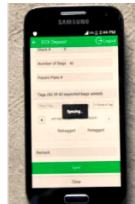




Improving the Performance of the Peruvian Coffee Supply Chain with New Digital Technologies



Columbia SIPA Capstone Project

Columbia University, May 9th, 2017

Background & Acknowledgments:

This report was produced for the Inter-American Development Bank in conjunction with Columbia University's School of International and Public Affairs (SIPA) as a Capstone Consultancy project. The authors Sydney Zetune, Diego Llosa, Isabella Perales, Gaurav R. Pradhan, Nikhita Kumar, Tomohisa Kunisawa and Aaron Roth, are graduate students concentrating in International Finance & Economic Policy, Economic and Political Development, and Urban Social Policy. Ulrike Zeilberger and Tim Meyer, SIPA capstone advisors, oversaw the research. Any views expressed herein are the authors' own and do not necessarily represent those of SIPA.

We would like to express our gratitude to Merit E. Janow, the Dean of SIPA, and Suzanne Hollman and Saleha Awal from the SIPA Capstone office.

The report is informed by several interviews with experts in the field. We would like to thank the following people for their valuable contributions: Geni Fundes of Central Cafe y Cacao, Dieter Wittkowski of FOMIN, IBM consultants Mohamed El Gayar and Frank Schmid, Maria Agustina Calatayud and Joaquin Dominguez of the IADB. We would also like to thank the coffee cooperatives we were able to visit during the fieldwork assignment in March 2017.

Columbia University, New York
May 9th, 2017

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1. Executive Summary

In 2013, the Roya plant fungus destroyed almost 70% of the Arabica coffee crop in Peru, a devastating blow to an industry on which more than two hundred thousand Peruvian families depend. Other regional coffee producing countries were less affected by this external shock because their industries were more organized and better prepared. Most Peruvian coffee farmers tend 2-4 hectares of land which yield a relatively low volume of coffee beans and these small producers account for 90% of the industry.

Coffee farmers' livelihoods rely on the market price, and this price is determined by the quality of the coffee, which has a strong correlation with technical education and how coffee is processed. Faced with limited resources and technical assistance, many farmers struggle to produce high quality coffee, and they are forced to abandon its production and may resort to planting other more lucrative crops including illicit ones. In light of this context, the Peruvian coffee industry is in desperate need of a catalyst to consolidate national policy, production standards, and a national brand, so that future risks to this USD \$1 billion industry are mitigated.

We first researched the coffee industry and the new digital technologies that could be used to improve the visibility of the supply chain. Moreover, we interviewed experts from IBM on their implementation of a technology system for Ethiopia's coffee industry, that helped one of the top global producers and exporters of coffee achieve traceability throughout their entire supply chain. With this knowledge, we developed a field work plan to test how new technologies could prove useful for the Peruvian coffee industry.

We designed interviews with local coffee producers in their cooperatives to understand the market structure, coffee production practices, as well as access and use of technology. The fieldwork took place between March 13th to 17th, and with the support of Central Cafe y Cacao, we visited seven cooperatives located in the Selva Central region of Peru, one of the major coffee producing regions. Later, we interviewed main stakeholders of the coffee industry from the Peruvian public sector.

Based on our fieldwork research, we found that there is not a standardized supply chain; there are hundreds of actors that process the coffee that eventually arrives to Lima. This lack of coordination in the industry is exacerbated by competing regional and national agencies, leaving absent a single united national organization. The end result is a supply chain with a multitude of processes and an overall lack of standards for coffee production, processing and distribution.

The unification of an industry is a long-term process, but we believe that in the short term there is a feasible way to improve the quality and quantity of coffee production through a series of technological and non-technological interventions. First, we recommend taking a baseline analysis of the coffee production industry to measure the future effectiveness of these interventions. Next, we have provided specific technological devices that can be implemented in different parts of the supply chain, with the proposal of a centralized data management platform to manage the data. With these interventions and a central platform in place, we can begin to trace the stages of the supply chain to make it more visible.

We recommend that an independent advisory panel of coffee experts is formed to guide the discussion surrounding standardization of the coffee process and the formation of cooperatives. This panel will help manage incentive systems to coffee producers to learn and invest in quality production methods, monitor the supply chain through internet connected devices, and help unite a highly-fragmented industry. We believe that after the success of such a plan, Peru will be more likely to adopt a national governing agency.

2. The World Coffee Market

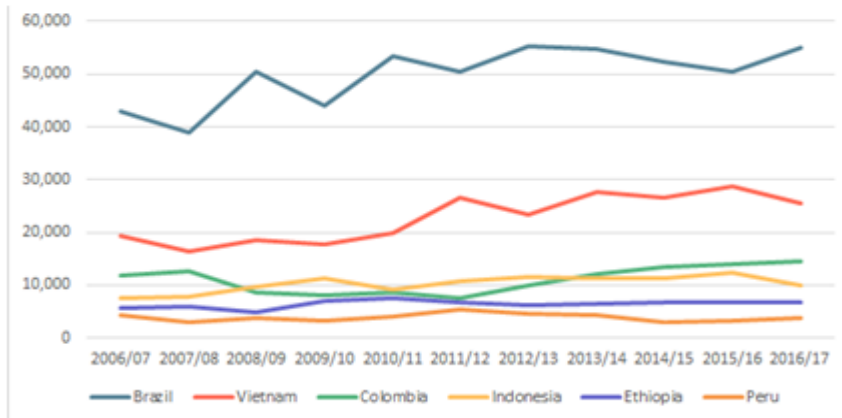
Peru is one of the top 20 producers of coffee in the world, and one of the top five exporters of Arabica coffee (Figure 1). Coffee represents an important agricultural export for the country, comprising 17% of Peru's total agricultural exports, and approximately 1 billion US dollars in annual revenue. More than 220,000 coffee growers, of which 90% are considered small producers (an average of two hectares), depend on coffee for their livelihood. On average, Peru exports approximately 96% of its 4.2 million bags of coffee (measured in 60 kg bags) to countries like Germany, Belgium and the United States, with these three comprising 60% of the buying market. Domestic consumption amounts to approximately 4% of Peruvian coffee production, of which half is consumed in instant soluble form.

Figure 1 - World Production (Arabica Coffee) in 2016/17



Source: ICO

Figure 2 - Top 5 Coffee Producing Countries and Peru Based on 1,000's of 60 kg Bags



Source: ICO

According to a report from the International Coffee Organization (ICO), Brazil is the world's leading coffee producer with 2,594 billion kilograms annual coffee production, followed by Vietnam which produces 1,650 billion kilograms annually, Colombia produces the 3rd highest quantity amounting to 810 million kilograms a year, and Peru is in 12th place with 192

million kilograms of annual production (Figure 2).¹ The question is, is there an opportunity for Peru to increase its production in the world market alongside these coffee producer behemoths, and if so, how?

When we look at how coffee is sold worldwide there are a few important factors to consider. Coffee is widely considered a commodity, yet it can achieve a higher price in three ways: brand, quality, a specific certification, or a combination of certifications. Typically, the commodity price is considered the "conventional coffee" price, but coffee producers are usually able to sell their

¹ International Coffee Organization Report 2015

harvest at a 30-60% markup if they can produce branded or premium coffee. Branded coffee typically comes from massive investments over decades in advertising and distribution channels to global and local markets. Brazil and Colombia are the regional leaders in both branding and production.

If countries do not yet compete on branding in the world coffee market, they still can produce a quality coffee to receive a premium price. We will refer to “quality” coffee from now on as “high quality” or “premium coffee” throughout the report. Premium coffee, as measured by the Specialty Coffee Association of America or the Coffee Quality Institute, is one that garners 83 points or above on a 100-point scale. Hypothetically, all coffee starts at 100 points, and testers deduct points for the taste, aroma, quantity and severity of defects. Therefore, to maintain an 83 (or more) point coffee, a coffee producer must maintain the quality from harvest until the buyer purchases the coffee. We will discuss this in more detail later on in the report.

Lastly, when coffee producers apply certain methods or clear certain processing guidelines they can apply to certifications. The most popular certifications are Rainforest Alliance, Organic or Fair Trade. New certifications are being introduced, some of them related to carbon footprint. These certifications will require heavy investment in the improvement of production processes or capital expenditure. Usually as the early movers for new certifications enjoy premium prices, more producers enter the market. As the market becomes saturated, the certification loses its luster and becomes more “conventional.” Based on our field work, for a small coffee producer, either independent growers or cooperatives, certification-led investments do not justify the initial capital outlay given the varying returns of certifications.

In summary, there are essentially two options to improve profitability and sustainability for coffee production in the long term, a) producing consistent quality at scale with limited costs or b) producing premium grade coffee at a lower volume. As we will outline below, our research indicates that the latter option seems ideal for Peru given that the investment needed to produce high quality coffee is more cost effective than pursuing cost cutting measures to improve the profit margin. However, the question remains on how to implement such a solution in order to revolutionize the industry as a whole.

3. Coffee Background in Peru

Historically, Peru did compete on volume and on quality with its regional competitors, Brazil and Colombia, but the past few decades have been a tumultuous experience for Peru’s coffee industry. Difficulties with inflation and politics in the government of the 1980’s led to a restructuring of the once consolidated coffee industry, later in the 1990’s with economic liberalization, elimination of quota systems, terrorism, and bad management practices brought on even more difficult for the industry². During these latter years, Peru removed itself from the ICO, and the industry began to fragment, leading to weaker market power and inefficient production.

² CCCP 2017

Internal terrorism in and around the coffee producing regions during the 1990's brought rapid destruction to civil life and the coffee cooperative structure. As Peru gradually recovered both politically and economically in the early 2000's, the proliferation of Organic and Fair Trade certification allowed the coffee industry to regain its former competitiveness. This process of certification was supported by international cooperation³. New certifications and joining international organizations helped Peru find its niche and bring the Peruvian coffee brand back to the world stage, and coffee once again was a way of life for thousands of families.

While the coffee industry began its recovery in the last decade, in 2013 an economic shock hit the industry as a whole. The Roya plant fungus destroyed almost 60-70% of all Arabica coffee plants in Peru⁴, considered the highest quality coffee variety, and brought serious questions to the future outlook of the Peruvian coffee industry. Given Peru's weak and uncoordinated industry, the recovery has been slow and the industry continues to struggle to regain production levels seen prior to 2013.

After 2013, the coffee industry responded by importing plague-resistant hybrid coffee varieties, albeit sacrificing the pure 100% Arabica coffee and its commensurate price. In recent years, coffee growers have sought to produce the 100% Arabica coffee variety by planting new types of Arabica varieties and incorporating new growing methods. As it will take 3-4 years for these new plants to mature, it is clear that the Peruvian coffee industry is still at a crossroads.

