Enabling Trade: From Farm to Fork

In collaboration with Bain & Company

January 2014
The Context of Enabling Trade: From Valuation to Action

The World Economic Forum’s Enabling Trade initiative works to reduce practical barriers to trade. The initiative’s 2013 report, *Enabling Trade: Valuing Growth Opportunities*, indicated that reducing supply chain barriers could increase the world’s gross domestic product (GDP) by over US$ 2.5 trillion. Building on the momentum of this finding, the 2014 report looks at how to accelerate reform. It concentrates on sectoral, regional and functional areas where the positive impacts of supply chain facilitation could be greatest, or where momentum for change is building. The four sections comprising the report are:

- Enabling Trade: From Farm to Fork
- Enabling Automotive Trade
- Enabling Trade in the Pacific Alliance
- Enabling Smart Borders

Each section is designed to be stand-alone, but the reader is nonetheless invited to become familiar with the broader Enabling Trade initiative.
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Enabling Trade: From Farm to Fork
Cutting food loss and waste is a great way to drive sustainability and development. It is a crucial step on the way to providing quality, nutritious food to a growing global and urban population. Supply chain improvement is an important tool in this effort. We see opportunities for businesses to collaborate in building better links between farmers and consumers, and for governments to ease trade and supply chain barriers in many forms, creating possibilities for growers and affordable choices for customers. To realize these benefits, we need improved communication between stakeholders, and an enhanced understanding of where food loss and quality reduction occur as a result of supply chain bottlenecks. We have embarked on concrete initiatives to smooth the path from farm to fork, and hope to contribute to a virtuous cycle of improvement linking farmers, transporters, processors, regulators, retailers and consumers.
Executive Summary

Getting agricultural goods to market more efficiently offers huge potential benefits across social, environmental and economic dimensions. Through a combination of case studies and secondary research, this report highlights the most significant supply-chain-related barriers faced by different actors, including their impact, and suggests potential solutions.

Food loss has significant negative social, environmental and economic impacts.

Globally, up to 1.3 billion tons of food is lost or wasted each year around the world, representing a massive set of inefficiencies in terms of environmental impact, hunger alleviation and economic development. In the case studies research as part of this report, estimates of food loss ranged between 10% and 40%. Food loss depresses incomes along agricultural value chains, and can have particularly devastating impact on smallholder farmers. It also drives up the end prices of food, restricting access for poor consumers and contributing to hunger and malnutrition. Lost or wasted food drives approximately 4% of world energy consumption,2 20% of freshwater consumption,3 and uses 30% of the world’s agricultural land area. In 2007, the total economic cost of food loss and waste was estimated at US$ 750 billion.4

Reducing food loss will require a global effort to improve agricultural supply chains.

In North America and Europe, 40% of losses occur at the household level after consumers purchase food. In sub-Saharan Africa and South/South-East Asia, however, only 6% of food loss and waste occurs at this stage. The remaining 94% is a result of inefficiencies in the supply chain, from harvesting through distribution.5 In the past 30 years, over 95% of horticultural development funding has gone towards pre-harvest efforts such as yield increases, while less than 5% has gone to postharvest improvements.6 This flow of resources has driven important advancements in production. Now, stakeholders have a direct interest in ensuring that the increased production resulting from their efforts enjoys a smooth and efficient route to market.

Specific solutions to food loss vary across value chains, but achieving tipping points of economic efficiency helps across the board.

In the three case studies covered in this report, losses occur in different percentages at varying stages in the value chain. However, one thing seems consistent across value chains: the lower the value of the food, the more susceptible it tends to be to loss. Reducing food loss requires resources, which must be outweighed by the expected benefits of loss reduction. The more profitable a crop is to all stakeholders along the value chain, the more resources that are available to ensure it gets from farm to fork.7

Three main levers exist to improve economic efficiency of agricultural value chains: reduced volatility of supply and prices, increased end-market prices and reduced costs. If investments do not allow farmers, companies and, subsequently, entire value chains to reach sustainable profitability by pulling these levers, governments will expend a huge amount of energy and resources with no momentum developed. An example is the low success rate of efforts to introduce grain storage technologies in sub-Saharan Africa; implementation was often done without a clear path to financial sustainability, and the focus on enhancing storage often overlooked economic incentives.8

If, on the other hand, policy-makers carefully coordinate food loss reduction efforts as part of a broader strategy to promote promising, high-potential value chains, tipping points of profitability can be reached. When this happens, the private sector is able to reinvest its retained earnings into the industry, and a virtuous, self-promoting cycle of development is triggered.

Reducing supply chain barriers contributes significantly to achieving economic efficiency.

Supply chain barriers directly impact economic efficiency. The World Economic Forum’s 2013 report Enabling Trade: Valuing Growth Opportunities estimated that reducing just a few supply chain barriers halfway to the world’s best practices could increase global GDP by 5%. The potential gains are even higher in the developing world: 12% in sub-Saharan Africa and 8% in South and Central Asia. Given the characteristics of agricultural goods and their susceptibility to supply chain barriers, the value at stake for the agricultural sector is likely even higher. For example, agricultural goods are extremely time-sensitive. Even for less perishable crops like cereals, each day of delay from harvest to market equates to a 0.8% tariff equivalent, versus 0.6% for textiles and 0.3% for pharmaceuticals.9
Impacts of the four types of supply chain barriers are felt in various ways across agricultural value chains:

**Market access.** Because of their health risks, agricultural exports are subject to additional regulatory controls. Overly strict standards are sometimes used as a form of protectionism, and lack of information about requirements and how to meet them mean that high-quality markets are often out of reach for developing-country suppliers. Overcoming market access barriers requires collaboration among governments, downstream actors and farmers to implement measures such as improved transparency and capacity building.

**Transport and communications infrastructure.** Transport costs are the most important challenge cited by developing-country suppliers in connecting to global value chains.\(^9\) The impact of poor transport infrastructure is especially pronounced for agricultural goods because of inherent characteristics such as low value-to-bulk ratios, fragility and perishability. Initiatives to improve underlying infrastructure are typically government-led, but private-sector involvement is critical in ensuring efficient allocation of resources along key transport corridors. Regulations impacting transport services should be designed to help enable competition, scale and standardization. Development of technologies to facilitate efficient movement and storage of crops is also important, and must be tailored to the constraints of specific value chains. Creative ownership models can help to overcome the challenges of mobilizing capital for investment in these improved technologies and logistical arrangements.

**Border administration.** Border delays have significant impacts on the movement of food, especially in developing countries. For example, the Burundi–Rwanda border adds the equivalent of 174 kilometres (km) in terms of increasing food prices; the Democratic Republic of Congo–Rwanda border adds a staggering 1,600 km.\(^{10}\) Redesigning border processes through streamlined government agencies, information and communications technology (ICT), and risk-based screening offer promising mechanisms to reduce delays; however, implementation requires overcoming vested interests, and strong political leadership is needed to create change.\(^{12}\)

### Business environment
Private-sector investment in commercial farming, vertical integration, transport services, food processing and large-scale retail networks allow for better logistics, improved technology and capacity building, if implemented well. Governments can take steps to create an enabling regulatory environment to facilitate these structural improvements. Modernization should be accompanied by inclusive planning, involving local stakeholders and helping those producers and traders with less competitive potential to find alternative opportunities.

### Solutions differ across value chains, so a thorough supply chain assessment is a pivotal part of taking action.

Some solutions fall primarily under the purview of the public sector (e.g. infrastructure improvements, redesigned border processes), and tend to have a positive impact across multiple crops. Others are primarily private-sector-led (e.g. farmer training, logistical arrangements), and tend to be value-chain-specific. Almost every supply chain improvement, however, can only be implemented successfully through a collaborative, data-driven process:

1. **Prepare.** Tackling supply chain barriers in a given country starts with establishing a group of public and private stakeholders with a clear governance structure. For example, the World Economic Forum’s New Vision for Agriculture initiative and Grow Africa platforms could be expanded to include stakeholders from the supply chain and transport community, as well as government representatives from ministries of trade and transport. To facilitate focused use of resources towards achieving tipping points, stakeholders should align on trade routes and crops with the highest potential.

2. **Diagnose.** The flow of goods along these high-priority trade corridors or value chains should then be mapped, from inputs to cultivation, to distribution and consumption. Interviews can help to develop first hypotheses of supply chain bottlenecks. Their magnitude can be thoroughly assessed by gathering cost, time and food-loss data while travelling along the corridor with shipments of agricultural goods. Much of the value comes by taking an integrated look across the whole chain and understanding the interactions among stakeholders.

3. **Plan.** For each barrier identified during the diagnostic phase, the core team can then define a long list of potential actions for reducing costs. A cost/benefit analysis of this list is important to ensure that resources are allocated where they will have the biggest impact.

4. **Mobilize.** A project manager for improving a value chain should be chosen from a stakeholder group that is trusted by all stakeholders. Clearly-defined owners from various stakeholder groups should take responsibility for each initiative. Subowners should be assigned and milestones set within each initiative, and transparent mechanisms for tracking progress should be put in place.

Public-private collaboration is critical throughout this process, as policy reforms and infrastructure investments should aim to maximize benefits for the private sector, such as providing as much regulatory consistency as possible.

Through coordinated action, leaders from various communities can share their expertise and resources to reduce supply chain barriers in agriculture, triggering increased economic efficiency and a virtuous cycle of investment. In the long term, this will contribute to increased incomes along the value chain, improved food security and increased environmental sustainability.
1. Introduction

With food prices on the rise and food security challenges being faced by a number of developing regions (Figure 1), the question of how to feed growing populations is a key concern of the international community. Efforts to increase food production in developing countries have achieved important successes through collaborative multistakeholder platforms, including the World Economic Forum’s New Vision for Agriculture initiative and Grow Africa partnership (Box 1). However, in a world where scarce resources and climate-change challenges curb the potential for continued production increases, post-harvest food-loss-reduction has a key role to play in achieving food security.

Despite the importance of reducing post-harvest losses, governments and donors have directed limited resources towards this goal. In light of this, the Forum’s Global Agenda Council on Logistics & Supply Chain Systems has championed the research for this report. Linking the Forum’s Enabling Trade and New Vision for Agriculture initiatives, as well as the Grow Africa partnership, this report aims to raise global awareness and understanding of the impact that supply chain barriers have on the movement of food, particularly in developing countries. It attempts to answer several questions: What are the impacts of supply chain barriers on three specific value chains and, by extension, the agricultural sector more generally? What costs do they impose, and what is their contribution to food loss? What solutions exist, and what is required for successful implementation of those solutions?

Improving agricultural supply chains will require increased dialogue and collaboration among leaders from government, civil society and the private sector. As such, this report is targeted towards ministries of agriculture, trade, transport, health and finance, as well as business leaders from agribusiness, logistics, transport and retail communities. All of these stakeholders have an important role to play in facilitating the efficient movement of food on its journey “from farm to fork”.

Box 1: The World Economic Forum’s New Vision for Agriculture initiative and Grow Africa partnership

The Forum’s New Vision for Agriculture initiative is a global platform that facilitates public-private collaboration to realize a vision of agriculture as a driver of food security, environmental sustainability and economic opportunity. The initiative collaborates on a global level with the G8 and G20, and has catalysed country-level, public-private partnership initiatives in 14 countries across Asia, Latin America and Africa. A regional partnership is jointly convened with the African Union and the New Partnership for Africa’s Development (NEPAD) to accelerate investments and transformative change in alignment with the national plans of African countries. The New Vision for Agriculture initiative is led by a broad network of 33 global companies in collaboration with 14 governments, working with international organizations, civil society, academic and farmers’ organizations worldwide to advance an action-oriented agenda. Together, these efforts have mobilized over US$ 5 billion in investment commitments and are projected to engage over 13 million smallholder farmers in the next three to five years.
2. Scope and Approach

Scope
This report aims to understand how supply chain barriers affect agricultural value chains. Geographic focus is on sub-Saharan Africa and South Asia. These regions were chosen based on agriculture’s significance to their economies, the potential impact of supply-chain-barrier reduction as identified in the 2013 *Enabling Trade: Valuing Growth Opportunities* report, and the magnitude of food losses as quantified by the Food and Agriculture Organization of the United Nations (FAO). Within these regions, crop/country combinations (i.e. “value chains”) were selected for case studies. In order to facilitate access to contacts and data, priority was given to value chains where Forum partner companies had operations. Additional criteria for crop selection were the percentage of waste as reported by the FAO, and the potential to alleviate hunger or contribute to economic development through import substitution or exports. Additional criteria for country selection were government willingness to promote change, and the ability to leverage multistakeholder partnerships supported by the New Vision for Agriculture initiative and Grow Africa partnership, in collaboration with the African Union and NEPAD.

Three case studies are included in this report:
- Nigerian Cassava Flour: Broadening Value Chains for Traditional Crops
- Indian Tomatoes: Adding Value and Reducing Losses through Processing
- Kenyan Avocados: Connecting to High-value Export Markets

Box 2: Impacts of Tariffs on Global Agricultural Trade Flows

Tariffs continue to be a major factor restricting world agricultural trade. Average global tariffs for agricultural goods are more than three times higher than for non-agricultural goods. Some agricultural tariffs are as high as 800%, and in no other area does domestic support distort international markets to the extent it does in agriculture. In 2011, member states of the Organisation for Economic Co-operation and Development (OECD) provided US$ 252 billion in agricultural support and protection. World Trade Organization (WTO) trade rules tolerate export subsidies in the agricultural sector, even though they have long since been prohibited for other goods.56

The case against tariffs has two elements: distortions created within a protected country by higher domestic prices, and costs imposed on other countries by decreased exports and lower world prices. Export subsidies drive similar but inverse distortions.

