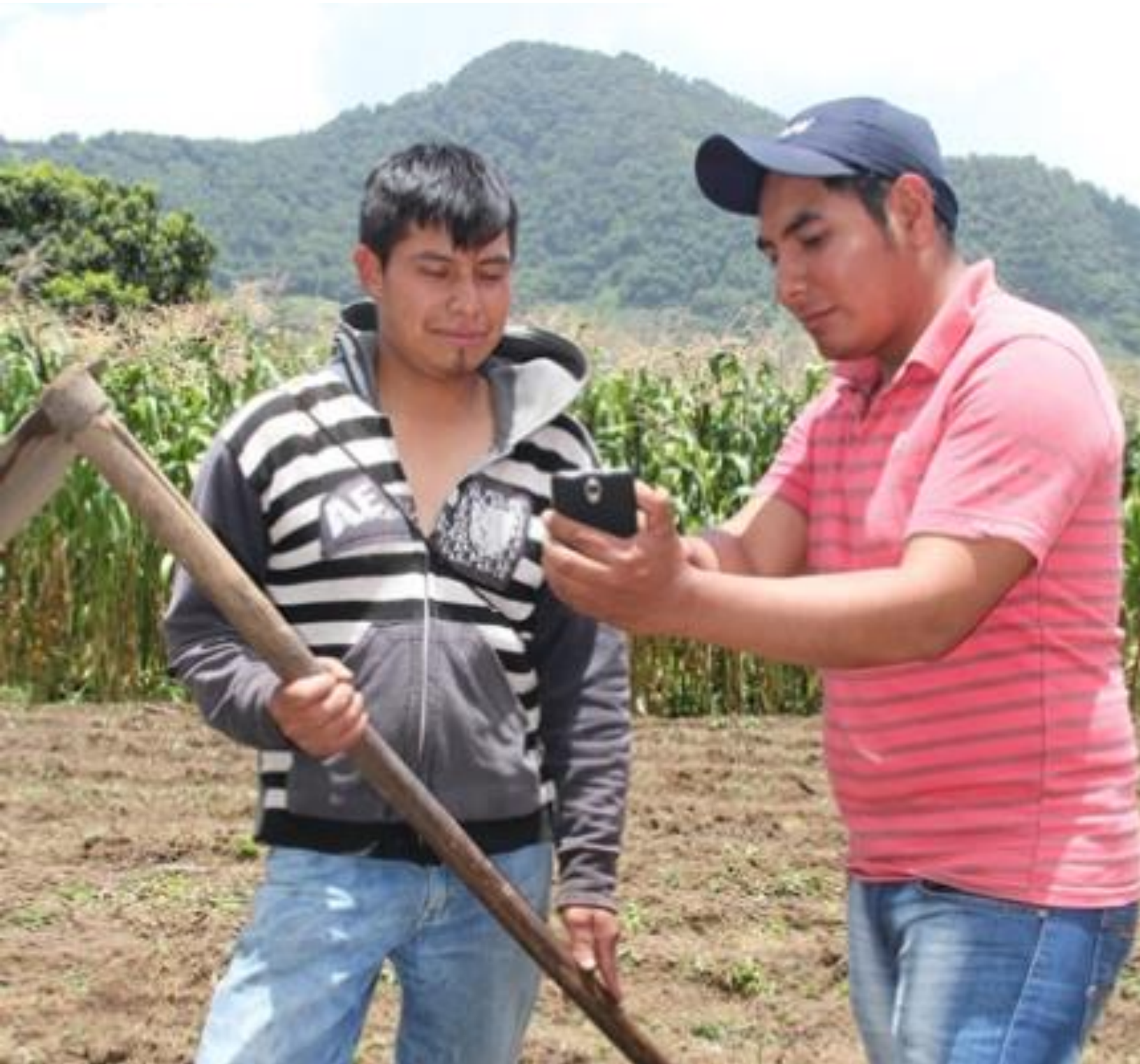
FEED THE FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Partnering for Innovation

Funding Traceability Technology: Lessons Learned for Commercializing Traceability Software in Emerging Markets



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Cover Photo: Fintrac Inc.

About Feed the Future Partnering for Innovation

Feed the Future Partnering for Innovation is a USAID-funded program that builds partnerships with agribusinesses to help them sell new products and services to smallholder farmers, who represent a potential market of more than 500 million customers worldwide. Businesses are provided with the investment assistance, expert guidance, and technical support they need to expand in emerging markets and create a growing and lasting customer base for their agricultural innovations.

www.PartneringforInnovation.org

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ACRONYM LIST

API	Application Programming Interface
FDA	U.S. Food and Drug Administration
FSMA	Food Safety Modernization Act
FSVP	Foreign Supplier Verification Program
LAC	Latin America and the Caribbean
SFSA	Syngenta Foundation for Sustainable Agriculture
USAID	United States Agency for International Development

EXECUTIVE SUMMARY

The United States Government passed the Food and Drug Administration (FDA) Food Safety Modernization Act (FSMA) in 2010 to shift the focus of food suppliers and federal agencies from responding to foodborne illnesses to preventing them. FSMA introduced new requirements for preventative food safety controls and mandatory standards for the production and harvest of fruits and vegetables, including the Foreign Supplier Verification Program (FSVP), which places a legal obligation on U.S. importers to ensure that the food they bring into the country is safe for consumption. While companies across the horticulture value chain began to dedicate resources to FSMA compliance, the United States Agency for International Development's (USAID) Bureau for Latin America and the Caribbean (LAC) became concerned that FSMA's stricter import requirements would inadvertently exclude smaller-scale actors from important and lucrative export markets.

USAID/LAC partnered with the Feed the Future Partnering for Innovation program (Partnering for Innovation) in 2016 to incentivize businesses selling proven food safety and export readiness technologies to target small-scale actors in the Latin American market and help them comply with FSMA requirements. Following an open call for applications, Partnering for Innovation selected two companies for investment: Farmforce and Solutions SA (Solutions). Both companies were developing and scaling software solutions for small- and medium-sized horticulture exporters interested in affordable traceability solutions.

Farmforce, a cloud-hosted software platform for the digital management of agricultural value chains, aimed to expand its pilot traceability operations in Guatemala by targeting a broader customer base in the horticulture, cacao, and coffee industries in Colombia, the Dominican Republic, El Salvador, Haiti, Honduras, and Peru. Solutions focused on developing a mobile-based software that uses geo-referencing technology to provide traceability down to the farm level and needed support to roll out its product in Haiti's mango industry.