4. Technology in the Agricultural Industry

Technology is transforming the way that all goods are produced and services are performed in the world economy. Agriculture around the world has benefited from the implementation of new technologies to improve the way crops are grown, monitored and harvested, and even how the final consumer interacts with the product (seen in appendix 2). This is ultimately clear in the lessons of the 4th industrial revolution: by using sensors and connected machines through a data management system, companies are able to show the end user the source of origin. Huge benefits such as increased economies of scale, precise cost-cutting, bottleneck reporting and supply chain optimization are radically changing the way companies compete in the industry.

We have assembled a few case studies that illustrate the role that technology can play in agriculture as a catalyst to improve production levels and traceability.

Case 1: Coffee traceability solution in Ethiopia⁵

Our Capstone team researched a new technology system that the Ethiopian coffee industry implemented with the help of IBM to achieve traceability throughout their entire supply chain. Ethiopia's coffee industry is one of the top global producers and exporters of coffee and

³ CCCP 2017

⁴ Source: *Peruvian Times* (2013). *Peru Helps Struggling Coffee Growers Against Coffee Leaf Rust*.

⁵ Interview with IBM Experts Mohamed El Gayar and Frank Schmid on Feb. 21st, 2017

continues to expand its reach in their mostly agricultural-based economy.

The Ethiopian Commodity Exchange (ECX) and IBM jointly built a traceability solution by implementing tracking technology into the Ethiopian coffee supply chain. Coffee producers deliver their coffee to a central processing facility where it is sorted, washed, and processed. After the processed coffee is put into 60kg jute sacks, the technology tracks each sack as it leaves the central processing facility and each subsequent stage in the supply chain. Each central processing facility receives a unique identifier that is printed in a QR code and displayed in numerical values below this code on a tag that is sewn into the bag. Throughout every stage of the supply chain, this tag is scanned by a smartphone/tablet/scanner, which reduces the risk of low quality coffee or counterfeit weights. This also serves to improve pricing transparency for all stakeholders in the industry, from global wholesale buyers down to the individual producers. With greater supply chain visibility, producers can justify a higher price more easily.

The core engine of this solution is an “event based” database system, specifically the Frequenz Information Repository and Intelligence Server (IRIS)⁶, which captures data from the tags that are sewn into the coffee sacks using mobile devices. Each data capture corresponds to a key stage in the supply chain. Once the data is captured, it is sent to an IBM database for storage, and the two systems are integrated. The implementation steps of the traceability system are found in appendix 3.

It is important to note that the genesis of this project began with the introduction of a law that requires all coffee bags to be identified, and there was an already functioning commodity exchange that managed the sale of coffee. With a solidified industry and regulatory approval, the Ethiopian coffee industry was well-positioned to implement a widescale technology platform.

Case 2: New irrigation system in E.&J. Gallo Winery ⁷

IBM brought innovative sensing technologies, physics, and big data analytics to E.&J. Gallo Winery in California to conserve water and increase crop yield. Advanced analytics calculate optimum water and fertilization needed by each plant, based on soil mapping, high-resolution satellite data, and farm-level observations. Then a fully automated irrigation system delivers water and fertilizer precisely when and where needed. This winery successfully reduced water consumption in the vineyard by 20%, with an expected 10–20% crop yield increase.

Case 3: Colombia⁸

The National Federation of Coffee Growers (Federacion Nacional de cafeteros) in Colombia, a nonprofit organization, employed their subsidiary, Almacafe, which handles warehousing, quality control, and logistics, to implement a traceability system using radio frequency identification (RFID) tags in 2007. These tags tracked specialty coffee for its internal supply chain, from farms to warehouses and during processing, bagging, roasting, and trading for

⁶ <http://frequenz.com/solutions/information-repository-intelligence-server/>

⁷ E&J Gallo Winery and IBM

⁸ Source: World Bank (2011) *ICT IN AGRICULTURE Connecting Smallholders to Knowledge, Networks, and Institutions*

export. The RFID tags each cost about US\$0.25 (paid by the federation), are encased in a water-resistant capsule, and are distributed to farmers with a farm identification number and a specialty coffee program code. The coffee is sold to one of 35 cooperatives and transported to one of 15 warehouses, where tags are read by two RFID antennas on either side of a conveyor belt with 99.9 percent accuracy for data and delivery time.

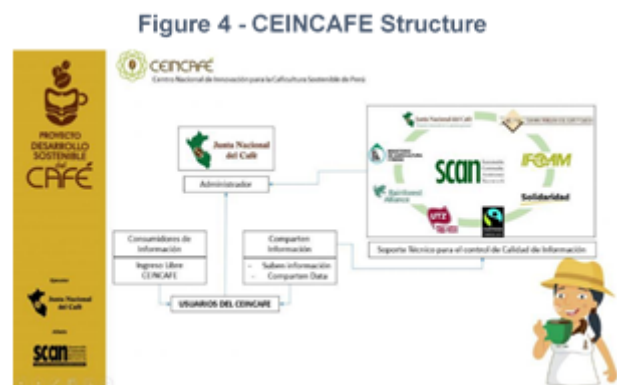
Case 4: Tanzania⁹

Technoserve provides Tanzanian coffee farmers with training to improve the quality of their coffee beans, thus helping them to secure higher prices on international markets. Trainers conduct multiple sessions to ensure retention and to cover many topics from equipment usage to appropriate fertilizer amounts. Technoserve reports having trained more than 12,000 farmers, with 60 farmer trainers running between 15 and 20 sessions at a time and uses a cell phone SMS data collection system to manage all stages of the training process. It helps reduce the time for data collection, collation and analysis, and reduces errors. Another application is the weighing and tracking of improved yields (or their absence) among a sample of trained farmers' coffee crops through SMS messages.

Case 5: Peru

Peru has had a number of initiatives, both national and regional, that have intended to integrate technology into the coffee industry, but thus far, these initiatives have had limited exposure or impact on the wider industry.

- CEINCAFÉ: National Innovation Centre for Sustainable Coffee Production of Peru – [CEINCAFÉ](http://www.ceincafe.org.pe/), created with the support of IDB-FOMIN. CEINCAFÉ is a virtual platform that includes products and services for research, innovation and knowledge to serve the entire coffee sector value chain, with the aim of promoting sustainability and competitiveness. <http://www.ceincafe.org.pe/>



Source: Ceincafe

- SIC CAFÉ: Under this project, carried out by the National Coffee Board, users have access in real time to information about what is happening within their cooperative and with their product: the number of producers, whether producers

⁹Source: FAO (2013). *ICT Uses for Inclusive Agricultural Value Chains*

are women or men, where the coffee comes from, and how the process is carried out etc.¹⁰

- RITS: Sustainable Harvest, an importer of high quality specialty-grade coffees from over 15 countries around the world, has developed an app for product tracking, cooperative management, and farmer learning, in collaboration with rural communities. Relationship Information Tracking System (RITS) is used by some farmers in the northern coffee cluster of Peru. Farmer cooperatives use RITS to track deliveries and define the variety and quality of different coffee bean lots. Roaster customers can also access videos, photos, quality and lot information from the supplier cooperatives. RITS can be used through any Internet connection or smart phone, but primarily uses Apple iPads and iPhones because of their user-friendly interface¹¹.

Unfortunately, none of these initiatives have come to reach a national adoption level and do not contain the production or management technology like the cases described before it. We do see how technology has improved and optimized the industries mentioned above, and indeed a technology application for the Peruvian Coffee Supply chain would help to limit quality and production variability, provide greater visibility into bottlenecks and inefficiencies, and improve pricing justification for their premium coffee. Before we turn to questions of implementation and process, we must first examine the greater issues surrounding the supply chain of Peru both in its historical and recent context to see just how and when technology can play a role. Our central question of this report is twofold: how can Peru increase production of high quality coffee and how can technology assist this goal?

5. Scope of the Peruvian Field Work

During the desk research stage of the project, we grasped a thorough understanding of the structure of Peru's coffee industry and coffee supply chain. The overarching aim of our project was to ascertain how coffee producers organize themselves under centralized production groups, such as cooperatives, what role these cooperatives play in the Peruvian coffee supply chain, and to identify the stages through which coffee passes before it is exported. There were several key themes that we set out to research in order to evaluate to what extent these factors impacted the supply chain:

- A. **Market Structure:** supply chain, central governing agency, national branding, pre-existing technology/IT infrastructure

¹⁰ Source: <http://www.juntadelcafe.org.pe/proyectos/sic-caf%C3%A9>

¹¹ Source: *FAO (2013). ICT Uses for Inclusive Agricultural Value Chains*

B. Current Agricultural Practices and Organizational Structure:
planting/harvesting/post-harvest practices, cooperatives organizational structure

Our field work consisted of a three-day trip to one of the main coffee producing areas in Peru, Selva Central. Evaluation of these themes was undertaken through informal, qualitative interviews with coffee producers, management and technical staff of cooperatives. We visited seven cooperatives of varying sizes, in the regions of Junín and Pasco. Additionally, we held a meeting in Lima with relevant public sector government bodies overseeing the production of Peruvian coffee (Ministry of Agriculture and Irrigation, Ministry of Production and the National Export and Tourism Agency).

6. Fieldwork Analysis

One main finding from the field work is that the industry has a problem with producing consistent high quality coffee and steady volumes to compete in the global market. This section presents a summary of our findings which include all factors that contribute to this inconsistency of quality and volume produced.

6.1 Market Structure Findings

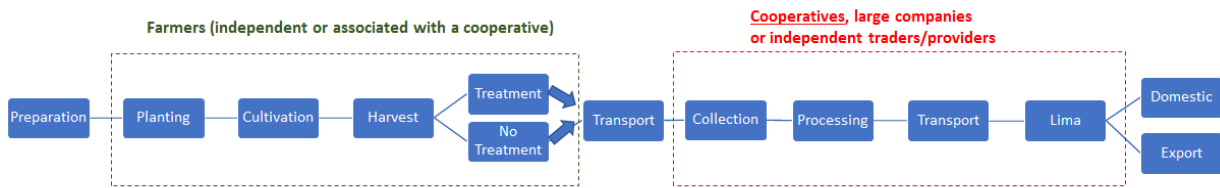
6.1.1 No Standardized Supply Chain

In general, there is no national or standard coffee supply chain at work where we could define a limited set of organizations or companies. However, we did find that the “collection” (“acopio”) stage plays a central role in the supply chain. Essentially, all coffee, whether it is processed individually by the farmer or with processing machinery, is aggregated at a central facility from where it is shipped to Lima. These central processing facilities may be owned by a cooperative, independent traders, or a large company. By the time the coffee leaves these facilities, its quality is pretty much determined (based on interviews with seven cooperatives and coffee experts). It is at this point in the supply chain where coffee beans are consolidated for shipment from the production region to the next stage of the process. This consolidation point marks a single point of transfer, where future traceability initiatives could be implemented.

Once in Lima, the coffee is transported and stored at warehouses, where quality is tested again. The majority (~96%) of the coffee is exported, through a process that lasts anywhere between a week to 12 weeks before it is loaded onto a container for export. The remainder of the coffee is kept in Lima for domestic consumption, which is usually lower quality coffee.

