1. Context

1.1. Introduction

Agricultural innovation can contribute to the transformation of agri-food systems necessary to achieving the Sustainable Development Goals (SDGs). Though innovation is an enabler of most - if not all - of the SDGs, its role is particularly significant when it comes to ending poverty (SDG1), ending hunger, achieving food and nutrition security and promoting sustainable agriculture (SDG2) and reducing inequality (SDG10). The challenges confronted due to the COVID-19 pandemic also highlight the need for increased investments in innovation solutions to address the food system challenges. The way we produce, commercialize and consume food should be innovative in terms of bringing new products, processes, and forms of organization into use, in order to increase effectiveness, competitiveness and resilience, and address the challenges faced by agri-food systems.

Innovation and technology have been crucial factors in balancing the supply and demand for food throughout the 20th century. Milestones such as the high yielding varieties and, more recently, the use of biotechnology, and improvements in pastures and advances in livestock genetics and health, are examples of the transformative potential of innovation and the social and economic benefits associated with these processes.

Latin American and the Caribbean (LAC) has clearly benefited from these past trends: the region accounts for 13% of the global production value of agricultural and fish commodities and 17% of the net export value of such products.}

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1 Innovation is the process whereby individuals or organizations bring new or existing products, processes or ways of organization into use for the first time in a specific context in order to increase effectiveness, competitiveness, resilience to shocks or environmental sustainability and thereby contribute to food security and nutrition, economic development or sustainable natural resource management. (FAO, 2018: http://www.fao.org/3/CA2460EN/ca2460en.pdf)

With the population of Latin America and the Caribbean projected to grow from around 625 million in 2010 to around 750 million by 2030, demand for food, particularly animal-based food, is expected rise significantly. Rising food demand within the region will be accompanied by rising food demand in export markets\(^3\). Meeting this demand in a sustainable way is a huge challenge even for a region with a large resource endowment. This increase in production must happen in the context of a changing climate and current agricultural practices that put an unsustainable pressure on land and other natural resources, such as fresh water.

At the same time, hunger, persistent malnutrition\(^4\), poverty, climate change, environmental degradation continue to pose challenges to the region. The increasing demand for food, and the significant social, economic, and environmental challenges requires a paradigm shift in the way food is produced. Agrifood systems in LAC will need to become more productive, cost efficient, transparent, sustainable and resilient to external shocks, such as those driven by climate change and the ongoing COVID-19 pandemic.

COVID-19 has exacerbated the need to improve the way current agrifood systems operate to become more agile and resilient in the face of unforeseen events. The Covid-19 pandemic is having a profound impact on socio-economic conditions, accentuating the already complex scenario faced by a region with significant structural weaknesses. According to estimates, extreme poverty is likely to increase by 4.5 percentage points (28.5 million more people), affecting 96.2 million people\(^5\).

Livestock food systems in the region can to contribute to multiple objectives that go far beyond the production of food. Among these multiple objectives, four stand out: (1) **economic growth**, (2) **job creation, and poverty reduction**, (3) **ensure access to safe and nutritious food for all**, and (4) **build resilience and ecosystem sustainability, including climate change mitigation**.

Making a positive and lasting impact on food security and poverty requires the capacity both to implement on a large scale tried and tested practices and to respond to new challenges and opportunities as they emerge. In other words, it requires the ability to innovate. Innovative solutions have the potential to not only transform current food systems by making them more productive, transparent and agile; they also have the potential to transform rural communities by improving producer livelihoods and strengthening resilience to external shocks. These practices, technologies or tools also benefit the environment by giving users the ability to optimize the use of natural resources, implement sustainable practices, reduce waste and adapt to climate change.

### 1.2 Transforming regional challenges into innovation-led opportunities

The livestock sector is continuously seeking ways to meet the basic needs of people, through ensuring food and nutrition security, poverty reduction, and economic development. At the same time, it must do its part to address climate change. The sector in Latin America suffers from systemic issues including productivity gaps and informality, inequality, financial inclusion and limited capacity to absorb shocks.

Innovative approaches and digital transformation can play a major role to turn these challenges into new development opportunities and address longer-term development challenges.

- **Innovation as an enabler for improved and equitable livelihoods**

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\(^3\) By 2050, the world’s population is projected to increase by more than two billion. A growing population, combined with shifting consumption patterns driven by urbanization and a growing middle class, imply that global food production will need to be 50 per cent higher in 2050 than in 2012 to meet demand.

