similar to hermetic bags in the previous chapter, the idea of spreading price information through mobile phones has been largely funded by donors eager to see agricultural productivity increases, but cost effectiveness of such interventions is obviously unclear.

[13] It is difficult to interpret some of this evidence. While certain studies find impacts significantly greater than zero and others do not, it may still be the case that impact estimates are statistically similar to each other.

support will likely remain necessary for organizations to recoup fixed costs associated with developing an information platform and collecting and processing information. Alternatively, as discussed above in the context of bundling services, local processors with market power may find it worthwhile to pay for the fixed costs associated with ICT expansion.

In sum, several factors constrain the effectiveness of ICT. The rollout of mobile money networks has not taken off in rural areas in most countries (outside of East Africa, South Africa, Ivory Coast and Senegal) to reach the poorest farmers. In large parts of Africa, a sizable share of the intended beneficiaries also lacks the literacy to benefit from text-based messages, especially if offered in a language other than their primary language. It is not evident how this constraint will be relaxed on short notice (but eventually the current cohorts of farmers will be replaced by better-educated ones.) Aker et al. (2016) mention that the use of ICT may be limited because many farmers switch off their phones "to preserve the charge," and share their phone and SIM card with others. This speaks to a broader concern—even if ICT solutions reduce transaction costs, they are still expensive. Wear-and-tear on phones sometimes imply broken screens and numerical keypads "rubbed blank"—compromising the usefulness of ICT. Cheap smartphones have poor battery life and their adoption may be constrained as a result. Moreover, many farmers receive multiple text messages, with conflicting content, and may find it difficult to discern which source can be trusted. In the absence of trust in the source, messages will be ignored.

Overall, a mixed picture emerges. It is easy to see the promise of ICT. While the current crop of services offered to farmers who struggle with their feature phones may be limited, smartphones are becoming more common and will eventually enable the delivery of a broader suite of services—in particular the delivery of customized, locally relevant and timely information about production (extension), prices, weather, and pests. Armed with a smartphone, extension services can be provided via video, so that also more complex information messages can be effectively shared. Of course an important question is whether or not the public (or private) sector will invest in videos on farming in rural areas. A major issue with African agriculture is the huge heterogeneity—in land quality, size, inputs, education, shocks—even over small geographic areas. It is therefore not easy to provide information that is really transformative for a large

variety of farmers. And even if relevant information is made available by a trusted source in a timely manner, farmers need access to markets to respond effectively. In other words, ICT innovations need to be part of a package of interventions—ICT is not a silver bullet that can transform African farming on its own.

8.6 Blockchain in Agriculture: Can It Lead to Growth?

So, if ICT cannot change agriculture quite generally, what about specific technologies? One ICT deserving special mention is blockchain in agriculture, since a cottage industry has recently sprung up around blockchain as a tracing mechanism for value chain transactions. Proponents of blockchain believe it will revolutionize agriculture as we know it. To be able to assess its potential to do so, we first need to briefly explain what is meant by blockchain.

Blockchain is what is known as a distributed ledger technology. In a distributed ledger technology, transactions between parties are electronically recorded in multiple places at the same time. The transactions occur through a secure code and they cannot be overwritten, so anyone who examines the ledger can tell whether any given transaction was fair (or not). Hence, proponents argue that fraud or other problems should be limited. Blockchain is a specific type of a distributed ledger that stores its data in blocks that link to one another, as in a chain (Natarajan et al., 2017). Blockchain is the technology behind Bitcoin and some other cryptocurrencies.

Agricultural proponents argue that the blockchain is an ideal solution for overcoming trust issues in value chains (e.g. Kamilaris et al., 2019). The notion is that because anyone can see the transaction ledger, there is a disincentive to cheat in transactions, whether that be in quality grading, price, or amounts being traded. In other words, traders could not give different prices for the same quality, because an external observer could call out their cheating. Alternatively, one could not theoretically buy a product at a low-quality grade and then sell it at a higher quality grade, since those grades would again be observable by anyone. As such, the blockchain in theory makes all transactions transparent to all who are interested in checking transactions. And so proponents of the blockchain would consider it an excellent replacement for the type of relational contracting observed among value chain actors in Africa.

There are two major challenges in Africa at present in operationalizing blockchain. First, it requires a good internet connection, so that transactions can be uploaded or checked anywhere. Second, it requires more than a simple cell phone; farmers need to have a phone that can access the internet. GSMA reports that 272 million people in Africa were mobile internet users in 2019, but suffice to say that they are likely concentrated among the urban and the well-off, rather than among smallholder farmers (Okeleke & Suardi, 2020). They project that number to increase to 475 million by 2025, and although that number implies a large number of farmers will be mobile internet users, it also means a large number of farmers will continue to lack internet access to use blockchain, even if they wanted to do so. Moreover, the GSMA is a trade association, so their estimate may be optimistic.

A larger challenge may lie in the incentives to actually check the transactions. Whereas blockchain or other distributed ledger technologies are certainly valid ways of making such transactions using digital cash, it is not as apparent that they would lead to the more trustworthy transactions that blockchain proponents would have us believe. If some trader systematically underpaid farmers before blockchain, the notion is that someone would spend enough time looking at the publicly available ledgers to notice that pattern and then warn the people with whom that trader transacts that the person is untrustworthy. Moreover, it would not seem to do anything about the type of collusion between found in Bergquist and Dinerstein (2020). Since the incentives to actually check the ledger by third parties are virtually non-existent (and costs of learning to do so exist, as well as potentially paying for data fees required to check it), it is not at all clear that transactions through blockchain should be considered more trustworthy than any other transactions.

