Design for DLT-powered Traceability Platform for Sustainable Commodities

Livestock in Ecuadorian Amazon Use Case

August 2021

I.   Executive Summary

The UNDP Global Centre for Technology, Innovation, and Sustainable Development engaged Convergence.Tech in respect of its Cultiv@te programme to develop a knowledge product to guide the design and implementation of a traceability system for livestock and related products in Ecuador. After a competitive open call for solutions, Cultiv@te, for its Ecuador challenge, selected Convergence.Tech, a Toronto, Canada-based company that uses blockchain technology to power solutions for the environment to design a platform to support traceability, certification, and incentives across the livestock sector through a digital system to motivate farmers to adopt more sustainable practices.

Convergence.Tech worked with PROAmazonía, an initiative led by the Ecuadorian Ministry of Environment, Water and Ecological Transition (MAATE), and the Ministry of Agriculture and Livestock (MAG) with support from the United Nations Development Programme (UNDP) to integrate sustainable production with forest conservation in the Amazon. This programme links national efforts to reduce deforestation with Ecuador's economic development priorities by promoting sustainable and integrated management of natural resources in a way that contributes to poverty eradication and sustainable human development. PROAmazonía strengthens Ecuador's positioning as a country committed to global efforts to combat climate change, the Paris 2030 Climate Agenda and the Sustainable Development Goals (SDGs).

This knowledge product covers the design of a traceability solution for the remaining steps of the value chain from slaughterhouse up to the final consumer as part of a second phase while integrating that with PROAmazonia's work already underway on a first phase on traceability from the ranchers up to the slaughterhouse. The intent of PROAmazonia is to ensure full transparency and traceability across the entire supply chain while linking price benefits and incentives back to cattle ranchers. The traceability platform is being developed in two phases:

Phase 1 - from the ranchers up to the slaughterhouse
The Ecuador government's Livestock Traceability System is generating an initial module that includes general information about the producer, the farm, the forest, input supplies, etc. This data will be integrated into the national systems that are in charge of animal health surveillance, combining vaccination data, mobilization guides and animal health certificates. Data from the industry and marketing will also be integrated into this system.

Phase 2 - from the slaughterhouse up to the final consumer
Convergence.Tech was selected to design a solution for the second phase of the value chain. Together with PROAmazonía, they co-developed a design for a traceability platform to support incentive payments and higher prices. This was done to develop a premium market around certified beef and ensure that the benefits flow back to producers who applied good agricultural practices.

PROAmazonía worked with Convergence.Tech over the period from January 2020 to January 2021 to engage stakeholders and design a solution to ensure physical traceability of livestock products from the municipal

slaughterhouses through the remaining steps of the value chain up to the end consumer and including future export markets while being integrated with Ecuador government's Phase 1 Livestock Traceability System. This knowledge product will share the steps in designing the traceability solution and a prototype to test its overall viability along with an understanding of both the technical requirements and the supporting processes complementing the technology (e.g., certifications and promoting consumer demand). It is intended to facilitate a future pilot for the traceability solution for livestock products in Ecuador. It is also envisioned the solution could be adapted for another country as well as for other commodities linked to deforestation and environmental degradation.

Stakeholder engagement was necessary in supporting the design thinking processes that our team used in the initial design process. It reflected the importance of taking a discovery-first approach and using user-centered technology design and design thinking to create an effective solution that is easy to use and tailored to work in these kinds of remote environments. It will describe the preliminary design for the prototype along with the key technology components. The knowledge product highlights key considerations for developing a detailed pilot implementation plan to test the solution under field conditions and provide for future improvements necessary to scale the solution to full implementation. It also highlights opportunities to extend the design for a traceability platform to other commodities linked to deforestation and environmental degradation.

II.   Background

Cultiv@te

Cultiv@te is a global innovation initiative that aims to find creative entrepreneurs, start-ups and R&D teams from around the world to solve challenges in agriculture. Working with 11 countries across Asia, Africa and Latin America, the programme selected 31 innovative and technology solutions for urban agriculture, rainfed agriculture, livestock farming and aquaculture after an open call for applications and competitive evaluation process.

The Ecuador challenge for Cultiv@te was complementary to the UNDP Ecuador office's support to the PROAmazonia initiative detailed below. PROAmazonía and Cultiv@te formed a partnership to fight deforestation and promote sustainable livestock farming. The UNDP Global Centre worked with UNDP Ecuador and PROAmazonía identifying livestock traceability and sustainability as their agricultural innovation challenge under the Cultiv@te program. This would support the PROAmazonía initiative, who jointly with the Ministry of Agriculture & Livestock and the Ministry of Environment, Water and Ecological Transition, identified capacity building as a main priority to move forward to sustainable production systems in support of their REDD+ program.

PROAmazonia

On May 22, 2017, the Ecuador Ministry of the Environment, Water and Ecological Transition (MAATE) and the Ministry of Agriculture and Livestock (MAG) signed an Inter-Ministerial Agreement to create the Amazon Integral Program for Forest Conservation and Sustainable Production (PROAmazonía) with the aim to reduce forest loss and degradation in the Ecuadorian Amazon.

The PROAmazonía initiative, implemented by the MAATE and the MAG, is supported by the UNDP office based in Ecuador, and is funded by the Green Climate Fund (GCF) and the Global Fund for the Environment (GEF) for a total of USD 53.64 million. The program seeks to link national efforts to reduce greenhouse gas emissions with the country's productive sectors, in-order-to reduce the causes of deforestation and promote sustainable management of natural resources using a landscape approach within the framework of Ecuador's Reducing Emissions from Deforestation and Forest Degradation (REDD+) Action Plan 2016 -2025. The REDD+ Action Plan contributes to Ecuador´s Nationally Determined Contribution (NDC) under the Paris Agreement on Climate Change and includes providing development training and stakeholder interventions to help farmers to adopt sustainable farming practices.

The main drivers of deforestation in the Ecuadorian Amazon are agriculture, in particular livestock, but also coffee, cocoa and palm oil production. The PROAmazonia program is working to stop the advance of the agricultural frontier by supporting the transition to sustainable production systems. To do this, the program employs a comprehensive approach that includes stakeholder roundtables, strengthening associativity, improving productivity, traceability and certification, enabling commercial linkages and promoting green financing. Ultimately, the program is also aiming to improve the income of farmers that are committed to protecting the Amazon Forest taking into account gender inclusion and equality.

Low productivity, prices and profits for farmers

Pastures for cattle-raising in the Ecuadorian Amazon Region are extensive with 65% of the land used for pastures and representing the main cause of land-use change. Recent studies[1] have indicated low levels of productivity and inefficiencies along the supply chain (Figure 1) which result in the provision of low-quality beef. As a result, cattle farmers face significant challenges related to low meat prices and high production costs.

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[1] Castillo, M.J. Análisis de la Productividad y Competitividad de la Ganadería de Carne en el Litoral Ecuatoriano. Santiago, Chile: Rimisp, Grupo de Trabajo: Desarrollo con Cohesion Territorial, Programa: Impactos a Gran Escala, Serie Documentos de Trabajo No. 144, 2015.
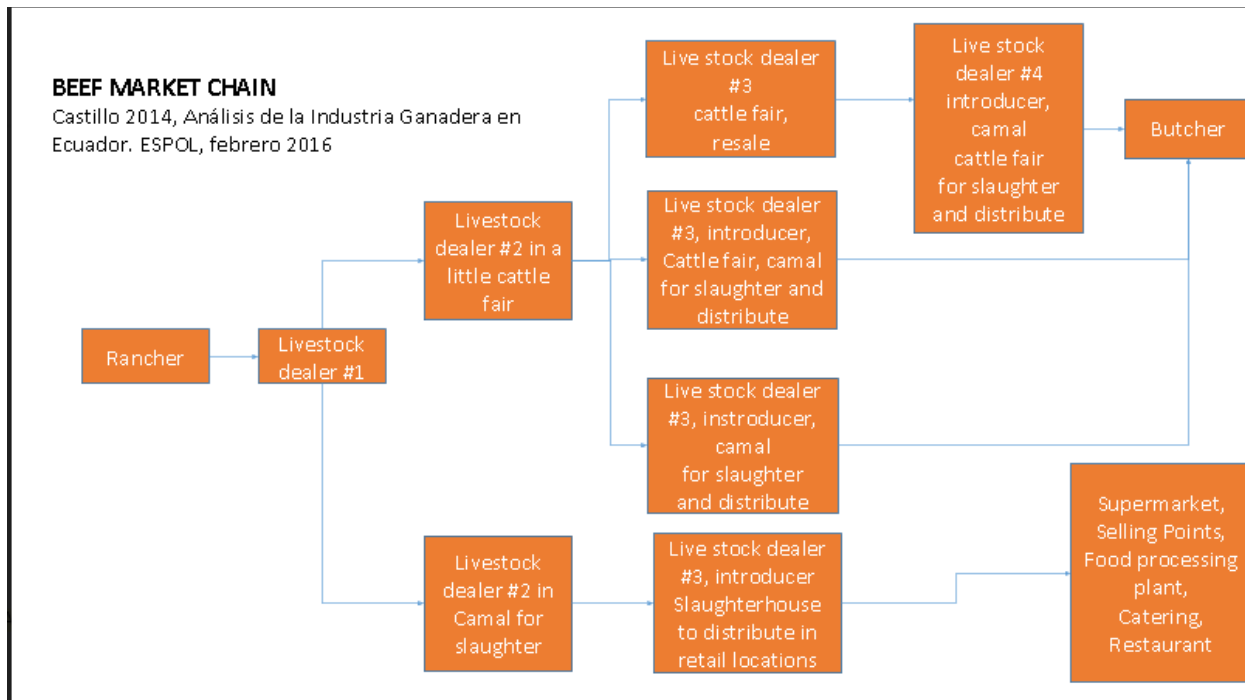
BEEF MARKET CHAIN
Castillo 2014, Análisis de la Industria Ganadera en Ecuador. ESPOL, febrero 2016