In summary, we found that there is not a standard coffee supply chain used throughout the region visited. However, we identified 10 stages that are followed by most producers (figure 5). We will label these into four general categories based on the time of year they take place: pre-harvest, harvest, post-harvest, and market.

Figure 5 - Peruvian Coffee Supply Chain - May 2017



Source: SIPA Capstone Team – March 2017

Pre-Harvest: August-February

1. **Preparation:** buying seeds and fertilizer, prepping fields
2. **Planting:** organizing labor force and planting seeds
3. **Cultivation:** applying fertilizer, plant care, testing soil

Harvest: March/April

4. **Harvest:** examining the coffee berry, organizing labor force, selective picking of berries
5. **Treatment:** on site coffee berry washing, hulling, and drying OR direct transport
6. **Transport to Facility:** to local central processing/collection facility

Post-Harvest: April/May

7. **Collection:** producers bring coffee crop to collection facility and noted in registry, whether in a cooperative or independent traders
8. **Processing:** central processing for non-individually processed coffee: sorting, washing, hulling, fermentation, drying
9. **Transport to Lima:** loaded into 60kg sacks for Lima

Market: June/July

10. **Lima:** warehouse to prepare for domestic buyers or exportation

While the supply chain has consistent actors including coffee growers, coffee pickers, processors, shippers, and exporters, there are hundreds of independent chains that exist to bring coffee to the port in Lima. The only formal standardization happens at the final processing stage and preparation for shipping where all exported coffee from Selva Central goes through the port of Callao. For these reasons, we believe that before a traceability system can be fully implemented in Peru, there must be considerable industry consolidation, so that these hundreds of supply chains, coalesce into a uniform supply chain. As such, the recommendations outlined in the following section will focus on technologies and other interventions that can be implemented now and in the short-term without having to wait for the industry consolidation to take place.

6.1.2 Lack of a Central Coffee Authority

Compared to other regional competitors, Peru is unique in that it does not have a central coffee authority that is either public or private, has a budget, and the authority to set the national policy regarding coffee production. As a result, there is weak coordination between relevant agencies that can promote and evaluate standards, national branding and cohesiveness.

For decades, other Latin American countries have created national institutions to lead their coffee industry through the joint work of the public and private sector:

- Costa Rica, 1933, Instituto del Café de Costa Rica
- Guatemala, 1960, Asociación Nacional del Café
- Honduras, 1970, and renewed in 2000, Instituto Hondureño del Café
- El Salvador, 1989, Consejo Salvadoreño del Café
- Nicaragua, 2001, Consejo Nacional del Café
- Mexico has the “Asociación Mexicana de la Cadena Productiva del Café” and the “Comité Nacional Sistema Producto Café”; however the creation of a National Institute is under consideration.

The most emblematic country united under one common authority and brand is Colombia. Colombia has the “Comité Nacional de Cafeteros”, as a dialogue space between the government and the coffee producers, whose representatives are elected democratically under the “Federación Nacional de Cafeteros” (created in 1927). Under this entity, they agree on the policies for the development of the coffee industry, financed with the resources of the “Fondo Nacional del Café”. This Federation unites over 500,000 coffee producers with 2,400 staff, of which 1,600 are dedicated to the “Extension Service” which regularly provides training and enforces quality standards throughout the country.

In Peru, the national main institution is the National Coffee Council (Consejo Nacional del Café), created in 2002 (Resolución Suprema N° 005-2002-AG). This Council is responsible for identifying, analyzing and proposing a legal framework and policy guidelines for the short, medium and long term development of the coffee industry. According to CCCP (2017), the National Coffee Council is solely an advisory body with no budget or resources for its operations. The Council is a public-private body formed by these institutions:

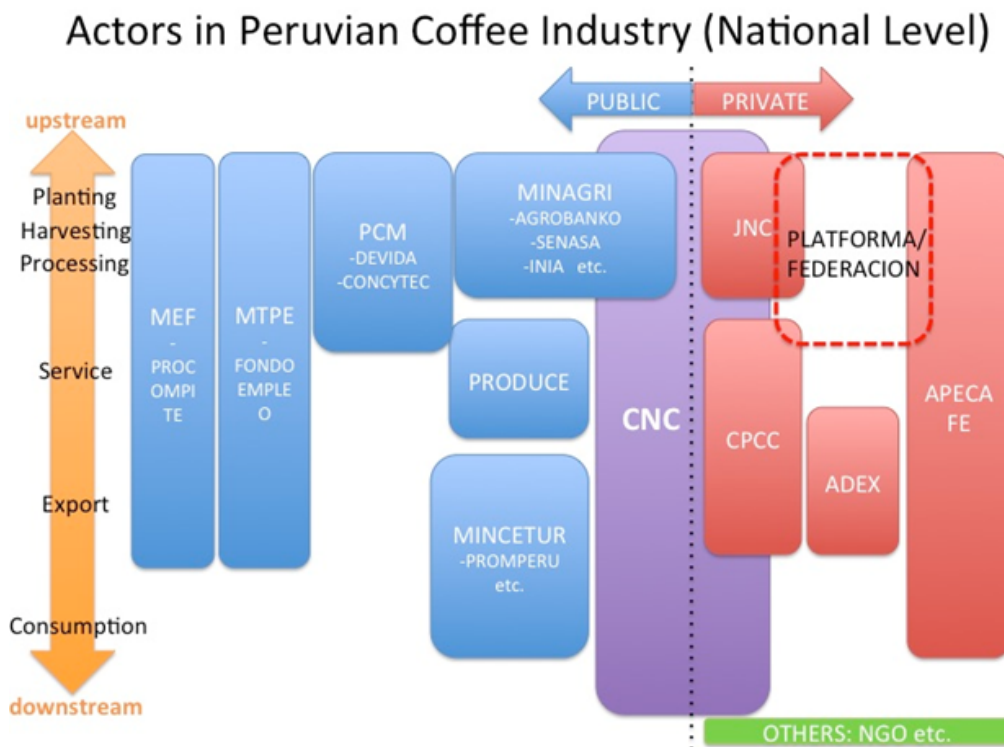
- The Ministry of Agriculture and Irrigation (Ministerio de Agricultura y Riego - MINAGRI), which chairs the Council: it has the mandate to promote the development of the peasant families through plans and programs of the agricultural sector. Since 2016, it is tasked with monitoring and evaluating the First National Agricultural Policy the main instrument of medium and long-term strategic agricultural development.
- The Peruvian Chamber of Coffee and Cocoa (Cámara Peruana del Café y Cacao): Created in 1991, brings together the main private sector companies (producers, exporters and manufacturers), operating in different areas of the coffee and cocoa value chains,

representing 70% of these exports.

- The National Coffee Board (Junta Nacional del Café - JNC): Created in 1993, it brings together a total of 56 coffee-growing organizations, including associations and cooperatives, with 70,000 family members.

In addition to the three actors that make part of the Council, there are other national and regional public and private bodies working directly or indirectly on the development of the coffee value chain that can be found in Figure 6 (for a more detailed description of national actors, see appendix 4). Thus far, the National Coffee Council's actions have been very limited and have no outstanding results in the development of the sector. The meetings of the Council were resumed in 2016, with the support of the United Nations Development Programme and the Swiss State Secretariat for Economic Affairs, with a view to investigate the options in terms of cooperation that would seek to strengthen the institutions behind the Peruvian coffee industry. The reactivation of the Council was highlighted by the representative of MINAGRI during our meeting in Lima.

Figure 6 - Public/Private Actors
Upstream & Downstream in the Value Chain



Source: SIPA Capstone Team - March 2017

Essentially Peru has no single entity to receive or address the key problems in the industry such as inconsistent quality, lack of standardization, low production volume, fragmented supply chain, and weak bargaining power in the global market. When we take into account that

approximately 60-70% of the coffee farmers in Peru are not even organized under associations or cooperatives, it further highlights the need for a central agency. This agency requires representation from the public and private sector that could coordinate the actions of all major national institutions, numerous regional/provincial organizations, and thousands of coffee producers. Without a centralized initiative, we believe that Peru will continue to suffer from low volume production, an unrecognized international brand, and low quality coffee which consequently means lower revenues for the industry as a whole. We will discuss what our plan recommends in Section 7: Recommendations.

6.1.3 Lack of National Branding

Without consolidated practices to produce a consistent quality cup of coffee, nor a national industry to promote it, it is clear that Peru struggles to promote its branding on a global level. Normally, marketing and promotion is done by individual cooperatives seeking out their own clients through coffee fairs in Lima, or at international events. The cooperatives that have the funding for travel, and can develop and promote their own brand, are successful in getting clients and receiving better prices for the premium coffee.

The Commission for the Promotion of Peru's Exports and Tourism (Comisión de Promoción del Perú para la Exportación y el Turismo - PROMPERU) is responsible for promoting exports of goods and services according to sectoral policies and objectives. As such, it promotes Peruvian coffee abroad. It works on the promotion plan of the Peruvian coffee and leads a Multisectoral Committee for that purpose. It plans to launch a national coffee brand linked to Peru's country brand, similar to other sectoral brands for products such as Alpaca, cotton, superfoods and cocoa. The initiative of a "Marca Cafe" is aimed at developing the availability of high-quality Peruvian coffee supply, promoting an increase in exports and seeking to diversify the markets¹².

6.1.4 Limited Pre-Existing Technology and IT Infrastructure

In our fieldwork we discovered that in the region of Selva Central the central processing facilities of cooperatives have internet service, but many of their producers (of which there could be hundreds located between 1 km to 80 km away from the cooperative facility) do not have internet access. Most coffee producers do have cellular service, and due to personal budget reasons do not have smartphones. This means that technology interventions that require internet connectivity will have to be located at the centralized processing facility.

In the harvest stage of the supply chain, we learned there is a device that properly measures the sugar percentage of the coffee berry to ensure that it is ready to be picked. This is called a refractometer (Spanish: brixometro) and provides a digital reading of the sugar content in the cherry. As far as we understand, these are not widely used; although they require no internet connection, the ripeness of the cherry can be observed without this device and producers would

¹² <http://www.ico.org/documents/cy2016-17/icc-119-14e-peru-coffee-policy.pdf>

require an investment to purchase them. When the coffee cherry is ripe, it is usually picked by hand for two reasons: 1) these coffee plants are located on the sides of mountains that are steep and would limit accessibility of machinery, 2) if machines could operate in these areas, they wouldn't be as accurate as a human testing the color and ripeness of the berry. These picking machines are used in other coffee producing countries that do not specialize in high-quality coffee, as these machines do not have the ability to selectively pick only berries that are ripe. Due to their cost, and inability to selectively pick the coffee cherries, these machines are not used in Peru.