During Partnering for Innovation's collaboration with Farmforce and Solutions, each company struggled to achieve targets related to commercializing their traceability products. Delays and confusion regarding the rollout of FSMA and its related enforcement and penalties undermined any sense of urgency to adopt traceability systems, suppressing the companies' primary driver and market for these tools. While both partnerships underperformed against their expected sales and impact targets, they generated unexpected benefits for exporters, smallholders, and the technology ecosystem in general.

This report presents lessons learned from commercializing traceability software solutions in emerging markets and considers how the technology and traceability landscape has evolved since Partnering for Innovation's partnerships with Farmforce and Solutions. Five key drivers for the adoption of traceability technologies are identified: 1) technology landscape; 2) business model; 3) small-scale capacity; 4) catalytic donor intervention; and 5) policy and enabling environment. These drivers provide insights that can guide discussions about lessons learned and future USAID investments in the sector. Finally, the report concludes that there are considerable opportunities to use traceability systems as a tool to pull smallholder farmers and other actors into commercial value chains in order to raise incomes and improve overall food security.

BACKGROUND

Feed the Future Partnering for Innovation

Feed the Future Partnering for Innovation is a USAID-funded program that provides pay-for-performance grants to private sector partners to de-risk the upfront investments necessary to introduce, scale, and market agricultural technologies and innovations in smallholder markets, thereby empowering the private sector to support development gains. Partner businesses receive the investment assistance, expert guidance, and technical support they need to expand in emerging markets and create a growing and lasting customer base for their agricultural innovations. These partnerships spur technology adoption and innovation in the smallholder market and drive responses to new and emerging industry needs, such as compliance with updated food safety controls and standards. Since Partnering for Innovation's inception in 2012, more than 1.7 million smallholder farmers have purchased $110 million worth of these products and services, enabling them to boost farm production, raise incomes, reinvest in their businesses, and increase food security.

The FDA Food Safety Modernization Act

In 2010, the FDA passed FSMA in response to outbreaks of various foodborne illnesses from fruits and vegetables, introducing new requirements for preventative food safety controls and mandatory standards for the production and harvest of horticultural products. FSMA also launched the FSVP, which places a legal obligation on U.S. horticulture importers to ensure that the food they import is safe for consumption. These requirements may be satisfied through an on-site audit of the supplier by the importer or an independent third-party certifier, or through documented approval by an officially recognized food safety authority in those countries where food safety systems have been approved by the FDA (Humphrey, 2017).

Companies across horticultural value chains dedicated resources to comply with FSMA and to coordinate implementation of the new regulatory requirements. Compliance was more challenging for small- and medium-sized businesses with limited resources (those with fewer than 500 employees and less than $1 million in total annual food sales) (Plimpton, 2017). To accommodate the different capacity levels of value chain actors, the FDA rolled out FSMA regulations in phases between May 2017 and July 2020, and provided modified requirements for small-scale importers and exporters.

Despite these efforts to provide greater compliance opportunities for smaller value chain actors, complicated supplier exemptions and ongoing deadline extensions left many small- and medium-sized businesses unclear about how and when they had to comply with FSMA regulations (Humphrey, 2017). To address this confusion, the FDA and other U.S. Government agencies developed training programs for small- and medium-sized global food businesses to help them navigate FSMA regulations, achieve compliance, and strengthen the safety of the food supply (Goldberg, 2018).

USAID/LAC Food Safety Technology Investment

As FSMA's compliance deadlines neared, USAID/LAC grew concerned that FSMA's stricter import requirements would effectively exclude smaller-scale aggregators, processors, and exporters with limited capacity to adopt preventative food safety measures, and eventually shrink or close market opportunities for the smallholder farmers who supply them. USAID/LAC determined that developing public-private partnerships to draw companies with proven food safety and export readiness technologies into the regional market would help small-scale actors comply with new regulations.

In 2016, USAID/LAC partnered with Feed the Future Partnering for Innovation to launch an open request for applications from private sector companies with tools or services to help small-scale value chain actors throughout the region improve food safety and comply with new regulations. Twenty-two applicants submitted proposals for food safety technology solutions and other innovations, and an independent review committee of funders, technical specialists, and area experts selected two companies for investment: Farmforce and Solutions.

TRACEABILITY

Traceability is the process by which a product is tracked as it moves from its original raw material form through harvest, processing, packaging, distribution, and consumption by the final customer.

Agricultural traceability systems use value chain data collected through manual paper entry, mobile applications, electronic barcodes, radio frequency identification, or other technologies to identify each step or ingredient that resulted in a final food product in order to fulfill food inspection and certification requirements (World Bank, 2017).

Effective traceability systems provide value chain actors with the data needed to prevent food safety concerns and allow regulatory authorities to identify the source of a food safety or quality problem, and initiate procedures to remedy it.

TRACEABILITY PARTNERSHIPS

The two private sector partners selected for investment under the USAID/LAC funding round – Farmforce and Solutions – were both software development companies focused on digital tools for small- and medium-sized horticulture exporters seeking affordable traceability solutions.

The companies were selected because of the potential for their traceability technology solutions to expand outgrower networks, incorporate more smallholder farmers into higher-value export markets, and provide targeted technical assistance to smallholder farmers to reduce rejection rates and crop losses. With the FSMA regulations slated to take effect in 2017 (one year after the partnerships' launch), traceability systems tailored to small- and medium-sized value chain actors could support regulatory compliance and build a diverse food business ecosystem to improve global food safety.

Partner Companies

While both Farmforce and Solutions focused on traceability technology, each company pursued very different approaches in their technology development, business model, and overall value proposition.

Farmforce

Farmforce is a global company that provides a cloud-based software platform for the digital management of agricultural value chains. Exporters in 35 countries across Africa, Asia, and Latin America currently use the software to digitally track products sourced from more than 520,000 farmers.

farmforce™	
Geographic Focus	Global (Asia, Africa, Latin America)
Key Solution	Enterprise Resource Planning Platform
Value Proposition	Operational and Inventory Management
Target Customers	Multinational Corporations, Premium Producers
Operational Ecosystem	Low barrier to entry, high fail rate, crowded space

Launched by the Syngenta Foundation for Sustainable Agriculture (SFSA) in 2012, Farmforce was designed to replace paper-based management systems with a comprehensive, added-value software solution to meet the various business needs of producers, distributors, and exporters, such as: managing export requirements and achieving regulatory compliance; improving production and on-farm management through use of data; and implementing full farm-to-fork traceability to deliver enhanced market access for farmers and buyers. Farmforce can also reduce fraud, enable improved communications, and quantify impact.