That said, there are potential benefits to digitizing transactions on value chains in general, as we have described in some of the previous chapters. There are multiple technologies that could lead to those benefits, including blockchain. However, there is no clear advantage of blockchain over other supply chain management ICT systems; systems that can only require a cell phone signal and not internet access would seem to dominate for the near future.

8.7 Conclusion

In this chapter, we have discussed several types of interventions that have been promoted or discussed as potential ways to help reduce transaction costs in African agricultural value chains. Whereas none of these ideas are without some merit, we argue all of them are unlikely to reduce transaction costs on their own. Considering in particular innovation platforms, producer organizations, and various types of ICT interventions, all have some promise but are not likely to work well in isolation of either other interventions or without a bundle of other interventions. In the next chapter, we discuss models of interventions we think can be more successful.

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CHAPTER 9

Structural Transformation 2.0: The Rocky Road Ahead…

Whereas the previous chapter was devoted to discussing "silver bullets," in this chapter we cover some potential ways that we think can be more successful in reducing transaction costs in agricultural value chains in Africa, therefore promoting economic development. As we have argued throughout this book, high transaction costs of all kinds reduce the promise both for agricultural value chains to modernize in Africa, and for smallholder producers to participate in these value chains. To catalyze a process of structural transformation in Africa, it is broadly important to reduce transaction costs so transitional and modern value chains can support the development process. Before we begin to discuss potential solutions, we spend a bit more time on whether and how structural transformation in Africa can occur.

9.1 Will Structural Transformation 1.0 Occur in Africa?

Before we begin to discuss methods of reducing transaction costs, we want to describe a bit more what we mean by "Structural Transformation 2.0" and why there are likely going to be differences between historical structural transformation processes that took place in the West and

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more recently in East Asia. The story underlying the well-known type of structural transformation is relatively consistent. As economies develop and grow richer, the agricultural sector loses its dominant role in the economy—laborers first move to the manufacturing sector, and later to the service sector. Rural–urban migration results, and the mechanization of farming reduces the demand for labor in rural areas. The growing manufacturing sector pays wages high enough to compensate laborers for the disutility of migration, but sufficiently low for manufacturing firms to be competitive. Wages paid to urban laborers are importantly determined by the price of food, so it is imperative that productivity in the agricultural sector increases (unless food can be imported in sufficient quantities). This implies a two-fold and interlinked transformation process—the reallocation of activity and production factors *across sectors*, and the re-organization of production and marketing *within the agricultural sector*. Re-organization of agriculture is both a cause and a consequence of structural transformation (e.g. Bustos et al., 2016).

The pattern across samples of rich countries is so uniform that industrialization-based structural transformation is sometimes seen as inevitable—as the only path forward for developing countries. Yet it remains to be seen whether experiences in other parts of the world provide a reliable guide for the development of African economies. Perhaps the concept of structural transformation should be reinvented and the role of smallholders in the process re-examined. In this closing chapter we probe these issues, realizing that we cannot do more than scratch the surface.

During the initial structural transformation in England, manufacturers did not have to compete with any incumbent manufacturers fighting to protect their export markets; they simply did not exist. When later now developed countries began to industrialize (e.g. Japan), its wages were so low relative to European manufacturers that they were able to successfully compete on international markets for labor-intensive manufactured goods. Austin and Sugihara (2014) argue that labor-intensive industrialization in Asia was made possible because it was preceded by a capital-intensive path of industrialization in Europe and the USA—raising local wages. Real wages of unskilled workers in London were approximately eight times as high as wages in Tokyo toward the end of the nineteenth century. This created sufficient "space" for the Japanese and compensated for relatively low productivity levels through low wages. Eventually, production in Japan also became more capital-intensive, and other Asian

producers successfully entered the vacated niche of labor-intensive manufacturers. That niche is still firmly occupied. African countries wishing to enter the global arena for manufactures must therefore "take on" hyper-efficient and low-cost producers from countries like China and Vietnam—with new low-cost producers from that region waiting in the wings. Moreover, robotization and innovations like 3D-printing will likely push down prices of manufactures further in the foreseeable future.

Hence, to catalyze a process of industrialization-based structural transformation, mediated by international trade of simple manufactures, African countries must be able to compete with the world's current manufacturing base. Frankema and van Waijenburg (2018) compare official minimum wages in Asian and African countries and conclude the nominal wage gap between Africa and emerging Asian economies (Bangladesh or Vietnam) is much smaller than the gap that existed between Britain and Japan in the nineteenth century. Wages in China may be creeping up, but the minimum wage is only three times higher than the (unweighted) average African wage. Since labor productivity in African manufacturing is very low, African labor costs *per unit of output* are high—too high to be competitive on global markets (Golub et al., 2018). Currently, Ethiopia is one of the few African countries where the gap in labor productivity nearly matches the wage differential. For African manufacturing to become viable, either income levels in Asia or labor productivity in Africa must substantially increase, and preferably both.

Frankema and van Waijenburg (2018) also draw attention to the importance of "proto-industrial roots and well-developed rural markets"—issues closely related to the population density of rural settlements. Here, too, Africa is at a distinct disadvantage. On average, Africa has lower population densities and fewer people living in cities, limiting conditions for labor specialization. Africa has also experienced erosion of these proto-industrial roots in recent decades, due to fierce competition on regional textiles markets and the subsequent loss of activity in this sector. Technology and skill gaps have grown wider, making it even more difficult for Africa to catch up.