In some cases, tariffs or export subsidies may provide the short-term boost needed to foster sector development and trigger a virtuous cycle of private-sector investment. However, these distortionary mechanisms are too often used as long-term forms of protectionism or subsidization. Continued international trade negotiations are thus critical to enabling greater overall efficiency in global agricultural markets.57

Approach
The conclusions of this report draw from the findings of the three case studies, which are based on a combination of primary and secondary research. For each case study, lead firms provided access to contacts and data along the value chain. In collaboration with these firms, the authors conducted interviews (and, where possible, field visits) to identify the most significant supply chain barriers restricting the movement of goods along the value chain and their contribution to excess costs, including food loss. A total of 80 interviews were conducted. The authors are very grateful for the contributions of the lead firms to the respective case studies: A.P. Møller-Maersk (Kenyan avocados), Flour Mills of Nigeria (Nigerian cassava flour), and Unilever and CHEP, a Brambles Ltd company (Indian tomatoes).
3. Case Study Highlights

The following summaries provide highlights from case studies, along with recommendations for initiatives that could be further explored for implementation in the short and long term. Further detail is provided in the Annex to this report.

Nigerian Cassava Flour: Broadening Value Chains for Traditional Crops

Nigeria is in the early stages of an agricultural transformation. Cassava is one of six target crops identified by the Ministry of Agriculture for special consideration, given Nigeria’s position as the global leader in cassava production and the many industrial end uses for the crop. Current production, however, is used only for traditional foodstuffs, aside from a few first movers into value-added products such as high-quality cassava flour (HQCF). Food loss is lower in the HQCF value chain (about 21%) than in the traditional value chain (about 36%), the latter driven by traditional processors’ rejection of small or woody tubers and the perishability of the end product. Achieving profitability in these nascent value chains, however, will require overcoming the logistical challenges of smallholder production networks and cassava’s extremely low value-to-bulk ratio, along with transport infrastructure challenges. Two potential solutions are highlighted here. Implementation of both will require collaborative effort among the public, private and donor-funded sectors.

- **Quick win:** One promising solution is the creation of collection points, allowing smallholders to consolidate loads for long-distance transport. The public-private Cassava Development Corporation (CDC) has been formed to drive progress in the industry. The implementation of collection points could be a way for the CDC to demonstrate early results and build momentum for tackling bigger issues, like the development of large-scale farming.

- **Long-term priority:** In addition to cassava-specific supply chain barriers, an organization is being formed to address poor efficiency of transport along Nigeria’s Lagos-Kano-Jibiya (LAKAJI) corridor, the main artery for goods flowing between ports and markets in Lagos and agricultural production zones further north. An initial donor-funded assessment identified considerable potential for reduction of costs and delays along this corridor, beginning with accelerating efforts to rehabilitate the nation’s rail network. Improving this underlying infrastructure will be a key enabler to achieving multiple tipping points that will drive continued private investment in Nigeria’s agricultural sector.

Indian Tomatoes: Adding Value and Reducing Losses through Processing

Tomatoes present a clear picture of the logistical challenges facing India’s fresh-produce sector. Although India is the world’s second-leading tomato producer, the supply chain is extremely fragmented, the processing industry is underdeveloped and losses during harvest, transport and at “mandis” (i.e. local marketplaces) are around 25-30%. A number of supply-chain-related barriers contribute to these losses and to overall inefficiency in the sector. The path to an efficient supply chain is long, however, as many solutions that are effective in developed countries such as the US and Spain are challenging to implement in the Indian context (e.g. cold storage, contract enforcement).18 Progress will require public-private collaboration, and two of the potential initiatives identified in this case study are highlighted here for further exploration and action:

- **Quick win:** Plastic crates significantly reduce losses during transport, and are now widely used in India. Further improvements in packaging are possible, along with associated logistical improvements. Unilever and CHEP are collaborating on a pilot to test these solutions, evaluating their impacts on food loss and overall cost competitiveness.

- **Long-term priority:** The processing industry generates fewer losses and higher yields thanks to the shorter tomato journey and the close working relationship with farmers. The Indian government should continue to work with the private sector to promote the development of this value chain. First movers in processing and established agri-business companies can help to provide training and access to inputs for farmers, demonstrating the benefits of cultivating tomatoes for processing. In the long run, the fresh and processed value chains could be completely separate.

Kenyan Avocados: Connecting to High-value Export Markets

A number of supply chain improvements have enabled Kenyan avocados to be profitably exported to high-value markets in the European Union (EU). Along the major trade corridor, the Kenyan government made targeted infrastructure improvements (e.g. Nairobi-Mombasa road, Mombasa port capacity and power), creating an enabling environment to promote private-sector investment. Exporters and transporters followed suit by introducing new technologies and capacity building. Their investments in refrigerated containers and covered trucks, along with support for smallholders to acquire export certifications, helped reduce quantitative and qualitative food loss and granted access to new markets. As a result, exports doubled from 10,000 metric tons (mt) in 1999 to 20,000 in 2003. More recently, exports have declined due to quality-related challenges, largely owing to unlicensed “briefcase exporters” and missed trans-shipments in Oman. In addition to loss of value, these and other challenges contribute to food losses of around 15% in the export value chain. Overcoming these hurdles will require new forms of collaboration among all stakeholders – government, farmers, exporters and shipping companies. The Kenyan avocado experience illustrates that value chains must be able to react to changes in market dynamics in order to maintain a virtuous cycle. Two high-potential initiatives have been identified:

- **Quick win:** A promising initiative is to better inform importers about what they really purchase. Key stakeholders (e.g. exporters, government, importers) could agree on a process to validate the quality of products sold, through grading or certification. Unofficial exporters could then sell their products to less quality-sensitive customers without affecting the reputation of higher-quality exporters and the Kenyan origin overall.

- **Long-term priority:** Shipping companies and port authorities from Mombasa and Salalah, Oman could collaborate further and exchange more information on potential delays and sensitivity of shipments. When a risk of trans-shipment is high, specific actions or fast-track processes can be put in place. This would minimize the number of missed trans-shipments in Oman.
4. Benefits of Improved Agricultural Supply Chains

Magnitude and impacts of food loss and waste

In a world where 12.5% of the population suffers chronic undernourishment, the fact that 30% of food produced for human consumption is lost or wasted between farm and fork is difficult to comprehend (Box 3). Reducing these losses would have significant social, environmental and economic benefits.

Box 3: Food loss versus food waste

“Food loss” refers to food that spills, spoils, incurs an abnormal reduction in quality such as bruising or wilting, or otherwise gets lost before reaching the consumer. Food loss typically occurs at the production, storage, processing and distribution stages of the food value chain, and is the unintended result of agricultural processes or technical limitations in storage, infrastructure, packaging and/or marketing.

“Food waste” refers to food that is of good quality and fit for human consumption, but does not get consumed because it is discarded – either before or after it spoils. Food waste typically, but not exclusively, occurs at the retail and consumption stages in the food value chain, and is the result of negligence or a conscious decision to throw food away.

Reduced food losses would contribute to global food security. The world faces a 6 quadrillion kilocalorie-per-year gap between food available today and that needed in 2050. If loss and waste were cut in half, the food saved would cover 22% of this gap, or enough to feed 500 million people. Furthermore, access to food is often overlooked as a key driver to reducing hunger and malnutrition. Reducing food loss would increase incomes for participants along the value chain, thus increasing their purchasing power. It would also help to bring down the cost of food to the end consumer and thus increase access.

Managing food losses has an important link to environmental benefits. If food loss were a country, it would rank third in carbon emissions after only the United States (US) and the People’s Republic of China (China). Produced but uneaten food occupies close to 30% of the world’s agricultural land area. While it is difficult to estimate impacts on biodiversity at a global level, food waste compounds the negative externalities that monocropping and agricultural expansion into wild areas create on loss of biodiversity, including mammals, birds, fish and amphibians.

Furthermore, food loss and waste drive economic losses of US$ 750 billion per year. These costs are borne to different degrees by a variety of actors, including farmers, transporters, processors, retailers and consumers. In developing countries, smallholder farmers are particularly vulnerable to financial losses as a result of food loss, as they often depend primarily on the cash generated from harvests to feed their families. Of the developing world’s 5.5 billion people, 1.5 billion live in smallholder households.

Box 4: Tesco’s Approach to Food Waste Reduction

Food waste is outside the scope of this report, as it is primarily an issue in developed countries and is already the focus of extensive research and prevention efforts. However, its magnitude is worth noting: food waste at the consumer level in industrialized countries (222 million tons) is almost as high as the total net food production in sub-Saharan Africa (230 million tons). Retailers are playing a key role in efforts to reduce waste. For example, Tesco in the UK has begun tracking food loss and waste in its value chains. Its figures show that 68% of bagged salad is wasted, and 35% of this waste occurs in the home. In addition to supply chain initiatives to reduce upstream losses, Tesco is taking steps to reduce consumer-level waste. The retailer has announced an end to multi-buy offers on large bags of salad, and is developing mix-and-match promotions for smaller bags. In-store tips are shared with consumers on how to store apples and bananas to extend their shelf life, along with creative ways to use leftover bread.
Supply chain barriers are key contributors to these losses, both directly and from consuming resources that could otherwise be invested in loss reduction. The Forum’s annual Global Enabling Trade Report defines barrier reduction in terms of “institutions, policies and services facilitating the free flow of goods over borders and to destination”. This definition also includes the movement of goods within the domestic economy, which is often one of the greatest challenges facing agricultural value chains in developing countries.

The Forum’s Enabling Trade Index organizes supply chain barriers into four main categories (Figure 3). These barriers drive food loss in various ways, in various value chains. For example:

- Market access: If containers of South African oranges arriving at US shores exceed maximum pesticide limits, and cannot be redirected to an alternate market, they must be disposed of.\(^{20}\)

- Border administration: Tomatoes traveling by truck across West Africa can be delayed for hours at border crossings, resulting in up to 30% loss in firmness, and many tomatoes being unsuitable for sale upon arrival at markets.\(^{31}\)

- Telecom and transport infrastructure: If a truck of Nigerian cassava breaks down in an area without cell phone reception, within 72 hours the roots will be unsuitable for human consumption.

- Business environment: Tomato value chains that include processing can reduce losses significantly versus fresh chains, but lack of reliable access to power and water can prohibit processors from investing in a country.

Such instances of physical food loss make a dramatic impression because the inefficiencies are so tangible. However, the costs that supply chain barriers impose on agricultural value chains are far greater than the costs of physical losses alone. A number of factors influence the degree to which supply chain barriers affect the end cost of a specific type of product. Due to their inherent characteristics, agricultural goods are particularly vulnerable to supply chain barriers (Figure 4). Furthermore, access to agricultural inputs is also restricted by these barriers (Box 5).

Reducing agricultural supply chain barriers

Big inefficiencies suggest big opportunities for improvement. The Forum’s 2013 Enabling Trade: Valuing Growth Opportunities report estimated that reducing even a restricted set of supply chain barriers halfway to global best practice would yield a 5% increase in global GDP. The potential gains are even higher in the developing world: 12% in sub-Saharan Africa and 8% in South and Central Asia. Given the characteristics of agricultural goods and their susceptibility to supply chain barriers, the value at stake for the agricultural sector is likely even higher. On top of this economic potential, the considerable social and environmental benefits of reduced food loss make supply-chain-barrier reduction in agriculture a huge opportunity.
Box 5: Impacts of Supply Chain Barriers on Inputs

Lack of access to high-quality inputs (e.g., seeds, fertilizer, pesticide) is a key driver of low agricultural yields in many developing countries. Efforts to reduce supply chain barriers should also aim to facilitate the movement of these inputs. For example, the use of fertilizer nutrients per hectare in Africa is less than 10, relative to about 100 in South-East Asia and South America. Low usage is partially driven by high costs due to supply chain barriers. Inland transport costs are the single largest cost item for fertilizer in Africa, accounting for 20% to 40% of farm gate costs. Successful barrier reduction is possible: Kenya stands out as a country that has liberalized and expanded fertilizer markets, resulting in higher rates of fertilizer use and yield increases of up to 20%. Liberalization efforts would also help to increase access to improved crop varieties and seeds through regional trade.

5. Tipping Points: Saving Food through Economic Efficiency

Across many different value chains, one thing is consistent: the less that food is worth, the more susceptible it is to losses. Reducing food loss requires resources, either in the form of capital expenditures or increased operating costs. These costs must be outweighed by the expected benefits of loss reduction. Therefore, the more profitable a crop is, the more resources that are available to ensure it makes its way from farm to fork.

Three main levers exist to improve the economic efficiency of agricultural value chains (Figure 5). Supply chain barriers influence each of these levers in different ways:

1. **Reduced price volatility**: Supply fluctuates dramatically in agriculture, particularly in developing countries. In years of oversupply, prices drop. As a result, the cost of harvesting and getting food to market can exceed potential revenues. Solutions to reduce volatility include stable policy and reduced export barriers. For example, when Zambian maize experiences a “bumper harvest” of 30% above average, closed borders drive a 50% reduction in prices, whereas open borders result in only a 26% drop.

2. **Increased prices**: Aside from volatility, low average prices can also drive food losses. European importers of Kenyan avocados lack visibility on the level of quality they will receive, due to the existence of unofficial exporters. As a result, they apply a price discount to the origin in general. If an improved system of grading were introduced, price segmentation could be created.

3. **Reduced costs**: The journey that Indian tomatoes take from farm to fork is extremely fragmented, involving regional and local marketplaces. The high number of touchpoints and middlemen add costs along the way, meaning that margins for each player become slim. As a result, investment has been less available for technologies such as plastic boxes, which reduce transport losses by up to 75%.

It is important to put food-loss-reduction efforts into the broader context of economic efficiency. As governments and companies have limited resources, investments to improve supply chains must be made in ways that will maximize the long-term positive impact on society.

If investments do not allow companies and, subsequently, entire value chains to reach sustainable profitability, governments will expend enormous energy and resources with no momentum developed.

One example is the low success rates of efforts to introduce grain storage technologies in sub-Saharan Africa. Implementation was often done without a clear path to financial sustainability, and the focus on enhancing storage often overlooked missing economic incentives.