Farmforce's target customers are multinational companies engaged in higher-value crops, such as coffee and cacao, in which consumer demand for transparency creates a price premium that offsets the high cost of the software. Large-scale companies tend to have the capacity necessary to analyze the high volume of data generated by the software and make organizational changes based on that analysis, thereby maximizing the value of the data and justifying the investment. For Farmforce customers such as Cargill, a multinational company that sources from smallholder cacao cooperatives across the West African region, the ability to scale and adapt a well-tested and stable software across different operating contexts is critical for supporting its complex business operations and ensuring its global competitiveness.

Solutions

In contrast to Farmforce, Solutions delivers hyperlocal data on smallholder farmer networks and production conditions in Haiti through AgroTracking, a mobile-based software created in 2011 by the company and GeoNova, a fruit exporter. The software uses geo-referencing technology to provide digital traceability of export crops sourced from nearly 40,000 mango farmers at present.

Solutions	
Geographic Focus	Local (Haiti)
Key Solution	Logistics Management
Value Proposition	Farmer Database, Production Conditions Tracking
Target Customers	Other Value Chain Actors (Distribution, Processing, Farm Services, Finance)
Operational Ecosystem	High barrier to entry, skewed by government-backed products

With AgroTracking, Solutions collects and manages its own high-precision, geo-referenced smallholder farmer data in Haiti and combines it with publicly available data for the benefit of value chain actors and service providers. GeoNova also populates the software database with its own related proprietary data. Exporters using AgroTracking are able to access vital localized

information on growing conditions, such as forecasted harvest dates, pest outbreaks, and weather events, while also maintaining proprietary data collections inaccessible to other users.

Additionally, Solutions provides additional value to AgroTracking by enabling customers to leverage smallholder data in proactively managing production, purchasing, and buyer logistics – a service of particular benefit to distributors, wholesale markets, and service providers looking to grow their businesses.

While Solutions' value proposition is primarily its extensive smallholder network and database, the company's long-term business strategy focuses on reaching different value chain actors in the country, including government programs, insurance providers, and financial institutions that deliver services and technical assistance to smallholder farmers.

Partnership Objectives

Farmforce

Partnering for Innovation's partnership with Farmforce focused on the expansion of its pilot operations in Guatemala through the development of a broader customer base in the horticultural, cacao, and coffee industries in Columbia, the Dominican Republic, El Salvador, Haiti, Honduras, and Peru. The company used partnership investment funds to promote exporter adoption of its traceability system through in-depth market research, marketing campaigns, and one-time subscription discounts of up to $1,000 per company.

In addition, Farmforce worked with local certifiers, international agencies, and expert partners to foster greater stakeholder awareness of international food safety standards and to provide information on various compliance tools and strategies. These local partners provided potential subscribers with an independent, regional perspective and could recommend that exporters adopt platforms such as Farmforce to comply with recordkeeping and traceability requirements. This approach was designed to build on the momentum generated by the pilot launch of the software in Guatemala and to scale its uptake across the region.

As part of the partnership terms with Partnering for Innovation, Farmforce was expected to secure at least six new subscriptions with exporters that source from smallholder producers of horticulture, coffee, and cacao.

Partnership At-a-Glance: ***Farmforce & Feed the Future Partnering for Innovation***	
USAID Investment	$254,312
Partner Co-Investment	$118,796
Investment Period	July 2017 – August 2018
Geographic Focus	Latin America and the Caribbean
Smallholder Impact	6 new subscribers impacting 1,714 smallholders

Solutions

While the partnership with Farmforce focused on scaling throughout the LAC region, Partnering for Innovation's collaboration with Solutions aimed to scale the company's efforts of formalizing mango traceability within Haiti. Informal production, harvesting, and aggregation techniques had led to widespread rejection of Haitian horticulture in international markets, and traditional paper-based traceability systems had proven unreliable and left exporters vulnerable to rejections of entire shipments at import points.

In response, Solutions focused partnership investment funds to establish fruit collection sites and washing stations, and to equip mango producer groups with harvest crates and smartphones, which would enable them to use the company's AgroTracking software to track to the point of production. Unlike Farmforce, Solutions directly managed data collection and served as a middleman by coordinating smallholder farmers and ensuring exporters gained access to fully traceable, high-quality produce compliant with international market standards.

As part of the partnership terms with Partnering for Innovation, Solutions was expected to support more than 9,000 smallholder mango producers in selling 800 metric tons of traceable mangoes to at least two partner exporters purchasing exclusively from these smallholder groups.

Partnership At-a-Glance: ***Solutions & Feed the Future Partnering for Innovation***	
USAID Investment	$376,491
Partner Co-Investment	$279,190
Investment Period	March 2017 – July 2019
Geographic Focus	Haiti
Smallholder Impact	2 new exporters impacting 8,800 smallholders

Partnership Results

FSMA was intended to be a key driver of traceability adoption in the region, and the partnership targets for both companies were negotiated under the assumption that traceability for FSMA compliance would become mandatory during the investment period. Instead, complicated exemption requirements, unclear enforcement, and ongoing delays of compliance deadlines undermined any sense of urgency around traceability adoption.

Small- and medium-sized companies, in particular, often did not learn about regulations until they engaged with their overseas buyers, lacked the technical staff or resources to know how to comply with regulations, and could not anticipate the impact on their business model (Plimpton et al, 2017). Exporters were also unable to confirm if reports generated by Farmforce or Solutions would provide acceptable documentation for FSMA and FSVP compliance. In addition, the FDA

announced in 2018 that it would exercise enforcement discretion for certain FSMA provisions, including FSVP for foreign horticulture suppliers (Goldberg, 2018). After this announcement, smaller exporters rightly assumed it would be unlikely for them to be found non-compliant, and therefore opted to risk regulatory violation and one-time fines rather than invest in an expensive digital solution.

Ultimately, the rollout and enforcement of FSMA regulations lacked clear directives and penalties for exporters who preferred to risk non-compliance rather than invest in traceability. As a result, Farmforce and Solutions lost their primary driver and market. Without FSMA to drive traceability uptake, both companies struggled to achieve commercial sustainability for their software products. In each case, the prospect of improved technology solutions and operational benefits failed to offer strong enough financial incentives on their own to drive traceability adoption.

With high upfront costs to implementing an effective traceability system and few short-term financial payoffs, importers, exporters, and smallholder farmers had no incentives to invest in traceability systems, and each value chain actor felt that those actors reaping greater traceability benefits should bear the costs. As a result, both Farmforce and Solutions pivoted their marketing strategies several times in an effort to better identify target customers for their products.