This argument does not imply there is no hope for manufacturing in Africa. Asian wages could keep rising, and so in the medium to long-run African exports will perhaps become competitive. Also, there will be pockets in specific sectors and in specific countries where African manufacturing can compete with Asian exports. Specific locational cost advantages will play a role, such as access to cheap land and natural resources. There

may also be opportunities due to low transportation costs to nearby urban centers, or culture-specific branding and marketing of specific commodities. However, the production and processing of primary products (agricultural commodities and natural resources) likely remain the mainstay of most African exports for some time to come. Structural transformation based on industrialization, European—and Asian style, is unlikely to occur in Africa in the same way, and will not happen on the scale needed to lift hundreds of millions of people out of poverty by moving them from farming to manufacturing.

If industrialization and exports of manufactured goods are unlikely to take off in Africa, can a process of structural adjustment still takes place? Gollin (2018) answers in the affirmative. Sustained growth requires sustained improvements in productivity—an outcome that is routinely associated with manufacturing. But growth theory is actually silent on the sectoral underpinnings of growth, and does not insist on the importance of manufacturing. Two-sector growth models typically feature a stagnant agricultural sector and a dynamic "other" sector that is subject to exogenous or endogenous improvements in productivity (say, through learning-by-doing, positive knowledge spillovers, or targeted investments in R&D). However, this dynamic "other sector" could be the service sector rather than the manufacturing sector. Like manufacturing, the service sector is often based in urban areas and benefits from learning-by-doing, technology spillovers, and knowledge spillovers. The modes of production are becoming increasingly similar (large, formal and organized), and there is no reason to believe that sustained productivity gains in the service sector cannot occur. Indeed, Western economies continue growing, in spite of a shrinking manufacturing sector.

Moreover, there is no need to assume the agricultural sector should be stagnant or display only slow productivity growth. While a fixed land base may imply diminishing returns to other production factors, the presence of a sizable "yield gap" between actual and potential output in Africa testifies to the scope for improving farm productivity. Moreover, the efficiency frontier continues to "move out" because of ongoing innovations. Note that in the United States productivity growth in agriculture dominated gains in manufacturing for the period 1987–2016 (Gollin, 2018). In other words, the concern that African countries may not be able to industrialize and export manufactures does not mean that economic development is stalled. Indeed, several African countries are in the midst of a process of urbanization and transitioning from agriculture to services,

with very little industrialization taking place (Gollin et al., 2016).[1] In Africa, there is also scope for productivity growth in agribusiness based on local processing of primary products.

Many services are non-tradable by nature. But Africa needs exports to finance the import of manufactured goods. It can "export people," through temporary migration, who send back money (remittances). Some exports can be based on tradable services like (eco)tourism and the hospitality industry, leveraging location-specific assets like wildlife, forests and beaches, or the cultural heritage. Certain agribusiness products are also exportable. Gollin (2018) argues that light processing of agricultural commodities and packaged food exports (e.g., chopped fresh vegetables or filleted fish) can compete with local food preparation in destination countries.

However, a service sector dominated process of structural transformation, say Structural Transformation 2.0, can only takeoff if productivity in agriculture increases. Low productivity in agriculture and associated high prices for food constrain the movement of people into the new sector. A pre-condition for productivity gains in smallholder farming is that transaction costs in agricultural value chains must come down.[2] This goes back to classical thinking about agriculture-led economic development along the lines of Johnston and Mellor (1961) and Timmer (2002).

We believe there are at least four ways to do so, and we cover them in the remainder of the chapter. First, we consider the constraints farmers face in increasing production. To do so, a promising method is through bundled interventions, which appear to be a preferred way to help smallholders overcome production constraints (Barrett et al., 2020). If smallholders can increase their surplus, then the cost per unit of purchasing from them declines. Second, we examine ways to change

[1] In addition to perceived differences in productivity growth, there are other reasons why industrial jobs are sometimes seen as "good jobs" by policy makers, compared to "bad jobs" in agriculture or the (informal) service sector. These reasons have to do with collective bargaining and unionization (increasing the share of the value added accruing to workers), and the idea that manufacturing jobs are more visible (resulting in more effective state monitoring and enforcement). However, Gollin (2018) argues that these characteristics could be extended to other sectors, including the formal service sector, and that these characteristics should not be misconstrued as an argument in favor of manufacturing per se.

[2] That is: unless countries can import both manufactures and food—an unlikely scenario for most African countries, except the ones exporting natural resources in large quantities.

farm organization, potentially through some consolidation. By changing farm organization, it could be possible to lower costs of procuring crops from farmers, hence lowering the search costs faced by traders. Third, we discuss infrastructural interventions that either would reduce transaction costs with certainty or could reduce them. Fourth, we briefly discuss ways to improve terms of trade between parts of Africa and the rest of the world. Finally, we note that not all of these methods might be appropriate in every place. Rather, context-specific combinations of them, informed by knowledge about local constraints, is likely to be helpful.

9.2 Approach 1: Bundling Interventions

The international community overwhelmingly targets policies and interventions at smallholders in hopes of reducing poverty and promoting food security. Growth in smallholder agriculture is promoted through a variety of interventions, ranging from technology transfer to market development. Many of these interventions seek to relax a single constraint—depending on the preferences and beliefs of the donor organization. The silver bullets discussed in the previous chapter illustrate this point. For example, innovation platforms aim to overcome coordination problems, subsidies aim to lower the price of inputs, and the establishment of producer organizations seek to achieve economies of scale in trading (and perhaps improve the bargaining position of producers vis-à-vis other agents in the value chain).