\(^4\) There has been a rise in hunger, with the number of undernourished people increasing. Food insecurity in LAC went from 22.9\% in 2014 to 31.7\% in 2019, due to a sharp increase in South America, and over 100 million people cannot afford a healthy diet. Likewise, almost a third of the region’s inhabitants – 205 million people – live in conditions of moderate food insecurity\(^5\).

\(^5\) Obesity has become the greatest nutritional threat in Latin America and the Caribbean. Nearly one in four adults is obese. Overweight affects 7.3\% (3.9 million) of children under 5 years of age, a figure that exceeds the world average of 5.6\%. (FAO (2018). *Latin America and the Caribbean Regional Overview of Food Security and Nutrition*, 2018)

Agriculture is an important source of employment in Latin America and the Caribbean, particularly in rural areas where 54.6 per cent of the labor force is engaged in agricultural production. Family farming plays an important role in reducing rural poverty, addressing food insecurity and malnutrition. In the region, the family farming sector is comprised of approximately 60 million people, occupying 81% of agricultural land and generating between 57% and 77% of agricultural employment. Family farming also plays a critical role in food supplies, providing between 27% and 67% of food at the national level. Therefore ensuring that smallholder farming pays and offers a life beyond subsistence is essential, not only to future food security, but also to lifting millions of people out of poverty.

This large number of smallholder producers that are often faced with barriers to market participation, lack access to resources, limited access to technologies and knowledge and do not have the capacity to absorb shocks. This implies a challenge, but also an opportunity for innovation and digital interventions to have a positive impact on rural economies and farmer incomes. Innovation and digital solutions can have a transformative effect, especially improving smallholder livelihoods through: aggregation to achieve economies of scale; enhancing awareness of improved farming practices; improving availability and affordability of quality inputs; and improving access to credit and markets.

Innovations are likely to impact agricultural labor markets in diverse ways. Besides the efficiency improvements or new production systems or supply chains they generate, more mechanized and automated production processes will likely replace many low quality, unskilled jobs in primary production.

However, at the same time, with the correct complementary actions and policies in place, the spread of technologies can foster the creation of higher-quality jobs in the food system. These policies must play a strong role in matching market needs and in ensuring a smooth transition to jobs that are more productive.

- **Innovation as a pillar for youth and gender inclusion**

The region of Latin America and the Caribbean (LAC) is home to around 658 million people, of whom around 18 per cent live in rural areas. Women make up approximately half the rural population, of which indigenous women comprise 20 per cent. Approximately 107 million people in the region, equivalent to 17 per cent of the total population, are young people, of whom 20 per cent (21 million) live in rural areas. It is evident that inclusive and sustainable rural transformation consistent with Agenda 2030 cannot happen without supporting small farmers, rural women, men and youth, including indigenous peoples, as change agents.

Women lag behind men in access to resources and growth opportunities, which affects their well-being and that of their families, especially in terms of food security. First, women do not participate in the labor force in the same numbers as men. Data from the region also shows that the proportion of women in employment has stagnated across the region, with only half of women participating in the labor force compared to 74.4 per cent of men. Second, women are disproportionately represented in lower-productivity sectors such as agriculture and insufficiently represented in higher productivity sectors. According to ECLAC, 77.6 per cent of women were employed in low productivity sectors (agriculture, commerce and services) against 55.4 per cent of men. Women in agriculture, work within inherently inequitable systems in terms of decision-making power, access to training, land, farm inputs, credit, and other productive assets. Women in the region remain an under-utilized asset and applying a gender lens to innovative solutions represents a significant opportunity for enhancing gender equality. For example, applying a gender lens more systematically throughout the investment process can improve the ability to identify risks of adverse impacts on women as well as opportunities for increasing positive

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8 FAO (2018). Panorama of Rural Poverty in Latin America and the Caribbean.
gender outcomes, and this potential exists for gender innovations as well as innovations that are not primarily striving for gender equality.

There are approximately 156 million young people between the ages of 15 and 29 in Latin America and the Caribbean, representing over one-fourth of the region’s total population. It is estimated that 30.3% of youth 15-29 in Latin America and the Caribbean live in poverty and almost 1 in 5 young people neither works nor studies, and a significant proportion of this group consists of young women.