If, on the other hand, policy-makers carefully coordinate efforts as part of a broader strategy to promote promising, high-potential industries, tipping points of profitability can be reached. When this happens, the private sector is able to reinvest retained earnings into the industry – including loss reduction efforts – and a virtuous, self-promoting cycle of development is triggered (Figure 6).
A successful example is Kenyan avocados. In the early 1990s, the Kenyan government liberalized the fertilizer market, leading to a 14 percentage-point increase in fertilizer use among smallholder farmers. Resulting yield increases, combined with government investment in the Nairobi-Mombasa highway and the provision of reliable power at Mombasa ports, helped to allow global shipping companies to invest in and introduce refrigerated containers. Beginning the cold chain at the packhouse gate increased the shelf life of exported avocados, allowing access to distant, high-value markets in Europe. Exporter profits generated from higher-end market prices are now being reinvested to help smallholder farmers improve product quality, driving further price appreciation.

Similarly, coordinated efforts in infrastructure, financing, policy and capacity-building helped to drive agricultural transformations in countries such as Brazil and China in recent decades. Implementation of the solutions proposed in the following sections should thus take place as part of a broader strategy to achieve tipping points within a naturally competitive agricultural sector. The work of the Forum’s New Vision for Agriculture initiative and Grow Africa partnership provides an example of how public- and private-sector actors can work together to create and implement this type of broader agricultural transformation strategy.
Endnotes


7. Even if solutions to food loss meet a minimum rate of return, other factors can inhibit their implementation: lack of access to cash, low appetite for long-term investments, lack of coordination/aligned incentives, and lack of knowledge.


12. See “Enabling Trade: Enabling Smart Borders” for additional detail on best practices for implementation of border process improvements.

13. Please see the World Economic Forum website for additional information on the New Vision for Agriculture and Grow Africa initiatives.


18. On field research conducted, November 2013.


6. Case Studies
1. Agriculture in Nigeria

In the 1960’s, Nigeria was a major exporter of groundnuts, cotton, cocoa and palm oil. In the decades following independence, the economy became increasingly centred on petroleum. Agricultural growth stagnated due to lack of investment and enabling policies. In 2001, the government launched initiatives to promote the sector’s development, triggering 11% annual growth in agricultural GDP over the following ten years. Despite this growth, the country still imports the vast majority of staple foods such as rice and wheat. In 2012, the Federal Ministry of Agriculture and Rural Development (FMARD) announced an updated approach to agriculture through the Agricultural Transformation Agenda (ATA). The programme aims to support the production of target crops through a favourable policy environment, access to finance and land, improved infrastructure and tax benefits.

2. Cassava in Nigeria

Cassava is one of six target crops receiving ATA support. Nigeria’s soil and climate are well suited to cassava cultivation, and the country is already the world’s largest producer of the crop, with 2011 production estimated at 52 million mt. Brazil, the world’s second-largest producer, produced only half that amount. The Nigerian cassava production landscape is dominated by thousands of smallholder farmers, with an average farm size of two hectares. Approximately 95% of the cassava produced in Nigeria is processed by local small businesses into traditional West African staple foods like garri. These foods are a key part of local diets – in fact, cassava makes up 40-50% of calories consumed in southern and central Nigeria.

Cassava is a versatile crop; its starch can be used in a number of value-added products, beyond traditional foodstuffs (Figure 7). The main focus of the ATA’s cassava programme is to facilitate the development of these “industrial” value chains. A small number of private-sector-led processing facilities for HQCF, starch and ethanol have been constructed in recent years. This case study focuses primarily on the development of the HQCF value chain. The lead partner company for this case study, Flour Mills of Nigeria, recently acquired a flour processing subsidiary called Thai Farms International (TFI). Through this connection, data and interviews with farmers, transporters and customers were obtained along the flour value chain during a three-week field visit to Nigeria.

3. High-quality Cassava Flour

HQCF (so-called to distinguish it from less pure, traditionally-processed cassava flours) can supplement wheat flour in bread, pasta and confectionery. Due to differences in its structural composition, however, it can only be used in limited percentages before the quality of the baked goods suffer (e.g. bread does not rise, biscuits crumble). In 2005, the government introduced legislation obligating wheat flour millers to incorporate 10% cassava flour in their wheat flour. Enforcement of this legislation largely failed due to insufficient HQCF production capacity, unreliable quality and high costs.

Figure 7: Alternative End Uses for Cassava

| High-quality cassava flour | - Can be used as a supplement for up to 5% of flour in bread (or more, with special additives)  
| | - Can be used in cookies and biscuits in larger amounts  
| Starch | - Competes with maize starch  
| | - Industrial uses include food, adhesive, dextrin  
| Sweeteners | - High cassava fructose syrup, glucose, sorbitol  
| | - Used in soft drinks and juice industries  
| Dried chips | - Used for ethanol production and animal feed  
| | - Reduced perishability for transport  
| Ethanol | - Fermented and distilled cassava  
| | - Industrial uses include fuel, beverages, industrial alcohol  

Production capacity has since grown, and bread and biscuit makers are increasingly incorporating HQCF. However, producers still struggle to profitably compete with flour made from imported wheat, despite the 15% wheat tariff protecting the nascent HQCF industry. A number of supply chain barriers contribute to this cost differential.

4. Impacts of Supply Chain Barriers and Potential Solutions

The HQCF value chain is nascent, fragmented and informal. Farmers harvesting cassava can choose to sell to “gari ladies” (local women who process tubers into traditional foods) or to industrial processors. This decision is taken at the time of harvest, typically without long-term contracts. Again, most cassava farmers own only a few hectares of land; the few commercial farms that exist, however, tend to supply industrial processors and are particularly relevant for the HQCF value chain. After harvesting, tubers are transported to the processor in trucks. Cassava tubers must be processed within 72 hours of harvesting due to rapid fermentation that renders them sour and unfit for consumption. As a result, harvesting typically only occurs once a guaranteed buyer is identified. This precaution helps to avoid food loss during transport; such loss only occurs in rare cases (e.g. a truck breaks down in an area without mobile phone coverage).

Upon arrival at the HQCF processing facility, the roots are weighed and their starch content measured. After processing, the HQCF is bagged and sent to customers (mainly confectionery producers). End markets are concentrated in the south of Nigeria, in and around the major cities of Lagos, Ibadan and Abuja.

Transport and Communications Infrastructure

Cassava roots are made up of only 15-20% starch; the rest is water, fibre, peels and skin. Although some waste by-products can be sold as animal feed, the starch is the most valuable component. As a result, the tubers have an extremely low value-to-bulk ratio, so any reduction in transport cost will have a relatively high impact on value chain profitability.

Reduced distances

Reducing the distance between farm and factory is one of the biggest long-term levers for improving HQCF profitability. One way of achieving this is through vertically-integrated farms and factories, which is discussed in further detail in the section on business environment. Whether vertically integrated or not, there is an optimal size for cassava processors, which balances the operational benefits of scale with the cost of transporting tubers across long distances. Finding this balance is a critical aspect of building a profitable Nigerian cassava industry, and should be considered when constructing any new processing plants.

Improved logistics

Aside from these long-term approaches, short-term solutions are available to reduce the cost of transporting product to existing HQCF processors such as Thai Farms International (Figure 8). Farmers typically pay for transport themselves, thus reducing their willingness to send tubers across long distances and encouraging them to sell to local gari processors. In turn, this barrier reduces industrial processors’ ability to procure the quantity of raw materials needed to maintain adequate capacity utilization (large industrial cassava processors’ utilization ranges from 20% to 50%).

Given producer cost structures, current HQCF market prices and average raw-tuber prices from August 2012-August 2013 (US$ 82/mt), industry profitability would be within reach if more raw materials were accessible.

Figure 8: Cassava Sourcing Footprint of Thai Farms International: Limited to a 200-km Radius

Potential suppliers can be divided into local smallholders, mid range smallholders and distant commercial farms. For local smallholders and distant commercial farms, creative solutions have been found to reduce transport costs and make the transaction profitable for farmers. For mid range smallholders, a solution has been identified but not yet implemented (Figure 9).

Local smallholders: vertically integrated transport

Initially, farmers were expected to arrange their own transport to processors through third parties. However, the additional margins charged by transporters added costs to the value chain, making it more difficult to compete with local gari producers. Consequently, some large Nigerian processors have acquired a small number of trucks to transport roots. Farmers still pay for the transport, but on an “at-cost” basis.

Distant commercial farms: backhauling

A huge amount of cargo enters Nigeria through the ports at Lagos and is then trucked north to markets. Trucks typically make the return journey without cargo due to the limited production of goods in the north. Recognizing this opportunity, TFI leverages its sister company, Golden Transport Company (GTC, also a subsidiary of Flour Mills of Nigeria), to move cassava grown in the country’s mid-regions to the south. GTC charges farmers for this service at cost, and everyone wins.
Figure 9: Creative Logistical Solutions Can Help to Increase the Supply of Raw Materials

Cost to deliver 1mt of cassava to factory gate (USD)

<table>
<thead>
<tr>
<th>Local small-holders</th>
<th>Distant large scale</th>
<th>Mid-range smallholders (Current)</th>
<th>Mid-range smallholders (Future)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertically integrated transport</td>
<td>Backhauling</td>
<td>109</td>
<td>Collection points</td>
</tr>
<tr>
<td>61</td>
<td>65</td>
<td>48%</td>
<td>80</td>
</tr>
<tr>
<td>6%</td>
<td>35%</td>
<td>17%</td>
<td>24%</td>
</tr>
<tr>
<td>62%</td>
<td>49%</td>
<td>35%</td>
<td>47%</td>
</tr>
</tbody>
</table>

1-year average factory gate price: $82/mt

- Transport
- Harvesting
- Production

Truck size (mt) | Distance (km) |
<table>
<thead>
<tr>
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<tr>
<td>3</td>
<td>20</td>
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<td>30</td>
<td>300</td>
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<td>3</td>
<td>60</td>
</tr>
<tr>
<td>40</td>
<td>60</td>
</tr>
</tbody>
</table>

Note: (*) Procurement is estimated based on the local selling price of avocados in Kenya.
Sources: Thai Farms International, farmer interviews, Bain analysis

Figure 10: Collection Points Offer Improved Logistics and Reduced Transport Cost

Mid range smallholders: collection points
Backhauling is an effective solution for large farms, which have adequate supply to fill an empty 30-mt truck. However, for midsized farms with harvests of 3-5 mt, other arrangements must be found. Even at current cassava prices, which are above the norm, transporting cassava in 3-mt trucks is generally not economical across distances exceeding around 60 km.14 The bulk shipments enabled by collection points could be moved using 40- or even 60-mt trucks, providing obvious logistical benefits and reducing risk for the farmer (Figure 10).

Collection points also offer an opportunity to implement improved storage methods. Tubers kept in the shade while volumes accumulate can reduce the onset of post-harvest deterioration.15 Other storage approaches (e.g. plastic bags, layering tubers with straw and soil) have extended tuber shelf life to a week or more and could be further explored, although costs would have to be carefully managed.16 Farmer education is an important component of implementing any of these methods, and could be coordinated jointly by the public, private and donor sectors.

TFI is currently organizing a pilot to test the collection point concept, which the company hopes to have operational in early 2014.

Future potential: primary processing
Another innovative method of reducing transport costs is processing tubers into chips or cakes to reduce bulk and extend shelf life, using small facilities located close to farms or collection points. Dutch Agricultural Development & Trading Company has developed Autonomous Mobile Processing Units, which travel to platforms in rural locations and source raw materials from local farmers. In the already uncompetitive HQCF value chain, this approach creates a main challenge by adding another layer of costs that are not easily compensated for by transport savings. Additional research may yield success in the future as the technology and efficiency of this model improve.

* Reflects current cost of 8,300 Naira (N/mt) vs 750 N/mt for transport to collection centre + 500 N/mt cost of running collection centre + 2,500 N/mt for transport from collection centre to Thai Farms.
Sources: Thai Farms International, Bain & Company analysis
Transport infrastructure

While requiring significant government investment, improvements to underlying infrastructure would generate benefits across a number of value chains, not only for cassava.

Cassava for industrial processing typically moves down the LAKAJI corridor, the most important transport artery in Nigeria, from production areas in the middle of the country (e.g. Kwara state) to processors located closer to Lagos end markets (Figure 11). Travelling by road along the corridor takes 130% more time per km and costs 25% more than a similar regional corridor between Burkina Faso and Ghana.

Figure 11: LAKAJI Growth Corridor – Nigeria’s Primary Route for Transporting Agricultural Goods

Source: USAID/NEXTT LAKAJI Growth Corridor Project

Investments in improved road infrastructure are important in the long term, but the most effective and feasible solution to bridge the gap in costs and delays is to restore Nigeria’s extensive rail network. Most of it is currently not operational; however, a significant budget allocation was made in 2009 to fund investments in rail rehabilitation, and a segment between Lagos and Kano opened for operation in 2012. Shipping a container along this segment is 25% cheaper by rail than by road. Private sector investment in wagons is now needed to help drive increased usage of this segment. In addition to infrastructure, regulations can also have important impacts on transportation efficiency (Box 1).

Box 1: Impacts of regulation on transportation services

Regulation can sometimes be even more important than infrastructure in enabling the efficient movement of agricultural goods. A recent study found that transportation costs along four African corridors are no higher than in other developing countries like China. However, transportation prices are far higher. High African profit margins – up to 160% in Central Africa – are a result of regulations that restrict entry of new companies.

Liberalization of movement within regions is also critical, both for reducing direct costs and for promoting competition. In Central America, Guatemalan exporters sending goods overland to Mexico are forced to offload their cargo from Guatemalan trucks at the border and reload it onto Mexican trucks, and vice versa. In both countries, this process adds direct costs that make exported goods less competitive and restricts competition in the transportation sector.

Exports of HQCF are not feasible in the near future, given Nigeria’s huge domestic market and lack of competitiveness versus other HQCF exporters. However, port infrastructure is important for this value chain in two ways. First, agricultural and processing equipment must be imported into Nigeria in order for the HQCF industry to grow, along with inputs for manufacturing fertilizer. Second, exports of cassava chips to China or Costa Rica are seen by some as an effective way to sell excess cassava in glut years, helping to smooth prices and reduce the potential “whiplash” effect of price volatility on production levels. Lagos port logistics reveal opportunities for improvement: almost 100% of transport costs between the port and Lagos proper could be avoided if best practices were implemented, such as increased use of rail and containers.