Academic researchers often welcome this approach to development assistance, as it allows them to better understand the importance of specific constraints to agricultural development. By relaxing constraints one at a time, researchers can design evaluations that allow them to better understand the black box that is smallholder production in its complex market environment, and to carefully identify the causal effect of interventions—especially if constraints are relaxed for randomly selected farmers. Unfortunately, this approach has proven rather unsuccessful at improving production or productivity. By and large, the impact of relaxing individual constraints has failed to unleash large-scale and widespread productivity gains. As we have described, smallholders face multiple constraints to increasing their productivity, and so it is not surprising that relaxing any one constraint individually typically does little to increase profits (Beaman et al., 2013) or yields (Udry et al., 2019).

As we discussed in Chapter 1, smallholder farmers in Africa are following their best interests; they make decisions that are approximately profit or utility maximizing. Yet the challenge is that transaction costs emerge on both sides of the market—eliminating the profitability of trading for farmers and their suppliers and buyers alike. Lowering the transaction cost of information exchange (due to innovative extension approaches, say) will not promote the uptake of new technologies or practices if key inputs cannot be purchased, or if farmers would perceive themselves as exposed to uninsurable risk by adopting. Subsidizing modern inputs will not result in widespread adoption unless farmers can reasonably expect that they can sell their marketable surpluses at an attractive price. While this insight might seem trivial, it is surprising how few interventions are based on a holistic or integrative approach—addressing all relevant constraints simultaneously.

That said, a small number of programs have tried to adopt multifaceted programs to help smallholders to increase their productivity. These interventions offer a "bundle" of services that reduce transaction costs across a range of markets. There are two clear examples of studies attempting to deal with multiple constraints. First, Ambler et al. (2019) test alleviating liquidity, information, and input market constraints among cash crop growing households in Malawi; they find the interventions have strong interactions with one another in increasing household investment and therefore production.[3] Despite only alleviating the liquidity constraint in the first year of the program, they find that overall production value increased by 17% among the group alleviating multiple constraints one year later and suggestive evidence it remains higher 2 years after the program ended.

Deutschmann et al. (2019) also use a flexible experimental design to evaluate the impact of an intervention based on this same philosophy for a sample of smallholders in Western Kenya. They bundle four components through the OneAcre Fund: credit (group-based lending for modern inputs such as improved seed and fertilizer), crop insurance, information (training program on improved practices), and storage solutions. All components have been "tried out" in isolation before—the innovation is in the idea of packaging them together. Farmers can voluntarily choose

[3] A linked intervention in Senegal increased livestock holdings after two years among households for whom multiple constraints were alleviated, but that intervention did not isolate the liquidity constraint due to sample size limitations (Ambler et al., 2020).

whether to sign up for the program or not (of course), and how much of their acreage to "enroll" in the program. The bundle increases total maize output by 26% and smallholder profits by 15%, within one year. Moreover, the treatment effect is robust across quintiles, suggesting that there is no need for a more sophisticated approach that tailors components for specific types of farmers. Another noteworthy finding is that beneficiaries from the treatment group enroll a larger share of their land after learning about the program during the first year.

Considering the evidence in combination, these studies suggest multifaceted interventions may be successful. The results echo earlier findings from the literature on poverty alleviation (Bandiera et al., 2017; Banerjee et al., 2015). While individual components (microcredit, training) are unlikely to lift households out of poverty, bundled interventions that tackle multiple margins simultaneously can do so and have lasting impact. However, rolling out a bundled intervention is costly. While there are presumably scale economies in simultaneously relaxing multiple constraints, some transaction costs remain. Inputs are delivered within walking distance of farmers, for example. Who absorbs these costs? Farmers themselves contribute, for example by paying an enrollment fee and interest on their loans. But residual costs remain uncovered by operations. On its website, the OneAcre Fund reports a financial sustainability rate of 76%, suggesting it depends on donations to cover about a quarter of its costs. Charity or public funding could thus be one way to make bundled services available.

Finally, this approach is predicated on the smallholder farming model. There are, of course, limits to how much money a smallholder can make if they are constrained to a few hectares. As a result, bundling interventions could help limit transaction costs in the short term, but even if they were quite successful transaction costs on the purchasing side of the ledger would remain; traders would continue to have to purchase from large numbers of farmers.

9.3 Approach 2: Farm Consolidation

Farmers associations are one solution to bundling agricultural product to reduce transaction costs. The idea is to mimic a larger farm. Yet perhaps the emphasis on improving the performance of smallholders is misguided to begin with. In an influential article, Collier and Dercon (2014) question the overwhelming emphasis on small farms: "If, over the

next half-century, Africa were to converge on the performance of much of the rest of the developing world both in growth and poverty reduction, what would be the defining features of the organization of its agriculture in 2060?" Their answer is that the empirical and theoretical basis for continued smallholder support is weak, and it is time to "consider more flexible organizational models in which not all bets are placed on a single unquestioned mode of production." In other words, we should consider the promotion of larger farms (though not megafarms, see Chapter 8) rather than smallholder farming. "Pampering" smallholders may imply a risk of perpetuating inefficient and unviable production modes—locking the rural poor into poverty.