Demographic trends, including aging populations and continued migration of people from rural to urban areas, are likely to become a major driver for labor scarcity in agriculture. Youthful populations offer an opportunity for many countries as the entrepreneurial and innovative energy of young people can help revitalize and enhance rural economies. This is particularly true in the agricultural sector, where new technologies and innovative farming practices have the potential to enhance the sector’s productivity. However, young people do not gravitate to farming. The use of emerging technologies to promote agri-enterprise incubation and facilitate agribusiness start-ups will likely make agriculture in general more appealing to younger generations, boosting youth employment. These technological innovations must however be complemented with social and institutional innovations targeting the underserved groups.

- **Opportunity for financial inclusion**

Livestock producers, particularly smallholders in Latin America face significant gaps in accessing financing, both for agricultural and non-agricultural financial needs. The region’s traditional financial institutions have historically regarded smallholder farmers as too risky which presents a number of highly constraining features including: (i) *high transaction costs* for engaging with a geographically dispersed market with limited absorptive capacity in remote, rural areas with weak infrastructure, (ii) *absence of collateral* due mostly to land tenure restrictions, and (iii) *systemic and correlated risks* linked to agriculture such as production risks, price volatility as well as environmental and weather shocks that can render a producer’s income irregular and repayment uncertain. The high vulnerability of smallholder producers to climate variability increases the riskiness associated with agricultural financing, often discouraging financial institutions from offering viable services despite widespread demand from smallholders.

The financing gap faced by smallholder livestock producers in Latin America and the Caribbean is an opportunity for innovations and digital interventions to have a positive impact on rural economies and farmer incomes. The increased availability of information on markets, climate and agronomic recommendations, as well as tailored financial technologies and mechanisms, the expansion of multiple marketing platforms for supplies and products, has the potential to empower small and medium-sized rural producers.

- **Opportunity to close the productivity gap and promote diversification**

Latin America and the Caribbean produces 13% of the global food production. The region is also the main net exporter of agricultural and food products, thus making the region a stronghold global food security. Currently, the region accounts for 42 and 42 percent of the global beef and poultry exports, respectively. In the many LAC countries that are net exporters of livestock products (Brazil, Argentina, Uruguay, Paraguay, and Mexico); the sector assumes additional importance through its role as a source of foreign exchange.

Notwithstanding that in the past, scientific and technological advancements have made it possible to increase food production, the uptake of these technologies have been uneven with many small-scale farmers being excluded from productivity-enhancing benefits. Important innovations from existing agrifood systems research are not adequately applied. As a result, productivity is still stubbornly low in large parts of the region and there is still a large yield gap between actual and potential productivity in many livestock systems. In addition, the sector also has a poorly diversified productive structure, resulting in low value-added.

The livestock sector can take advantage of existing and emerging disruptive technologies to increase productivity of their enterprises and increase their competitiveness. In addition to helping increase the quantity of food, emerging technologies can also enable improvements in the quality of food and
resource management. Technology such as biotechnology can also play a vital role in diversifying natural resource-based economies. Digital platforms, e-commerce can expand markets and improve efficiency. Improving transport infrastructure and logistics should also promote further competitiveness.

2. Current innovation landscape in support of sustainable, resilient and low emissions livestock supply

In recent years, Latin America and the Caribbean has witnessed an increase in innovation throughout the agriculture and food sector, an ongoing phenomenon that continues to expand in the region and across different productive sectors. A development worth mentioning is the emergence of entrepreneurs, developing technologies and start-ups in several countries. A 2019 assessment by IDB showed that there are more than 450 start-ups in the LAC region focused on technological innovation. The growth in the different countries is considered proof of the expansion of Agtech innovation in the region. However, significant concentration is seen in Brazil, accounting for 51% of all the start-ups surveyed. Argentina ranks second in importance, with 23% of the regional total. Chile, Colombia, Uruguay, Peru and Mexico follow in order of importance.

In the past, much of the thrust and focus of efforts to mobilize innovation have focused on economic objectives. Innovation developments have occurred in the context of evolution of local and global challenges facing the food system, including the increasing need to produce more food. Today, however, innovation asserts itself as a process with a plurality of goals, responding to the need to address social and environmental challenges that confront the region.