Figure 1: Ecuador Beef Value Chain

Most cattle farmers are small herd owners (less than 50 cattle) and this type of producer often holds cattle among other farming activities more as a traditional way of life and use of cattle as a form of savings or even social status as opposed to optimizing profits. 43% of the total cattle population in Ecuador are directly linked to meat production with many reflecting traditional breeds with slower growth rates than other more productive breeds such as Charolais and Brahman crosses. As a result, studies[2] suggest that animal sales are sporadic and not necessarily at optimum weight or value but at times of most economic need. To ensure a regular supply, the meat processing industry and the service sectors (restaurants and supermarkets) rely on intermediaries to collect the animals from farms and transport them to cattle markets or directly to slaughterhouses. These studies note that intermediaries can be of different operational scales, and there can be more than one intermediary between production and slaughter, hence increasing opportunities for losses and damages that are later reflected in the quality of the meat.

Most slaughterhouses in Ecuador are publicly owned and operated (86%) and controlled by municipalities that often offer subsidized rates. Intermediaries often called "introducers" bring the animals to the municipal slaughterhouses and then sell them to authorized wholesalers, who after the slaughtering distribute the meat to

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[2] Castillo, M.J. Análisis de la Productividad y Competitividad de la Ganadería de Carne en el Litoral Ecuatoriano. Santiago, Chile: Rimisp, Grupo de Trabajo: Desarrollo con Cohesion Territorial, Programa: Impactos a Gran Escala, Serie Documentos de Trabajo No. 144, 2015.

their different clients (e.g., restaurants, butchers, and supermarkets), including other intermediaries in meat distribution. In some cases, there are up to three intermediaries which ultimately reduces prices received by cattle farmers. Slaughterhouses do not have a very active role in the beef market supply chain because they only offer a service to wholesalers creating a disconnection between cattle production, slaughtering, and beef distribution. 86% of slaughterhouses in Ecuador are municipal, out of which 90% have been classified as unsuitable due to poor hygiene standards resulting in low quality products with poor customer perception (UNDP Culiv@te 2020). The system is thus pervaded with multiple gaps. Within the supply chain, there is also an inequitable distribution of profits, putting farmers at a disadvantage.

The need for a more traceable and sustainable supply chain

The absence of a traceability system in Ecuador also poses challenges. The long beef value chain makes the connection between producer and consumer difficult. In addition to the disparate distribution of profits in the value chain, there is a lack of knowledge about beef quality and the related environmental impacts on the consumer end of the chain.

Most of the meat is going to local traditional markets, with the premium segment being catered by imported meats due to lack of "quality" related differentiation efforts by local producers. Beef consumption in Ecuador, with a population of over 17 million, is low with an annual per capita consumption of 11 kilograms; South America's per capita beef consumption is roughly 45 kilograms per annum. There is also relatively low demand for high-quality beef, likely because of the absence of information and education on beef quality.

The relatively low productivity of the livestock sector makes it inefficient from a carbon emissions standpoint in addition to having significant biodiversity impacts. Many cattle-raising practices have a traditional system of extensive production, which degrades the soil and its pastures that threaten the conservation of higher carbon and biodiversity landscapes in the Amazon region. The need to modernize the beef cattle sector has been recognized by the Ecuadorian government, which has executed various cattle production and processing improvement programs, including programs related to animal breeding, pasture management, animal health, and animal slaughtering at municipal slaughterhouses (Ministerio de Agricultura y Ganadería [MAG], 2013).

The PROAmazonia program is aiming to improve the income of farmers that are committed to transitioning to sustainable production systems by promoting silvopastoral systems, or grasslands with dispersed trees that contribute to carbon sequestration as well as enhanced productivity through improved cattle breeding practices cross-breeds and improved pasture to transition from traditional system of extensive production to more intensive production systems. To do this, the program employs a comprehensive approach that includes stakeholder roundtables, strengthening associativity, improving productivity, traceability and certification, enabling commercial linkages and promoting green financing.

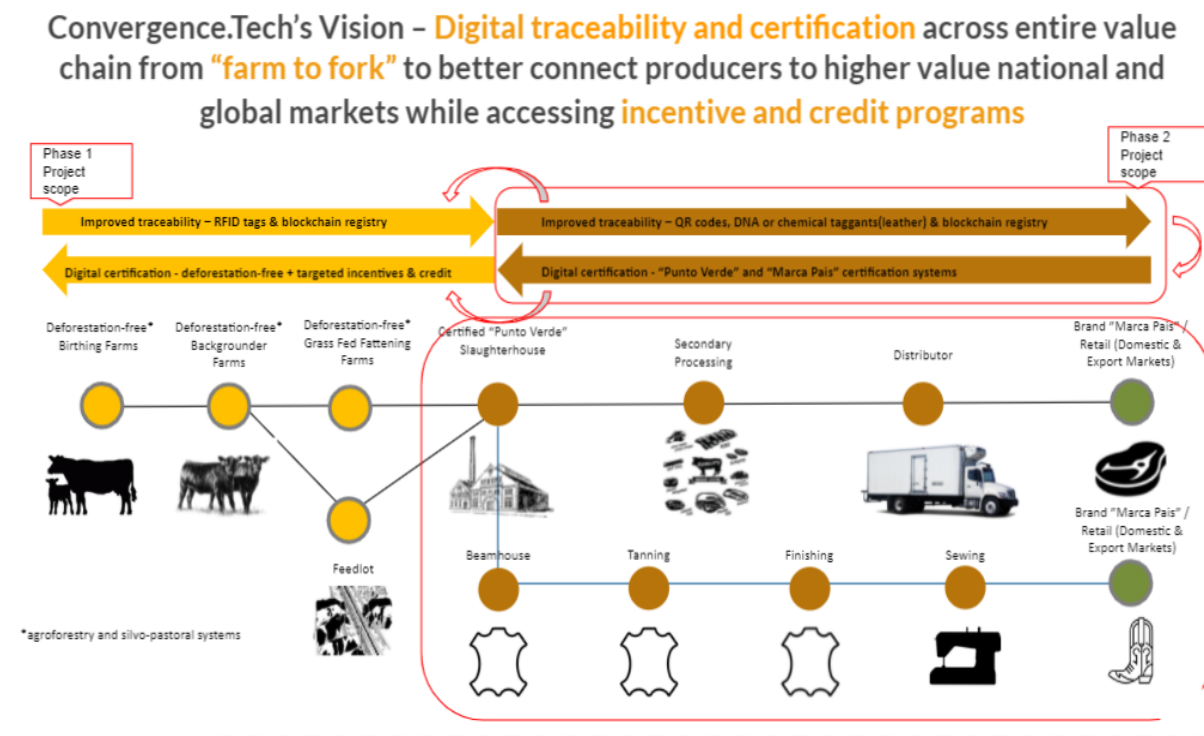## *A solution for livestock traceability and sustainability*

The Cultiv@te programme was a timely fit for the PROAmazonía initiative, enabling the discovery of the most

innovative solutions from around the world to tackle Ecuador's complex livestock challenge. PROAmazonía's Programme supports the sector's transition to sustainable production systems through improvements in productivity and enabling traceability and certification of livestock products. It also aims to increase the income of farmers who help to protect the Amazon rainforest through deforestation-free meat and dairy production.

Convergence.Tech was selected for Ecuador's challenge through multiple rounds of evaluations. The proposal (Figure 2) involved designing a platform to support traceability, certification, and incentives across the livestock sector through a digital system that motivates farmers to adopt more sustainable pasture management. Convergence.Tech's overall vision involved:
- designing a digital traceability and certification system to eventually encompass the entire value chain from "farm to fork"
- connecting producers to national and global markets while targeting producers for incentive programs like carbon offsetting/insetting or leather impact credits from the leather sector.

Figure 2: Convergence.Tech Cultiv@te Proposal

Through initial scoping work with UNDP and PROAmazonía, Convergence.Tech focussed its core technology and innovation on a traceability solution for the remaining steps of the value chain from slaughterhouse up to the final consumer. Key players in the beef cattle sector comprise a number of participants or actors. The value chain analysis of meat production in the study areas consists of a complex network of stakeholders, who work within specific stages from farm to fork. The chain integrates beef cattle producers, traders, butchers, wholesaler's meat dealers and retailers. The beef cattle are moved from farmers to traders, then to butchers who slaughter the animals and convert them into marketable products. This was part of a second phase in implementing a

traceability system integrating work already underway in a first phase on traceability from the ranchers up to the slaughterhouse to ensure full transparency and traceability across the entire supply chain while linking price benefits and incentives back to cattle ranchers.