Although we know that transaction costs will be lower if buyers must visit just one farm rather than 100 farms to purchase crops, a major issue that arises is whether larger farms are as productive as smaller ones. This question has been heavily debated in the literature, especially in the context of land redistribution (rather than land consolidation) taking land from large farms and giving it to smallholders, squatters or tenants. If smallholders are more productive than large farms, then policies to redistribute land may be justified both in terms of improved equity and improved efficiency. Land redistribution not only shifts the distribution of wealth across social groups in society, but would also increase overall land productivity. Conversely, if smallholders are more productive, then land consolidation would seem like bad idea as this would imply sacrificing production in the aggregate. These are relevant issues for policy makers.

Economic thinking about the relation between farm size and productivity has evolved considerably through the years. Boserup (1965) theorized that smaller farms can be more intensively farmed, and are likely to be more productive than larger farms. Sen (1962) indeed documented an inverse relationship between farm size and output per hectare in Indian agriculture, suggesting that smaller farms are more productive than larger ones.[4] Small farms may be more productive because farming takes place by family members and there are no labor incentive issues, as hired labor may shirk since monitoring is difficult (e.g. Binswanger & Rosenzweig, 1986). Small farms may also be more productive due to transaction costs—in particular costs related with accessing factor markets. Households with little land and a lot of family labor will work "too hard" on

[4] The origins of the inverse relationship between farm size and productivity can be traced back further in time, all the way to Chayanov (1926).

their farm because they cannot buy or rent more land (due to the failing land market) and cannot work off-farm (due to the failing labor market).[5]

A priori, however, it is not evident that small farms are more productive than large ones. Smallholders may be less productive because transaction costs prevent them from engaging in markets for credit, inputs, and selling output. For example, Suri (2011) shows evidence consistent with this view, as many Kenyan farmers with high gross returns to hybrid seeds choose not to adopt them because the fixed costs of obtaining seeds (including travel costs) are simply too high. Lacking access to inputs and information, productivity on small farms could be relatively low.

9.3.1 The Inverse Relationship Between Farm Size and Productivity

The inverse relationship (IR) between farm size and productivity has been a lively and contested research topic since Sen's observation, and most early empirical studies supported the IR hypothesis (see Eastwood et al., 2010 for a review). However, this consensus has begun to crumble in recent years. While simply correlating measures of (land) productivity with farm size generally produces negative coefficients, it is not so easy to interpret the evidence. There are three arguments to suggest the IR is more of a statistical artifact than anything. First, Collier and Dercon (2014) argue that analysts have looked for the inverse relationship in the wrong place. Most analyses, they claim, simply compare different types of smallholders—very small to small—and do not include farms of an optimal commercial size. They argue that if larger farms were included in the sample, the sign of the correlation could well be reversed.

Second, there may be omitted variables correlating with both farm size and productivity. For example, farms with very fertile soils can be subdivided in smaller units and still support a family. If analysts fail to control for soil quality in regressions explaining differences in land productivity, then farm size is likely to negatively correlate with productivity. However, the role of omitting (or imprecisely measuring) land quality traits in explaining the inverse relationship appears not very important. Using

[5] However, rather than leveraging this inefficiency and push smallholders to further raise land productivity, a more sensible path forward would be to reduce transaction costs, improve market participation and raise rural welfare by enabling rural families to rent out part of their labor or rent in more land—both of which should attenuate and perhaps eliminate the inverse relationship.

laboratory tests on soil samples, Barrett et al. (2010) show that only a small part can be explained by differences in land quality.

Third, there may be *non-random measurement error* of the independent variable (plot size) or the dependent variable (harvests). Early studies defined land productivity as self-reported production (by the farmer) divided by self-reported plot size. Both production and plot size estimates can be "off", and if the direction of this bias is correlated with farm size, then the result would be a spurious correlation between farm size and productivity. Indeed, this seems to be the case for the harvest variable. Recent work objectively measured harvest levels using crop cuts and constructed a more precise measure of land productivity. Desiere and Jolliffe (2018) find that farmers tend to over-estimate (or at least over-report) their harvest on small plots, and underestimate (under-report) on larger plots. In their data, self-reported yield is negatively associated with plot size, but measures based on crop cuts are positively associated with plot size. Gourlay et al. (2019) address non-random measurement error in both the dependent and independent variables by using crop cut measures for production and GPS-based measured for plot size (also see Abay et al., 2019). They, too, find that models based on farmer-reported data support the inverse relationship, but that this negative correlation disappears when objective measurements are used.[6]

Based on the most recent evidence, therefore, it appears that the empirical basis for the IR is weak at best, and should not be (mis)used to advocate a near-exclusive policy focus on smallholders. As argued by Collier and Dercon (2014), "more flexible organizational models in which not all bets are placed on a single unquestioned mode of production" should be considered. It is evident that consolidation efforts should be based on voluntary participation and not discriminate against certain types of farmers (e.g. female-headed households).

[6] The evidence for biased reporting of farm or plot size is weak. If smaller farmers systematically underreport land area, compared to larger farmers, then their yields would be artificially inflated. However, the empirical basis for such claims is not strong. Carletto et al. (2013) find that replacing farmer estimates of land size by GPS-based measurements only strengthens the empirical basis for the IR.