Both companies faced other unexpected challenges beyond their control during the investment period. In 2017, Hurricanes Matthew and Irma devastated Haiti, reducing mango production and resulting in a 75 percent decline in mango exports from normal levels during the first month of the harvest. Additionally, the harvest began approximately two months later than usual – a likely result of climate change. These factors eroded Haiti's advantage in mango production as it typically harvests several months ahead of Mexico, a large mango producer and one that Haiti cannot compete with directly.

Anti-government protests in 2017 and 2019 added to these challenges as they shut down Port-au-Prince and the mango export facilities located there; key roads in and out of the capital were blocked, internet and phone services were cut off, and Solutions' employees could not safely travel to the office or field. Meanwhile, in 2017, Farmforce was purchased by a subsidiary of Eisblink Holding AS, a Norwegian consulting company, and is now an independent business. This spinoff required a strategic shift from nonprofit development to corporate growth, and resulted in a period of flux just as the investment period began.

Consequently, both companies struggled to meet their partnership goals. Farmforce reached its target number of six new subscribers, but without FSMA to drive uptake, few if any of the companies continued using the software once subsidized pricing ended. While Solutions did work with the required number of smallholder mango farmers, they did not effectively track and report mango sales through their AgroTracking software, instead relying on in-place tracking systems, such as paper receipts. From this perspective, both companies failed to perform as expected against negotiated targets during the investment period.

LESSONS LEARNED

While Farmforce and Solutions underperformed against their target sales and impact milestones, the partnerships, from a broader perspective, generated a number of unanticipated benefits for exporters, smallholders, and the technology ecosystem overall. To better understand these benefits, Partnering for Innovation developed an analytical framework to identify five key drivers of traceability technology adoption. The framework draws on direct partnership lessons learned, a comprehensive literature review, and primary interviews with key informants who have experience in developing, managing, and/or investing in agricultural traceability systems.

Five Key Drivers of Traceability Technology Adoption

Driver 1: Technology Landscape

The technology landscape includes available technologies, the entities that develop them, and the degree to which they are integrated so that users have access to a wide range of effective options to meet their traceability needs.

Driver 2: Business Model

Effective business models allow value chain actors to profitably incorporate traceability into their individual business operations in a way that increases efficiency and maximizes the value of the data collected.

Driver 3: Small-Scale Capacity

Small-scale capacity ensures that traceability interventions support small-scale value chain actors, and not just larger actors along the chain.

Driver 4: Catalytic Donor Intervention

Donor intervention can catalyze change and improve the overall ecosystem, information, and market for traceability technology solutions.

Driver 5: Policy and Enabling Environment

Policy and an enabling environment facilitate traceability uptake and market access for value chain actors through the standardization of and support for food safety requirements.

For each of the five drivers, Partnering for Innovation drew on the partnership experiences of Farmforce and Solutions to extract a core lesson of use for broader learning and application in achieving USAID objectives for technology commercialization, including product diversity, market growth, and smallholder access.

Driver I: Technology Landscape

Despite the availability of many agricultural technology solutions, no single technology provider has created an end-to-end farm management solution that satisfies all needs. As companies race to provide data tools, they often keep them proprietary, resulting in an ecosystem overwhelmed with incompatible information generated by different systems. Collaboration across data platforms can promote interoperability, allow new players to leverage existing technologies, drive user acquisition, and promote market expansion (Ge, Lan et al, 2017). New technology investments should promote innovation and interoperability to foster an agile technology landscape able to respond to evolving challenges.

The creative use of technology can also help support smallholders by promoting rural access to markets and overcoming infrastructure and financial constraints (Banerjee, Rini et al, 2015). As technology solutions mature and reach a critical mass of data, collected farmer information can be used as an additional asset to help the private sector tailor its product offerings more effectively, inform public sector investment in rural communities, and support additional smallholder services (World Economic Forum, 2019).

Partnership Experience

Farmforce and Solutions are operating in a much more crowded technology landscape today than when they were first established. A huge variety of software and applications have proliferated over the last decade, ranging from simple smartphone applications that provide inexpensive product tracking to complex enterprise management platforms that integrate multiple business systems for real-time management.

While both companies offered high quality technology solutions for value chain traceability, they struggled in the current more diversified ecosystem to respond to new market demands and emerging technological advancements. Farmforce, for instance, had not yet finished adapting its program for Latin American users at the time of rollout and some important functions were not fully functional until the end of the investment period.

Photo Credit: Farmforce

Likewise, Solutions' AgroTracking software architecture lacked fully developed operational features, such as real-time responsiveness, farm-level tracking, and access to a critical mass of farmer data. Without these technology features in place, neither company was able to gain sufficient market share over competitors by driving adoption of their technology *solely* as a traceability solution for horticultural exporter customers. Both companies also failed to effectively predict market demand for their software in the absence of regular enforcement of FSMA requirements.

Farmforce's high-end product provided an overwhelming wealth of data to export companies, but its target customers were not able to leverage the tool's deeper analytical capability to justify its cost. For smaller value chain actors, such as small- and medium-sized exporters, distributors, or processors, off-the-shelf products still require considerable and costly tailoring to meet niche operations. These potential customers often compare the upfront and continual costs of adopting traceability software with the cost of hiring staff to manually track products on paper.

In light of this, and given an increasingly diverse and specialized software ecosystem growing throughout the region, Farmforce faced significant competition from a range of much cheaper traceability applications providing simple reporting of paper-traced data. In fact, once Farmforce's subsidized pricing period ended, all new subscribers switched to one of the many less expensive reporting apps, created internal traceability systems to meet their own needs, or returned to paper-based systems. As a result, the company shifted its focus in the region to targeting larger companies trading in higher value crops, such as coffee and cacao, where consumer concern for ethical labor practices and sustainability can drive price premiums or market access, creating a financial incentive for traceability adoption.

Likewise, Solutions found that small-scale value chain actors were not a profitable market segment without the enforcement of FSMA driving traceability adoption. The company also shifted to a different market segment namely, local value chain actors such as produce buyers, processors, and service providers as well as public-supported farmer programs. Key to this shift is the fact that Haiti, unlike the technology landscape throughout the rest of the region, has a heavily skewed technology market due to the government's promotion of a handful of development aid-funded traceability programs. As a result, Solutions found it difficult to gain traction with exporters who were already receiving subsidized pricing for traceability software. However, by targeting public-supported farmer programs with its geo-referenced, smallholder database, Solutions offers a unique product in the technology landscape, despite its significant upfront investment. The company continues to rely on public sector support in reaching a critical threshold of content in AgroTracking, which, if achieved, is anticipated to further drive demand.

Lesson Learned

Invest in solutions for improved compliance, interoperability, or improved data collection and visualization rather than in individual software products.