While the value-chain for meat was the initial focus, there was also consideration about incorporating the value-chain for leather given the potential to engage impact partnerships to incent sustainably produced leather in addition to meat. While there are many different types of leather and therefore many variants on the manufacturing process, there are a number of common steps of the leather production cycle including: preservation at the slaughterhouse to allow transport and storage of the raw material; cleaning and processing the hides at the beamhouse; tanning the collagen of the hides to transform them into leather; finishing through several processes to upgrade the leather; sewing into finished products; and retailing.

III. Designing the DLT-powered Traceability Platform for Sustainable Commodities (Ecuadorian Livestock Use Case)

Traceability is a growing requirement for many commodities driven largely by growing consumer awareness and increasingly to obtain market access as governments such as the EU consider new regulations regarding commodities linked to deforestation in addition to existing health regulations. Convergence.Tech participated in the UNDP Cultiv@te program to facilitate establishing supply chain traceability for Ecuador's beef supply chain that could help efforts to mitigate Amazon deforestation, foster good agricultural practices, improve access to higher value national and export markets while helping improve the livelihood of Ecuadorian beef producers. The desired outcome was to design a prototype for a new technology platform that could be piloted and eventually deployed more broadly to improve the productivity and sustainability of Ecuador's beef industry.

This is an area where blockchain technology is seen as providing a possible solution. The technology can build trust among the supply chain partners, where blockchain's distributed-ledger can be used to store and authenticate supply chain transactions. Further, a blockchain-based traceability system would provide a unique opportunity, flexibility, and authority to all partners to trace-back their supply network and create a transparent and sustainable supply chain.

Generally, traceability comes in three forms. Depending on the specific goals, objectives and circumstances, one of the three different approaches would be selected to support the traceability initiative. The three forms are as follows:
1. **Product Segregation** – Certified materials and products are physically separated from non-certified materials and products at each step in the supply chain.
2. **Mass Balance** – Certified and non-certified products may be mixed; however, the exact volumes of certified materials are tracked such that an equivalent volume of the product can be sold as certified.
3. **Book and Claim** – A company can obtain sustainability certificates through a relevant standards body for the volume of certified materials put into the system. The certificates can be bought and sold meaning that sustainability claims can be made via the existence of a certificate even though the actual product may not have been certified. An advantage of the book and claim approach is that it provides an opportunity to bypass long and complex supply chains, allowing a greater portion of the incentive payments to reach the producers, yielding greater adoption of sustainable practices.

Goal Mapping

Identifying the primary goals upfront guided the design of the traceability solution. Defining goals is vital to any design task. Without clear design goals, the design would lack clear direction, purpose, and intent. Good goals help articulate the problem the solution is required to solve: the need it satisfies and the value it provides.

This step began with a scan of other jurisdictions (Table 1) that have or are implementing traceability systems

for livestock production and their associated motivations.

	Launch date	Premises ID	Individual cattle ID	Electronic cattle ID	Motivation
Australia	1999, mandate in 2005	M[b]	M	M	Market access, food safety, animal disease
Brazil	2002	M	M	V[b]	Control FMD[e] and market access to EU
Canada	2002	M	M	M	Market access accelerated with BSE [f]
European Union	1997, current law in 2000	M	M	V	Animal health and BSE response
Japan	2003	M	M	V	Response to BSE discovery to restore consumer confidence
Mexico	2003	V	V	V	Animal health, census, traceability
New Zealand	2006	V	V	V	Market access and animal health (TB) [g]
South Korea	2004, updated in 2009	M	M	V	Consumer food safety assurance and animal health
Uruguay	2006	M	M	M	Control FMD and market access
United States	2013	V[d]	V[c]	V	Control diseases for animals crossing states

[a]Table adapted from Bowling et al. (2008) and Schroeder and Tonsor (2011).
[b]M=mandatory and V=voluntary
[c]Michigan requires mandatory individual cattle identification since 2007.
[d]Mandatory premise identification for Wisconsin and Indiana

[e]**Foot-and-mouth disease (FMD)** or hoof-and-mouth disease (HMD) is an infectious and sometimes fatal viral disease that affects cloven-hoofed animals.
[f]**Bovine spongiform encephalopathy (BSE)**, commonly known as mad cow disease, is an incurable and invariably fatal neurodegenerative disease of cattle.
[g]**Bovine Tuberculosis (TB)** is a contagious, debilitating disease affecting cattle.

Table 1: Jurisdictional Scan of Traceability Goals

This informed a discussion with Convergence.Tech, PROAmazonia, MAATE and the MAG about the specific goals and objectives for the design of a traceability system in Ecuador. A range of possible goals were identified and linkages amongst them are reflected in the goal mapping chart below (Figure 3).

Figure 3: Goal Mapping Chart

This goal mapping step in the design process then led to proposed preliminary goals for the design of the livestock traceability system, how the design would incorporate features to achieve these goals and some of the associated benefits for the PROAmazonia program. The overarching goal was to improve the productivity, sustainability and profitability of the livestock sector in Ecuador (Figure 4). This would be achieved in part through supporting traceability, certification and incentives across the livestock sector through a digital system to motivate behavioural changes by farmers to adopt more sustainable practices.

Figure 4: Overarching Goal

This included incorporation of climate smart practices including silvopastoral systems, agroforestry or grasslands with dispersed trees that contribute to carbon sequestration. It was also designed to enhance productivity through improved cattle breeding practices cross-breeds and improved pasture to transition from a traditional system of extensive production to more intensive production systems thereby alleviating forest conversion pressures and the corresponding loss of carbon stocks and biodiversity. A related objective was to link price benefits and any environmental financial incentives back to cattle ranchers to promote improved livelihoods. In addition to better branding of Ecuador meat products linked to product claims around sustainability, achieving improved prices for meat products was also dependent on improved quality and food safety of these products that would allow them to access higher value national and export markets from premium cuts.

An example of how these goals contribute to the overall objective of protecting the Ecuadorian Amazon are reflected in a possible Theory of Change model in Figure 6 below. The example also portrays the traceability platform as an input into activities that generate outputs in support of these goals and the overall objective.

Table 2: Example of a Theory of Change and Role of Traceability Platform as an Input

Inputs	Activities	Outputs	Goals	Impact
• Training • Certifications • Traceability platform	• Deforestation-free certification • Targeted incentive and loan programs • Grant programs that promote sustainable livestock practices (agro-forestry, silvo-pastoralism)	• Contribute to REDD+ Action Plan, NDC • Access to financial incentives linked to sustainability - RBP's, impact credits • Environmental and social safeguards (i.e., protection of biodiversity, Indigenous land rights)	• Improve Sustainability Practices of Producers	• Protection of Ecuadorian Amazon Forest
• Training • Certifications • Traceability platform	• Branding • Claims framework • Access high value export markets • Tracking productivity/ performance data (age, breed, live weight, dressed weight) • Grant programs that promote productivity improvements (breeding & genetics, agro-forestry, pasture improvement)	• Improved prices/sales • Improved productivity of existing farms • Reduced pressure to expand into Amazon (reduced deforestation) • New agroforestry related income sources (tree crops, nuts)	• Improve Livelihoods for Producers	
• Training • Certifications • Traceability platform	• Vaccinations • Animal disease monitoring and inspection (BSE, FMD, TB) • Monitoring animal transport • Slaughter inspections • First freeze date • Best before/expiry date	• Reduced animal losses due to disease/herd destruction • Improves animal weight gain • Consumer confidence	• Increase Food and Animal Safety	

Research/Stakeholder Input

To understand the perspectives and motivations of stakeholders that might interact with the traceability system as well as participate in a pilot of the platform, the Convergence.Tech team participated in a broad range of stakeholder meetings over the late Spring and Summer in 2020 with cattle farmers, cattle breed organizations, municipal slaughterhouses, the food inspection agency, retailers and the national leather tanner association facilitated by PROAmazonia.   Of note, the team met in October 2020 with the Vice-Minister and Undersecretary of MAG to ensure that the prototype design would align with Ecuador's development vision about what they wanted to achieve in addition to Cultiv@te goals. MAG staff identified the following important contributions:

- Propuesta de Políticas de Estado para el Agro Ecuatoriano 2020-2030
- REDD+ Action Plan
- Deforestation Free Proposal (MAATE)
- Premium and Sustainable Strategy - deforestation free
- Codigo Organico del Ambiente

The October meeting was followed by a broad stakeholder meeting in November to discuss in greater detail the prototype design, planning for a pilot, and funding needs to execute a pilot. Their feedback and input on the preliminary design provided a strong picture for how to complete the design of the platform.