9.3.2 *Hub and Spoke Systems?*

One alternative might be to develop market-mediated approaches to bunding transactions, that do not rely on continued support. Many outgrower schemes in horticulture fit this bill. A large plantation or processing firm engages in relational contracting with nearby smallholders to augment the supply of crops. them to meet the quality criteria set by the "hub." They also have a guaranteed market for their produce. As we discuss at least briefly in Chapter 3, there are several examples in the literature of such outgrower schemes that work—they tend to help farmers to increase the quality and quantity of their output and improve their livelihoods. Similar outgrower schemes are rarer in the domain of food crops.[7] But maybe they should not be.

A pre-condition for outgrower schemes to work is that farmers cannot "side sell" their crop away from the hub. For the central partner to make upfront investments in smallholder production it needs reassurance that side-selling does not occur. Other traders, who did not make these investments themselves, are always able to "outbid" the central partner and still make a profit. Recall from Chapter 3 that sustained cooperation in relational contracting is supported by the prospect of future gains from continued cooperation. The presence of competing traders limits the space for relational contracting and restricts the bundle of services that can be profitably offered to farmers.

This argument implies policy makers face a complex trade-off. The central firm or hub in an outgrower scheme may be able to absorb the transaction costs associated with offering a bundle of transactions, but only if it has market power on local sourcing markets. Governments that seek to promote the modernization of farming may therefore consider regulating entry in local processing of food crops like wheat, maize, and beans. Smallholders will share in the extra value thus created to secure their continued cooperation, and the extent to which they benefit depends on their alternative options. Too much regulation will turn local sourcing markets into a monopsony, in which case nearly all benefits accrue to the hub—threatening the "inclusivity" of development. Too little regulation may turn local sourcing markets in competitive spot markets, in which

[7] Some outgrower schemes also exist in cereal production. For example, large beer brewers sometimes contract local farmers for a steady supply of grains meeting certain specifications.

case the hub is unable to offer a bundle of transactions to interested smallholders—impeding development.

Even without hub and spoke type systems, large farms appear to have potentially positive spillovers on smallholders. Deininger and Xia (2016) study smallholders near large farms recently established in Mozambique and find positive effects on agricultural practices and input use, though not on income, and in fact smallholders near those farms report perceiving they are worse off than before (even if they are not). In Ethiopia, Ali et al. (2016) also find modest impacts on input use, particularly fertilizers and improved seed. Khadjavi et al. (2021) conduct a trust experiment in villages close to newly established large farms in Zambia and find that trust improves in those villages relative to others farther from large farms; they suggest the result is from improved sharing of public goods within communities. So even if smallholders cannot access output markets developed by large farms, the establishment of large farms can lead to increased input availability, presumably at better prices, and can create social changes.

To summarize this discussion, some land consolidation could be quite helpful in reducing transaction costs in obtaining agricultural products from farms and should not compromise productivity. How consolidation might take place is tricky, although less so in some countries that still have fallow or unused land; in such countries, providing tracts of land for development near smallholders would be helpful if conditions were placed on companies to set up hub and spoke systems. In countries without unused land, land consolidation is more complex. Growing agricultural value chains would imply employment generation, but there is no guarantee that farmers leaving their land would obtain those jobs. More thought is needed before implementing any consolidation plan.

9.4 Approach 3: Infrastructure Investments

The most obvious way to increase market participation would be to reduce transaction costs directly by cutting transport costs. Transaction costs concern the costs of searching for partners and contacting them, negotiations and "contracting," and monitoring and enforcing the contract. In the context of rural Africa, where population density is low and markets are thin, a significant share of these costs is caused by the relatively long distances that have to be traveled for transacting partners to meet. Nearly one billion people worldwide live more than 2 km

from a paved road. Much of the traveling therefore takes place on poor roads, at a very high cost per kilometer traveled. Farmers incur these costs each time they buy inputs, attend a training, or sell output. Few traders visit these places, so local output markets are not very competitive, and farmers may be uncertain about receiving any decent price offer at all. Investments in physical infrastructure could significantly reduce travel costs, increase competition on local markets, and possibly induce a switch from subsistence production to market production (Krishna and Sheveleva, 2017).

Improved road infrastructure facilitates structural transformation by enabling farm households to trade on markets and respond more strongly to market incentives in terms of input use and crop choice (de Janvry et al., 1991). It also enables rural workers to access outside nonfarm jobs, either by moving to areas with manufacturing, or by facilitating the growth of rural firms. As mentioned, labor productivity outside agriculture is higher than in agriculture (Gollin et al., 2014), but high transportation costs are a barrier to the spatial and sectoral reallocation of labor (Bryan et al., 2014). Gollin and Rogerson (2014) show that higher transport costs lead to a larger agricultural workforce and a larger share of households that largely produce for subsistence.

While it is quite intuitive that investments in rural roads promote the re-organization of agriculture and the reallocation of production factors across sectors, to rigorously demonstrate such effects is not a trivial exercise. Assessing the causal impacts of rural roads is difficult due to the endogeneity of road placement. Infrastructure investments imply high costs and potentially large benefits, so the building of new roads is often correlated with economic and political characteristics of locations. Policy makers may target advantaged or disadvantaged regions for new roads, and may try to cater toward specific constituencies as well.[8] This point implies the comparison group for impact analysis for road building should be carefully selected.

The existing research on the impact of (rural) road building in Africa is largely congruent with expectations.[9] Rural road construction is associated with increases in farm and nonfarm economic growth, as well

[8] For example, Blimpo et al. (2013) find that, after controlling for the economic importance of areas and other factors, politically marginalized areas have fewer roads.