Business Environment

Reduced policy risk

Dramatic fluctuations in supply and demand make long-term profitability elusive for both producers and processors. Lack of data and poor information flows mean that farmers must rely on price signals to make production decisions. Seeing prices spike, farmers increase the area of cassava planted in the following year. Thousands of smallholder farmers may react in this way and overcompensate, causing a glut in the market (Figure 12). The process then repeats.

Many improvements to the value chain can decrease the volatility of supply and demand, including better provision of information, improved contract enforcement, vertical integration and low-cost primary processing to increase shelf life. However, one key solution could be implemented immediately and at essentially no cost: increased consistency in government policy, given past supply fluctuation in response to policy changes.

Unpredictable policies drive volatility in production volumes and prices (Figure 13). For example, Nigeria imposed a 110% tariff on rice in January 2013. Changes like this have immediate and important impacts on demand for cassava, due to gain’s role as a substitute for imported grains.

Corruption and fraud

Corruption and other unscrupulous business practices impose costs along the HQCF value chain as well as all agricultural value chains in Nigeria. “Informal fees” at the border drive additional costs of US$ 70 per 20-foot-equivalent unit, making it more expensive to import farm and processing equipment. Counterfeit fertilizer limits potential yields in the short term, and reduces fertilizer adoption rates in the long term. Truck drivers sometimes take unofficial side jobs along their routes to earn extra pocket money. According to some transport operators, a common scam is when drivers collaborate with state border agents to fake truck breakdowns. A tow truck is then “hired” and exorbitant charges are sent to the transport parent company, with the driver and government agent ultimately sharing the proceeds. Too often, funds earmarked for development of the agricultural sector and associated infrastructure somehow fail to translate into the intended investments.
Strong political leadership and an effective judicial system are required to drive change in the long term. Over the short term, the private sector can help to reduce the impacts of corruption and fraud, and to accelerate the rate of change. Scale gives companies valuable leverage and resources. GTC has the resources to test its fuel quality, thus reducing scams in the long run. When the testing system was first implemented, 4-5% of loads were rejected; rejection percentages are now negligible. Large transport companies have GPS tracking on all trucks to locate them in case of breakdowns and to reduce illicit movements. Companies also maintain in-house maintenance crews, bypassing the “tow truck” scam. Beyond individual company scale, collaboration between private-sector actors can provide additional leverage in lobbying governments for transparency on tracking funds, and for implementation of electronic processes to reduce corruption at the borders.

Enabling structural changes

HQCF processors face intense competition for raw materials from local garri processors. Garri is an important part of the traditional Nigerian diet and, as such, demand is very inelastic. However, bakers are extremely price sensitive. Because wheat flour is directly substitutable, HQCF processors have a maximum price for what they can pay for tubers, since they cannot pass raw material cost increases on to consumers. Development of commercial-scale farming will expand supply, reduce production costs and thereby provide a buffer for HQCF processors, with vertical integration giving them control over their own raw material supply. Nigerian production costs are around US$ 40/mt compared to Thailand’s at US$ 30/mt; bridging this gap is a critical step towards achieving the tipping point of industry profitability. 27

Aside from consistent regulatory policy and reduced corruption and fraud, two additional aspects of Nigeria’s business environment could encourage private-sector investment in this space: reliable non-transport infrastructure and access to agricultural finance. As part of its Agricultural Transformation Agenda, the FMARD will create staple crop processing zones (SCPZs) for target crops. The plan is for the SCPZs to receive government support, such as access to finance, land ownership, and power, water and road infrastructure. Implementation of this plan would improve the competitiveness of HQCF and the agricultural sector as a whole.
Border Administration

Movement of goods within Nigeria is subject to regulations and fees that also add to total costs. Trucks are stopped at local and state borders and charged additional fees, which add approximately 6% to the cost of transporting cassava. (Figure 14). If permits to operate a truck in each area are obtained in advance, the impact of these “on-the-spot” fees is reduced, but getting permits every year is a huge burden. Trucks are required to carry about 50 individual permits costing US$ 75-150 per truck per year, not to mention the administrative trouble of navigating the application process (figure 15). Reducing this burden should be a priority for the LAKAJI growth corridor initiative. Discussions among national, state and local governments should include an analysis of the potential impacts of establishing a “free zone” for the movement of trucks – both in terms of lost permitting revenues and increased trade.

National border administration is also relevant for the development of the HQCF value chain, both to facilitate access to equipment and inputs, and to develop cassava chip exports while reducing tuber price volatility. In 2012, a pioneering agribusiness company attempted to ship four containers of chips to China. After coordinating the logistics required to source, chip, pack, and transport the cassava to the Lagos port, the company encountered so many challenges at the border that it abandoned the effort.

Figure 15: Permits Required to Operate a Commercial Truck in Nigeria

Market Access

Cassava chip importers, such as China and Costa Rica, have minimum standards for chip specifications (e.g., maximum moisture content, minimum starch content); these specifications are clearly communicated and are not exceedingly strict. Particularly for initial shipments, chip exporters must work with processors to ensure that these quality standards are met in order to establish a credible reputation and compete with established Thai chip exporters.

5. Conclusion and Recommendations

A number of supply-chain-improvement initiatives could help to reduce the overall food loss (Box 2) and bring the HQCF value chain to its tipping point of competitiveness with wheat flour (Figure 17). Some would benefit all agricultural value chains, and others are specific to cassava. Promising progress is being made along both fronts. Based on the initial analysis done in this case study, two priorities are highlighted for further consideration.

Box 2: Food Loss in Nigerian Cassava Value Chains

Note: Food loss figures are estimates only. Garri-value-chain figures are based on a German Federal Ministry for Economic Cooperation and Development (BMZ) survey of 200 farmers, 30 garri processors, 30 garri marketers and 25 starch processors. HQCF figures are based on these BMZ results, adjusted to reflect farmer and processor interviews conducted by the authors.

Food loss occurs at higher rates in the traditional garri value chain (about 35%) than in the industrial HQCF value chain (about 20%) (Figure 15). Garri processors peel tubers by hand, so small tubers are discarded. Also, garri is susceptible to post-processing losses due to higher moisture content and informal storage methods.

Harvesting: Manual harvesting is the predominant method across both chains, resulting in about 5% of tubers being damaged and left on the field. During harvesting, about 2% of tubers are left on the field due to their small size. “Not sold” reflects the rough estimate that 25% of the harvests are discarded every five years due to gluts in supply, driven largely by changes in policy (import tariffs of substitute products and politically-driven...
Figure 16: Food Loss in Nigerian Cassava Value Chains (Estimates)

Note: Totals are estimated, as percentages are based on different quantities.

Promotion of certain crops. Importantly, supply surges reduce prices, making it less economical to spend money to avoid food loss along the value chain.

Post-harvest handling and storage: Farmers reported losses of 1-2% during storage of fresh tubers, and 1-2% during transport; losses are roughly consistent across value chains. While very rare, storage and transport losses occur over entire cassava shipments. For example, if an identified buyer does not arrive to pick up a load within 72 hours, the tubers are no longer sold. Again, this type of loss occurs more often in years of oversupply, when buyers are difficult to find.

Processing and packaging: Garri processors reject about 10% of all tubers deemed too small or too woody for hand peeling. HQCF processors can reject entire loads that are spoiled or have extremely low starch content, although this rarely occurs (impact estimated at 5%). After these 5-10% losses due to rejections, processing itself drives further losses of 1-2% in both value chains.

Distribution: Processed garri incurs losses due to poor storage methods, pest infestation, spoilage/moisture and transport. HQCF losses have been assumed to be negligible as the product has low moisture and is less vulnerable to spoilage; it tends to be packaged, transported and stored in more formalized, protected environments.

Figure 17: Potential Initiatives to Reduce HQCF Supply Chain Barriers

Note: (*) Ease of implementation is assessed based on the number of stakeholders, nature of stakeholders, time for implementation, investment required, need to adapt/change the legal framework, and contentiousness of reform.
Sources: Bain & Company analysis; interviews
Cassava-specific initiatives

A private-sector-led body is being formed to further this nascent industry’s development. In October 2013, FMARD convened a group of public and private stakeholders to discuss the structure and role of a new Cassava Development Corporation (CDC). An external consultant facilitated the session, and the group aligned on a board structure and an initial list of activities that should be pursued by the Corporation.

To leverage the CDC, the establishment of collection points could be a “quick win” that would generate results in a short time frame and create additional momentum for further initiatives.

Existing processors can drive progress on this initiative by conducting analyses of the optimal locations for collection points. Thai Farms has already identified a location where it could source raw materials from up to 1,000 local smallholders. Donor-funded agencies can facilitate the development of farmer cooperatives to supply tubers to this collection point, open up channels of communication between processors and farmers, and potentially mediate negotiations. Government’s role could be to assist with providing access to land for the collection point, a potentially contentious issue that is already a challenge for Thai Farms with its collection point location. Throughout implementation, the CDC can be used as a forum for sharing roadblocks and best practices among processors, as well as the public, private and donor sectors. Successful performance on this quick win will build stakeholder confidence in the potential of the CDC to achieve results, create momentum to drive progress on other initiatives and mobilize additional funding from donors and the government.

Sector-wide initiatives

In addition to the cassava-specific initiatives, broader investments in infrastructure will benefit the agricultural sector as a whole. USAID has funded the NEXTT project, for which an external consultant has done an initial assessment of the LAKAJI corridor’s performance as a trade route. Through primary field research and extensive interviews with various stakeholders, data was collected on the costs and time required to travel along this route. These metrics were benchmarked against regional and global best practices to identify bottlenecks and opportunities for improvement. High-level recommendations to the government have been drafted based on the findings. A list of investment opportunities for the private sector along the corridor has also been generated, from cultivation to warehousing to ICT.

The NEXTT team is now mobilizing a group of public- and private-sector stakeholders to translate these opportunities into action. This process is a prime example of how a third-party organization can help catalyse progress by creating a data-driven understanding of opportunities. Success will depend on how engaged and optimistic various stakeholders are about the initiative’s potential to positively impact Nigeria’s agricultural sector. Strong leadership and targeted communications are called for to achieve this level of excitement and engagement.

Endnotes

2. Reference FTA yield successes.
13. Confidential underlying data provided by Thai Farms International/Four Mills of Nigeria.
17. There are of course exceptions, both in terms of farm and processor locations.
19. Adjusted for differences in total kilometres, as LAKAIJ corridor is 10-15% longer than Oluagbodumo-Toma.
30. Interview, Martin Fregene, FMARD. October 2013.
32. Loss data come from two sources: interviews with processors and farmers conducted in October 2013, and “Food losses in cassava and maize value chains in Nigeria.” BMZ/022.
34. Interview with Louwe Burger, Managing Director of Thai Farms International. October 2013.
Indian Tomatoes: Adding Value and Reducing Losses through Processing

1. Introduction

India ranks second in the world for both total agricultural land and farm output. The country benefits from highly diversified climatic and soil conditions, and agriculture is a core part of its economic, political and social constitution. A long period of agricultural expansion began in the 1970s, but the slowdown in agricultural growth has become a major concern. The Government of India is now prioritizing efforts to reduce poverty through increases in agricultural productivity. However, there is a need to shift away from an over-regulated, subsidy-based model towards healthy fundamentals, achieved through efficiency gains along the supply chain. Better post-harvest transport and storage of crops is an important piece of the puzzle: one-third of food losses in India occur during storage and transit. Improved back-end supply chain processes and better cold-chain facilities could reduce food loss and save up to US$ 15 billion annually, apart from securing over US$ 5 billion in additional export revenue.

Tomatoes, the second most-widely grown vegetable in India after potatoes, provide a good perspective on the post-harvest challenges facing the country’s agriculture. India is the second-largest tomato producer worldwide, with about 17 million tons produced in 2010-11 and behind only China (about 40-50 million tons). Indian tomato production has doubled in the past decade.

Despite this overall growth, yields are low at around 20 tons/hectare (ha), compared to the world average of 33 tons/ha and China at about 48 tons/ha. Though there are some regional disparities, the main reasons for low yields are the lack of knowledge about agricultural best practices and limited access to inputs (e.g. seeds, crop protection, fertilizers, irrigation).

India’s tomatoes are primarily sold on the fresh domestic market. The processing industry represents only about 1% of total production, versus approximately 14% in China. Only around 1-2% of Indian tomatoes were exported in 2011, but interstate trade within India is significant. This is driven by variations in production per capita across states (e.g. from 70 kilograms (kg)/capita in Andhra Pradesh to 10 kg/capita in Bihar), as well as varying harvest seasons.

2. Indian Tomato Supply Chain

Indian tomatoes are usually produced and harvested by smallholder farmers. Farmers stuff tomatoes in plastic boxes and then transport them to mandis, where tomatoes are traded in open markets. Traders purchase the farmers’ merchandise and sell it at the mandi to local retailers or to traders from other states. When tomatoes are sold to traders, they are transported to another mandi and the same iterative process occurs. Otherwise, when sold to local fresh distributors, tomatoes are transported directly to the retail location. Despite the fragmented value chain with multiple middlemen, evidence shows that tomatoes are a profitable crop for farmers.

In 2011, the cost for producing tomatoes in Uttarakhand state was around 1.5 Indian rupees (Rs)/kg (US$ 0.03), while the 2011 average wholesale price was 11.7 Rs/kg (US$ 0.25).

Parallel to the fresh-tomato value chain, a small but growing percentage of the tomato production is taken to facilities for processing. According to an Indian tomato expert, “the processing industry currently cannot afford to purchase tomatoes for more than 4 Rs/kg, so depending on market conditions and prices, it might be hard for processors to secure sourcing of tomatoes.”