USAID's investments in Farmforce or Solutions were made when the technology landscape had fewer software options, functionalities, and actors. The landscape has since evolved into a crowded market that is saturated with many competing and unvetted solutions to meet different value chain management and traceability needs.

As a result, public investment in the development of technologies tailored for niche markets should no longer be a priority. Instead, there is significant opportunity to invest in technologies that *connect* different software products, enable reporting for multiple standards, and help companies capture and combine data more effectively. Investments in publicly developed and

open-sourced application programming interfaces (APIs) that could be used with existing off-the-shelf traceability platforms are one opportunity. Another would be applications to help solve cross-cutting problems, including those that pull common traceability information for multiple compliance reporting formats, enable cost-efficient data collection, and facilitate the effective visualization of that data.

Driver 2: Business Model

While the technology landscape driver considers available traceability solutions, the business model driver focuses on the ability of businesses to use these solutions and the resulting data to generate additional value. Value chain actors that can leverage these tools beyond compliance reporting to streamline business operations will be more likely to adopt new technologies. The upfront and ongoing costs of implementing traceability systems require capital and investment in technology infrastructure, hardware and software, recordkeeping systems, harvest processes, farmer services, and ongoing management costs (Banerjee, Rini et al, 2015).

Additionally, inconsistent traceability and food safety standards can result in individual value chain actors adopting multiple traceability systems to meet different market requirements (World Economic Forum, 2019). These cost barriers limit technology adoption and also tend to favor large-scale producers or vertically integrated value chains. Traceability solutions that can drive profits through individual product premiums or through improvements to overall operational efficiency have the greatest opportunity for success. Additional opportunities to drive profits from traceability data include linkages with public sector programs, insurance providers, and financial institutions (UN Global Compact, 2014).

> *"Before we tried Farmforce, an audit of our whole network required multiple paper copies from different systems entered by different people into different spreadsheets multiple times to generate a 1,500-page audit report—it was absolute madness!"*
>
> Former Farmforce Subscriber

Partnership Experience

Customers of both Farmforce and Solutions stated that implementing traceability systems allowed them to look deeper into their data collection and management systems, and helped them think through modernizing paper systems, conducting deeper analysis in real time, determining opportunity costs of different activities, and making more strategic decisions that helped lower operational costs over time. However, customers also reported that Farmforce is cost prohibitive ($552 per license per year), and that they were overwhelmed by the volume of data output and had little capacity to determine which data points would help them make better business decisions. Many exporters stated that they wanted simple, inexpensive reporting tools that would meet export requirements without requiring significant operational changes.

The benefits offered by Farmforce—improved product quality, inventory management, staff coordination—were not high priorities for exporters and many of them lacked the corporate

agility to translate software recommendations into operational improvements. In addition, none of the Farmforce customers used the software-generated reports for FSVP compliance at it was unclear if the reports would be acceptable. Additionally, most organic or FairTrade certifying bodies required paper records and ink signatures, with few of them accepting Farmforce online documentation and electronic signatures. As a result, there was a fundamental lack of value placed on the data created by Farmforce and neither exporters nor importers were incentivized to invest in improved traceability.

Unlike Farmforce's flat subscription fee, Solutions charges a comparatively smaller fee automatically scaled to purchase volume (fee charged is per dozen traceable mangoes entered into the system by individual buyers and exporters). The lack of rigorous FSMA enforcement and a limited domestic regulatory environment, however, translated into low demand for traceability products. In response, Solutions provides value chain actors and service providers with highly specific, localized information on smallholder farmers and their production. The company has done this by collecting and managing its own data from different partner programs and operations as well as from publicly available sources.

Solutions plans to market AgroTracking primarily as a logistics—not traceability—solution by gradually increasing data on production conditions, yield forecasts, and logistics considerations in value chains like mango, vetiver, horticulture, and coffee to a critical threshold level of content. Until that level is achieved, however, the software will likely be sustained by public sector service providers as funders and customers.

Lesson Learned

Help companies make the business case for traceability by demonstrating the benefits of software adoption.

As one software subscriber stated, "the typical exporter is not running a technology or data-driven business, so it's a tough market for these types of platforms." Value chain transparency on its own does not provide sufficient incentive for companies to shift operations and adopt a new software; rather, there needs to be a clear opportunity for maximizing investments in data collection and management.

For existing value chain actors, overcoming the barrier to systems change is significant and requires substantial financial incentive to invest in costly data collection and management. Donors, impact investors, and others could support traceability uptake by demonstrating exactly how subscribers can leverage data—beyond traceability and compliance reporting—to make strategic business decisions and streamline operations. In fact, developing multiple business cases for different value chain actors, crops, and geographies to underscore how traceability data can be used in different contexts will strengthen the market as a whole.

Software developers in the traceability market rarely have sufficient value chain expertise to help subscribers determine which types of data to track and how that information could be used to increase profitability. Additionally, there is often lack of understanding about how to tailor

software rollout in a way that addresses specific business needs. These limitations point to a critical gap in software developers' ability to effectively market their traceability platforms. Leveraging the public sector's value chain expertise to provide clear protocols for maximizing software use within different business models will add complexity and enhance users' ability to fully benefit from software functionalities.

Driver 3: Small-Scale Capacity

Donor investments in traceability tend to be made with the goal of ensuring the inclusion of smallholder farmers in complex value chains and increasing their access to premium export markets. While donor support has been shown to increase exports in low-income countries, this support tends to favor farmers with greater assets, higher levels of education, and those better served by transportation infrastructure who are already exporting their products; additionally, the support may actually further marginalize smallholders with fewer resources (Humphrey, 2017).

The disproportionate marginalization of smallholder farmers also occurs when traceability requirements are enforced without adequate investment or public infrastructure, which in many cases disadvantages small-scale producers, processors, and distributors who have more limited financial capital and operational bandwidth to implement new processes (World Bank, 2017).

At the same time, traceability systems can also offer significant benefits for smallholder producers, provided they are appropriately supported with technology, technical assistance, financing, and value chain collaboration (Humphrey, 2017). For example, traceability technologies have the potential to improve smallholders' overall productivity and efficiency by providing monitoring data on production practices, crop health metrics, and overall yields (World Economic Forum, 2019). Traceability systems can also help smallholders command higher prices in some markets for high-value products and provide a means for verifying that their products meet required production standards in profitable global markets (World Economic Forum, 2019).

Partnership Experience

Adopting traceability systems can make it more difficult for smallholder farmers to participate in value chains, as a significant amount of high-quality data is needed from each producer to maintain an accurate understanding of sourcing and logistics.