Through the extensive consultations with government bodies, producer organizations, slaughter houses, and end users (restaurants), the team confirmed the need to create a technical solution that:

a) complimented the initial "Phase One" traceability system that is being built by MAG,
b) traced the animal and processed products through the remaining steps in the supply chain (from slaughterhouse to retail),
c) captured data to identify relevant attributes of the animal/meat (e.g., grass fed, producer's use of Climate Smart agricultural practices, deforestation impacts, live weight/ dressed weight, etc.), and
d) provided capacity to incent a transition to sustainable production practices, to build a differentiated brand around these products and a mark of sustainability that would increase the value to producers through a willingness of consumers to pay more for these differentiated products.

Key Design Considerations

A key design feature MAG and MAATE highlighted during the consultation phase was that all parts of the supply chain including retailers needed to ultimately be represented in the solution. The intent was to develop a traceability system that was based on a product segregation model where certified livestock products are physically separated from non-certified livestock products at each step in the supply chain (i.e., to support quality, prices and branding in addition to sustainability). However, there were a number of reasons to consider adopting some elements of a book and claim system at least in the short-term to increase the supply of sustainably produced livestock while a full-traceability system is put in place from "farm to fork" in stages.

Long and complex supply chains

There are many actors involved from the cow/calf farm through to the final products offered to consumers. A calf may be born on one farm, moved to a 'backgrounder' farm for a period of time, then go to a 'direct' farm or feedlot before going to slaughter. There may be fewer steps involved, or even sometimes more. To date, there are few countries in the world where the animals are traceable between the different farms; even the United States does not mandate that animals be tracked as they move from farm to farm.

Similarly in Ecuador, the beef supply chain can involve many steps. While in some supply chains such as for the large and small supermarket carnicerias (SuperMaxi) and large processors (Agropesa) these may be fairly consolidated, they represent only a small proportion of the market for meat consumed in Ecuador. The majority of meat is bought and sold in local markets across the country as fresh meat and can involve multiple changes in ownership. The characteristics of this supply chain mean that traceability can be very expensive to implement in most cases.

Need for Financial Incentives that Target First Mile (i.e., Livestock Farmers)

As noted previously, commercial partnerships are essential to overcome the lack of economic incentives for farmers to become more sustainable and efficient in their practices. Almost all of the money that a brand pays for the "sustainability impacts" is intended to go to the farmer to create an effective incentive system.

However, in Ecuador and many other cases, supply chains are long and complex with brands having little ability to influence supply chains. In addition to the overall physical traceability challenges this raises, a long supply chain also means that each participant in the supply chain will apply their own mark-up. Typically, that mark-up will be applied to the full cost of their input materials. If that input cost includes the premium that was initially paid to the farmer by a brand to promote sustainability, then that premium will be inflated as well.

While the Convergence.Tech team was tasked with designing a traceability system for the value chain from slaughterhouse up to the final consumer as part of a second phase, the challenges associated with a long and complex supply chain suggested the need to start working at both ends of the supply chain - increasing the supply of deforestation-free cattle while also working to create consumer demand for deforestation-free meat and any other claims such as grass fed.

There are a couple of examples of incentive systems globally (Figure 5) that could be modelled to help overcome these challenges and bridge the gap between primary producers and brands in the short-term while brands work back through the physical supply chain and develop the market for their brands over the longer term. Farmers in the Amazon could receive carbon offsets/insets, book and claim/impact credits or offtake agreements linked to supermarket chains, restaurant chains, fashion brands and footwear brands who are making claims around carbon neutrality, net-zero, Deforestation Conversion Free (DFC) or grass-fed beef.

Financial Incentives for Beef and Leather when **Supply Chains Long and Complex**

Financial Incentives like Impact Credits, Offtake Agreements, Loans & Grants can Bypass Physical Supply Chain when Brands have Little Direct Leverage with Farmers and Slaughter Houses to Demand Traceability

Figure 5: Example of Financial Incentives Targeting "First Mile"

In this case, carbon offsets/insets, book and claim or leather impact credits, offtake agreements (i.e., contracting in advance for some of the production), loans and grants could be:

- targeted to farms to build supply of Deforestation/Conversion-Free (DCF) cattle;
- used to encourage brands to purchase from targeted high-risk areas; and
- able to send market signals to protect forests and adopt climate smart agricultural practices where it is needed most.

Carbon Insets

Carbon insetting is very similar to carbon offsetting, except the activities that lead to carbon footprint reduction take place within the context of the value chain (Figure 6). Early definitions originate in part from a 2009 technical paper from Ecometrica, which defines the "new paradigm" of insetting as an investment within the company's sphere of influence or interest, but outside of a company's Scope 1 and 2 emissions[3]. It is used to meet carbon neutral or net-zero commitments by food and textile companies. Carbon insetting ensures that a company is taking direct responsibility for the carbon emissions in their own supply chain and are improving sustainable management practices directly at the source. Carbon insetting can also be more appealing to companies because

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[3] https://ecometrica.com/assets/insetting_offsetting_technical.pdf

investing in these inset projects can help make a company's supply chain more resilient and improve the quality of its raw materials.

- Financial funding for climate protection stays within the company or the value chain and is recovered from the prices received for the product.
- Stakeholder relationships are strengthened.
- Active supply chain management helps to identify strengths and weaknesses.
- Companies can consolidate their image as one who wants to take responsibility for achieving the goals of the Paris Agreement.
- Companies can achieve a significant incentive for farmers to adopt climate smart practices by paying a sufficiently high price for carbon insets.

Other differences compared to carbon offsetting include:
- With carbon offsetting, project development is usually for the "carbon market" generally, while carbon insetting projects are created by developers for specific businesses through exploring their supply chain and GHG emissions.
- Carbon insets offer potential alignment with Ecuador's constitution where all rights to environmental services belong to the state (i.e., payments flow through government to producers to achieve ghg reductions towards Ecuador's NDC) and private carbon offsetting projects or emissions transactions are not permitted. Collaborating partners can agree who has ownership of the emissions reductions and how the reductions will be communicated through claims or reports on the reductions.
- In carbon offsetting projects, the purchaser and the offset provider are normally discrete entities, while carbon insetting projects are a collaborative activity among the developer and the stakeholders of one or more businesses.

Figure 6: : Carbon Offsetting versus Insetting

Roundtable on Sustainable Palm Oil (RSPO) Credits (Book & Claim) & Leather Impact Credits

The Book and Claim supply chain model (Figure 7) supports the production of RSPO certified sustainable oil palm (CSPO) products through the sale of RSPO Credits. It allows RSPO certified mills, crushers, independent out-growers, and independent smallholder groups to sell RSPO Credits to the supply chain actors at the end of

the supply chain, while selling the physical palm oil products as non-certified/conventional (i.e. Certified and non-certified physical products may be mixed but all are sold as non-certified while supply chain actors are able to make claims regarding supporting a volume of certified production equivalent to their overall product sales). Under the RSPO Book and Claim certification system, the supply chain is not monitored for the presence of sustainable palm oil. Manufacturers and retailers can buy Credits from RSPO-certified growers, crushers and independent smallholders.

Figure 7: RSPO Book and Claim Model

Impact Incentives

Impact Incentives (Figure 8) are similar to the book and claim model providing a market mechanism for brands to deliver their expectations back to the start of the supply chain and provide financial rewards to encourage best practices. Impact Incentives refer to the certificates that are traded in support of a sustainability claim. The certificates are issued when a set of criteria have been confirmed to have been met, and the physical goods and the Impact Incentives are traded separately from each other. The Impact Incentive certificates represent a specified quantity of verified material that has been produced but has not been physically traded as verified goods. The way they work is quite simple; farms that meet a chosen standard or benchmark will be able to sell incentives for their volume of output, and brands can purchase these incentives to balance out their use of these output materials. The farms selling the incentives may or may not be in the immediate supply chain of the brands, as the incentives trading system does not address physical traceability. While this means that brands cannot make any content claims on their products, they can by-pass the cost and complexity of long or opaque supply chains in order to deliver impact quickly and efficiently. Brands and retailers can still make claims about their support for best practices having an efficient and effective tool to demonstrate their commitment to their CSR

goals, and to build up the supply of more sustainable commodities that they can eventually link to with physical sourcing.

An excellent example of how this works can be seen under the Textile Exchange's Leather Impact Incentive System[4] which is a component of the Leather Impact Accelerator (LIA)[5]. A one-year pilot phase is now underway.

Figure 8: Impact Incentives. Source: The Textile Exchange - Impact Incentives

Under these certification systems, rather than having their support to farmers eroded by 'the middlemen' in the supply chain the end buyers (brands or retailers) can transfer their support directly to the critical sourcing areas, with just a small fee paid for the transfer of the incentives.

Incorporating this design feature allows more time to address the challenges associated with designing and implementing traceability of physically separated products from non-certified materials at each step of a long and complex supply chain. It would allow Ecuador to start working at both ends of the supply chain - increasing the supply of deforestation-free cattle while also working to create consumer demand for deforestation-free meat and any other claims. Downstream buyers making product claims can begin to support farmers and farmers can receive incentives to follow best practices earlier. Only a small amount would need to be held back to cover the costs of the trading platform and the Partner Program supporting the program.