There is therefore a mixed situation between an established fresh market and a developing processing industry (details on food loss across the value chain are covered in the Box and Figure 18).
Box 1: Food Loss in the Indian Tomato Value Chain

Note: Food loss figures are estimates only. Figures are based on secondary research, supplemented by a limited number of primary interviews.

The amount of food loss in the supply chain highly depends on the length of the tomato journey. Although tomatoes used for processing and for fresh consumption come from the same production sources, losses differ at the harvesting stage.

Fresh-tomato value chain

Harvesting: Tomato harvesting is done manually in India, which reduces food loss. Labourers can pass through fields 10 to 12 times, picking only the tomatoes that have achieved the ideal level of ripeness. Despite the losses that manual harvesting avoids, handling damages, quality sorting, pests and diseases drive losses of about 10% at this stage.

Post-harvest: The main sources of losses for tomatoes are during transport and handling. Poor road quality, exposure to unfavourable environmental conditions like heat and sunlight, suboptimal packaging quality, long distances and the high number of touchpoints drive losses of about 15-20% at this stage.

Distribution/consumption: Main sources of distribution losses are damages in transport and storage, unmet standards or inadequate remaining shelf life due to poor stock rotation. It is estimated that losses of 15-20% are incurred in India at this stage. In South and South-East Asia, 7% of fruits and vegetables purchased are wasted at the consumer level.

Processed-tomato value chain

Overall, the processed chain enjoys fewer losses thanks to a shorter journey and increased flexibility on quality.

Harvesting: Generally, harvesting losses are similar across the two value chains, with two important exceptions. First, given less strict specifications for processed tomatoes (e.g. size, colour, damages), farmers’ knowledge and efficiency of farms; fewer tomatoes are discarded during harvest versus the fresh-tomato supply chain. Second, processors represent a good alternative for farmers in oversupply situations, so tomatoes that otherwise may have gone unsold have a route to market.

Post-harvest: Processed tomatoes benefit from a shorter supply chain. Indeed, processors typically source directly from the farmer or from the local mandi, which mechanically reduces the impact of loss drivers. Although not quantified, evidence from interviews indicates that the journey to processors generates fewer food losses than the journey to fresh end-markets.

Processing: The extent of losses in tomato processing depends on the equipment and technologies that are used. In general, processing technologies are quite close and therefore opportunities for losses are limited.

Distribution/consumption: Once processed, tomatoes are packed aseptically, and their shelf life can be extended for about 2 years. This further reduces the losses at distribution and consumer levels compared to tomatoes for fresh consumption.

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Figure 18: Food Loss in Indian Tomato Value Chains (Estimates)

- Fewer losses than fresh supply chain
- Shorter journey for tomatoes in fresh format
- Less handling due to fewer intermediaries
- Not available
- Fewer losses
- Longer shelf life, almost 2 years
- Not available
- Fewer losses
- Longer shelf life, almost 2 years
- Not available
- Fewer losses
- Longer shelf life, almost 2 years
- Not available
- Fewer losses
- Longer shelf life, almost 2 years
- Not available

Note: (*) Primary and secondary processing are typically at different places but, in its paste format after being primarily processed, there is no loss due to its long-term perishability and the mode of transport used (i.e. in metal barrels). (**) South and South-East Asia data for fruits and vegetables.
3. Impacts of Supply Chain Barriers and Potential Solutions

Transport and Communications Infrastructure

Plastic crates minimize losses during transport

As a result of Indian government support (e.g., 50% subsidy in Maharashtra) and private-sector involvement, farmers are using plastic crates (Figure 19), which reduces losses by up to about 75% (Figure 20)\(^3\). Although the costs for this type of packaging can be recovered in 10-20 trips,\(^2\) farmers cannot afford it due to cash constraints and external support has been required.

In the future, a new generation of packaging could reduce losses even further. Pilots are currently being conducted by Unilever and CHEP to test the costs and benefits of these new solutions. In addition, foldable plastic packaging or nestable containers could be introduced. As current plastic crates cannot be folded or efficiently stacked, backhauling becomes an inefficient operation, reducing truck utilization rates and the overall profitability of tomatoes.\(^4\)

Lack of cold-chain infrastructure generates significant food and value losses

Cold storage for Indian tomatoes could only be realistic in the very long term, and only for high-end consumers who are willing to pay a premium for fresh tomatoes. However, the case of Indian cold-chain development for potatoes, a higher-value crop with a longer shelf life, provides an interesting perspective on the complexities of post-harvest loss reduction.

At present, Indian cold-storage capacity is only around 30 million tons, while requirements are about 60 million tons.\(^5\) Due to the limited profitability of cold storage projects, investors must have a long-term horizon, which is challenging for the private sector in high-risk, developing-country environments. To overcome this situation, the Indian government has subsidized up to 50% of the cost of building cold-storage facilities (mainly for potatoes) in the Agra region. Once they have been constructed, local private actors have taken over ownership and operations, and have managed to achieve profitability.

Aside from availability of long-term financing, another barrier to the adoption of storage technologies is cash constraints, which farmers face at harvest time, forcing them to sell quickly. To overcome this, the Indian government first removed price-fixing regulations, allowing cold-storage owners to set prices freely. This flexibility reassured banks of profitability and freed up loans. These loans are offered to the cold storage operators, amounting to 25-40% of the current price for a 50-kg sack of potatoes.\(^6\) The cold storage operators then lend this amount to farmers. Once the potatoes are in storage, the decision to sell is taken mutually by the storage operator with the farmer. After sale, the farmers pay a flat rental rate for having stored the potatoes. As Bijay Kumar, Managing Director of the Indian National Horticulture Board, says, “there have certainly been reductions in post-harvest losses of potatoes [from the growth in cold storages in the area].”\(^7\)

In the tomato industry, farmers have adapted their harvesting strategy to deal with this lack of infrastructure. They pick their tomatoes when green instead of red-ripe,\(^8\) so that the tomatoes can be sent on longer distances as they will take longer to ripen (Figure 21).\(^9\) Moreover, farmers have introduced new tomato varieties that are more resistant to transport bumps and handling.\(^10\) In the long run, the tomato supply chain could marginally benefit from the operationalization of the cold chain, mainly to serve the emerging Indian upper class.\(^11\)

Absence of large trucking fleets drives inefficiencies in tomato transport

Logistics costs account for 6-10% of average retail prices in India, higher than the global average of 4-5%.\(^12\) High transport costs are a key driver of this gap.

Variations in taxation across Indian states drive fragmentation in the market. India is divided into more than 30 states (including the seven union territories),\(^13\) each with its own taxation specificities. According to one large Indian transporter, “each state tries to encourage investment in warehousing by giving tax deductions. The resulting landscape of small distribution centres is one of the reasons why large transporters tend not to enter the perishables sector.”\(^14\) Because of the taxation rules, most logistics companies end up having small stocking points in all states where they operate, rather than the hub-and-spoke distribution model prevalent in many other large countries.
Consequently, large logistics companies cannot benefit from scale and therefore lose their competitive advantage when compared to smaller transporters.

Moreover, many mid-sized Indian cities—usually Tier 2 or Tier 3—have enforced “truck curfews”, prohibiting trucks from accessing the city during daytime. If trucks arrive after dawn and before dusk, they have to wait outside the city, generating long delays and losses due to overripe tomatoes.46

All of these factors present risks to the transport of perishables and discourage larger trucking companies from entering the market. This impacts the tomato value chain overall because it benefits neither from the companies’ investment capacity (e.g. refrigerated trucks, high-quality vehicles, maintenance), nor from their scale and expertise in transport and logistics (e.g. backhauling, capacity utilization across networks).47

**Figure 21:** Green Tomatoes Take Longer to Ripen Once Harvested

Post-harvest tomato maximum lifetime by storage condition (2013, in # days)

![Figure 21: Green Tomatoes Take Longer to Ripen Once Harvested](chart)

Business Environment

Certain structural improvements would contribute to efficiencies along the value chain, and should be encouraged through collaboration between the public and private sectors.

Develop the processing industry to improve efficiency and reduce losses

Experience from other countries shows a high correlation between GDP growth and development of the tomato processing industry,48 and the Indian government is supporting this development. As the Indian middle class grows, consumption habits change and shift towards more processed food.49

Processors can create an environment that enables better yields for farmers and reduced food loss. First, processors help farmers gain access to inputs, equipment and training on good agricultural practices. Hindustan Unilever’s public-private partnership (PPP) in Maharashtra has demonstrated that professionalized farms can achieve higher yields and lower waste than unskilled farms.50

Furthermore, processing significantly shortens the tomato’s journey from farm to end customer, in terms of distance and number of intermediaries. In Maharashtra, one primary processing facility is not more than a two-hour drive from farms. In contrast, tomatoes sent from this same farm to the large markets in Delhi take three days to arrive after being handled, transported, graded and repacked twice. Shorter journeys mean lower costs and, in most cases, reduced losses. Processing also increases the shelf life of tomatoes from weeks to years.51

The main reason why the tomato processing industry has yet to successfully develop is that processors have not managed to obtain reliable and consistent sourcing of raw materials at the required cost and quality.52 Volatility in production levels and variations in harvest timing contribute to dramatic price swings. For instance, average prices in Mumbai declined by over 60% from January to February 2011 (Figure 22).53 As a result, processors are usually only able to source their tomatoes during the peak season. Furthermore, firmness, sugar content and colour are the most important factors for determining tomato quality for processing. The primary objective of processors is to have varieties that maximize sugar and solid content, and the traditional varieties grown in India are not optimal for this, which is not necessarily the case for the fresh market.54 Thus, processors are affected by lower processing efficiency.55

Vertical integration can help to circumvent challenges in raw-material supply. Currently, a PPP in Maharashtra involves the state government, a local primary processing company and Hindustan Unilever.56 This primary-processor, wide-ranging programme aims to improve farming techniques, yields and product quality. Ideally, the benefits that farmers get from this collaboration will create long-term trust, and encourage farmers to supply the local processor and respect contracts.

**Figure 22:** Interstate Trade Triggers Price Volatility

Need for interstate trade

Tomato consumption by origin in Chennai - Tamilnadu (2004, in tons/day)

<table>
<thead>
<tr>
<th>Month</th>
<th>Andhra Pradesh</th>
<th>Karnataka</th>
<th>Tamilnadu</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apr-Jun</td>
<td>270</td>
<td>200</td>
<td>360</td>
</tr>
<tr>
<td>Jul-Sep</td>
<td>~470</td>
<td>100</td>
<td>210</td>
</tr>
<tr>
<td>Oct-Dec</td>
<td>~400</td>
<td>80</td>
<td>300</td>
</tr>
<tr>
<td>Jan-Mar</td>
<td>~360</td>
<td>~80</td>
<td>~200</td>
</tr>
</tbody>
</table>

High volatility in prices

Average monthly fresh tomato price in Mumbai (2011, in Rs/Qtl)

- Prices divided by more than 3x over month

<table>
<thead>
<tr>
<th>Month</th>
<th>Andhra Pradesh</th>
<th>Karnataka</th>
<th>Tamilnadu</th>
</tr>
</thead>
<tbody>
<tr>
<td>JAN</td>
<td>6,950</td>
<td>5,831</td>
<td>6,507</td>
</tr>
<tr>
<td>FEB</td>
<td>5,780</td>
<td>4,751</td>
<td>5,201</td>
</tr>
<tr>
<td>MAR</td>
<td>4,967</td>
<td>4,568</td>
<td>4,830</td>
</tr>
<tr>
<td>APR</td>
<td>6,314</td>
<td>4,843</td>
<td>5,225</td>
</tr>
<tr>
<td>MAY</td>
<td>7,538</td>
<td>5,780</td>
<td>6,149</td>
</tr>
<tr>
<td>JUN</td>
<td>~3,000</td>
<td>5,193</td>
<td>~2,443</td>
</tr>
<tr>
<td>JUL</td>
<td>~3,100</td>
<td>5,519</td>
<td>~2,200</td>
</tr>
<tr>
<td>AUG</td>
<td>~3,300</td>
<td>~3,643</td>
<td>~2,570</td>
</tr>
<tr>
<td>SEP</td>
<td>~3,400</td>
<td>~3,743</td>
<td>~2,630</td>
</tr>
<tr>
<td>OCT</td>
<td>~3,500</td>
<td>~3,843</td>
<td>~2,690</td>
</tr>
<tr>
<td>NOV</td>
<td>~3,600</td>
<td>~3,943</td>
<td>~2,750</td>
</tr>
<tr>
<td>DEC</td>
<td>~3,700</td>
<td>~4,043</td>
<td>~2,810</td>
</tr>
</tbody>
</table>

4. Conclusion and Next Steps for Industry Stakeholders

Based on this initial case study, a list of initiatives has been drafted (Figure 23), along with a high-level assessment of expected benefits and ease of implementation. While this exercise is intended to be directional only, two initiatives emerge as high-priority and merit further discussion. The first – investing in a new generation of plastic packaging and related supply-chain enhancements identified by mapping – could be considered a quick win due to the relatively high ease of implementation. The second initiative – developing the processing industry – is a longer-term opportunity with possible high value (e.g., fewer food losses, potential to export) but more challenging implementation requirements.

Quick win: invest in new-generation plastic packaging and improved logistics

Unilever and CHEP are collaborating on a pilot to test further improvements in packaging technologies and logistical arrangements. For example, before a packaging solution was identified, a discussion and mapping effort were executed in order to understand the pain points in the supply chain. From this, the decision was made to compare the performance of nestable crates with foldable crates. As part of the loading and unloading processes, crates are usually thrown onto the ground for sorting. Farmers identified that, during this step, mud can become stuck in foldable crates due to the open cavities in the base of the container. The nestable solution was preferable in this regard.