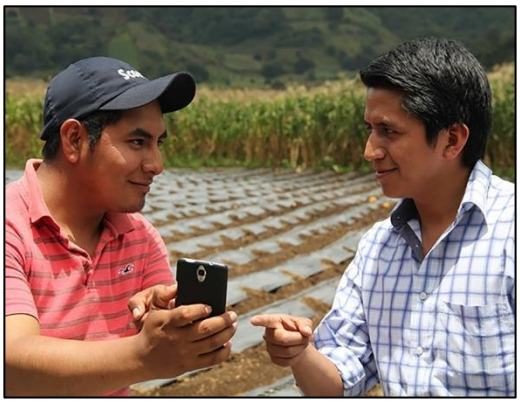

Photo Credit: Fintrac Inc.

Achieving this level of data collection and management typically requires that either individual farmers invest in a smartphone and internet access, and receive ongoing training in data collection, or that export companies employ and manage field agents or technical staff to travel to individual farms and collect data on behalf of the farmers.

With limited smallholder infrastructure and technical capacity, both Farmforce and Solutions rely on either their customers' staff or their own network agents to ensure consistent, quality data collection. As a result, most smallholder farmers do not perceive a significant difference when buyers implement traceability systems, and so it is difficult for smallholders to grasp the impact of traceability on market access.

If not properly implemented, traceability requirements may also incentivize exporters to drop smallholders with lower production or less capacity from their network and instead focus on farmers with more infrastructure, education, and resources. However, for Farmforce and Solutions, the companies' shift to target premium crop producers and support service providers may ultimately offer stronger market opportunities and more integrated technical assistance and complementary support to smallholder farmers. For example, both Farmforce and Solutions are explicitly leveraging traceability to develop credit histories for smallholders and to link them with financial services and loan opportunities.

Traceability systems can also highlight to exporters the value of investing in production, harvest, and post-harvest technical assistance for smallholder farmers to ensure high quality and price premiums for traceable products. These services appear to offer high value to smallholders by way of increased yields, improved quality, premium prices, and consistent market access, all of which results in higher incomes.

Targeting high-value crops such as coffee, cacao, and vetiver also significantly increases the number of smallholder farmers impacted, as the number of outgrowers contributing to these value chains is typically much higher than the number producing GlobalGAP- or FSMA-compliant horticulture.

Lesson Learned

Link traceability to provision of complementary smallholder services.

Improving linkages between traceability software providers and government or development organizations could create opportunities to provide additional services to smallholder farmers. These services could include access to weather forecasting information, input distribution, technical assistance, crop insurance, and credit opportunities.

As publicly-funded traceability technologies, both Farmforce and Solutions developed a deep catalogue of smallholder farmer-specific location, production, and income information that could have been applied to achieving other USAID objectives, such as identifying eligible smallholders for agricultural training and extension services, coordinating smallholder service delivery, locating demand for potential input supply hubs, or creating a production or income history for smallholder access to microfinance or microinsurance products. These services could not only connect smallholder farmers with information and novel pathways to increased incomes and profitability, but could also provide buyers, processors, and other aggregators with key logistics data to ensure consistent product supply, quality, and delivery.

Solutions' business model shift reflects this, as it has identified the Government of Haiti and other development stakeholders operating in the country as key target customers for optimizing the value of its farmer database. Finally, linking publicly-funded traceability technologies with regional food security programs supporting smallholder farmers could help donors both identify smallholder farmers and provide them with appropriate services that improve production, quality, and consistency for aggregators and processors.

Driver 4: Catalytic Donor Funding

Donors can drive inclusive technology development by investing in scaling commercially viable, lower cost technology solutions to enable adoption of emerging technologies that would otherwise be inaccessible due to high capital investment and operational cost requirements (World Economic Forum, 2019). In addition, donors can provide catalytic financing of upfront capital investment costs (e.g., blended financing models) to support long-term capital and operational costs of traceability. Policy incentives should also be offered to balance the needs of smaller-scale value chain actors with larger-scale players, and should encourage common requirements and tools across the food system to accommodate growers, processors, and exporters operating within multiple value chains (World Economic Forum, 2019).

While donors should focus on building market efficiencies through collaboration and innovation rather than by selecting individual companies or technologies to invest in, they can also help increase traceability adoption more broadly by promoting traceability uptake in market segments where food safety challenges are low, targeting less challenging commodity markets with a much lower quality threshold (compared to horticulture, for instance) or by focusing on food processing (Humphrey, 2017).

Finally, donors should support traceability in coordination with complementary strategies that have a more direct impact and lead to improved, more sustainable practices related to production of key commodities; for instance, donors can make direct investments in programs and technologies to improve crop production and yields in producer countries or in the implementation of sustainable agriculture training programs at the producer level (UN Global Compact, 2014).

Partnership Experience

Donor funding allowed both Farmforce and Solutions to grow and take hold in difficult markets targeting inclusive access for smallholders – a market niche not served by commercial software developers. However, the technologies they offered were ultimetely funded as tools to help exporters meet FSMA requirements. This focus required partner funding to be used for a narrow set of food safety activities, and resulted in both companies developing communications and marketing strategies focused solely on FSMA compliance and traceability benefits.

Ultimately, target customers were not compelled by these messages due to the lack of FSMA enforcement and limited financial incentive to invest in costly traceability software. Additionally, Farmforce and Solutions were unable to shift their messaging during the investment period.

Together, these constraints potentially limited business growth during the startup phase for these companies.

The assumption that FSMA would drive business growth and underpin these investments was ultimately the main challenge encountered by both companies. While this issue could not have been fully anticipated, donor funding could focus more generally on conducting a more critical investment analysis of market drivers and customer incentives during the investment negotiation and due diligence process. This upfront analysis could allow USAID to create multiple pathways for business growth, technology innovation, and sector harmonization, and push partners to better plan for contingencies and develop more thorough risk mitigation strategies, especially when their business model is dependent on a single policy or market driver.

A deeper analysis of potential customer numbers and incentives may have revealed that focusing investments on traceability products targeting premium crops, such as coffee and cacao, could have yielded higher numbers of impacted smallholder farmers, a critical mass of technology uptake, and greater financial incentives for ongoing exporter investment.

Lesson Learned

Conduct a more in-depth market analysis upfront to determine the best investments and provide stakeholders with relevant market intelligence.

Partnering for Innovation's program model is to identify a development need for private sector intervention, and then facilitate an open call for proposals from potential private sector partners that may be able to help address that need. Private sector actors are asked to define the market landscape themselves as part of their proposal submission. Conversely, traditional venture capital requires a thorough landscape analysis upfront to identify companies for investment that are ripest for high returns. In-depth market research could help donors and investors identify the most promising market opportunities and provide technology providers and users with more information about sector needs to help them better navigate the landscape.