Some cooperatives have already invested in sophisticated machinery yet there are many producers who still use basic technology to dehull and dry their coffee cherries due to being located far from central processing facilities or because these facilities themselves use simple technologies. We are not confident that these machines could be retrofitted with internet technology because the machines are not computerized and an upgrade to their operation would be better served by replacement. On this note, we noticed a lack of working capital for the majority of cooperatives that would limit them from purchasing newer, more advanced computerized machinery.

In regards to a traceability system, internet connectivity or modern machinery may not be necessary to achieve a coordinated, visible system. In the Ethiopian case study mentioned above, there were certain facilities that tracked the electronic code via smartphone, and others that simply recorded this numbered code in a log on paper, or in a laptop. By tracking this code, whether automatically or manually, the industry can develop a more standardized coffee supply chain. We recommend the use of this code tracking system which will be managed by the web platform we will discuss in detail later in the report.

6.2 Current Agricultural Practices

In our field work research, we have identified that the coffee quality is almost completely determined in the period between when it is picked from its branch until when it leaves the central processing facility. This period is normally one week to three weeks and to ensure high quality coffee, certain methods and processes must be carried out to exact standards, or else the quality will suffer. We believe that by focusing on the improvement and standardization of this one to three week period holds the greatest opportunity for improving the coffee industry overall.

6.2.1 Lack of Standards Across the Industry

Coffee producers and cooperatives, whether large or small, are either operating on their own principles of organization and production, or those dictated by the wholesale buyers when negotiating a contract. Besides the client standards found in contracts, the only widespread consistencies we found were in the guidelines proposed by certifications (for example, organic or Fair Trade).

It is important to note that producers can follow a clear set of procedures and standards to reach a high-quality bean as measured by the grading system. Despite this, we observed that the production methods, and procedures followed during the harvest and post-harvest stages

were divergent throughout the industry.

The lack of coordination in the coffee industry can also be observed in the many differences between cooperatives. These cooperatives vary in size, capacity, leadership, coffee quality achieved, production levels, techniques employed, amongst other variables. During our fieldwork, we observed these differences between the seven cooperatives we visited. Although not entirely similar, these cooperatives can be grouped into two categories. The first category, which we will refer to as Group A encompasses the “model” cooperatives; the second category, Group B, will refer to the cooperatives with a weaker internal structure.

6.2.2 “Group A” Cooperatives: High Standards

The cooperatives within this group managed 50 and 186 coffee producers. These cooperatives had well established relationships with both buyers and financial institutions, that we attribute to the younger and college educated leadership. In terms of the type of technical assistance provided, these cooperatives focused on building personal relationships with their associates, and tailoring their training to the individual needs of each producer. As a result, these cooperatives produce high quality coffee, as measured by the 100-point coffee grading system. The higher quality coffee produced is reflected in higher prices, providing stable revenue streams for the farmers, and opportunities to expand their production business.

In terms of the payment system used, the cooperatives in Group A paid farmers a percentage of the product they turned in upfront, and the remaining percentage a few months later. This payment system was established to reflect how the cooperative itself receives payments for their product, regardless of whether they utilized trade financing or not. In both cases, cooperatives receive an upfront payment (either directly from the buyer or from the financial institution), and the remaining payment when the coffee beans arrive at their final destination.

By matching the payments provided to the farmers with the cooperatives cash flows, two benefits were generated. First, the financial strain for the cooperative was reduced, as no additional funding is required when cash inflows and outflows are matched. Second, by establishing these delayed payment systems, a sense of loyalty was generated between the cooperative and its associates. This loyalty stems from a perception of risk-sharing that is created when payments are delayed.

Figure 7 – Group A: Cooperatives with High Standards

Characteristics	Grano de Oro	Yanesha
Year Founded	2011	2011/2016
Altitude (meters)	1300-1600	1400-1850
Type of Coffee	Arabica (80%: 84 pts, 20%: 86% pts)	Arabica, Robusta
Location	Chanchamayo, Junin	Villa Rica, Pasco
Number of Farmers	50	186
Production per Hectare	Average 15-18 quintals, up to 30	N/A
Price per Quintal	\$215 USD (for 84-85 point coffee) \$190 USD (fair trade coffee)	\$400 USD (for 86 point coffee)
Benefit Process	By family. Standardized process.	Mixed. Centralized in Oxapampa. Not-centralized in Villa Rica
Technical Assistance	Yes, personalized	Yes, very personalized
Taster on Staff	Yes	Yes
Traceability System	Yes. Paper-based.	Excel sheet
Payment System	They receive 50% of payment when product arrives at Lima's port and 50% when it arrives in the final destination . They don't have credits or access to financial institutions. Payments to producers reflect this payment scheme.	They receive 70% of payment upfront and 30% once product arrives to final destination. Payments to producers reflect this scheme. Strategic alliance with Rabobank
Quality Control	Enforce quality controls throughout the production process.	Enforce quality controls throughout the production process.
Other Traits	1) Sell entire production to a single client 2) Have ongoing projects sponsored by government agencies (PINIA, Agroideas)	1) Actively participate in international fairs 2) Have developed their own brand 3) Have ongoing projects sponsored by government agencies (PINIA, Sierra Exportadora)
Challenges	Expensive and scarce manual labor during harvesting season	Lack of technologies to improve and control quality

Source: SIPA Capstone Team - March 2017

6.2.3 “Group B” Cooperatives: Inconsistent Standards

Some cooperatives, however, present themselves as organized administrative structures, even though they often lack the resources or financial assistance to properly function. Lack of access to affordable financing hinders the cooperative's ability to invest in proper equipment and distribute among its producers capital to both increase and improve production. The issue of proper financing is exacerbated in those cooperatives without proper leadership. Those responsible for managing the cooperative, its daily operations, and group of producers are not prepared to run a business type organization and tackle the many challenges this entails. These cooperatives experience inconsistent production levels, and tend to produce lower quality coffee.

Figure 8 - Group B: Cooperatives that Need Improvement

Characteristics	La Florida	Perene	Satipo	Pangoa	Alto Palomar
Year Founded	1966	1966	1965	1978	2001
Altitude (meters)	1000-2000	1600-1800	500-1800	700	1200-1800
Type of Coffee	Arabica	Arabica	Arabica	Arabica	Arabica
Location	Chanchamayo, Junin	Chanchamayo, Junin	Satipo, Junin	Satipo, Junin	Chanchamayo, Junin
Number of Farmers	800	380	633	700	85
Benefit Process	60% centralized 40% not-centralized due to distance (processed individually)	Have a centralized plant, but not utilized by all producers due to distance	N/A	N/A	Yes
Technical Assistance	Yes, but not personalized nor continuous	Yes, but not personalized nor continuous	Yes, but not personalized nor continuous	Yes, but not personalized nor continuous	Yes, but not personalized nor continuous
Taster on Staff	No	No	No	No	No
Challenges	1) Deterioration of land 2) Expensive and scarce labor supply 3) Weak administration 4) Producers selling coffee outside cooperative to third parties 5) Unable to produce consistent quality coffee and maintain a uniform production level 6) Lack of established long-term commercial relations with clients	1) Unable to produce consistent quality coffee and maintain a uniform production level 2) Lack of established long-term commercial relations with clients 3) No quality controls throughout production process	1) Unable to produce consistent quality coffee and maintain a uniform production level 2) Lack of established long-term commercial relations with clients 3) Lack of management skills at the administrative and leadership level	1) Unable to produce consistent quality coffee and maintain a uniform production level 2) Lack of established long-term commercial relations with clients	1) Unable to produce consistent quality coffee and maintain a uniform production level 2) Lack of established long-term commercial relations with clients

Source: SIPA Capstone Team - March 2017

In addition, they are unable to provide continuous technical assistance and best practices to producers, which negatively impacts their revenue growth. Members of the group often experience discontent and are more prone, at times, to sell their products to third parties due to the cooperative's inability to properly administer both the production and selling process. Even though we observed cooperatives that present characteristics of both Group A and Group B, both are facing the underlying challenges caused by a weak management structure. The coffee industry in Peru is fragmented, which has thwarted any effort to create uniform standards and best practices that guide the proper governance of these institutions.

7. Recommendations

Given the vast heterogeneity we found across the industry, we believe that Peru's coffee industry is not consolidated to a level where a single technological solution could be feasibly implemented from both a cost and scope perspective. However, we do believe technology does have a role to play in certain stages of the supply chain where data can be collected, and visibility enhanced, to inform future decisions regarding industry improvement. Furthermore, the fragmentation of the industry, and the lack of internet connectivity we found, highlights the need for interventions that go beyond the implementation of technology.

As such, we have divided this section into two subsections, 7.1. will focus on interventions related to technology, which we believe will be crucial for collecting data that will inform decision-making in the industry as well as national policy and help create a foundation for future technology implementations. Section 7.2 will focus on non-technological interventions, which we believe will help consolidate the industry and promote the standardization of processes instrumental for improved quality control.

7.1 Technological Interventions

We have referred to various case studies to show how technology can optimize industries bringing about greater visibility to the supply chain, improving efficiencies and helping achieve scale. Like many agricultural industries, the production of coffee adheres to a certain set of standards, and deviations from these standards will result in a degradation of the quality or loss of the crop itself. We would like to illustrate how certain technologies can help maintain the quality and enforce standards throughout the supply chain. We will focus on improving the supply chain from pre-harvest until the point where the coffee leaves the central processing facility. As mentioned previously, this central processing facility is a key actor in the value chain because it represents a single gate from which all coffee enters and eventually leaves for transport to Lima.

7.1.1 Baseline Analysis

Before any technological intervention is done, we believe it is fundamentally important to carry out a baseline analysis of the production level of the central processing facility. This means first and foremost to do a simple diagnostic of data gathered from the most recent season. The purpose of gathering this initial data is to create a benchmark which will allow for monitoring and evaluation of the interventions that will be implemented herein.

- Number of Producers who deliver coffee to the facility
- GPS locations of coffee producers and central processing facilities
- Start date for receiving first shipments
- End date for sending last truck to Lima
- Amount in kilograms of coffee processed, total
- Amount in kilograms of each coffee quality level, percentage above 83>

This data would be then housed in a central data web platform which we will discuss in greater detail in the following section.

7.1.2 Pre-Harvest: August-February

a) Preparation: this stage involves taking inventory of all the producers who have committed to selling their coffee to the local facility, and helping them prepare their fields for planting and ensuring that they have adequate levels of plants, seeds, fertilizer and labor to prep the fields.