Livestock production in Latin America has already and continues to benefit from a wide range of existing innovations. Advances in animal nutrition and health, improved genetics and artificial breeding techniques, plant breeding, use of fertilizers and crop protection chemicals, mechanization and the recent addition of biotechnology are some examples. Several practices and technologies show great promise for increasing productivity while reducing the environmental impacts of livestock production and enable livestock producers to adapt to climate change. One such approach is the “silvopastoral” system, which combines trees (“silvo”) and managed pasture (“pastoral”) in order to improve animal and grassland productivity and contribute to carbon capture and biodiversity recovery. Another approach that shows similar promise in the region is the Climate-Smart Livestock (CSL) approach that promotes the implementation of low-carbon production technologies and practices. During COVID-19 pandemic, in countries where CSL and Agroecology approaches are implemented, there have been demonstrated benefits of these approaches in supporting communities in adapting to the challenges posed during the global health crisis. In Colombia, Mexico, and in the Dry corridor of Central America, initiatives implementing adapted silvopastoral systems are present while in Ecuador, Uruguay and Republica Dominicana, FAO supports the piloting of climate smart livestock approaches. Additional innovations identified in the region include innovations for repurposing nutrients (Costa Rica), innovations in feeding (Costa Rica), innovative practices to optimize production of pasture and water use (Mexico).

[Case study 1 - Colombia and Mexico, Intensive silvopastoral systems] [Case study 2 - Guatemala, El Salvador, Nicaragua, Costa Rica and Panama, Multi-layer agroforestry systems adapted to the Central American Dry Corridor for food security, resilience and sustainability] [Case study 3- Costa Rica, Waste

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12 This section presents case studies documented in an accompanying publication “Innovaciones en el sector ganadero Compendio de experiencias en América Latina y el Caribe”. Please refer to the document for more information on the cases presented.
13 According to FAO (2018) agricultural innovation is the process whereby individuals or organizations bring new or existing products, processes or ways of organization into use for the first time in a specific context in order to increase effectiveness, competitiveness, resilience to shocks or environmental sustainability and thereby contribute to food security and nutrition, economic development or sustainable natural resource management.
14 Inter-American Development Bank (2019). Agtech Innovation Map in Latin America and the Caribbean
16 Emerging responses to the COVID-19 crisis from family farming and the agroecology movement in Latin America – A rediscovery of food, farmers and collective action
management: Incorporating the bioeconomy at the farm level] [Case study 4- Ecuador, Uruguay and Republica Dominicana, Climate-Smart Livestock Approach] [Case study 5- Chile, Costa Rica, Argentina and Bolivia, Integrated strategies for adapting to climate change] [Case study 6- Costa Rica, Local alternatives to animal feeding as a strategy to address nutrient constraints and climate change in livestock production systems] [Case study 7- Mexico, Introducción del método Keyline en fincas ganaderas]

New technologies are also transforming how innovations are conceptualized, designed and commercialized and, more generally, how businesses operate. Scientific revolutions are happening in various fields of knowledge, from biology with genomics, from physics and chemistry with nanotechnology, from information technology and communication, with numerous innovations that increase our ability to respond to risks and challenges. Technology is also becoming increasingly connected and merging with other disciplines e.g. engineering and biology. Biology and biotechnology offer potential to improve the efficiency of food production from livestock; to reduce environmental impact; to reduce the impact of disease; improve animal welfare; to enhance product quality and nutritional value, and to safeguard human health. In Colombia, Sciphage, a spin-off of the Universidad de los Andes dedicated to the development of organic bio-products to address the global crisis of antimicrobial resistance (AMR), which affects the livestock sector industry, the environment and human health. It has applied biotechnology to develop SalmoFREE, a feed additive that enhances the health of animals and reduces the use of antibiotics.