The experience from Partnering for Innovation's investments in both Farmforce and Solutions demonstrates that a stronger pre-investment analysis could have helped identify traceability drivers upfront, enabling a range of investments into more diverse approaches that were more responsive to private sector needs in terms of price, user experience, and software functionality. This research could have also helped both Farmforce and Solutions pivot their business models more efficiently when FSMA enforcement failed to materialize. Donors and impact investors can make more strategic investments by conducting in-depth pre-investment market research to identify the most promising market opportunities with the greatest potential for scalable results and by mapping solutions, companies, and needs upfront.

Driver 5: Policy and Enabling Environment

There exist multiple globally recognized food safety and production certification standards, but no standard format for how the data required by these standards should look or be organized. Small-scale producers, processors, distributors, and exporters working within multiple value chains therefore struggle to track and integrate traceability data to meet different requirements (World Bank, 2017). In addition, premium certifiers are invested in maintaining control of their proprietary certification and audit processes, while government legislators are reluctant to impose directives on foreign food producers (Humphrey, 2017).

The development of clear, consistent, and globally harmonized standards for data collection, governance, ownership, and sharing is therefore needed (World Economic Forum, 2019). Vertical collaboration within value chains could help address governance issues, improve stakeholder engagement, enable effective communication and training programs, drive development of new technologies, bring down technology costs, and support innovative financing to achieve scale (UN Global Compact, 2014). Establishing policies, standards, and services to acheive inclusive scaling of traceability technology would also foster the inclusion of smallholders in higher-value markets around the world (World Economic Forum, 2019).

Partnership Experience

Government reluctance to dictate policy for various supply chain scenarios and market conditions in producer countries resulted in a lack of clarity around FSMA reporting, exemptions, and enforcement. Likewise, a lack of harmonization between FSMA, GlobalGAP, and other certifying bodies also meant that exporters or processors with certifications had to implement yet another reporting system to be FSMA-compliant. In addition, exporters and processors were unwilling to collaborate or share proprietary processes with their competitors in navigating regulatory compliance requirements, as it was perceived as jeopardizing their competitive edge in an extremely tight market. Many value chain actors in producer countries therefore preferred to risk penalties for non-compliance rather than make the considerable upfront investment. This was a critical blow to the initial business growth strategies of both Farmforce and Solutions.

> *"If FSMA was enacted and really enforced, and the government was setting consistent norms and standards, then we could be the Microsoft of Haiti!"*
>
> Jean-Maurice Buteau, GeoNova Owner

While FSMA compliance is currently under-enforced, stronger enforcement is clearly on the horizon and global consumers are likely to be more demanding about health and food safety given the impact of the global COVID-19 pandemic. As a result, export companies that can proactively lay the foundation for compliant food production and processing systems now will likely experience a more seamless transition and secure a market advantage over their competitors as regulations become stricter.

By establishing themselves in a regional market that has not yet reached critical demand, both Farmforce and Solutions are gaining a firm hold in their target markets and investing in brand awareness and a customer pipeline ahead of changes in FSMA enforcement.

Lesson Learned

Promote harmonized policymaking and technology infrastructure development to drive traceability uptake and facilitate compliance.

There are a vast number of food safety standards and production certifications in existence. Each regulator or certifying body acting independently and enforcing its own proprietary set of rules results in a highly fragmented ecosystem of regulatory compliance. Navigating this landscape requires considerable knowledge and capacity, which can significantly limit the growth of private sector aggregators, processors, distributors, and exporters who are unable to invest in acquiring the expertise necessary to manage multiple data collection and reporting systems.

In the case of Farmforce, subscribers were unclear whether its traceability reporting would be accepted for FSMA compliance, or whether existing systems for GlobalGAP or FairTrade certification would suffice. With each certifier carefully guarding its proprietary certification process, it was impossible for exporters to get clear answers on how they could streamline the information they needed to meet requirements.

For Solutions, beyond confusion around required reporting, most of the smallholder producers and small-scale aggregators in its network did not have the physical infrastructure needed to track traceability data in real time. In fact, Partnering for Innovation was one of the only funders who helped them purchase smartphones, fruit crates, and materials for aggregation sites with public funding. Public sector actors have the expertise to help develop markets, increase capacity for technology use, and create good practice guidelines.

Facilitation of clear, consistent, and regionally or globally harmonized standards and tools for traceability data collection, governance, ownership, and sharing will streamline traceability adoption for value chain actors targeting multiple agricultural markets around the world. In addition, aligning reporting requirements and standardizing data formats between multiple globally recognized food safety standards, and providing clear communication around expectations for enforcement, will encourage seamless traceability across supply chains and create a more robust food system.

CONCLUSION

The USAID-funded investment in food safety technologies through Partnering for Innovation's partnerships with Farmforce and Solutions offers important insights and a unique opportunity to evaluate what works—and what does not work—in commercializing traceability products. The company's partnership experiences offer consistent lessons despite their differences in business model, country context, operational approach, and target customer. These findings help validate

best practices for investing in traceability solutions and technology innovations that drive adoption and facilitate smallholder market opportunities.

Both companies' business models and marketing strategies were completely reliant on the single driver of FSMA rollout and enforcement. When that driver failed to materialize, neither company had sufficient risk mitigation strategies in place, and in fact, the terms of their funding made it difficult for them pivot to different customer messaging and market segments. While USAID's investment mechanism through Partnering for Innovation was designed to provide private sector partners with maximum flexibility, in this case, narrow funding objectives around food safety compliance limited partners' ability to shift their marketing approaches when FSMA enforcement failed to drive traceability uptake. As a result, the program could not push these partners to mitigate the lack of clarity around FSMA enforcement more creatively and in a way that resonated more powerfully with their target markets. Despite these challenges, both companies did achieve the broader goal of increasing traceability adoption and improving global food safety by seeding the market and encouraging technology innovation.

Farmforce, in particular, signaled the market potential of traceability software to other software development companies in Latin America and provided an anchor around which the technology ecosystem could coalesce and develop. On a smaller scale, Solutions proved commercial viability in Haiti's skewed technology marketplace and demonstrated creative approaches beyond a simple software subscription model. As a result of these investments, the market for traceability tools grew significantly, and a more robust and diverse ecosystem of technology solutions developed throughout the region.