Future trials defined by Unilever and CHEP will work to identify the best crate and will include the following:

- Test crates over varying distances and storage times to quantify impact on food loss
- Evaluate robustness of the selected crate to meet supply chain conditions
- Determine potential cost savings from the selected crate (beyond reduced food loss)

Figure 23: Potential Initiatives to Reduce Tomato Supply Chain Barriers

<table>
<thead>
<tr>
<th>Initiatives</th>
<th>Food loss</th>
<th>Value at stake</th>
<th>Ease of implementation¹</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Team</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Invest in new generation plastic packaging (e.g., foldable)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Low to high feasibility</td>
</tr>
<tr>
<td>Improve farmer cooperation and facilitate access to inputs (e.g., seeds, varieties) or training on agricultural best practices</td>
<td>Low impact</td>
<td>High impact</td>
<td>Low to high impact</td>
</tr>
<tr>
<td>Shorten supply chains and promote direct marketing (e.g., Maharashtra farmers having access to Delhi without having to go through several mandis)</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Low to high feasibility</td>
</tr>
<tr>
<td>Develop processing industry through better contract enforcement or backward integration</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Low to high feasibility</td>
</tr>
<tr>
<td><strong>Logistical</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harmonize state regulations to facilitate the scalability of transport</td>
<td>Low impact</td>
<td>Low impact</td>
<td>Low to high feasibility</td>
</tr>
<tr>
<td>Relax truck movement limitations to mitigate delay risks for perishables</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Low to high feasibility</td>
</tr>
<tr>
<td>Develop cold chain infrastructure (facilities, trucks)</td>
<td>Low impact</td>
<td>Low impact</td>
<td>Low to high feasibility</td>
</tr>
<tr>
<td>Invest in rural road infrastructure</td>
<td>Low impact</td>
<td>Low impact</td>
<td>Low to high feasibility</td>
</tr>
<tr>
<td><strong>Regulatory</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Structural</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: (*) Ease of implementation is assessed based on the number of stakeholders, nature of stakeholders, time for implementation, investment required, need to adapt/change the legal framework, and contentiousness of reform. Sources: Bain & Company analysis; interviews

Attract large retailers to modernize supply chain efficiency

Local small-scale retailing, the prevalent distribution method in India, also struggles to overcome the impact of barriers. Fragmented local retailers lack the experience, scale and capital to professionalize distribution through investments like cold-chain facilities. When multinational retail chains enter developing markets, their investments reduce costs and food loss along the value chain. A 2008 study shows the impact of bringing a modern supply chain with consolidation points, where losses are reduced by 50-60% compared to traditional vegetable supply chains in India. 57

Legislation can either encourage or discourage this type of foreign investment.

Border Administration

Exports of Indian tomatoes are very limited; therefore, the tomatoes do not face international border-crossing issues. Domestically, many permits and various documents are needed to use different roads. 58 According to interviews, however, tomato transporters are able to cope well with this barrier, and it was not cited as a major concern. 59

Market access

Given the low level of international trade for Indian tomatoes, market access challenges are not highlighted in this study.
In addition to container selection, there are other potential benefits of an overall supply chain solution. Optimized crate storage, for example, can allow for space-saving and protection from the elements during the off season. In addition, as volumes increase, tomatoes will need to be transported further than the current 50-km radius, so a supply chain solution incorporating equipment pooling may become more viable (figure 24). In this model, a service provider retains ownership of transportation equipment (e.g. pallets, reusable plastic containers), and manages the network, providing customers with equipment when necessary. This model allows farmers, processors, manufacturers and retailers to utilize the equipment without having to make a capital investment. Other efforts are underway to optimize the packaging and movement of semi-processed tomatoes, such as using 1,000-litre intermediate bulk containers (Figure 25).

Finally, standardization of supply chain infrastructure will be a critical step along the path to modernization, especially as labor costs increase and mechanization becomes more attractive (Box 2).

---

**Box 2: Australian example of standardization as a supply chain enabler**

Australian supply chain infrastructure was first regulated decades ago, and benefited from the 1,165 millimetre (mm) x 1,165 mm pallet already being a de-facto standard for a unit load device. Accordingly, truck-trailer widths and lengths, warehousing racking dimensions and forklift specifications were all developed to efficiently optimize the seamless interaction of all elements of the supply chain infrastructure. In an emerging or non-standardized economy such as India, such issues should be considered within policy-makers’ broader, aligned interests.
Long-term priority: develop the processing industry

The current PPP in Maharashtra provides promising evidence of the potential benefits of a developed processing industry in India.6 However, to be sustainable, the private sector needs a push from the government in order to establish proof of concept. Farmers, seeing improved yields and reliable streams of higher revenues, would want to take advantage of this opportunity. Eventually, processing could not compete with the fresh market for harvested tomatoes, but rather on land utilization (i.e. which tomatoes to grow, processing-dedicated or fresh-dedicated). The final aim would be to have the land profitability converging between processing-dedicated and fresh-dedicated tomato varieties.

One critical enabler for developing the processing industry is a business-friendly environment for established companies that can provide expertise and investment. For example, companies like BASF, Bayer or Unilever can facilitate access to better-suited inputs and technologies (e.g. seeds, crop protection, soil treatments) and train farmers on good agricultural practices.

Despite the promising progress to date, the processing industry will require time to develop. The government can further ensure that the necessary elements are in place to ease progress. First, creating a conducive policy environment to facilitate investment is critical. In addition, continued support of multistakeholder platforms like the World Economic Forum’s New Vision for Agriculture initiative can help to disseminate best practices and identify opportunities for collaboration along the value chain. Finally, investments in underlying infrastructure and distribution networks provide the backbone for private sector companies like Unilever and CHEP to continue innovating towards more efficient movement of goods. These companies are working closely with the government to define initiatives and policy that best support growth in the sector.

Endnotes

1. On-field research conducted, November 2013.
3. India Brand Equity Foundation report on agriculture, August 2013.
13. Interview with Indian tomato expert, 15 October 2013.
16. Interview with Indian tomato expert, 15 October 2013.
18. Interview with Indian tomato expert, 15 October 2013.
19. Interview with Indian tomato expert, 15 October 2013.
23. Interview with Indian tomato expert, 15 October 2013.
25. On-field research conducted, November 2013.
30. Forbes article “ Cultivating India, One tomato at a time”, published 1 November 2013.
34. On-field research conducted, November 2013.
35. Hindu Business Line article “India seeks New Zealand’s help for developing cold storage” 3 September 2013.
36. “Indian potato cold storage example is a summary of an article from the Economic times in India “How Agra became India’s cold storage hub and what impact it has on the price of potatoes”, http://articles.economic times.indiamedia.com/2012-08-12/news/33154883_1_cold-storage-potatoes-vegetable-prices/, 12 August 2012.
37. “How Agra became India’s cold storage hub and what impact it has on the price of potatoes”, 12 August 2012.
39. Interview with Indian tomato expert, 15 October 2013.
41. On-field research conducted, November 2013.
42. Interview with commercial tomato farmer, November 2013.
45. Interview with Indian large transporter, Regional sales manager, November 2013.
46. Interview with Indian large transporter, Regional sales manager, November 2013.
47. Interview with Indian large transporter, Regional sales manager, November 2013.
48. Analysis done in 2011 for countries producing at least 1 million ton of potatoes, percentage of potatoes assessed against the GDP per capita. For population data, World Bank Data; for GDP, Economist Intelligence unit data; for tomato production, FAOSTAT; for level of processing, World Processing Tomato Council.
51. Interview with Indian tomato processor, 23 October 2013.
52. Interview with Indian tomato processor, 23 October 2013.
54. Forbes article “ Cultivating India, One tomato at a time”, published 1 November 2013.
57. On-field research conducted, November 2013.
58. Forbes article “ Cultivating India, One tomato at a time”, published 1 November 2013.
1. Introduction

Kenyan Avocados: Connecting to High-value Export Markets

Kenya is frequently cited as a “bright spot” in African agriculture. Conducive government policy, strong donor support and private-sector leadership have helped to create success stories in exports to the EU; for example, French bean exports climbed from zero in the late 1980s to 19,000 tons by 2010. Policy changes supporting this growth include the liberalization of the fertilizer market. Following the removal of price controls and subsidies, increased competition led to lower fertilizer end-prices, triggering a 14 percentage-point increase in adoption rates among smallholders. Today, agriculture amounts to half of Kenyan GDP and employs 75% of the Kenyan workforce. Kenyan policy-makers and agribusiness players continue to prioritize the growth of agricultural exports, both in green beans and other cash crops like avocados.

Kenya is one of the world’s largest producers of avocados, with production of 110,000 tons in 2010. For comparison, the largest producer is Mexico with about 1 million tons produced annually. Local varieties dominate Kenyan production (about 70% of total), whereas Fuerte and Hass, the varieties suitable for export, make up approximately 20% and 10%, respectively. Most of the avocado farms are near Nairobi, where the export packaging factories are located.

Of the total production, 20-25% is exported. Europe is the main destination, with 75% of exports in 2010. Kenya ranks as the sixth-largest exporter to Europe, with a 5-6% share of volume in 2010, and enjoys a competitive advantage versus Peru, its main competitor in Europe: the Kenyan Hass harvesting season extends later in the year than Peru’s, granting Kenya a window of opportunity.

The focus of this case study is on the high-value, high-growth market of avocado exports to Europe. Kenyan avocados sell in Europe at roughly three times their domestic price, making the export opportunity extremely attractive.
2. Kenyan Avocado Export Supply Chain

An estimated 70% of Kenyan avocados – even those for export – are produced on smallholder farms (Figure 26). When not linked to exporters through an out-grower scheme, farmers market their avocados through middlemen, either legally government-certified agents or unofficial brokers. These middlemen typically harvest avocados themselves and organize transport to Nairobi packhouses. This initial leg of transport is usually done with small pickup trucks. Once at the factory, avocados are quality-checked, sorted, washed, waxed, pre-cooled and packed in cartons (Figure 27). Once packed, exporters stuff the cartons into refrigerated containers (“reefers”) outside the processing gate, and shipping companies then transport the reefers to the Mombasa port. There, the reefers, which are controlled-atmosphere-treated, are loaded onto a ship and later trans-shipped in Salalah, Oman. Finally, the reefer containers are unloaded in Europe and delivered to importers (see Figure 28 for an illustration of the overall value chain economics).

Most often vertically integrated with exporters, packers procure and package a 4 kilogram (kg) carton of avocados at a cost of about US$ 4.10. An additional US$ 1.60/carton is required for shipping to Europe by sea in a reefer (Figure 28). With the import price fluctuating around US$ 7-8/carton, the supply chain overall is profitable.

Figure 28: Kenyan Avocados Sell for a Healthy Margin in the EU, Freeing Up Resources for Investment

Avocado Europe CIF exporter cost bar (2013, in $/kg) (Estimates)

- Peruvian selling point in EU: 2.06
- Kenyan selling point in EU: 1.71
- Exporter margin: 0.20
- Sea Shipping: 0.40
- Transport to port: 0.06
- Packaging: 0.44
- Producing: 0.59

Note: (*) Procurement is estimated based on the local selling price of avocados in Kenya
Source: Interviews
This situation was enabled by government-led infrastructure investments, followed by private-sector investment in reeferers, which helped to reduce transport costs versus expensive air shipments. Once this tipping point of profitability was reached, investments started to naturally flow into the sector.

3. Impacts of Supply Chain Barriers and Potential Solutions

Successful initiatives to overcome supply chain barriers are presented, as well as some remaining opportunities to overcome challenges to future growth.

Transport and Communications Infrastructure

Corridor infrastructure investments benefit multiple value chains.

Mombasa is the pivotal port for East African countries and is accessed via the main corridor, the Nairobi-Mombasa highway. By the early 1990s, the quality of this road had deteriorated due to high traffic. The Kenyan government, with the help of the World Bank and the EU, decided to invest in rehabilitating the highway. Investments were made over approximately a decade, ending in 2005. Travel time from Nairobi to Mombasa was reduced by 40%, from 12 to 7-8 hours, and costs decreased as well. Typically, road rehabilitation projects in East Africa drive operational cost reductions of 15%. Although this saving has a marginal impact on the Kenyan avocado industry—less than 1% of the European end price—the incremental benefit is applied to many different value chains. The overall benefit for Kenya and Kenyan agricultural export value chains is thereby important.

Introduction of reefer container technology has made Europe accessible for Kenyan avocados.

One of the major challenges previously faced by this industry was the lack of suitable transport equipment. If not cooled, avocados ripen faster than the time it takes to ship them to Europe. Exports to Europe, therefore, were only possible through expensive air shipments. Alternatively, transporting by sea was only feasible for the more proximate Middle East, where avocados sell for much less than in Europe.

Recognizing this opportunity, exporters first engaged temperature-controlled, break-bulk vessels to replace expensive air freight. They then approached A.P. Moller-
Early packing of containers ensures an uninterrupted cold chain.

When dealing with perishable produce, maintaining an uninterrupted cold chain is critical for food quality and safety. When refiners were first introduced, refiners preferred to transport avocados to Mombasa in regular trucks and pack the refiners at the port. Over time, refiners realized that they could command a price premium in EU markets if a cold chain was begun as close to the farm as possible. This price premium outweighed the costs of bringing an empty refiner to Nairobi and loading it at the packhouse gate. This extended cold-chain-arrangement also simplified logistics by eliminating one touchpoint at the port, and is now common practice (Figure 29).

The use of open-truck transport from farmers to packhouse results in sun damage.

Transporting avocados from the farm to the packhouse is often done using small, open trucks (Figure 30). This transport mode triggers approximately 5% food loss, mainly due to sun exposure on the top layer of fruit, but also due to spillage.

When sourcing directly from farmers, refiners have introduced covered trucks for this leg of the transport route. This investment can be recovered quickly, given avocados’ high value and the gains from eliminating losses. An investment of about US$ 10,000 in a covered truck can be paid back in approximately 20-25 trips (Figure 31). However, scaling this intervention to the broader market faces two issues. First, for the investment to be paid back quickly, the truck must make frequent filled trips, which does not always occur due to the atomized Kenyan smallholder model. This challenge could be addressed by exporters introducing shaded collection points. Second, access to finance is a common challenge for actors in agricultural value chains, making the upfront investment required for a covered truck difficult from a cash-flow perspective. Here, farmers could form cooperatives to pool resources, and governments or donors could provide guarantees or loans. A long-term solution is to develop commercial farming, where scale and access to resources facilitate such investments.