- **Communication:** SMS/smartphones for up to date information on best pricing for new coffee plants, fertilizer and seeds; preparation checklist sent via email or posted on web pages for printing
- **Devices:**
 - **GPS devices:** smartphones or GPS devices, of producers' fields, uploaded to web platform
 - **Soil Testers:** for proper levels of acidity
 - **Drones:** using drones to survey fields from above

- **Weather Vanes:** 24/7 monitoring of weather at the central processing facility

b) Planting: requires a great labor effort to plant new coffee beans into designated fields, currently cannot be done by machines or automated

- **Communication:** Web platform for communication to organize labor forces, and information checklists
- **Irrigation system:** soil sensors and automatic watering

c) Cultivation: this is the longest stage of the supply chain and involves the careful monitoring of the health of the coffee plants and staying attuned to weather patterns and advisories

- **Communication:** SMS/smartphones for direct messaging to technicians or coffee producers with timely weather information and other current news.
- **Devices:**
 - **Soil Testers:** for proper levels of acidity
 - **Drones:** using drones to survey fields from above to test for Roya or other fungi
 - **Weather Vanes:** 24/7 monitoring of weather at the central processing facility

7.1.3 Harvest: March/April

a) **Harvest:** examining the coffee berry to see when it is ripe to be picked off the plant for processing.

- **Communication:** SMS/smartphones for direct messaging to technicians or coffee producers with timely weather information and other current news.
- **Devices:**
 - **Refractometer:** (brixometro) to test coffee berry sugar level
 - **Drones:** using drones to survey fields from above to test for Roya or other fungi
- **Treatment on Site:** for producers who want to process on site, due to large distances to the central processing facility, on site coffee berry washed, hulled, dried, and loaded into bags for transport to local processing facility
 - Drying tarps, rakes and small manual/automatic machines for de-hulling,

7.1.4 Post-Harvest: April/May

a) **Collection: (Spanish: “acopio”)** all producers bring coffee crop to central processing facility

- **Communication:** SMS/smartphones for direct messaging to technicians or coffee producers on directions, and availability. Web platform for hours of availability and other relevant info.

b) Processing: (Spanish: “planta de beneficios”) central processing for washing, hulling, fermentation, drying

- **Communication:** SMS/Smartphone/Tablet updates to web platform for monitoring
- **Devices:**
 - **GPS devices:** smartphones or GPS devices for the central processing facility location, uploaded to web platform
 - **Water tanks:** ripe berries are heavy and sink, bad/not ripe berries float
 - **Hulling Machines:** conveyor belts take ripe berries to be hulled are placed in storage containers
 - **Fermentation Tanks:** berries are left to ferment 24-48 hours, need to test proper acidity
 - **Drying Area:** testing for percentage of humidity in the coffee berries (approximately 11%)
- **Testing/Grading:** local tester gives grade to coffee beans
 - **Preparation to test:** roasting machine, grinding, and official testing equipment by Q coffee or SCAA associations (cups, spoons, kettles)
 - **Sorting Machines:** moving beans to separate into storage areas for testing/approval
 - **Tablets:** tasters can enter relevant information to web platform
- **Tracking Tags:** begin process for coding all coffee that leaves from central processing facility
 - **If Tester/Grader:** coffee quality is marked and loaded into specific bags and tags
 - **No Tester/Grader:** only central processing code is printed
 - **RFID or QR codes:** unique tag attached or sewn in that also has a printed number code

c) Transport to Lima: loaded into 60kg jute sacks for Lima, with tags tracked and visible

- **Communication:** SMS/Smartphone/Tablet updates to central processing facility management and to web platform
- **Checklists:** tracking date left and arrival plan

7.1.5 Market: June/July

a) **Lima:** warehouse receives new coffee and preps for export or domestic buyers

- **GPS devices:** smartphones or GPS devices for the warehouse location, uploaded to web platform
- **Tracking Tags:** received/scanned and updated to central processing facility, web platform
- **Communication:** producers, cooperatives and companies can see that the

shipment has arrived

- **Testing/Grading:** warehouse tester gives grade to coffee beans or reaffirm quality if tested before, updates sent to web platform
- **Domestic/International Buyers:** can visit web platform to see variety and quality available for purchase
- **Ready for Export:** final tag scan before going to domestic buyer, or being loaded into container for shipping.

7.1.6 Centralized Data Management Platform

We recommend the creation and use of a central web platform where all baseline data, training modules, and progress will be managed. The administrators of this platform should include the advisory panel, IDB or a special project team, and will monitor and evaluate the progress of each cooperative and hone in on the details of each producer.

Short-Term Components of the Web Platform:

- **Login:** used by the administration of cooperatives
- **Registry Module:** name of cooperative, number of producers, number of hectares managed, average quality level, production statistics, GPS location, photos, background
- **Training Module:** contains sets of modules based on production, harvest, post-harvest training
- **Monitoring & Evaluation:** a module that displays real-time cooperative specific data such as coffee quality, quantity produced, production per hectare, price demanded
- **Communication Channel:** cooperatives can receive SMS or email alerts regarding national/regional events or weather advisories

In the short-term the web platform will be used to capture data in order to gather information on the GPS location, production techniques, production volumes and other related details on each coffee producer in Peru. The data on production metrics will be inputted into the web platform by the technicians that train and monitor the producers' progress, through the use of tablets. This data will be accessible by the advisory panel to monitor the success of the training intervention and help provide assistance at the various stages of production. We see the platform as a fundamental way to share best practices between the advisory panel and technicians from all coffee producing groups. In the short-term, the training modules should be simple portals where technicians can access the standard training methods and programs proposed in section 7.2.3. Eventually, the web platform will take the form of a 'Coursera' for coffee by providing producers with on-demand training courses and assessments to enhance the sustainability of their vocation.

Over the long-term, the collection of this data will provide greater visibility into the supply chain, and overall health of the coffee industry. Furthermore, as data is aggregated, it should be used to develop production and budget forecasts, as well as other metrics relevant to inform public

policy concerning the sector. Additional details on the long-term functionality of the platform are described in the following section.

Long-Term Functionality of the Web Platform:

Our long-term vision for the web platform is a centralized system that can be used both by cooperatives and producers, as well as by the central governing agency proposed in section 7.2.4. This web platform will be a database of production, quality, price, and export information, as well as a training and information system. Data collected through weather and soil sensors should also be housed in the platform. As such, the long-term capabilities of the platform should include the following functions:

- Production Forecasts
- Budget Forecasts
- Risk Management:
 - Identify possible vulnerabilities in the chain, and inform risk management plans due to weather, or natural disasters
 - Prevent future risks if no actions were taken
 - Rapid implementation of risk management procedures or prevent disruptions and real-time information
- Quality Trends
- Pricing Trends
- Wholesale Buyer Preferences
- Centralized Training Modules - “Coffee Coursera”
- Coffee Exchange
- Communication Channel to Cooperatives

The proliferation of actors involved in the coffee industry, which include not only public and private bodies but also international NGOs and technical cooperation organizations, generates a large amount of information dispersed in different sources. Despite the efforts to create virtual libraries, such as the one available in the National Innovation Centre for Sustainable Coffee Production of Peru – [CEINCAFÉ](#), administered by the National Coffee Board, the information is still not consolidated.

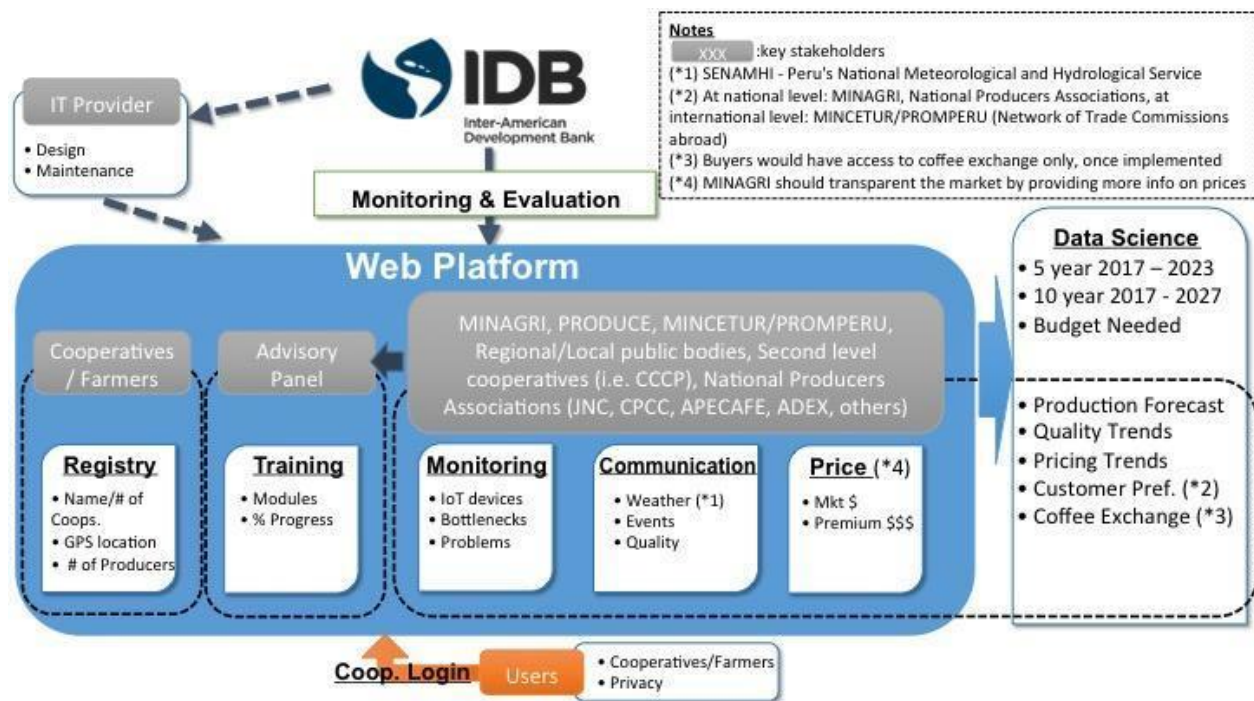
As such, in terms of serving as a communication channel to cooperatives, we envision the web platform as a single window in terms of access to information, current news and details of events to be held at the domestic and international level. To overcome the fact that producers have limited internet connectivity, we propose the dissemination of this news and weather information to be sent to producers via SMS texts. Users of the platform (identified in figure 6) will be able to upload such information periodically in order to ensure that all actors are well informed about recent developments, avoiding asymmetric information among stakeholders or duplicating efforts. Some of the stakeholders that generate large amounts of information, such as the Ministry of Agriculture and Irrigation, or the national producers’ associations and second-level

cooperatives, are key in this stage.

For example, MINAGRI could provide more information about prices (domestic and international), similarly to the service that it currently provides through “El Datero Agrario”, a service that uses cellphones to provide information about average prices for agricultural products traded in the main wholesale markets. The purpose is to increase the capacity of negotiation for farmers. MINAGRI, in coordination with Peru’s National Meteorological and Hydrological Service (SENAMHI), could also provide information about weather conditions. Some important steps have been taken with the signing of an inter-agency cooperation agreement between JNC, SENAMHI, the Inter-American Institute for Cooperation on Agriculture IICA and MINAGRI (through SENASA) to implement an early warning system for coffee cultivation. This platform would timely warn producers if there are environmental conditions conducive to develop a phytosanitary epidemic that could affect their coffee plantations.