Farmforce and Solutions helped make the business case for product traceability and greater business efficiencies more generally. Value chain actors face significant barriers in overcoming existing corporate culture and systems change in order to incorporate traceability into their business operations. However, whether or not value chain actors continued to subscribe to the companies' software after the investment period, all of them acknowledged the worth of digital solutions in better managing their businesses, and all of them are using some type of new traceability tool to streamline operations and prepare for stronger regulatory enforcement in the future. In addition, both Farmforce and Solutions have diversified their client base to include new value chains in Latin America with a higher consumer demand for labor and environmental transparency. Because most aggregators and exporters buy and sell multiple crops, use of traceability in these value chains is likely to drive further uptake in horticulture as corporate management systems are upgraded.

Since USAID's investment in Farmforce and Solutions, the technology ecosystem has grown considerably and offers opportunities for donors and impact investors to support inclusive food safety and traceability systems, and ensure market access for smallholder outgrowers. By designing investments and partnerships that are tech-agnostic, deliver a business case for traceability, incorporate smallholders, draw on robust analysis, and promote harmonization in policy and the enabling environment, traceability can be a tool to incorporate farmers into commercial value chains, raise incomes, and improve overall food security.

ANNEX I: METHODOLOGY

This report required two key phases of research: (1) a targeted study of Feed the Future Partnering for Innovation-funded (Partnering for Innovation) traceability software in the LAC region and (2) an investment analysis of traceability software more broadly, especially in the horticulture sector.

The study of the program-funded traceability software was informed principally by primary interviews of key informants, including company staff, software users, relevant donors, and traceability experts. In addition, a broader landscape analysis was conducted via desk research, including a project document and general literature review of both academic and gray publications, and field research with both Farmforce and Solutions staff, customers, outgrowers, and donor representatives.

During the investment analysis, research findings were synthesized and distilled into recommendations for future funding opportunities for traceability tools. All research was conducted by The Development Practice with support from Feed the Future Partnering for Innovation.

Research Questions

To fully evaluate the program's experience and determine best practices for impact investing in traceability software, The Development Practice conducted research, interviews, and analysis to answer the following key research questions:

- How have the Partnering for Innovation program's partnerships to improve product traceability for export performed against negotiated targets?
- How have the funded traceability software programs impacted smallholder farmers compared to their expected benefit in maintaining stable export markets for smallholder farmers?
- What role did the failure to enforce key aspects of the FSMA for smaller exporters have on the success of the program's partnerships? How might the risks have been mitigated?
- How are the funded traceability software programs expected to perform against commercially sold software? How cost-effective would these investments be if paid in full by the private sector? How might the funded programs better develop their competitive edge?
- Are there policies or other enabling environment issues that could limit or improve the functionality of these traceability systems?
- What best practices, lessons learned, or recommendations based on the research findings could support these partners toward commercial sustainability?
- What best practices, lessons learned, or recommendations based on research findings could support USAID in evaluating future impact investment opportunities for traceability software?

Desk Research and Primary Interviews

Partnering for Innovation Partnership Document Review: The Development Practice conducted initial desk research on traceability programs funded by USAID through Partnering

for Innovation: Farmforce in Guatemala and Honduras and Solutions SA in Haiti. Key sources included partnership proposal, negotiation, and subaward documentation; partner progress reports and deliverables; partnership impact and evaluation data/reports; and all other background information related to each partnership that was provided by program.

Relevant Literature Review: A broader literature review was conducted for the funded partners, as well as for relevant competitors in the horticulture sector including Farmforce (Kenya) and commercial traceability software such as FarmERP, Agrivi, Conservis, or e-Prod. As these are private sector partnerships, the literature review was conducted primarily through targeted Google searches, as well as Web of Science and Google Scholar searches for any academic literature. Initial searches around key terms for *traceability* and *commercialization* were completed to identify relevant articles and other valid search terms for identifying articles of interest. Further search terms included *crop traceability software, farm management software, export traceability, horticulture traceability, supply chain traceability, outgrower management system, food safety and modernization act, FSMA horticulture import requirements*, as well as terms related to each of the targeted companies (Farmforce, Solutions, and selected commercial software). Search results from all sources were reviewed and prioritized for relevance to the research questions above.

Key Informant Interviews: The Development Practice also conducted primary research with key informants able to speak specifically to the investment experience with Partnering for Innovation's selected partners or who are traceability and value chain experts more broadly. Interview questions were focused on the program's traceability commercialization partnerships, success factors, and key constraints. All remote interviews were conducted via telephone or online conference with call notes documented by the interviewers, and all relevant ideas and quotations from key informants are cited and attributed throughout this report.

Field Research: Key informant interviews with Farmforce, Solutions, and their in-country customers, outgrowers, and donor representatives were scheduled to be conducted in-person in both Guatemala and Haiti. However, due to COVID-19 travel restrictions, all travel was prohibited during the interview period. As a result, The Development Practice conducted initial interviews with all high- and medium- priority informants via telephone or online conference, including those informants from the software companies who would otherwise be interviewed in person as part of the field research phase.

In addition, The Development Practice conducted remote interviews with other stakeholders such as exporter software customers, software shareholders, and traceability experts via telephone or online conference. This approach allowed initial results to be collected, synthesized, and shared with both Partnering for Innovation and USAID via report or online webinar, and allowed for more of a conversation on findings and recommendations that can then be further supported or field tested with additional stakeholders when travel is once again permitted potentially in 2021.

Investment Analysis and Case Study Development

Investment Analysis: Key factors for success or failure to building an effective business model for traceability software were identified with focus on the role FSMA played in incentivizing

exporters to adopt traceability systems and the impact on adoption when key FSMA regulations were not implemented or fully enforced for smaller exporters. In addition, Partnering for Innovation-funded partnerships were compared to similar investments in Farmforce Kenya (which was ultimately not selected by USAID for promotion nationally in favor of building a new proprietary system), as well as to Agrivi and e-Prod, commercially available software with sustainable operations and relevant market share.

Case Study Development: In addition to the Partnering for Innovation investment analysis in traceability software, The Development Practice created short case studies comparing the key factors and lessons learned from Farmforce (Guatemala), Farmforce (Honduras), Solutions (Haiti), Farmforce (Kenya), and comparable commercial traceability software Agrivi and e-Prod to generate a broad set of recommendations and guidelines for future investments in traceability software and agricultural monitoring software in general. These case studies helped demonstrate the variety of best practices across both donor-funded and commercially developed traceability software in different contexts around the world.

Report Submission and Knowledge Dissemination Event: The Development Practice compiled the findings from the desk and field research as well as case studies into a technical report highlighting lessons learned from the commercialization of Farmforce and Solutions, findings from research conducted on the other traceability software studied, and recommendations for successfully commercializing traceability software in emerging markets. The report targets external audiences, including USAID, the wider international development community, and the private sector. The Development Practice also hosted a webinar in February 2021 to discuss its research, findings, lessons learned, and the way forward in the commercialization of traceability software.

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