Figure 31: With Sufficient Volumes, Investment in Covered Trucks Is Rapidly Paid Back

### Cumulative savings of operating a covered vs. open truck by number of trips*

<table>
<thead>
<tr>
<th>Number of trips</th>
<th>US$ 10,000 investment paid back in about 20-25 trips*</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>2,500</td>
</tr>
<tr>
<td>10</td>
<td>5,000</td>
</tr>
<tr>
<td>15</td>
<td>7,500</td>
</tr>
<tr>
<td>20</td>
<td>10,000</td>
</tr>
<tr>
<td>25</td>
<td>12,500</td>
</tr>
</tbody>
</table>

Note: (*) For a 5-ton truck capacity, assumption made of saving 5% of food losses at European prices of 1.70 USD/Kg

Sources: Bain & Company analysis; interviews

Trans-shipment in Salalah is unreliable and leads to quality issues.

In addition to overland transport challenges, Kenyan refiners face a strong competitive disadvantage versus exporters in Peru and South Africa due to trans-shipment at the Salalah port in Oman (Figure 32). Peruvian and South African refiners are shipped directly to Europe. Ships from Kenya, however, have to steer wide of the Somali coast for piracy reasons, making the trip longer and more expensive due to insurance coverage. Moreover, vessels sometimes miss the trans-shipment in Oman and must wait for a week in Salalah’s port. While specific data on the frequency of this issue is difficult to obtain, both refiners and importers indicate it has a significant impact on operations. Another contributing factor is that the peak period for Kenyan avocados occurs during the Khareef, or monsoon season, in Oman; the severe weather significantly affects operational efficiency at Salalah’s port.

When trans-shipment is missed, importers must either maintain additional inventory or default on customer commitments. Relationships are thus damaged, and Kenyan avocados as a whole are seen as a less reliable product. In addition to the reliability issue, avocados can become overripe from delay, driving both quantitative and qualitative losses. Qualitatively, overripe avocados suffer from price discounts, meaning exporters lose revenue on a per-avocado basis. Quantitatively, avocados lose physical weight over time. In practical terms, the decrease in weight creates the need to repackage cartons at arrival. Traded in 4 kg cartons, avocados are often overpacked in Mombasa (to around 4.4 kg when leaving Kenya) in anticipation of weight loss during transport. With a normal journey of around 25 days (Figure 33), the cartons arrive weighing above 4 kg. If the cartons miss the trans-shipment in Oman, they risk weighing less than the required 4 kg; thus the need to repack the avocados to comply with the 4 kg standard. Repackaging triggers a loss of value because importers charge exporters a US$ 2,700 fee per reefer for this additional handling.
Market Access

A number of market access barriers can restrict the movement of agricultural goods (Box 1). In the case of Kenyan avocados, the biggest barriers are the challenges of attaining consistent compliance with quality requirements of European customers.

Box 1: Market access in agriculture

Many non-tariff barriers can restrict the movement of agricultural goods, including sanitary and phytosanitary standards (SPS), technical barriers to trade (TBT), export and import bans, variable import tariffs and quotas, restrictive rules of origin, and price controls. Lack of open borders contributes to price volatility, drives food loss, and creates unpredictable environments that reduce the private sector’s willingness to invest.

For example, sanitary and phytosanitary standards (SPS), are intended to protect human, animal, or plant life or health. However, according to the WTO, “a sanitary or phytosanitary restriction which is not actually required for health reasons can be a very effective protectionist device, and because of its technical complexity, a particularly deceptive and difficult barrier to challenge.”

Furthermore, information about newly imposed SPS requirements is not always clearly communicated, or exporters lack access to the information. As a result, ~0.85% of agricultural products are rejected at import borders, equating to an annual product value of approximately $4 billion in 2000-01.

Governments have a primary responsibility to ensure that their own policies impacting market access are harmonized, scientifically justifiable, and predictable. They also have a central role to play in helping domestic producers and exporters successfully navigate market access barriers.

Overall, farmers lack a clear understanding of optimal harvesting techniques (e.g. the effect of picking timing on avocado size, pest management). The resulting practices trigger losses for exports, especially at the processing gate during the quality check performed by packers (details on food loss across the value chain are covered in the Box 2 and Figure 34). Although redirected to local markets, rejections are around 10% during the peak summer season, even if they vary during the year.

Box 2: Food Loss in the Kenyan Avocado Value Chain

Note: Food loss figures are estimates only and based on a limited number of primary interviews with various actors along the value chain.

Although functioning and suitable for exports to Europe, the Kenyan avocado supply chain – as it is structured today – still suffers from around 15% food loss at the different stages of the avocado journey from farm to importer (Figure 34).

Harvesting: Current manual harvesting techniques, still widely used among smallholder farmers, generate about 7% in avocado losses due to fruit damage from falling on the ground, poor handling and loading on pickup trucks.

Transport: Since pickup trucks are open vehicles, the first layers of avocados are exposed to the sun and must be discarded as they become overripe, even to the point when they cannot be redirected to domestic markets. Moreover, avocados can fall off trucks due to bumpy roads between farmers and packers in Nairobi. This step of the supply chain causes about 5-6% in avocado losses.

Packaging: Once at the packaging gates, avocados are quality checked. Harvesting techniques are not always well suited to exports (e.g. the picking timing for avocado size), due to lack of training on European standards. This stage generates many rejections, but rejected avocados are redirected to domestic value chains. During the peak season, it is estimated that around 10% of avocados are rejected at the packhouse gate due to small size.

Sea shipment: Shipment to Europe is a critical and risky step in the supply chain regarding food losses. The losses are binary. If vessels arrive on time, losses are essentially zero due to reefer technology; however, if a container misses trans-shipment in Oman, a delay of one week can occur and, as a result, the avocados become overripe during transport. These avocados are not completely discarded, but significant weight loss occurs. Although it is difficult to quantify the frequency of missed trans-shipments, importers claim that these situations drive avocado losses of about 1-5%.
At the other end of the value chain, quality issues mainly stem from “briefcase exporters” who sell avocado containers on the spot, usually with no long-term contracts. These small exporters significantly affect the reputation of Kenyan origin, as most of their shipments are of lower quality and consisting of poorly sorted avocados that are difficult to sell in Europe. Importers purchasing Kenyan avocados struggle to predict the level of quality they will receive, creating a climate of mistrust. As a result of this and other factors, Kenyan avocados sell at a 15-20% discount to Peruvian avocados in European markets.

Business Environment

One structural improvement to the value chain that would mitigate the impacts from a number of barriers is large-scale farming. The development of such farms offers many benefits: lower losses during harvesting and quality checks, profitable investment in covered trucks and improved long-term relationships with importers. Kakuzi Farms, a vertically integrated, large-scale Kenyan avocado farm/packer/exporter, generated on average 18% earnings before interest and tax (EBIT) in the avocado segment over the last three years, compared to the industry average of about 10-15%. Government should provide the enablers, where feasible, for replicating this success story, for instance by facilitating access to finance and land ownership while integrating high-potential smallholders.

Border Administration

Kenya is implementing a redesigned border management system to reduce costs and delays (see the case study in the report’s “Enabling Smart Borders” section for more details).

4. Conclusion and Next Steps for Industry Stakeholders

The Kenyan avocado value chain has passed the tipping point of profitability and is now functioning well. However, some challenges are slowing the virtuous circle of investments in this industry. Two main priorities or initiatives for the Kenyan supply chain have emerged (Figure 35). The first – mitigating the impact of unofficial exporters – could be considered a quick win due to the relatively high ease of implementation. The second initiative – mitigating missed trans-shipment in Oman – is a longer-term opportunity with high value at stake but more challenging implementation requirements.

Quick win: mitigate the situation concerning “briefcase exporters”

European importers and Kenyan exporters agree that unofficial exporters have a negative effect on the reputation and pricing of the overall Kenyan origin. To begin with, the industry could benefit from an organization established to develop and promote Kenyan avocados. The organization could be composed of the Horticultural Crop Development Authority, an exporters’ association (potentially created as a division of the Fresh Produce Exporters Association in Kenya), shipping companies and customs authorities (KenTrade).
Using this organization as a platform, a next step would be to further understand and quantify the issue, including an assessment of root causes through primary data gathering and interviewing key stakeholders (including importers). The findings could help drive a brainstorming session for developing potential solutions, along with a preliminary assessment of value, ease of implementation and risks.

As a short-term initiative, exporters could create a consortium of high-quality growers and define common standards. This could include an advertising budget to communicate on the Kenyan “brand”, as well as specific packaging or labels. Importers could potentially have access to an online database for checking exporter compliance with the brand’s standards. In the long term, possible initiatives include investing in more traceability, monitoring and testing resources.

Longer-term opportunity: mitigate the trans-shipment risk in Oman

In the short- or medium-term future, direct routes from Mombasa to Europe are not feasible because volumes are far from sufficient. Consequently, the risk of missing trans-shipment can only be mitigated through improved processes and coordination between key stakeholders. The root cause of missed trans-shipments cannot be pinpointed by any actor along the value chain. To determine the cause, solutions must begin with additional investigation.

Without the benefit of that analysis, however, a few potential solutions can already be suggested. Concerned shipping companies, as well as Mombasa and Salalah port operators, could better coordinate with each other when the risk of missing trans-shipment is high. The Kenyan government could continue to invest in the Mombasa port to increase capacity and improve processes, in order to better manage vessels and avoid delays. Shipping companies could better communicate the time sensitivity of their vessels’ merchandise to Salalah port authorities. Finally, prioritization of loading and unloading could be done jointly to create fast-track processes for containers.

Endnotes
10. Interview with Kenyan avocado exporter, 2013.
17. Interview with association of exporters, October 2013.
18. Interview with Kenyan avocado exporter, October 2013.
27. Interview with Kenyan avocado exporter, 2013.
29. Main criteria come from interviews with Kenyan avocado importers and APM Maersk representatives.
32. Interview with Kenyan Sales representative for APM Maersk, 2013.
33. Interview with Kenyan Sales representative for APM Maersk, 2013.
34. Interview with association of exporters, October 2013.
35. Based on a Kenyan avocado price of -5604 kg carton, 5% boxes per trip and 5-ton average truck capacity.
37. Interview with Kenyan avocado exporter, October 2013.
38. Interview with Kenyan avocado export, October 2013.

40. Interview with Kenyan avocado exporter, October 2013.

41. Interview with Salalah Port statistics supervisor, November 2013.

42. Following paragraph comes from an interview with a Kenyan avocado exporter.

43. “Africa can help feed Africa,” World Bank, October 2012


46. Interview with Kenyan avocado exporter, October 2013.

47. Interview with Kenyan Sales representative for APM Maersk, 2013.

48. Interview with Kenyan avocado importers, October 2013.

49. Interview with Kenyan avocado exporter, October 2013.


51. Interview with Kenyan avocado exporter, October 2013.

52. Interviews with Kenyan avocado exporters and importers.

53. Interview with Kenyan Sales representative for APM Maersk, 2013.
7. Lessons for Implementation of Solutions

As demonstrated through the case studies, specific requirements for identification and implementation of solutions vary, depending on the crop, end market and starting point of any particular country and value chain. This makes it difficult to define broadly prescriptive recommendations. Across various scenarios, however, certain best practices regarding roles, collaboration and process can be identified.

Lead actors differ by type of solution

Because many supply chain barriers have impacts across multiple crops, programmes to reduce barriers often begin with an industry-wide approach. Within this broader approach, specific value chains with the highest potential can be identified based on private-sector input, and initiatives to support specific value chains can be created.

Figure 36 provides a simplified view of the key solutions by type of barrier, scope (industry-wide versus value-chain-specific) and proposed lead actor.

Typically, the public sector is best positioned to tackle solutions that reduce the barriers themselves, usually with positive impacts across the agricultural sector. Many barrier reduction solutions require regulatory changes. Non-regulatory solutions, such as infrastructure projects, typically relate to the provision of a public good, which has incremental benefits for various actors throughout the entire agricultural sector (and, in most cases, other sectors as well as communities). It is therefore difficult for the private sector to pool resources and align incentives to address these issues. Furthermore, the public sector has a role to play in managing externalities (Box 6).

Solutions aimed at reducing barrier impacts are often targeted towards specific value chains. For these efforts, the private sector is better equipped to allocate resources, implement solutions and drive results, especially in developing countries. Benefits accrue more directly to those who bear the costs, and payback periods are often shorter. Wherever possible, companies should take the lead on these solutions: for example, a programme to introduce plastic tomato containers to smallholder farmers will likely be more efficient and sustainable if led by a large processor rather than the government, due to the private sector’s more rigorous focus on obtaining a return on its investment.

Across these efforts, donors or other external agents are important providers of various forms of support to both public and private partners, including coordination, capacity building, analysis and resources. First, donor involvement can help to ensure that the interests of the poorest stakeholders, such as smallholder farmers, are properly represented. Donors can also support access to best practices and the delivery of improved information on agricultural output and food stocks, to enhance policy-making and guide decisions on infrastructure. Given their relative impartiality, third parties can be well placed to facilitate collaboration between actors. For example, international organizations such as the World Bank can explore financial-support mechanisms to help governments exploit cross-border synergies from coordinated policy reforms that are otherwise difficult to achieve. Finally, external agents help with monitoring the impact of interventions: identifying and overcoming roadblocks to implementation, encouraging transparency, ensuring that poor stakeholders benefit, and capturing and disseminating lessons.