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[4]Textile Exchange, Industry Tools, Impact Incentives https://textileexchange.org/impact-incentives/
[5] Leather Impact Accelerator https://textileexchange.org/leather-impact-accelerator/

IV. Design for Traceability Solution

The design phase helped to establish a prototype and overall understanding of both the technical requirements and the supporting processes required to compliment the technology (e.g., certifications, promoting consumer demand, establishing incentives and financing) to meet the project goals.

Once a prototype is prepared, the design phase needs to allow for a series of pilots to allow for starting small, learning from each pilot, improving and refining the solution before broader deployment.

To meet the overall project goals, it was important to recognize and integrate key components that either "fed into" the technical solution or were complementary initiatives necessary to realize the solution's potential. For example, certain attributes of the farm and/or animal needed to be validated or 'certified' such as the use of "Climate-Smart" agricultural practices, or a confirmation that no deforestation activity had occurred on the farm. There was also a recognition that at the retail end of the supply chain, consumer marketing campaigns were necessary to educate the consumer about the beneficial attributes (e.g., meat quality, grass-fed, deforestation free, etc.) of the products available to them.

Design thinking Embedded in Prototype Design

These requirements were incorporated into the design thinking that was embedded into the prototype design. The Preliminary User Personas in Figure 11 illustrates the rigour of the detailed design thinking our team used to develop the prototype and reflects the development of a series of user personas for various actors along the value chain.
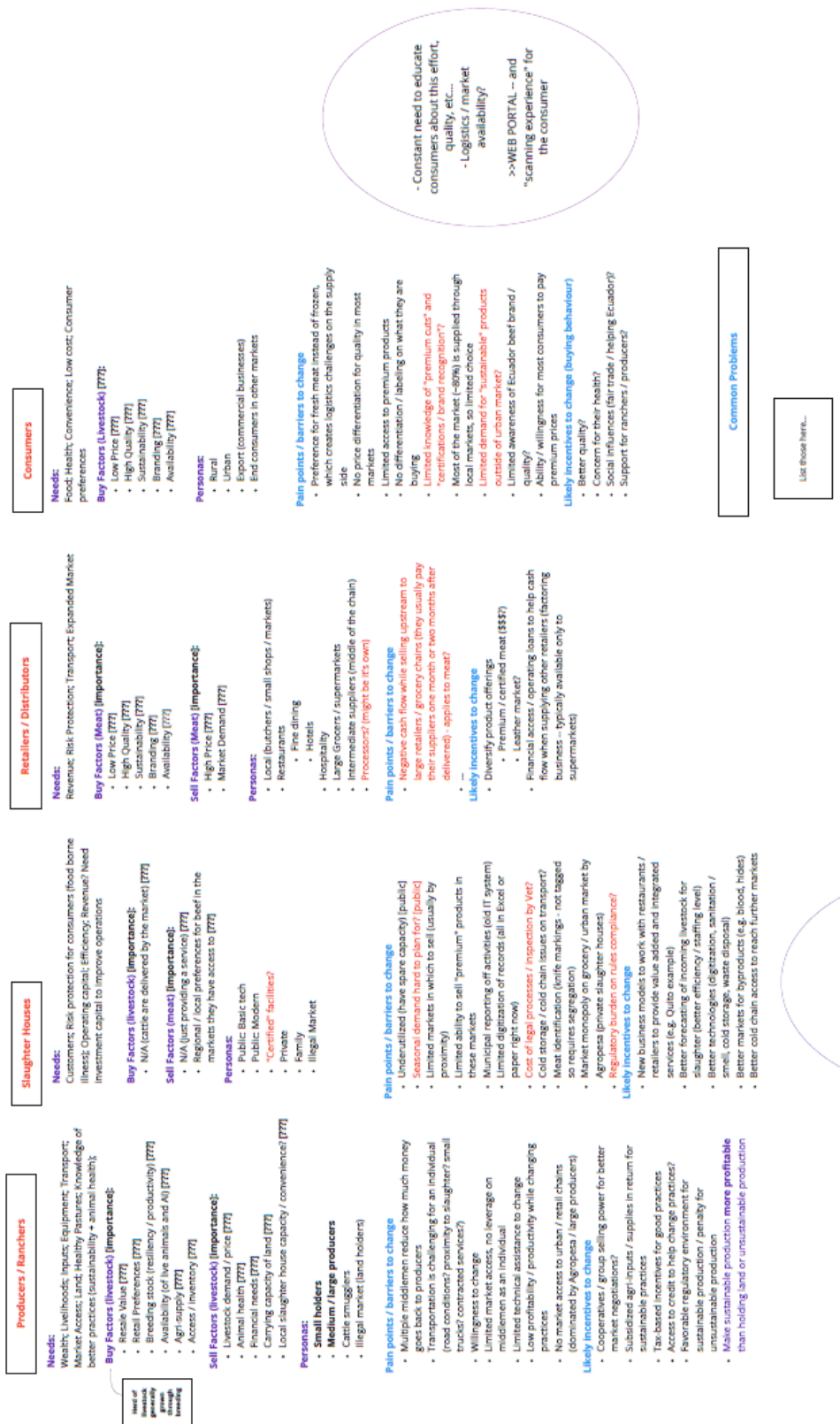
Preliminary User Personas (What We Know)

Producers / Ranchers

Needs:
Wealth; Livelihoods; Inputs; Equipment; Transport; Market Access; Land; Healthy Pastures; Knowledge of better practices (sustainability + animal health);

Buy Factors (livestock) [importance]:
- Resale Value [???]
- Retail Preferences [???]
- Breeding stock (resiliency / productivity) [???]
- Availability (of live animals and AI) [???]
- Agri-supply [???]
- Access / inventory [???]

Sell Factors (livestock) [importance]:
- Livestock demand / price [???]
- Animal health [???]
- Financial needs [???]
- Carrying capacity of land [???]
- Local slaughter house capacity / convenience [???]

Personas:
- **Small holders**
- **Medium / large producers**
  - Cattle smugglers
  - Illegal market (land holders)

Pain points / barriers to change
- Multiple middlemen reduce how much money goes back to producers
- Transportation is challenging for an individual (road conditions? proximity to slaughter? small trucks? contracted services?)
- Willingness to change
- Limited market access, no leverage on middlemen as an individual
- Limited technical assistance to change
- Low profitability / productivity while changing practices
- No market access to urban / retail chains (dominated by Agropesa / large producers)

Likely incentives to change
- Cooperatives / group selling power for better market negotiations?
- Subsidized agri-inputs / supplies in return for sustainable practices
- Tax-based incentives for good practices?
- Access to credit to help change practices?
- Favorable regulatory environment for sustainable production / penalty for unsustainable production
- Make sustainable production **more profitable** than holding land or unsustainable production

Slaughter Houses

Needs:
Customers; Risk protection for consumers (food borne illness); Operating capital; Efficiency; Revenue/ Need Investment capital to improve operations

Buy Factors (livestock) [importance]:
- N/A (just cattle are delivered by the market) [???]

Sell Factors (meat) [importance]:
- N/A (just providing a service) [???]
- Regional / local preferences for beef in the markets they have access to [???]

Personas:
- Public: Basic tech
- Public: Modern
- "Certified" facilities?
- Private
- Family
- Illegal Market

Pain points / barriers to change
- Underutilized (have spare capacity) [public]
- Seasonal demand hard to plan for? [public]
- Limited markets in which to sell (usually) by proximity)
- Limited ability to sell "premium" products in these markets
- Municipal reporting off activities (old IT system)
- Limited digitization of records (all in Excel or paper right now)
- Cost of legal processes / inspection by Vet?
- Cold storage / cold chain issues on transport?
- Meat identification (knife markings - not tagged so requires segregation)
- Market monopoly on grocery / urban market by Agropesa (private slaughter houses)
- Regulatory burden on rules compliance?

Likely incentives to change
- New business models to work with restaurants / retailers to provide value added and integrated services (e.g. Quito example)
- Better forecasting of incoming livestock for slaughter (better efficiency / staffing level)
- Better technologies (digitization, sanitation / smell, cold storage, waste disposal)
- Better markets for byproducts (e.g. blood, hides)
- Better cold chain access to reach further markets

Retailers / Distributors

Needs:
Revenue; Risk Protection; Transport; Expanded Market

Buy Factors (Meat) [importance]:
- Low Price [???]
- High Quality [???]
- Sustainability [???]
- Branding [???]
- Availability [???]

Sell Factors (Meat) [importance]:
- High Price [???]
- Market Demand [???]

Personas:
- Local (butchers / small shops / markets)
- Restaurants
  - Fine dining
  - Hotels
- Hospitality
- Large Grocers / supermarkets
- Intermediate suppliers (middle of the chain)
- Processors? (might be it's own)

Pain points / barriers to change
- Negative cash flow while selling upstream to large retailers / grocery chains (they usually pay their suppliers one month or two months after delivered) - applies to meat?
- ...