[9] Evidence from Asia on the effects of infrastructure is a bit more mixed. For example, Asher and Novosad (2020) study the effect of rural road construction in India and find

as poverty reduction. Wantchekon and Stanig (2015) find that transport costs and access to markets are a strong predictor of poverty across sub-Saharan Africa. Dercon et al. (2009) study the impact of public investments in improving road quality in Ethiopia, and find that access to all-weather roads has large effects on poverty and consumption growth.

Aggarwal et al (2018) take a deeper look at the underlying mechanisms, and consider the relationship between market access and agricultural productivity in rural Tanzania. An additional standard deviation of travel time is associated with 20–25% lower input adoption and output sales.[10] Transportation costs are a large component of the final price (inclusive of trade cost) of fertilizer. According to their model, travel costs are equal to 6% ad-valorem per kilometer of travel, adding up to 40% of total costs when traveling to the closest input dealer. They estimate that halving travel costs, which can be accomplished by paving rural roads, would double adoption of fertilizer. Minten et al. (2013) support the claim that the last mile(s) cost of obtaining inputs can be daunting, and that lowering these costs should be a priority. Farmers living 10 km from the input dealer pay per-unit transaction costs as high as the costs needed to bring fertilizer from the international port to the input dealer—a distance of about 1,000 km.

The beneficial effects of improved road infrastructure on technology adoption in agriculture may extend beyond cost savings on buying inputs and selling output. For example, credit constraints may be eased if farmer profit margins increase or the collateral value of their land increases. And investments in roads lead to other benefits as well; for example, if roads improve, then it becomes easier to obtain health care as well, which could also increase labor productivity (Klemick et al., 2009). The evidence suggests that investments in rural infrastructure can provide a major boost to the modernization of farming. In recent years, the development of rural infrastructure has been a priority for many countries.

that the main effect of new roads is facilitating the movement of workers out of agriculture. They do not document effects on ownership of agricultural equipment, input use, crop choice, production levels, income, or assets, and conclude that, even with improved market access, remote areas still face disadvantages that impede development.

[10] Input usage in the most remote villages is about one-third of that in the least remote villages, and maize sales are only 45% as high.

9.4.1 Technology Infrastructure

As we discuss in the previous chapter, ICT considered broadly is something of a "silver bullet." Yet infrastructure around ICT as well as other technologies can be helpful in reducing transaction costs in agricultural value chains. For example, investments in good cell tower infrastructure will help spread accessibility everywhere; it was the change in the presence of cell towers that Jensen (2007) found led to price convergence in fisheries markets, rather than the presence of phones or price information. Here, government can play an important role by encouraging such private sector investment with subsidies or tax breaks for strategic investments. Such policies have an advantage of being gender neutral, as they do not involve household assets that can be dominated by men.

Second, solar technologies have been improving dramatically and could also play an important role in improving both livelihoods and value chains. For example, Aevarsdottir et al. (2017) show that subsidizing solar lamps with mobile charging points in Tanzania lead to improved outcomes including higher incomes and labor supply. Other RCTs centered around solar electricity access in Africa are ongoing. These projects have not yet used solar technologies in, for example, helping develop cold storage for produce, which can extend the reach or potential of perishable crops. Incentivizing solar firms, including those off the electricity grid, has the potential to reduce transaction costs for farmers.

9.5 Approach 4: Boosting Demand and Improving Regional Trade

One path forward may be for African countries to mimic strategic choices by the majority of rich countries, back in the day when they were trying to develop a fledgling manufacturing sector. The Korean economist Ha-Joon Chang (2002) describes in his book "kicking away the ladder" how developed countries, who themselves once regulated trade and supported infant industries through other means, currently deny African countries access to these same strategies. Frankema and van Waijenburg (2018) observe that few African regimes have the freedom to set their own development goals and choose their own strategies: "donor countries and international organizations have a serious handle on African domestic economic policies." Nevertheless, exclusively focusing on the supply-side of (agricultural) production may be inefficient. Perhaps it is a good idea

to also explore options to boost demand for agricultural commodities, and other goods and services.

What if African countries were free to experiment with industrial and trade policies, and discover what works for them? As argued above, investing in industrialization-based structural transformation may not be an optimal strategy for many African countries—targeting the agricultural and service sector may yield greater prospects for development. But some countries may be able to develop a comparative advantage in *specific* manufacturing sectors, for example, in processing and packaging of agricultural commodities. Prioritizing the development of such sectors may be a viable strategy for long-run development. While the domestic markets of most individual African countries are too small to fully benefit from economies of scale in production, regional blocks of countries could form a union and jointly shield prioritized segments of their manufacturing sector from foreign competition. In addition to import tariffs, export taxes on unprocessed primary goods would help the African processing industry gain a foothold on the metaphorical ladder. Carefully crafted industrial policy could create the conditions under which a process of industrialization-based structural transformation—accompanied by a process of agricultural transformation—is set in motion. In the absence of such policies, this remains a pipedream for most African countries.