With escalating demand from consumers for higher food safety standards, better animal welfare and improved sustainability across the livestock supply chains, new disruptive innovations are emerging to enable farmers to monitor the health of their herds in real-time, prevent disease outbreaks, and optimize nutrition. Innovative ways to protect, treat and tend to the animals means the field of animal health is now evolving to parallel advances in human care. For example, the One Health Initiative advocates for collaboration between medical disciplines to link human and animal medicines. [Case study 8- Colombia, Biotech innovations in the poultry sector for human and animal health]

Innovations in the fields of information technology and communications, remote sensing, advanced instrumentation, automation and robotics indicate that precision agriculture is emerging as common practice in agriculture. These tools and processes will allow smarter use of natural resource base, ensuring more productivity, efficiency and sustainability in production systems. The mobile ecosystem in Latin America and the Caribbean is conducive to the development of digital services. The region has a unique mobile subscriber base, more than 416 million, of which 78 percent (326 million) have access to the mobile Internet. It is projected that by 2025, 90 percent of mobile subscribers will be mobile Internet users.17

Digital technologies allow increasing numbers of food system actors to shift toward highly optimized, individualized, real-time, hyper-connected and data-driven practices, made possible by the use of highly interconnected and data-intensive computational technologies. At the farm level, precision agriculture techniques are being used to improve management of crop and livestock systems, while agricultural robots and auto-steering equipment accelerate operations while reducing labor requirements. At the distribution stage, e-commerce and digital marketplaces provide virtual spaces in which to match sellers and buyers, lowering marketing costs and facilitating trade in agriculture inputs and outputs. Distributed ledger technologies (DLT) such as blockchain show potential to improve the transparency, transactions and the inclusiveness of agri-food value chains. And financial digital technologies (FinTech) 18 hold significant promise for modernizing and reinforcing rural finance.

Increasingly digital technologies are combined with approaches such as climate smart livestock approach-CSL and agroecology with the aim of promoting best practices. Examples of such initiatives are piloted in Ecuador, Honduras, Costa Rica, Republica Dominicana, Uruguay and Argentina for smallholder dairy systems.

18 FinTech refers to the use of digital technology to create and deliver financial services, typically with the help of mobile phones or internet-enabled devices
In Latin America and the Caribbean, digital solutions, from mobile-based agri advisory to digital financial services and agri e-commerce platforms, have the potential to transform current food systems by making them more productive, cost efficient and transparent. They also have the power to transform rural communities by increasing yields, closing knowledge gaps, improving access to new markets and opening access to assets that would otherwise be out of reach, enabling access to credit and finance and strengthening resilience to climate change. The following examples demonstrate how digital technologies can be applied to improve the efficiency and functioning of agrifood systems:

a) Big Data and precision agriculture. Producers and agricultural companies are increasingly using "smart farming" solutions to enhance efficiency, productivity and decision-making. Such technologies not only aid the monitoring and management of production, but also generate large volumes of data that can be gathered, analyzed, and interpreted to inform critical farming decisions and achieve system optimization. Technologies of precision livestock farming (PLF) have the potential to contribute to the wider goal of meeting the increasing demand for food whilst ensuring the sustainability of production, based on a more precise and resource efficient approach to production management – in essence ‘producing more with less’. In the livestock sector, sensors or smart ear tags and collars allow improved monitoring of diets, diseases, and fertility, while 3D cameras can be used to monitor livestock movements and track animal weight or combining drones and satellite imagery to monitor pasture resources. In Peru, Alium a start-up seeks to improve the efficiency of poultry operations through the information collected by installed sensors on poultry farms using the concept of Internet of things (IoT). To address the challenges associated with on-farm labor and consequent low productivity on dairy farms, Embrapa in Brazil, is researching into the integration of robotic milking in silvopastoral systems. Although still in its initial phase, in Uruguay, Costa Rica and Argentina, precision technology (use of drones and satellite imagery) are being piloted to monitor pastures and support producers in taking decisions on pasture management.

b) Management software and information and education services for producers. These management systems allow livestock producers to organize operational and stock information, by prioritizing and scheduling tasks, as well as sorting out the information to keep records of activities and results. By analyzing and correlating information about weather, soil quality, probability of diseases, historical data, marketplace trends, and prices, farmers will make decisions that are more informed. Data-driven advisory based on tailored information to support decision-making, maximize productivity and reduce costs. Technologies such as sensors, satellites and drones, as well as big data analytics, underpin many of these services. Information-based services provide producers with agronomic and livestock advice and best practices, information on market prices, weather and climate information as well as financial and digital literacy training. Costa Rica’s digital platform for livestock aims to create an automated information management system that integrates climatic, geographical and soil variables and best practices to improve access to information that can support improved decision-making. As in other parts of the world, digital advisory services in Latin America increasing in sophistication and are facilitating the bundling of services. In Colombia, tools like Control Ganadero offer integrated and holistic solutions to address the different needs of livestock producers, from keeping detailed records of cattle to monitoring weather events, linking livestock farmers to veterinarians, livestock buyers and sellers, and providing farmers with insurance to transport livestock. In Brazil and Colombia, Bovcontrol digitizes livestock supply