Likely incentives to change
- Diversify product offerings
  - Premium / certified meat ($$$?)
  - Leather market?
- Financial access / operating loans to help cash flow when supplying other retailers (factoring business - typically available only to supermarkets)

Consumers

Needs:
Food; Health; Convenience; Low cost; Consumer preferences

Buy Factors (Livestock) [???]:
- Low Price [???]
- High Quality [???]
- Sustainability [???]
- Branding [???]
- Availability [???]

Personas:
- Rural
- Urban
- Export (commercial businesses)
- End consumers in other markets

Pain points / barriers to change
- Preference for fresh meat instead of frozen, which creates logistics challenges on the supply side
- No price differentiation for quality in most markets
- Limited access to premium products
- No differentiation / labeling on what they are buying
- Limited knowledge of "premium cuts" and "certifications / brand recognition"?
- Most of the market (~80%) is supplied through local markets, so limited choice
- Limited demand for "sustainable" products outside of urban market?
- Limited awareness of Ecuador beef brand / quality?
- Ability / willingness for most consumers to pay premium prices

Likely incentives to change (buying behaviour)
- Better quality?
- Concern for their health?
- Social influences (fair trade / helping Ecuador)?
- Support for ranchers / producers?

- Constant need to educate consumers about this effort, quality, etc...
- Logistics / market availability?

>>WEB PORTAL -- and "scanning experience" for the consumer

Common Problems

List those here...

Figure 9: User Personas

The core experiences of these key actors interacting with a traceability platform were then highlighted:

1. **Producers**
   - Producers registered into the program, through ProAmazonia, Agrocalidad, or other organizations. Geospatial information about property collected.
   - Trial a "deforestation free" claim, potentially others (e.g., good agricultural practices)
   - Digital wallet to receive incentives and financing
   - Integration with MAG Phase 1 traceability will be explored as part of pilot for producer data

2. **Slaughterhouses**
   - Scan ear tag to access and record information
   - Segregation of cattle that meet program criteria (e.g., deforestation-free, good agricultural practices - climate smart)
   - Mass balance approach to control integrity during slaughter process
   - "Incentive" is released to the producer for participating in the program. A QR/ barcode code is attached to the meat to maintain traceability.

3. **Retailer / distributors**
   - Each sale of meat through the value chain is registered by scanning the QR/ barcode attached to the meat
   - Distributor
   - Butcher
   - Restaurant

4. **Consumers**
   - At any point in the supply chain, via web portal
   - Can scan QR/ barcode, see data, learn, and participate
   - QR/ barcode code leads to traceability data and marketing tools, **differentiating** meat that came from the program.

Preliminary Design

The Convergence.Tech/ PROAmazoia team developed a prototype based on their preliminary design and presented this at the Singapore Week of Innovation and Technology (SWITCH) on December 9, 2020. SWITCH brings together leaders, entrepreneurs, creators, accelerators and investors from the Global-Asia innovation ecosystem and is organised by Enterprise Singapore (ESG) and supported by National Research Foundation (NRF).

The prototype was designed to meet the objective of helping the livestock sector in Ecuador better market and differentiate their products on the back of their sustainability certifications, creating meat products with provable

certification claims and traceability back to their origin. The preliminary design (Figure 10) is innovative in how it pushes the beginning of the supply chain towards greater digitization and can help farmers tap into incentives.

The design for the traceability solution captures sustainability information in digital transaction certificates that are attached to data passports for registered livestock and associated meat products. Livestock producers would register their farms and be issued RFID ear tags by the Ecuadorian agency responsible for the control and regulation for the protection and improvement of animal health, plant health and food safety (Agrocalidad) to record the point of origin information and the beginning of the data record. A digital identity wallet and document passport would be created so that when the cattle or meat products are sold to a new buyer, that information, and changes of custody thereafter would be tracked with new data added to the registered meat thereby enriching the traceability data. The cattle would be tracked using RFID ear tags and the meat products themselves and/or paperwork would be tagged with a QR code with the data being logged into the digital system. During any change-in-custody, tags or QR codes would be scanned creating traceability. The present back-and-forth exchange of unverifiable paper documents is something that is made much easier, with high assurance data that can be validated as authentic in real-time by use of our technology.

The digital identity wallet created for livestock producers at the time of registration would allow them to track any credits or incentives. It would contain provable certifications or claims made about the origin of the livestock products while enabling them to sell "proof packages" containing all the information to downstream buyers thereby driving more value directly back to them. The incentive to do this comes by way of purchasable data passports that contain the provable certification and claims information, which actors along the value chain in turn can use as proof of sustainable sourcing or as a marketing tool to incentivize their buyers and their branding. At any sale of registered meat products, payment credits are released to the digital wallet, delivering a micropayment to the livestock producer.

This is traceable by anyone who wishes to inspect the provenance of the meat that is being sold to them, and is a key data point that weighs into purchasing decisions made by buyers, who have specific sourcing standards, certification and information requirements for the meat they purchase. For consumers interested in sustainable purchasing, it also provides an opportunity to transparently see where their meat is coming from and under what conditions and certifications they were produced. This is all being done using privacy protecting digital identity wallets and open standard W3C-compliant verifiable credentials, to build an ecosystem around certification-based traceability.

This in turn can help with both the sustainability and efficiency of small livestock farmers as well as building a brand around their certified products that Ecuador can help market to both domestic consumers as well as export markets.

Figure 10: Highlights of Preliminary Design

Due to the current cost and complexity of tracking livestock products along a very fragmented physical supply chain, the design accommodated the various types of incentives noted previously including carbon insetting or impact credits as the main tool for companies to signal their expectations and support best practices at the start of their supply chains where small farmers account for much of livestock production. While full traceability is being implemented along the entire value chain from farm to fork, the design enables downstream buyers like retailers interested in the sustainability of their meat products to also purchase credits directly (similar to an impact credit or carbon insetting program) to create a market delivering more value back to the livestock producers and encouraging increased supply of sustainably produced meat products. This is in response to the design considerations recognized at the outset including:

- Many supply chains are long, complex and opaque: companies that want to connect with and support better sustainably produced livestock products find it too expensive or time-consuming to identify their sources.
- there may not be enough sources of sustainably produced livestock products available to justify companies investing in tracing their supply chains back to the start
- small farmers are being asked to change their practices but are not getting sufficient financial support to adopt those good practices.

V. Need for Pilot Testing

While first developing a prototype was important in establishing the overall viability as well as an understanding of the technical solution, and supporting processes (e.g. product 'certifications', promoting consumer demand, productivity improvements, incentives and financing), to implement a national traceability system for the value chain for livestock products and the other commodities prioritized by PROAmazonia, there will be a need to conduct a series of pilots to better understand the scope and complexities of introducing a traceability system for the entire value-chain.

The meat supply chain in Ecuador is long and very fragmented with most meat serving small local markets. Only a relatively small proportion of meat products are destined at serving higher end butchers or restaurants as well as large retailers. The many actors such as farmers, traders, slaughterhouses, butchers, etc. all have different capacities, motivations and connectivity issues that affect their ability to use and interact with a digital traceability platform. There is not yet a sufficient supply of sustainably produced livestock nor consumer or export demand to justify significant investments in a very elaborate livestock product traceability system similar to other countries like Uruguay.

Similar to traceability platforms Convergence.Tech designed and piloted with the UNDP in India, Afghanistan, Mongolia, Uzbekistan and Morocco, there is a need to spend considerable time on the ground to really understand the environment, people, culture, technology readiness, etc. before broader deployment can take place. This is where many digitalization projects often fail and anything less than a phased approach could result in a system that falls short of the objectives.

The purpose of the design phase was to facilitate a series of pilots for this particular traceability solution. The desired outcome of the piloting phase will be to test the new technology under field conditions so that, after any necessary improvements, it could eventually be deployed more broadly in a way that is effective in improving the productivity and sustainability of Ecuador's beef industry.

The first step in designing a system of pilots is to develop specific goals for each pilot and they would include:

- Gauging technical viability of the solution and confirming the related design
- Making connection to the relevant certification systems to be adopted by livestock producers in the Amazon
- Deforestation-free
- Good agricultural practices (e.g., climate smart)
- Other (e.g., grass fed, animal welfare)
- Keeping costs low while obtaining enough validated learnings to build on by both:
- Minimizing duration
- Adequately considering the producer's perspective and industry practicality along with the consumers perspective
- Keeping the scenarios simple to improve probability of successful completion

- Creating a provisional plan to scale
- Tracing meat through to consumers
- Being able to tell a relevant story to consumers in terms both in terms of the:
- Quality of the meat products; and
- The appropriate mechanism in which to relay the story that will be received by consumers (i.e., QR code, point of sale info, linked website etc.)

A series of different pilot options were developed and evaluated against these goals. The options are not mutually exclusive and are designed to be additive subject to funding priorities to represent the primary pathways from livestock producers in the Amazon Region of Ecuador to the different markets for meat products including the local fresh market (Option1), butchers and restaurants selling higher value specialized cuts (Option 2) and a large processor with ownership of downstream grocery store/retail chains (Option 3).