A visual summary of the web-platform’s functionality is described by Figure 10, shown below:

Figure 10 – Centralized Web Platform



7.1.7 Traceability in the Supply Chain

In the Ethiopian case study, the IoT traceability solution begins at a central processing facility where farmers take coffee beans for processing. After this two week processing period, each coffee bag is tagged with the unique code given to the central processing facility. A QR code is printed onto a tag, and this tag is sewn into each coffee bag. At each stage herein, the tag is

scanned with mobile devices: smartphone/tablet/scanner. The data captured from the tags at each stage is sent to a database for storage and can be tracked.

Based on the Ethiopian case study, we believe that a simple traceability system could be implemented in the short term without the necessity of a large-scale involvement from the government, national agency, or massive changes in the industry. In the case of applying an analogical solution to the Peruvian coffee supply chain, the traceability system could begin at the central processing facility.

We recommend tracking the coffee from its central processing facility to the warehouse in Lima because the fragmentation of the supply chain prior to this stage would inhibit the implementation of tracking codes to each single producer. In addition, from an IT-technological point of view, there is relatively reliable IT infrastructure at the collection center, which is indispensable to the system, and not as much at the producer level. However, once the web-platform is rolled out, and the registry completed as mentioned in section 7.1.6, and GPS location of cooperatives and independent producers are in place, this traceability system could be expanded to trace the coffee back from the collection center to the individual producers.

The key technology needed for the traceability system is a centralized database that captures all data from each stage in the supply chain. We recommend that the web-platform described in section 7.1.6 is designed to have the capability to house the information generated from the traceability system.

7.2 Non-Technological Recommendations

The technological recommendations above aim to improve the traceability and allow for data capture. However, given the fact that quality improvement relies on the standardization of processes and manual skills of coffee farmers, we present the following non-technological recommendations.

7.2.1 Advisory Panel: Coffee Experts

In order to design the training program mentioned in the previous section, we recommend creating a small, independent coffee advisory panel. This advisory panel could be formed by a multidisciplinary set of national and international experts in specific coffee-related areas (agronomy, social development, marketing, barista, coffee industry management, digital technologies, etc). The members of the advisory panel do not necessarily have to represent a specific public or private actor in the supply chain. They would be part of the advisory panel by their own merit. We recommend that, based on their knowledge and assessment of the industry and its trends, the advisory panel focus on specific areas, such as: administration of cooperatives, production standards, technology implementation, marketing and exportation. This advisory panel would create the best practices for administration and production and a set of progress-based modules that are housed and managed in the central web platform. The advisory panel will be responsible for creating the content used to train those that will train technical staff based in each cooperative.

We feel confident that this advisory panel would be best suited to expand on the content for the web platform, and would have the capacity to improve the structure of the recommendations that we provide.

7.2.2 Formation of Well-Managed Cooperatives

As mentioned previously, approximately 60-70% of coffee producers in total do not belong to a cooperative, and are referred to as independent. Independent producers face additional challenges to those affecting producers associated with cooperatives. Cooperative members we interviewed highlighted how, without the organization and structure that cooperatives offer, independent coffee producers face hardship accessing world markets, and are unable to form direct relationships with buyers, as their production is insufficient to meet buyers' demands.

Independent farmers can sell their product to third-parties, who often take advantage of their vulnerability and grossly underpay for the coffee beans. Furthermore, these producers do not receive technical assistance, as there is no formal organization that can provide these services on a continuous basis. Based on our interviews, we found that access to financing is restricted, as traditional institutions do not have the capacity to service these remote geographic locations, and do not provide microloans.

Given the additional obstacles faced by independent producers in terms of access to technical assistance, financing, and markets, we believe the formation of cooperatives is essential. Independent coffee producers should be encouraged to associate under cooperatives, action which would facilitate the provision of technical assistance, the creation of direct relationships with end-buyers, and strengthen farmers' bargaining powers. Furthermore, if all coffee producers were associated under cooperatives, the industry will also begin to consolidate, and the standardization of processes and supply chains would become feasible.

From our observations during the fieldwork, we identified seven best practices which strengthened the management and operations of cooperatives. These best practices were derived from actions observed in Group A cooperatives, and should be seen as a framework that guides the governance of both newly formed, and established cooperatives.

Figure 9 - Summary of Best Practices in Cooperatives

Best Practices	Description	Benefit
Payment System	Payments from cooperatives to producers must match payments the cooperative receives from the final buyer of the coffee beans.	1) Producer loyalty to the cooperative is strengthened through this risk-sharing payment system 2) Eased financial strain on cooperatives. No additional funding is required to pay producers upfront.
In-house Experts	Professionally trained coffee graders and technical assistance personnel should be part of the cooperative's employee base	1) Provide ongoing technical assistance to producers on a continuous basis, at a lower cost to cooperative 2) Ability to grade coffee in-house and establish a quality control
Personalized Assistance	Tailor assistance programs based on each producer's needs	1) Ensure quality is homogenous across all partners 2) Strengthen ties with partners and foster loyalty to cooperative
Management	Hold elections to elect President and Board of Directors every two years	1) Increase transparency and accountability 2) Allow producers to be represented by the leaders of their choice 3) Increase mobility in leadership roles, and allow younger producers to hold office
Centralized Processing Plants	Establish centralized processing plants across each cooperative's production regions, accessible to all producers.	1) Ensure quality is constant across all producers, as a single process is used for all beans 2) Facilitate access to processing plants
Price Transparency	Publish price reports to inform producers of market prices of coffee depending on quality	1) Build awareness amongst producers of relationship between quality and price 2) Promote transparency regarding the cooperative's financial situation
Digital Database	Utilize a digital database to record production and quality information by producer	1) Promote quality control 2) Identify producers in need of further technical assistance 3) Leverage data to improve training programs

Source: SIPA Capstone Team - March 2017

7.2.3 Standardization of Training Programs: improving farmers' skills

As we have mentioned in previous sections of this report, the quality of the coffee is determined by various factors, most of which occur between the harvest of the coffee cherry and the process followed until the coffee bean reaches its exportable state, known as "green" coffee. With the objective of improving the quality of coffee produced in Peru, we propose the design of standard training programs to be used by technical assistance staff to improve harvest and post-harvest techniques amongst the coffee producers.

Although many cooperatives do provide technical assistance, and past interventions aimed at improving producers' skills have been implemented, many producers continue to miss

essential quality controls needed to obtain high-grade coffee. However, we do recognize cooperatives play a key role of sharing technical expertise and we recommend that the trainings are imparted by the cooperatives' technical staff. From this point forward we will refer to this local coffee agronomist as a 'technician'.

This technician is paid to ensure that best practices are followed by all producers of the cooperative. If producers do not follow specific training/production methods, then the technician should be held accountable, and can be dismissed from their position. Each technician carrying out the trainings should be provided a tablet device where they can collect and input baseline data, quality and production metrics etc. prior to delivering training. The data collected by the technicians should be housed in the web platform.

Recent research in the field of behavioral economics has found traditional training methods have little impact on producers' behavior as they ignore cognitive limitations affecting all human beings. However, studies undertaken to improve cotton farmers' skills in Uganda, and seaweed growers' productivity in Indonesia, have shown simple changes in the design of technical assistance trainings can have a significant impact and improve farmers' behavior. We believe findings derived from these research papers are applicable to the coffee producers in Peru, and should be incorporated in the design of standard technical assistances to be provided to coffee producers. Additional details on the studies, their findings, and recommendations on how they can be adapted to coffee producers in Peru are outlined below.

- 1) Design technical assistance interventions to enhance learning through noticing¹³: Hannah et. al find farmers must attend to many dimensions and take many decisions throughout their production process, and are unable to notice every factor which can impact yield and quality of the crop. Through a field experiment of seaweed farmers in Indonesia, the authors find traditional technical assistance interventions have little impact on farmers' behavior. However, significant changes in behavior, farming methods and consequently productivity, are seen amongst farmers who receive technical assistance which highlights variables directly related to yield and quality, and who receive summary reports at the end of the harvest period. These summary reports, help farmers notice dimensions of their practices they had previously failed to take into consideration. The summary reports provided to each seaweed farmer contains the following metrics:
 - Variables and methods used by each farmer (i.e. size of the seaweed pod planted, distance between each pod)
 - Yield obtained by farmer using said methods/variables
 - Price obtained for crop
 - Optimal variables and methods (i.e. optimal size of the seaweed pod to increase yield)
 - Yield and price information that would have resulted from following the optimal practices (which were taught during the technical assistance stage)

¹³ Hannah et. al "Learning Through Noticing: Theory and Evidence from a Field Experiment" (2014)

Below we briefly outline how these findings can be adapted to design more effective technical programs to be used to improve coffee producers' harvest and post-harvest skills:

- a) Administer a baseline survey to assess which dimensions of the coffee production process the farmers currently know and pay attention to
 - b) Identify the dimensions of the harvest and post-harvest process ignored by the producers to incorporate into technical assistance programs
 - c) Technical assistance is provided to all farmers, placing special emphasis on the factors relevant to quality (b), identified in (a) as dimensions not currently taken into account by the farmers
 - d) The technician visits the producer on a regular basis, collecting information of the methods and dimensions used by the producer and inputs the information into the tablet (i.e. when the producer chooses to pick cherries, how the drying is done, % of humidity, etc)
 - e) When the process is finished, and the producer sells the coffee to the cooperative, metrics on the quality and price of his crop are collected by the technician
 - f) Each farmer receives a summary report shortly after, containing the following information:
 - i) Methods and dimensions used by the producer (collected in (d))
 - ii) Quality of coffee obtained, and price received for coffee
 - iii) Optimal methods and dimensions that should have been used
 - iv) Quality of coffee that could have been obtained, and corresponding price
 - g) At the beginning of the next season, the farmer receives another copy of the report, as a reminder of what factors he or she should notice during the harvest and post-harvest stages to improve quality and price of coffee
- 2) Leverage social networking as a tool for information dissemination and retention¹⁴: In rural areas in developing countries, information sharing occurs through word of mouth; as such, social networks play a key role in facilitating the spread of new and optimal farming techniques. Through a randomized experiment done amongst cotton farmers in rural Uganda, results indicate farmers who participated in training programs which also randomly partnered each participant with another farmer, previously unknown to them, significantly improved their farming techniques and yields. Farmers were given a photograph of their partner and were encouraged to speak with them on a consistent basis and discuss planting and harvesting techniques being used, to reinforce skills acquired during training. Most importantly, improvements seen were greater for the poorest and less skilled farmers participating in the trial.