Figure 36: Public- or Private-Sector Solutions – All Require Collaboration (Not Exhaustive)

<table>
<thead>
<tr>
<th>Market Access</th>
<th>Border Administration</th>
<th>Transport and communications infrastructure</th>
<th>Business Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solutions led by public sector</td>
<td>- Mechanisms to lobby for fair international SPS &amp; TRT standards</td>
<td>- Targeted investment in transport infrastructure (road, rail, port and ICT)</td>
<td>- Reduced corruption</td>
</tr>
<tr>
<td>Objective: Reduce barriers themselves</td>
<td>- Effective processes for testing, tracking, and certification</td>
<td>- Regulation that allows the development of a competitive, standardized transport services industry</td>
<td>- Effective systems for contract enforcement</td>
</tr>
<tr>
<td>Scope of benefits: Entire agricultural industry</td>
<td>- Free provision of information on existing standards</td>
<td>- Coordination among state / national border agencies that inspect agricultural goods</td>
<td>- Consistent/predictable policy environment</td>
</tr>
<tr>
<td></td>
<td>- Training of private-sector actors on standards and how to meet them</td>
<td>- Implementation of e-customs</td>
<td>- Investment in power/ water infrastructure</td>
</tr>
<tr>
<td></td>
<td>- Training of private-sector actors on how to navigate border processes</td>
<td>- Fast lanes for perishable goods</td>
<td>- Access to finance*</td>
</tr>
<tr>
<td>Solutions led by private sector</td>
<td></td>
<td>- Optimized packaging and storage technology (e.g. plastic boxes, silos)</td>
<td>- Structural supply chain improvements (consolidation, vertical integration, processing)</td>
</tr>
<tr>
<td>Objective: Reduce impacts of existing barriers</td>
<td></td>
<td>- Improved logistical arrangements (e.g. collection points, equipment pooling)</td>
<td></td>
</tr>
<tr>
<td>Scope of benefits: Specific agricultural value chains</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Public support in accessing agricultural finance should be a temporary measure, only used when absolutely necessary to facilitate sector development (example: initial investments for grain silos or cold storage)

Source: Bain & Company analysis
**Box 6: Managing Social and Environmental Externalities**

Externalities resulting from food value chains are significant, and their costs are borne by society as a whole, rather than by actors along the value chain. The government’s role must, therefore, include putting measures in place that attempt to compensate for these externalities. One of the biggest societal risks resulting from increased supply chain efficiency in the agricultural sector is the impact that commercialization and consolidation of production can have on vulnerable smallholder farmers. Smallholders lacking the potential to undertake profitable agricultural activities should be supported in exiting agriculture and seeking nonfarm employment opportunities. Another important externality is the environmental impact of food loss. Governments must estimate the societal costs that losses impose, in terms of water and land usage and carbon emissions. These costs should be included as a consideration when making policy and investment decisions.

**Collaboration between stakeholders**

**Public and private**

Almost every solution in Figure 36 requires a flow of information from one sector to another. For example, in order for the government to lobby on behalf of domestic companies for fair standards in export markets, the relevant government agency needs to understand which standards domestic producers feel are questionable and problematic. In addition to information, some solutions require complex negotiations if competing interests or joint project investment and ownership are involved.

**Within the public sector**

- **Nation to nation.** Negotiations between national governments are important in establishing harmonized standards for agricultural goods, regional liberalization of transport industries, alignment on investments for international corridor infrastructure and improved border processes.
- **Ministry to ministry.** Logically, the development of a country’s agricultural sector has traditionally fallen under the Ministry of Agriculture’s jurisdiction. However, experience increasingly shows that managing post-harvest routes to market can be equally important in improving the long-term sustainability and scalability of growth. This new approach requires various ministries to overcome a siloed, jurisdicational way of thinking. Ministries of transport, trade, investment, health and finance, and even the judicial branch of government, are all implicated in providing support to achieve agricultural tipping points.
- **Federal, state and local governments.** Federal, state and local governments must align incentives to reduce domestic transport checkpoints and coordinate resource allocation for infrastructure investments.

**Within the private sector (Figure 37)**

- **Vertical.** While the public sector works to reduce barriers, companies operating at different stages in the value chain must collaborate to overcome the impacts of existing barriers. For example, Unilever and CHEP are partnering on a pilot in India that maps the supply chain, identifies bottlenecks and evaluates tomato containers that will deliver multiple benefits, including reduced food loss, enhanced food safety, and improved efficiency and sustainability.
- **Horizontal.** Companies operating at the same stage in the value chain are typically competitors. However, collaboration between competitors through industry associations can be an effective way of lobbying the government to prioritize barrier removal, especially in nascent, high-growth markets. For example, exporters can advise border agencies on ways to streamline testing processes. Horizontal collaboration can also occur across different value chains – exporters may be dealing with different crops, but they share a common interest in reducing border delays.
- **Cross-industry.** Supply chain barriers impact not only agriculture, but all industries that involve the movement of goods. Hence, private-sector companies across industries all stand to benefit from the reduction of barriers and their impacts, and can join forces to drive action. The Borderless Alliance, a multisector consortium of West African companies, has organized and funded the provision of transparent, freely available information on companies’ rights when crossing borders.
Structured process to drive action

The process proposed in this section could be applied during implementation at a variety of levels and stages – either at the sector or the value-chain level (Figure 38).

1. Prepare

Establish governance structures and sources of funding. Establishing a core group of representatives is important to drive progress in an inclusive way. A new structure can be formed, or existing structures may be leveraged. For example, the Forum’s New Vision for Agriculture initiative and Grow Africa partnership have achieved great success in accelerating investments in agriculture through public-private partnerships. These platforms could be expanded to include stakeholders from the supply chain and transport community, as well as government representatives from ministries of trade and transport.

Resources are required to support a core team that will coordinate actors, conduct analyses and manage communications. Donors and third-party consultants can play a role as part of this team.

Identify priority corridors and value chains. To facilitate focused use of resources for achieving tipping points, stakeholders should be aligned on trade routes and crops with the highest potential. The types of questions that can be explored include:

- Which crops are best suited to the country’s climate, and in which regions?
- Are there structural barriers-to-entry prohibiting long-term competitiveness?
- Will production be targeted towards the domestic market or export markets? Which export markets?
- Does the country have greater potential to be competitive in fresh or processed goods?
- Along which trade routes do the highest volumes of these products move?
- How profitable are actors in existing value chains, or how far from profitability are they?
- What existing initiatives can be leveraged?
- Which anchor companies are willing to provide initial investments to generate momentum along the corridor?

Based on the answers to these questions, stakeholders should align on strategic objectives for the project.

Figure 38: Proposed Process for Supply-Chain-Barrier Reduction

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Establish governance structures and sources of funding</td>
<td>- Map supply chains</td>
<td>- Co-create list of initiatives</td>
<td>- Convert roadmap into an actionable implementation plan</td>
</tr>
<tr>
<td>- Identify priority corridors and value chains</td>
<td>- Gather public- and private-sector input on impact of barriers</td>
<td>- Conduct cost/benefit analyses</td>
<td></td>
</tr>
<tr>
<td>- Measure and benchmark supply chain performance</td>
<td>- Phase initiatives into an integrative roadmap</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

0. Communicate - Manage open channels for input and provision of information

Source: Authors

Figure 39: USAID/NEXTT’s Time and Cost Benchmarking Exercise along the LAKAJI Corridor

<table>
<thead>
<tr>
<th>Country/Region</th>
<th>Export Markets</th>
<th>Time for Import (Days)</th>
<th>Cost for Import (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>Chicago</td>
<td>3 days</td>
<td>$1,583 USD</td>
</tr>
<tr>
<td></td>
<td>Newark</td>
<td>4-5 days</td>
<td>$2,341 USD</td>
</tr>
<tr>
<td>Nigeria</td>
<td>Lagos</td>
<td>5 days</td>
<td>$1,958 USD</td>
</tr>
<tr>
<td></td>
<td>Jibiya</td>
<td>7-14 days</td>
<td>$1,958 USD</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>Ouagadougou</td>
<td>12.5 days</td>
<td>$3,041 USD</td>
</tr>
<tr>
<td>Ghana</td>
<td>Tema</td>
<td>4-5 days</td>
<td>$2,451 USD</td>
</tr>
</tbody>
</table>

Source: United States Agency for International Development (USAID)/Nigeria Expanded Trade and Transport (NEXTT)

Figure 40: Criteria for Ease of Implementation of a Supply-Chain-Barrier Reduction Initiative

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of stakeholders</td>
<td>Easy</td>
</tr>
<tr>
<td>Nature of stakeholders</td>
<td>Easy</td>
</tr>
<tr>
<td>Time for implementation</td>
<td>Easy</td>
</tr>
<tr>
<td>Investment required</td>
<td>Easy</td>
</tr>
<tr>
<td>Need to adapt/change legal framework</td>
<td>Easy</td>
</tr>
<tr>
<td>Contentiousness of reform</td>
<td>Easy</td>
</tr>
<tr>
<td>- Limited number of stakeholders to engage</td>
<td>- High number of stakeholders to engage</td>
</tr>
<tr>
<td>- Limited complexity of stakeholders (e.g. public companies)</td>
<td>- High complexity level of stakeholders (e.g. governments)</td>
</tr>
<tr>
<td>- Implementation can be done in a few months</td>
<td>- Implementation will require several years</td>
</tr>
<tr>
<td>- CAPEX/resources required estimated in U$ million</td>
<td>- CAPEX/resources required estimated in U$ billion</td>
</tr>
<tr>
<td>- No/limited need to adapt legal framework of countries involved</td>
<td>- Important change in legal framework of countries involved</td>
</tr>
<tr>
<td>- Limited reluctance to change given stakeholder’s interests</td>
<td>- High reluctance to change given stakeholder’s interests</td>
</tr>
</tbody>
</table>

Source: Authors
2. Diagnose

Map supply chains. The flow of goods along these high-priority trade corridors or value chains should then be mapped, from inputs to cultivation, through distribution and consumption. It is important to identify all relevant stakeholders that are active along the chain, and to understand their roles.

Gather public-and private-sector input on the impact of barriers. Interviews, workshops and focus groups can help generate a first hypothesis on supply-chain pain points. The views of members of each key stakeholder group identified during the mapping phase should be taken into consideration. Quantitative cost data from actors operating along the route can be helpful in informing the benchmarking exercise.

Measure and benchmark supply chain performance. To thoroughly assess the impact of barriers, three types of data should be gathered through field research: costs, time and food loss. By travelling along a corridor with shipments of agricultural goods, a research team can measure the costs (both official and unofficial) and time required for each step, which can then be compared against benchmarks (see Nigerian example in Figure 39). Input from interviews should guide this research; for example, if transporters indicate that conditions vary dramatically between day and night, or between different seasons, these variations should also be measured. Average time per step is a helpful indicator of performance, but variations in time can increase food loss, reduce processing capacity utilization and drive additional inventory costs.

Measuring food loss within the priority value chains is another important part of the process. Food loss can occur not only during transport, but also during harvesting, processing and packaging. Defining the scope of the measurement exercise is thus important.

Measurement is not straightforward; loss can be measured in calories, nutritional value, weight or economic value. To address these challenges, the World Resources Institute is designing a Global Food Loss and Waste Protocol. Lack of available data on food loss means that benchmarking may have to be done through field visits to best-practice countries. As part of their research for the Indian tomatoes case study, Unilever visited suppliers in Spain and the US to measure loss levels and learn about best practices that could be applied in the Indian context.

3. Plan

Co-create a list of initiatives. For each barrier identified during the diagnostic phase, the core team can then define a long list of potential actions for reducing costs. This list should form the basis of an integrative discussion among stakeholders. This session is useful to generate additional ideas, eliminate unfeasible ones and begin to assess what would be required for implementation.

Conduct cost/benefit analyses. A critical analysis of the resulting list of initiatives is vital to ensuring that resources are allocated where they will have the biggest impact. A cost-benefit analysis is imperative, with a view to achieving a minimum rate of return on capital invested. Key factors for prioritizing initiatives should be their potential value and the ease of implementation, with the latter depending on a variety of factors. Figure 40 presents an example of criteria that could be considered.

Prioritize and phase initiatives into an integrative roadmap. Action plans can be structured so that different pieces can be presented to sources of outside funding. For example, the public sector could provide the initial investment in cold storage, while a private company could assume ownership of operations.

4. Mobilize

Convert roadmap into an actionable plan. For each initiative, clear owners from various stakeholder groups should take responsibility; moreover, subowners should be assigned, milestones set and transparent mechanisms to track progress put in place. Potential key performance indicators include transport time, cost, trade volumes, food loss and land use around corridors. Risks should also be identified at this stage, and mitigation measures incorporated into the plan.

Through coordinated action, leaders from various communities can share their expertise and resources to reduce supply chain barriers in agriculture, triggering increased economic efficiency and a virtuous cycle of investment. In the long term, this type of development will contribute to higher incomes along the value chain, improved food security and increased environmental sustainability.
Acknowledgements

Enabling Trade: From Valuation to Action is the result of collaboration among many individuals, institutions and firms. The authors are very grateful to all the firms we interviewed for their valuable contributions, as well as those who reviewed materials. We would like to specifically thank A.P. Moller-Maersk, Flour Mills of Nigeria, Unilever and CHEP for their support in developing the agricultural case studies, and the Inter-American Development Bank for its leadership on the “Enabling Trade in the Pacific Alliance” section.

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- China Association of Automobile Manufacturers
- CHEP, a Brambles Ltd company
- Deutsche Post DHL
- Flour Mills of Nigeria Plc
- Food and Agriculture Organization of the United Nations
- Hyundai Motor Company
- International Food Policy Research Institute
- K-Cingle-CUPIA; Korea Customs UNI-PASS & Single Window Agency
- Kenya Trade Network Agency (KENTRADE)
- Renault-Nissan Alliance
- Schaeffler Technologies AG & Co. KG
- Syngenta AG
- Unilever Plc
- Tenneco Inc.
- The Inter-American Development Bank
- The World Bank
- Transport Intelligence
- United Parcel Service, Inc. (UPS)
- Verband der Automobilindustrie
- Wal-Mart Stores, Inc.
- World Customs Organization
- World Economic Forum’s New Vision for Agriculture
- World Trade Organization

Consultative group
Finally, the authors would like to thank all the companies that generously provided interviews for the various case studies.
The World Economic Forum is an independent international organization committed to improving the state of the world by engaging business, political, academic and other leaders of society to shape global, regional and industry agendas.

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