Goals	Ability to confirm technical viability	Ability to align with certification under development	Duration/ Costs	Simplicity/ Risk	Ability to Plan to scale	Ability to trace meat to consumer	Ability to tell story to consumer (quality of story and mechanism to tell story)
Option 1 Sucua[a]	moderate	unknown	1.5 weeks, low-moderate cost	connectivity, fragmented value chain, poor ability to trace thru to retail market	Good if Sucua slaughter house typical of Amazonia, if enough regional consumer interest	Uncertain given lack of packaging at retail	Limited. Serving fresh market in Amazon where price is a primary driver of purchase
Option 2 Rastro Quito[b]	moderate	unknown	5-7 days, lowest cost	connectivity at farm level, more viable retail path to interested consumers in Quito (restaurants, etc...)	Good if Quito slaughterhouse typical to those in Amazonia, trialing more direct retail channels	Good but small volumes to niche markets	Good/ niche. Ability to serve high end Quito market for specialized cuts (restaurant or retail)
Option 3 Agropesa[c]	low (industrialized value chain)	unknown	1.5 - 2 weeks to trace through to retail/ consumer, highest cost	integration with Agropesa systems theoretical for pilot, risk of small pilot volume being lost in complex commercial operations	Learnings may not translate to smaller slaughter operations	Best if strong corporate cooperation .	Good with significant portion of market share, larger urban markets

Table 3: Pilot Options Based on Markets Supported by Local Slaughterhouse

a) Empresa Publica Municipal de Faenamiento Industrialización y Comercialización de Ganado, Productos y Subproductos o Derivados del Gobierno Autonomo del Canton Sucua; Huambi, Canton Sucua, Morona-Santiago
b) Empresa Publica Metropolitana de Rastro Quito; Chillogallo, Quito, Pichincha
c) Agropesa slaughterhouse Corporacion Favorita

The design of each pilot also needs to:

1. Document the requirements including hardware, software, licenses, smartphones, RFID tags, etc.
2. List all key technical and support resources including their role and responsibilities.
3. Provide a breakdown of the pilot costs including hardware, software, licenses, project management,

and other services and who will be responsible for funding the costs.

4. Generate a schedule that outlines key activities specifying the party responsible and its expected completion date.
5. Describe the success criteria and metrics across a variety of categories, such as system performance, operations costs, user performance, user satisfaction, and business goals.
6. Define how the results will be evaluated including the processes by which lessons learned will be incorporated into the final solution deployment
7. Identify the risks for the proposed pilot including the actions that can be taken to control them.

Timeline

An example of a plan to execute these pilots over the course of 12-18 months would allow for:

- Customization of the tooling for the local context.
- Sourcing a suitable tag supplier(s) in the region for both cattle and labelled products.
- Actual deployment and field testing for 5–15-day periods depending on the number of Options selected to gather results and test design.
- A comprehensive report back on findings, observations, and scale-up strategy for the pilot subject to it proving to be a viable solution and to allow for a more accurate estimate of scale-up costs and strategy, and
- Generating positive momentum to increase chances of finding follow-on funding.

Activity	Description	Timeframe	Outcome
Final round of stakeholder consultations and engagement targeted to pilot participants to finalize and pilot design	Workshops with smallholder farmers, tappers and wage labourers with dedicated women only sessions to ensure that the detailed design ensures that they are effectively engaged in the final pilot project and traceability platform design. This will include using both formal channels, such as community-wide meetings, and informal methods to provide appropriate channels to achieve this participation while ensuring appropriate and dedicated input from women.	One month	Ensures that livestock farmers, traders, slaughterhouses, fresh market sellers, butchers and large retailers wage including women only sessions to ensure that they are effectively engaged in the final prototype and pilot design.
Finalizing the project document	Project document that includes requirement specification document on which the traceability platform pilot project will be prepared and the design for the pilot project to test the traceability platform.	One month	Final document reflecting detailed design requirements for the pilot project and traceability platform prototype based on input from livestock farmers, traders, slaughterhouses, fresh market sellers, butchers and large retailers wage including women to meet objectives relating to improved sustainability and

			livelihoods.
Developing an initial prototype	Develop an initial prototype as an early model of the traceability platform for testing and evaluation purposes by livestock farmers, traders, slaughterhouses, fresh market sellers, butchers and large retailers wage including women. It will provide specifications for a real, working traceability system for the software developers. It represents an important first step between the formalization and the evaluation of the proposed traceability platform.	One month	A prototype screen for registration data and digital wallet for the 3 different pilot options representing the primary pathways from livestock producers in the Amazon Region of Ecuador to the different markets for meat products including the local fresh market (Option1), butchers and restaurants selling higher value specialized cuts (Option 2) and the large processor with ownership of downstream grocery store/retail chains (Option 3).
Completing iterative product customization	Evolution of traceability platform prototype solution to reflect detailed design requirements based on input from livestock farmers, traders, slaughterhouses, fresh market sellers, butchers and large retailers wage including women to meet objectives relating to improved sustainability and livelihoods.	Two months	A prototype solution ready for pilot testing
Completing the pilot	initialize pilot project design to support first	Two months	Completing the first phase of testing at a

(alpha) phase testing	end-to-end testing of the platform to ensure that it meets the requirement specifications and functions correctly. It will involve engaging a small more limited number of livestock farmers, traders, slaughterhouses, fresh market sellers, butchers and large retailers including women. The pilot (alpha) phase testing will then conduct with these groups at certain locations (i.e., prior to field testing).	overall including 5-15 days for on the ground deployment of each of 3 options	small number of locations (i.e., prior to field testing) with: - 1 or 2 livestock farmers - 1 or 2 slaughterhouses - 1-2 fresh market sellers or butchers/restaurants and 1 large retailer
Evaluation of pilot results	Evaluation of pilot results through feedback from livestock farmers, traders, slaughterhouses, fresh market sellers, butchers and large retailers wage including women to ensure the product really works and does everything it's supposed to do and to identify bugs and potential enhancements before deploying the traceability platform more broadly.	One month	Evaluation of pilot results and finalization of project requirement specification document based on which the final traceability tool will be prepared.
Further specification and solution refinements	Any changes based on feedback from livestock farmers, traders, slaughterhouses, fresh market sellers, butchers and large retailers wage including women will be	Two months	Updated specification document and further customization of the traceability tool to ensure that it ultimately meets project objectives of

	incorporated to address any bugs and potential enhancements.		improving sustainability of livestock products and improved livelihoods for livestock farmers including women.
Field (beta) testing	Field (beta) testing representing the final round of testing before a traceability platform is fully deployed. A larger group of livestock farmers, traders, slaughterhouses, fresh market sellers, butchers and large retailers including women will be given a nearly finished product to evaluate the traceability platform's performance in the field reflecting the environment in which it is to be ultimately used. The actual field (beta) testing will be relevant to the ultimate goals of improving sustainability of livestock production and improved livelihoods for livestock producers in the Amazon Region of Ecuador. There are a few requirements that the traceability platform will need to comply with in order to be ready for beta testing: •The traceability platform should have all	Three months	Deployment of the tool to 50-100 livestock farmers including women as well as 3 - 5 slaughterhouses and 3-5 fresh market sellers or small butchers/restaurants in addition to working with 1-2 stores for large retail chains. Training on using the tool will be provided to these target groups with several dedicated sessions for women. A user manual would be developed and provided to users to support these training sessions and ultimate support full deployment. Any errors or bugs would be fixed following field testing and before full deployment.

	the features that are planned for the release version. •The platform should be stable (participants should not face unpredictable crashes). •Participants will be representative of the target stakeholders including livestock farmers including women as well as slaughterhouses, small butchers/ restaurants and large retailing chains. collection centres and factories for whom the intervention is intended. •Participants will complete real-world scenarios while interacting with the traceability platform, and they will do it in the real environment in which they work and operate (not in central or a lab-like environments).		
Full deployment	The release of the final version of the traceability platform will be rolled out to and installed across all the devices to the targeted groups who will work with it along with additional training as needed. This will include permission sets	Ongoing	The release of the final version of the traceability platform with ongoing monitoring to ensure that it ultimately meets project objectives of improving sustainability of livestock production

	configuration, that ensures different, strictly limited access rights for the target groups securing them, the whole software and the information it's based on. This will also involve real-time monitoring, updates, maintenance.		and improved livelihoods for livestock farmers in the Amazon Region of Ecuador.