¹⁴ Vasilaky & Leonard, "As good as the networks they keep? Improving farmers' social networks via randomized information exchange in rural Uganda" (2014)

Extrapolating the findings of this second study to improve the design of technical assistance trainings for coffee producers, we recommend the incorporation of social networking as a key element of the trainings. The following points illustrate how this could be achieved:

- Producers receive technical assistance in groups
- During group trainings, each producer is randomly assigned to another producer, whom they have previously no relationship with. These producers will become partners throughout the harvest and post-harvest stages
- Each producer receives a photograph of their partner, and their mobile number
- During the trainings, the partners play “games” together, designed to reinforce the skills emphasized during training
- During the harvest season, producers are encouraged by the technician (and possibly via SMS reminders) to contact their partners and discuss methods, practices, and skills learnt during trainings

These two studies, and the applicability of their respective findings for the design of technical assistance trainings in Peru, have been recommended given the significant impact both had on improving farmers’ skills. They were identified as being simple enough to be easily incorporated and utilized by technicians, yet are by no means the only lessons from recent behavioral economic research that could be relevant in the design of these standard training practices. Furthermore, we recommend that a feedback mechanism is built into these standard technical assistance trainings to continuously collect information from the field, identify if the desired impact is being obtained, and adjust the design as needed if weaknesses are observed.

7.2.4 Creation of a Central Governing Agency

As highlighted in section 6.1.2, Peru would improve its performance in the coffee industry if it had a central agency that represents the public and private actors and that could coordinate the actions of all major national institutions, numerous regional/provincial organizations, and thousands of independent coffee producers.

Recently, some initiatives have been launched to organize producers in a way that those who are independent are also represented. During the first National Coffee Congress (February 24 and 25, 2017, Lima), the creation of a Peruvian National Federation of Coffee Farmers (Federación Nacional de Cafetaleros del Perú) was proposed. Despite these efforts, a centralized institution that encompasses public and private sectors would provide more leadership and a united vision of the industry.

Indeed, the idea of a central governing agency is not new. Under the framework of the USAID Project “Strengthening the Coffee Value Chain in Peru Program”, in July and August 2012, the staff in charge of the project met with the National Coffee Council to discuss a congressional act to formally move forward with the formation of a National Coffee Institute. Moreover, the SCVC

program, together with the JNC, hired a legal consultant to draft a bill for the formation of such an institute to proceed with the formation of a national coffee institute (USAID 2013). In 2014, the former Minister of Agriculture and Irrigation declared that the Executive Branch would present a bill for the creation of the National Coffee Institute before Congress. It was expected to function as of 2015 but to date the institute has not been created. Currently, there is a bill (Proyecto de Ley 956/2016-CR) that declares the creation of the institute to be a national priority. However, the bill just establishes that MINAGRI would prioritize the actions needed to consolidate its creation.

While the creation of this central governing agency is urgent, we recognize that it is not an easy process as several interests (including economic and political) are involved around the coffee industry and its representation both in the public and the private sector. Political willingness and a clear strategy would be required for any effort that tries to consolidate a very fragmented industry dispersed from the north to the south of the Peruvian territory.

7.3 Monitoring & Evaluation:

In the sections above we have presented both technological and non-technological recommendations that can be implemented by the IDB in efforts to improve the sustainability of the Peruvian coffee industry. As with any intervention program, we suggest the monitoring and evaluation of any programs that are designed based on the recommendations we have proposed. Monitoring and evaluation will help the IDB extract relevant information from the past and ongoing activities that can be used as the basis for programmatic fine-tuning, reorientation and future planning.

We propose a simplified results framework to be done in the planning stage that will guide the monitoring and evaluation processes. This will ensure that we are monitoring and evaluating in line with the outcomes we first envisioned to achieve¹⁵.

Intended Result	Indicators	Baseline	Target	Means of verification
Improve Coffee Quality	100 point scale	<ul style="list-style-type: none"> Central Processing facilities Warehouses in Lima 	Reach >83 points “High Quality” or “Premium” Coffee	Tasters/Graders at export warehouse
Improve Coffee Production	Thousands of 60kg jute bags	Export warehouses in Lima	Improve to pre-2013 levels	Export Records
Consolidate the Industry	Number of national/regional agencies	Use this report as of 2017	One national agency	Nationally recognized agency that all coffee producers report to

¹⁵ M&E Handbook - UNDP

Visibility of the Supply Chain	Each stage is known and tracked	Use this report as of 2017	Coffee can be traced to a central processing facility	GPS coordinates with time and date stamp
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7.3.1 Monitoring

Monitoring should be an ongoing process that will happen throughout the implementation of the project to help answer whether the interventions we intended to take have been done, and to help us ascertain whether we have made progress towards improving coffee quality and production. The stakeholders will receive regular feedback on the progress being made through the central web platform and take corrective actions, if outcomes we set out to achieve are not being achieved. This means implementing tracking strategies and new strategies that ensure progress in the right direction with the careful oversight by the advisory panel.

Monitoring would include timely review of the training content and plan through a feedback mechanism. Necessary corrective actions should then be taken for improving and updating the training procedures. The stakeholders involved in this would be the advisory panel and technicians who are responsible for the content and delivery of the training. Our proposal of a centralized web-platform is also a step towards consistent monitoring of statistics and self-tracking of the outcomes and achievements we set out to achieve.

7.3.2 Evaluation

Evaluation will be a rigorous and independent assessment after each coffee season with the data on the web platform as well as official government records regarding exports. The process of evaluation must be independent, transparent, ethical, impartial, of high quality and timely. This will strengthen synchronization and capacity development, reduce transaction costs and management burden, improve stakeholder coordination, enhance ownership and accountability and, lead to better learning and sharing of best practices. A joint evaluation of the program could be carried by an IDB project team. The evaluation purpose, scope, objectives and criteria should be well-defined before beginning with the evaluation. The criteria could be effectiveness, efficiency, sustainability and impact.

The analysis will involve questionnaires, interviews, observing program operations, and reviewing or entering data from the existing data sources as well as a field work visit by a future Columbia SIPA Capstone team visiting coffee cooperatives in Peru. Accordingly, recommendations will be made for the future strategy, modification and new initiatives. A sound monitoring and evaluation will create significant data which would be fed into the web-platform and used by the stakeholders for making informed decisions not only in the short-term but to measure progress over the long-term. It will also increase accountability, make new information and literature available for the participants and build a body of knowledge for a sustainable and growing industry.

8. Limitations of the Fieldwork

It is important to note that the fieldwork took place over a short period of time and observations were therefore, limited in their nature. We were able to visit seven cooperatives of which there are more than 300 in Peru. Furthermore, we were not able to visit any of the independent coffee producers which comprise approximately 72% of total coffee production. There are three major regions for growing coffee, and the only region we visited was the Selva Central.

As a result, our research findings may be biased and may not fully represent the problems faced by the Peruvian coffee industry. Moreover, we were unable to conduct interviews with other major actors such as national producers associations. Given the constraints of our fieldwork analysis, we would encourage further research into the two other major coffee producing regions as well as interviewing independent coffee processing groups and national producers associations.

9. Factors Affecting Recommendations

There are three major factors that may hinder the implementation of our recommendations, these being political sensitivity and agendas, inconsistent coordination of efforts and weather and climate conditions.

Political Agendas

It is evident that there are many actors involved in the Peruvian coffee supply chain, from regional to national influence, that each have differing goals and perspectives regarding the future of the coffee supply chain. As such, certain conflicting political agendas may hinder the successful creation of a national governing body especially if its proposition eliminates other agencies or personnel. Our report indicates that divergent agendas can negatively impact the production of a consistent quality across the coffee industry, which is evident in the history of coffee in Peru. It is important therefore, that new implementations are focused on stakeholder analysis of all major players, and that their agendas and goals are carefully listened to and respected. We do believe that a better coffee industry will benefit everyone and therefore this message of improvement for all must be clear at the outset.

Inconsistent Coordination of Efforts

In light of the multitude bodies contributing to the coffee industry, there is likely to be many inconsistencies in the efforts of those involved in implementing our recommendations. Despite testing the willingness to implement recommendations during our primary research stages of the project, we cannot guarantee that there genuinely will be a coherent uptake of the proposed changes. For example, there is no guarantee that all Peruvian coffee producers will utilize the

web platform to their advantage, nor can we assume that a national governing body can feasibly be created to serve the interests of all those contributing to the coffee supply chain.

Weather/Climate

During the fieldwork, we were exposed to shifting weather patterns in Peru and witnessed the country declare a national emergency as a result of heavy rains. This was just a small reminder to the existence of such phenomena and how pre-existing logistical issues within the supply chain will affect the efficient transportation of coffee beans. As the global climate changes, the functioning of Peruvian cooperatives and other intermediaries may well have to adapt to ensure the consistent quality production and transportation of coffee. However, due to limited resources it is unlikely that modifications in the modus operandi of all Peruvian cooperatives will be a fast process.

10. Conclusion

It is clear that the Peruvian coffee industry has yet to reach its full potential in terms of productivity and supply chain consistency. As aforementioned, increasing the quality of coffee produced in Peru would ensure that farmers attain a high market price for their good. However, due to the lack of knowledge, and scarcity of financial and physical resources, producers often struggle to maintain the production of high quality coffee. Moreover, the industry is particularly fragmented in terms of production standards, lacks a central 'coffee authority' and the absence of an international brand. As a result, we have put forward recommendations that deal directly with the lack of visibility in the supply chain, technical education in the industry and its lack of consolidation which correlate to the productivity and sustainability of the coffee supply chain.