In fact, there are already several regional trade agreements in place in Africa that attempt to experiment with ways of regionally shielding the manufacturing sector from other sectors. These agreements, which are sometimes broader than just trade agreements, include ECOWAS (Economic Community of West Africa States), EAC (East African Community), CEMAC (Economic Community of Central African States), and SACU (the Southern Africa Customs Union). Though some of these agreements are quite long-standing (SACU has existed since 1910), one of the main challenges in making these unions more effective is that coordination between countries is actually more difficult to achieve in practice than it is on paper—resulting in high transaction costs. Despite the fact they are free trade zones, goods continue to be checked at the border, leading to hold-ups and requests for bribes from customs officials. Moreover, some countries do not respect the rules of agreements they have made; Nigeria, for example, continues to charge tariffs against other ECOWAS countries. And within regional blocks, countries can have different trade priorities, making it difficult to come to agreements on

tariff rates to charge on imports from external countries into the regional blocs. Brenton and Isik (2012) argue that an important component of any such agreements would be to also integrate services; if, for example, the banking sectors in two neighboring countries lack integration, then other transaction costs in intraregional trade can still be costly. Of course, integrating services also facilitates the process of services-based structural transformation discussed above.

If coordination issues can be solved, with creative use of World Trade Organization (WTO) rules related to agriculture, African governments might be able to promote domestic and regional agricultural markets as well. One example relates to regional development programs within countries, which are considered a "green box" policy.[11] In coastal cities, imported food is often cheaper than domestically produced food; governments of countries with large coastal cities could implement regional development programs meant to assist farmers in competing against those imports. WTO rules also allow for unlimited spending on domestic food aid to consumers. Urban consumers could be given food aid coupons targeted at domestically or regionally produced foods in lieu of foods that tend to be imported; such a policy could also promote other goals, such as targeting healthier food products. While such subsidies should be monitored to ensure that producers remain otherwise competitive, and implementation issues (e.g. related to targeting) will likely emerge, policies that combine demand and supply-side interventions are likely more effective in promoting development than policies that exclusively zoom in on part of the puzzle.

9.6 Closing Words

The majority of the world's poor live in rural areas in developing countries, and directly or indirectly depend on the agricultural sector for their livelihoods. In Africa, agricultural productivity gains are necessary to unlock the potential that agricultural value chains have to increase incomes and generate employment. There has been progress since the turn of the century, but progress has been slow, and sometimes so slow that it drives well-meaning and well-informed experts to despair. That

[11] Green box policies are considered non-distortionary to international trade and so are unlimited, while amber box policies (including direct subsidies) are limited to 10% of total value of agricultural production for LMICs that are WTO members.

said, it is also fair to conclude that there have been several promising developments. Without a concerted effort, the opportunities implied by these developments may go to waste, as that progress must outpace the adverse effects of ongoing population growth and climate change. Nevertheless, we are moderately optimistic about the future. While the debilitating effect of extremely high transaction costs has since long curbed the modernization of African smallholder agriculture, it is possible that the times are finally a-changing.

We believe there are areas of promise that deserve both further study and follow-up. For example, information, access to credit, inputs, insurance, and output markets are complements in the process of agricultural modernization—the value of any specific intervention may increase when market imperfections are addressed simultaneously. In some countries, encouraging the establishment of larger farms or hub and spoke type systems could help reduce transaction costs for traders to buy products. Building more rural roads can reduce also transport costs, as can investing in technology infrastructure, which could improve the reliability of ICT or lead to increased opportunities for farmers, including ways to store their perishable products for a short period of time. In most circumstances, however, doing any of these things in isolation will not accomplish much. A clever combination of these interventions and policies, possibly complemented with interventions to promote domestic or regional demand for key (agricultural) commodities, is required to kickstart structural transformation. The optimal combination differs from country to country. And while elements in this mix can be provided by markets, it seems inevitable that governments will need to play a leading and coordinating role in this process.

However, it is important to remain realistic. Our understanding of how policies and interventions interact is limited. Moreover, history teaches us that periods of rapidly increasing modernization and market integration typically have "winners and losers." When interregional trade in medieval Europe took off, the average person in what is now the Netherlands initially grew shorter—not taller (van Bavel, 2019). Time series measurements of skeletons dug up from church cemeteries reveal that people became poorer during this era of market integration and had less to eat. The "green revolution" in Asia has, across the board, contributed to poverty alleviation and cheaper food for consumers, but here too there were winners and losers in rural areas. Some farmers fell behind urban residents, exacerbating inequality. The industrial revolution

in Britain created the proletariat. As the industrial revolution diffused across Europe, an estimated 50 million Europeans tried their luck elsewhere—for example on the other side of the Atlantic (Frankema & van Waijenburg, 2018). Push factors played a role in this process.

We close this book with what might be considered a speculative and provocative statement. If economic transformations create "losers" in the short- and medium-term, they also imply an opportunity (or obligation) for the rest of the world to engage and offer assistance. In addition to conventional development assistance in various forms, it seems worthwhile to reconsider the policy agenda with respect to international migration. As demographic realities in the West will necessitate shrinking labor markets, opening a "safety valve" to the younger populations of African countries through regulated migration could be a final way to improve African value chains and maintain living standards in the West at the same time. To make such policies palatable to European and American polities, migration could be organized as a temporary opportunity for selected individuals (who return after a fixed period of time), with restricted opportunities to benefit from the welfare system or participate in electoral processes. Such policies would kill multiple birds with one stone. They provide incentives for Africans to invest in human capital accumulation (to earn higher wages in foreign labor markets), they generate flows of remittances into the hands of potential African entrepreneurs, they foster the transfer of knowledge and technology, and they help African politicians reduce the pressure to create jobs for swelling populations at home. Exporting service providers, rather than services directly, enables Africans to engage in global transformation processes, and provides an impetus to domestic development by facilitating a process of structural transformation 2.0.

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