Technology components to run a pilot

The technology components of the solution are reflected in Figure 11 below and comprise:
- Mobile application (GPS enabled) with a digital wallet.
- NFC / smartcards for identity (where required for offline situations).
- Cattle RFID tags.
- QR / barcode labels for sides of beef and product packaging.
- Blockchain backend as an events and identity registry.
- Public web interface for promotion and presentation of the traceability and certification data to consumers and stakeholders.
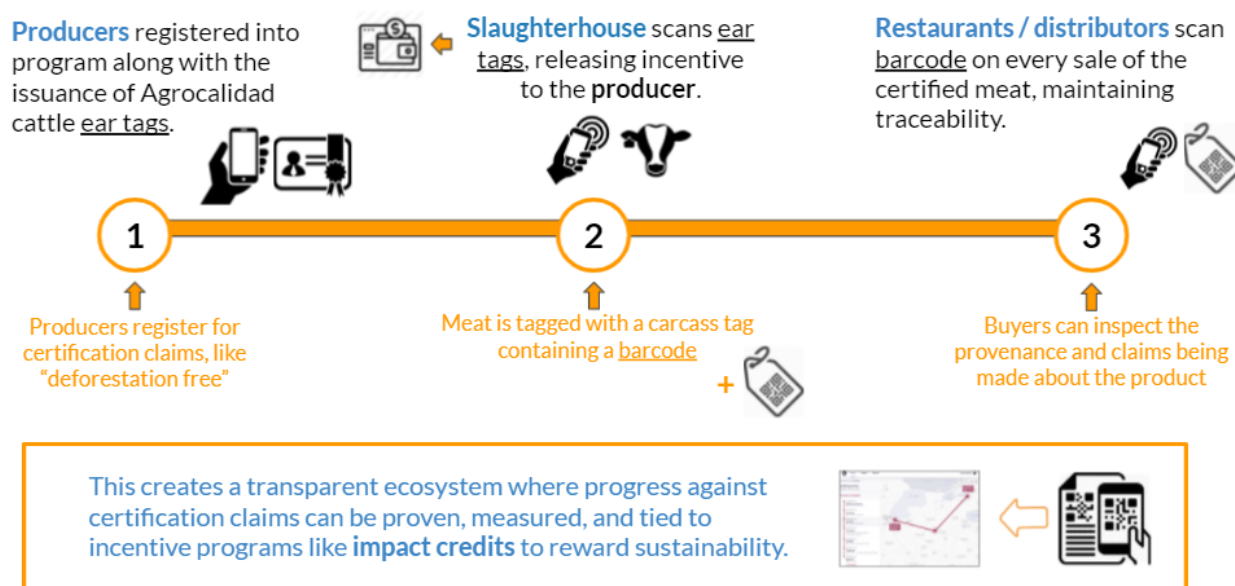

Producers registered into program along with the issuance of Agrocalidad cattle ear tags.

Slaughterhouse scans ear tags, releasing incentive to the **producer**.

Restaurants / distributors scan barcode on every sale of the certified meat, maintaining traceability.

1

2

3

Producers register for certification claims, like "deforestation free"

Meat is tagged with a carcass tag containing a barcode +

Buyers can inspect the provenance and claims being made about the product

This creates a transparent ecosystem where progress against certification claims can be proven, measured, and tied to incentive programs like **impact credits** to reward sustainability.

Figure 11: Technology Components Integrated into Solution

Additional provisions would be put in place for digital wallets for producers who don't have direct access to smartphones or good connectivity so that they would also be able to participate in the program through

agricultural extension officers.

Funding for Pilot

Pilot costs depend on the scope and scale of the partners involved in an initial trial which is being explored. A preliminary estimate that a meaningful set of pilots could be executed for between US$75,000-150,000 to gauge the initial viability of the technology and its potential for impact in the field. The pilot would initially target suitable production regions in the Amazon. Execution of the pilots as per the example provided in Table 4 above would inform final design and allow more accurate estimates of full scale-up costs for the platform. Costs could be minimized by tapping into the resources of existing field programs (e.g., certifications bodies, Agrocalidad and government efforts, ProAmazonia projects, etc.). The aim is to design an affordable solution for farmers by deriving operating funds from climate financing and government programs to get the program started and driving value back to the farmer.

The longer-term goal is to deliver the solution using a Software-as-a-Service model, at no cost to small holders, incorporating funding sources from other pools of funding such as carbon offsetting/insetting or impact incentives in the Textile (Leather) Sector and other international funding sources. The aim is to have industry fund operating costs of the technology by tapping into impact credit programs for sustainable commodities and certification programs. By building a platform that derives value from the claims being made, which industry and consumers value, our belief is that this solution could become financially sustainable using a model that does not impose costs on smallholders and has only a small cost per certification and then runs in a Software-as-a-Service model for retailers ("brands") who are interested in making provable product origin claims. This envisions an introduction in domestic markets with the potential for expansion into exports over time. Overall pricing of the solution can be determined based on market testing of the final feature set and estimated transaction volumes.

VI. Summary and Key Considerations for Digital Traceability of Forest-risk Commodities

This knowledge product covers the design of a traceability solution for the remaining steps of the value chain from slaughterhouse up to the final consumer as part of a second phase while integrating that with PROAmazonia's work already underway on a first phase on traceability from the ranchers up to the slaughterhouse. The design integrates traceability, certification and incentives across the livestock sector through a digital system to motivate farmers to adopt more sustainable practices. The design process was aligned with the intent of PROAmazonia to ensure full transparency and traceability across the entire supply chain while linking price benefits and incentives back to cattle ranchers.

This knowledge product discusses the importance of stakeholder engagement and design thinking processes that our team used in the design process. It noted the importance of taking a discovery-first approach, user-centered technology design and design thinking to create an effective solution that is easy to use and tailored to work in these kinds of remote environments. It described the preliminary design for the prototype along with the key technology components.

The knowledge product also highlighted key considerations for developing a detailed pilot implementation plan to test the solution under field conditions and provide for future improvements necessary to scale the solution to full implementation. While the intent was to develop a traceability system that was ultimately based on a product segregation model where certified livestock products are physically separated from non-certified livestock products at each step in the supply chain (i.e. to support quality, prices and branding in addition to sustainability), a number of reasons including the length and complexity of the supply chain as well as ensuring pricing and incentives reach the upstream farmers suggest adopting some elements of a model like RSPO's book and claim or the textile Exchange's Impact Credits system at least in the short-term to increase the supply of sustainably produced livestock while a full-traceability system is put in place from "farm to fork" in stages.

Implementation in a phased approach reflects the need to improve certain aspects of the Ecuadorian value chain for livestock products to "grow into" the opportunities created by a traceability solution. For example, a long-term goal of creating a consumer willingness to pay a premium for products with specific quality and sustainability attributes will take time. On the other hand, an area that we incorporated into the solution is a digital wallet to incorporate incentives such as carbon offsets/insets or impact credits under a book and claim model which may be able to yield improved revenues to sustainable producers in the medium term.

The solution can be scaled broadly across the livestock sector which is the largest user of land resources and accounts for one-third of global agricultural gross production value. Around 1.3 billion people depend on livestock for their livelihoods, among which are 600 million poor farmers. At the global level, livestock accounts for an estimated 14.5 percent of greenhouse gas emissions, including all direct and indirect emissions along the production chain such as land-use change, feed production and transport.

Traceability is a growing requirement for many other forest-risk commodities including leather, palm oil, cocoa,

coffee, soy, natural rubber, argan oil etc. Since 2001, over 70 million hectares of commodity-driven deforestation has increased CO2e emissions from tropical tree cover loss (2.4 Gt/yr. to 4.2 Gt/yr.). Low incomes for small farmers limit their incentive and ability to adopt sustainable practices. The design for a traceability solution provides incentives directly to small farmers to follow sustainable practices by linking them to downstream companies making product claims. It would also support national efforts such as in Ecuador to contribute to their National Determined Contributions (NDCs) under the Paris Agreement. It also allows countries like Ecuador to create a brand for their products and improve access to higher value export markets such as the EU that is considering regulations for forest risk commodities.

The solution, while designed for livestock products in Ecuador, was designed to be configurable and thus transferable to other geographies and commodities using a Software-as-a-Service model. Depending on the commodity and context, all three approaches including 1. Product Segregation; 2. Mass Balance; 3. Book and Claim can be used and supported by this software solution. Traceability is rapidly becoming a key requirement for any commodity management solution that addresses the supply chain for these commodities and this is an area where blockchain technology is seen as providing a possible solution in the future that can address all three methods.

The design was also developed with the intent of incorporating incentives such as related to carbon offsetting or insetting, book and claim or impact incentives in the Textile (Leather) Sector and depending on the product claims for downstream users. In this regard, Convergence began to identify other countries, commodities (e.g., leather) and international funding sources and would propose working with the UNDP Global Centre for Technology, Innovation, and Sustainable Development to identify other countries and funding to be able to pilot a similar prototype.

VII. Appendix

Stakeholder Meetings

2020 stakeholder meetings included:

- Menagerie/ Undersecretary + technical meetings
- MINENV/ REDD+
- PROAmazonia--Proposal for Forest Monitoring System (QFIELD-Geographer, Global Forest Watch)
- Charolais Association
- Agrocalidad
- Slaughterhouses:
- Empresa Publica Metropolitana de Rastro Quito; Chillogallo, Quito, Pichincha
- Empresa Publica Municipal de Faenamiento Industrialización y Comercialización de Ganado, Productos y Subproductos o Derivados del Gobierno Autonomo del Canton Sucua; Huambi, Canton Sucua, Morona-Santiago
- Arosemana Tola Livestock Association
- Casa Gangotena
- ARCSA
- National Association of Tanners of Ecuador
- Potential Additional Interviews
- Retail (Large Supermarket / Small Supermarket Carnicerias)
- Corporacion Favorita (Agropesa/ SuperMaxi)
- Foodservice sector
- Consumer organizationsDesign Artifact