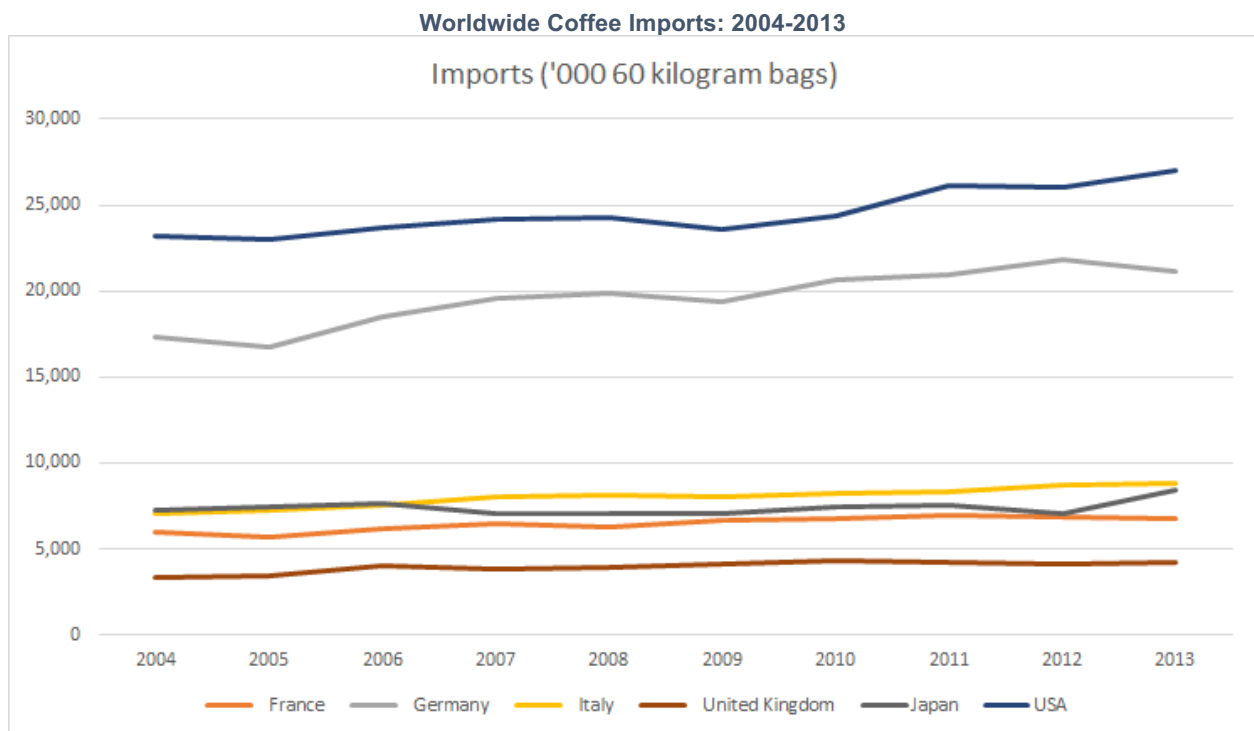
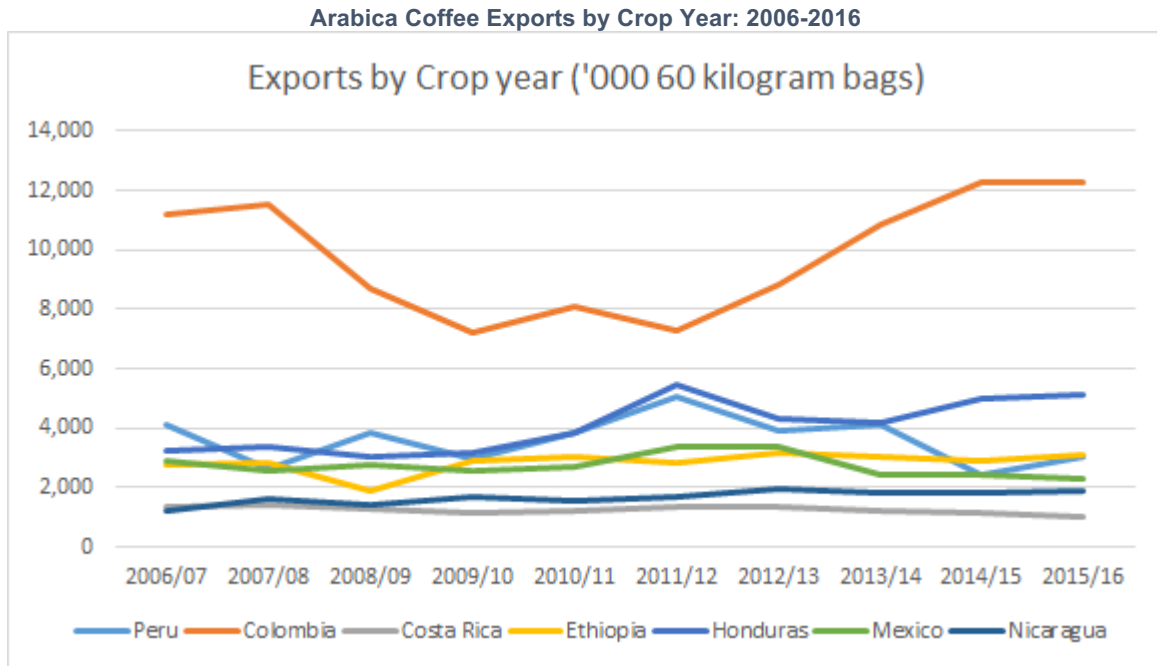
Having completed desk research and firsthand fieldwork, we established that the Peruvian coffee industry could certainly benefit from the widespread incorporation of technologies that enhance coordination of the actors in the supply chain. However, the industry as a whole is not ready to adopt a single large-scale technology solution because of the apparent inconsistencies throughout the supply chain. Bearing in mind these disparities, we have advocated for feasible and short-term solutions such as devices that measure acidity, humidity and sugar content, as well as a web-based data management system to be managed centrally by an independent advisory panel. This panel would oversee the delivery of technical education to coffee farmers and provide them with incentives to learn about and ascribe to more efficient production techniques.

Our proposed platform will also allow for the monitoring of the supply chain and help solidify a divided industry. In addition to the web platform, we have indicated the importance of traceability in the coffee supply chain, and advise the use of a tracking system such as coded tags for the transportation of coffee beans, to trace each batch back to its original processing facility. To address the lack of consolidation in the industry further, we also recommend the formation of a central governing authority to oversee the standardization of practices and assert

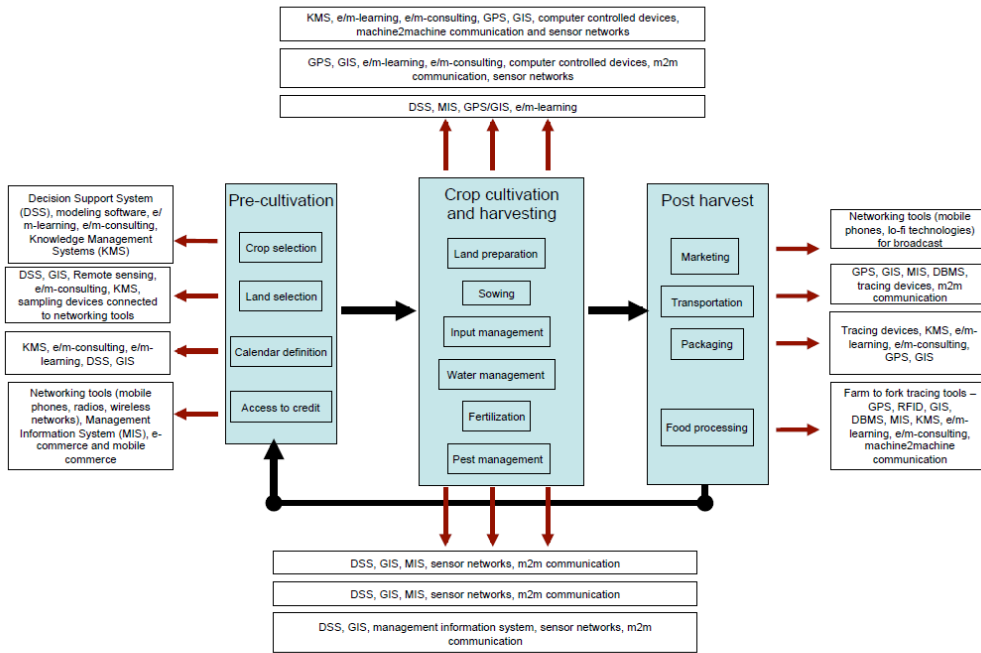
the importance for all coffee producers to be represented by cooperatives.

Many of our recommendations can be implemented in the short-term whereas we have set apart others that can only be developed in the long-term as a consequence of the industry's readiness and the complexity of the specific proposal. We are confident that with the incorporation of technological and non-technological solutions, as described in this report, the Peruvian coffee industry can secure high quality production levels and ensure its sustainability in an increasingly competitive environment. With these key changes to the industry, Peru will be better prepared to compete on an international level and ensure the livelihood of thousands of coffee producers who depend on the coffee industry and increase the overall GDP of the country.

Appendix 01 – World Coffee Graphs from data from the ICO



Appendix 02 - Mind Map for ICT in Agriculture



Source: FAO

Appendix 03 - IBM Traceability Stages in the ECX Case Study

Step1: Assigning tags to the bag @ processing station

- Farmers take coffee beans to the processing station. Bags of coffee are tagged (tag is sewed on the bag) and becoming unique by an individual number and the processing station.

Step 2: Dispatch @ processing station

- All bags are scanned during loading the truck that is registered by number plate and photo. All data including the geographic location of the scanning, time, date, number of bags, and a list of serials is transferred to the database.

Step 3 : Delivery center arrival @ECX delivery center

- The trucks that arrive at the ECX delivery center are registered by time and date.

Step 4: Sampling of coffee @ECX delivery center

- Samples are taken from each coffee bag loaded on the truck to check the grade of the coffee. After scanning with a mobile device, the final coffee grade is uploaded to the database.

Step 5: deposit @ECX warehouse

- All bags are unloaded from the truck. Bags are scanned at the stock location within the ECX warehouse.

Step 6: pick up delivery @ECX warehouse

- Exporter arrives at ECX warehouse with pickup documents, including information such as type or grade of coffee purchased, and the number of bags purchased.

Step 7: deposit @exporters facilities

- Coffee bags are transported to the exporter. All bags are scanned, and the origins of the coffee are identified. The exporter also confirms the quality of coffee to check if it matches the taste their customer expected.

Step 8: bulking of coffee @exporters facilities

- The coffee beans from different origins are mixed on request by the client. The new lot is created and becoming tagged.

Appendix 04 - Public/Private Actors in the Supply Chain

- Agricultural Bank (AGROBANCO): a semi-public entity, responsible for the execution of the 2014 National Plan for the Renovation of Coffee Plantations (Plan Nacional de Renovación de Cafetales).
- The National Agrarian Health Service (Servicio Nacional de Sanidad Agraria – SENASA): it is the national authority for agricultural health, seeds and organic farming.
- Exporting Sierra and Selva (Sierra y Selva Exportadora): it promotes and develops productive economic activities in the Sierra and Selva regions.
- The Ministry of Production (Ministerio de la Producción – PRODUCE) has provided funds for innovation and research projects in the coffee industry and houses the National Quality Institute (Instituto Nacional de la Calidad – INACAL) responsible for the National Quality System: standardization activities for the coffee products.
- The Ministry of Foreign Trade and Tourism (Ministerio de Comercio Exterior y Turismo-MINCETUR): it is responsible for setting, directing, implementing, coordinating and supervising foreign trade, including national development plans and programs.
- The Commission for the Promotion of Peru's Exports and Tourism
- The Ministry of Labor and Employment Promotion
- The Coffee and Cocoa Committee in the Peru's Exports Association (Asociación de Exportadores)
- The Peruvian Association of Specialty Coffee (Asociación Peruana de Cafés Especiales – APECAFE)

To the complexity of the relations within and between the public and private sectors at the national level, it should be added that this complexity is replicated, to some extent, at the regional level. For example, the 2014 National Plan for the Renovation of Coffee Plantations points out that, at the regional level, regional Councils and/or Technical Tables have been constituted as spaces for debate and proposal. In the particular case of Selva Central, historically, it has not shown signs of integration, as cooperatives show a dynamic of individual growth. In addition to the presence of Central Café y Cacao del Peru, other actors that represent the interest of the coffee industry at the regional level in Selva Central (CCCP 2017, p. 20) are:

- Selva Central Regional Coffee Council.
- The Federation of Coffee Farmers of Selva Central.
- Regional and Local governments
- Regional Coffee Institute (Instituto Regional del Café)