19 Smart farming refers to the use of sensors, drones, satellites and other farm assets to generate and transmit data about a specific crop, animal or practice to support agricultural activities and make informed decisions.
chains, transforming data into information and offers benefits for the entire livestock production chain, connecting farmers, field agents, the processing industry and the final consumer.

Case study 14: Costa Rica, Plataforma digital pecuaria  
Case study 15: Control Ganadero, Colombia Holistic and integrated digital advisory services for livestock producers in Colombia  
Case study 16: Brazil and Colombia, Digitalization of milk supply chains

c) Innovative platforms for buying and selling. Access to markets in fair conditions is one of the main ways to reach smaller or vulnerable producers. Online “marketplaces” are a convenient platform to gain visibility in terms of input, availability and prices, as well as to improve the marketing conditions, even for small producers. The region is seeing a proliferation of e-commerce platforms for products, inputs, machinery, and services for the entire agricultural supply chain. These services can help smallholder farmers overcome the knowledge gaps that limit productivity. The most common tools are agricultural value-added services that provide information on market prices but also weather and agricultural best practices through voice, SMS, WhatsApp or an app interface. The Substapp digital application launched in Ecuador allows livestock producers to engage in direct marketing of their animals. The App eliminates the need for intermediaries and logistical costs associated with marketing of livestock. Applications such as Substapp emerge as an alternative to facilitate the commercialization of livestock in the face of mobility restrictions associated with the health emergency due to COVID-19. In Brazil, a web-based platform brings together actors who do not necessarily know each other, but who pool their resources to slaughter animals at an earlier age, while allowing the recovery of pastures. The platform also offers participation of other actors, such as input providers and transporters.

Case study 17: Substapp, Ecuador, Platform linking cattle producers and buyers  
Case study 18: Brazil, Digital platform to share resources in livestock supply chains

d) Innovative food products and services. There is a growing number of platforms that seek to integrate farm-to-consumer marketing and reduce intermediation costs, establishing a more efficient supply chain, for the benefit of small-scale producers and consumers. For example, agri e-commerce reduce transaction costs and can contribute to more advantageous producer prices and increased market access that better reflect product quality. Online e-commerce could provide platforms to significantly influence consumption patterns and increase access to nutritious foods. These platforms usually work with local cooperatives, which act as production aggregators for a group of producers in a given area. In addition, the farm-to-fork movement is growing strong. People want to know where their food comes from, and as industrial agriculture, hormones, and carbon emissions become increasingly concerning, it becomes more important to know the life cycle of food. In Colombia, La Canasta has introduced a web-based platform to support marketing of dairy and egg products from smallholder. It connects small producers and consumers through a virtual platform, facilitating access to agro-ecological food in the city, generating minimal food and packaging waste, and seeking alternatives for the value chain to have a low carbon footprint.

Case study 19: La Canasta, Colombia, Improving market access through short marketing chains

e) Traceability along the supply chain. Consumer demand for food safety and sustainability is driving digital procurement tools to incorporate traceability. Data-sharing platforms and blockchain, can significantly improve the logistics of the value chains and better traceability, while digital technologies, like internet of things (IoT), artificial intelligence (AI), machine learning (ML) and distributed ledger technology (DLT), drive more efficient, productive and traceable supply chains. These technologies can improve methods for farm-to-fork traceability by strengthening animal health, disease control and prevention, better managing food safety and fraud risks, ensuring compliance with animal production and food standards, simplifying procedures, facilitating trade, certification of exports and raising consumer awareness. Uruguay has betted on the adoption of a mandatory national traceability system for cattle “the National System of Livestock Information (SNIG)” whose main objective is to ensure the traceability of cattle, both individually and by groups of animals, from the origin of the animal to slaughter. In Brazil and Paraguay, a private sector-led Geospatial monitoring platform called SMGeo is used to evaluate and monitor the environmental, social and labor compliance of livestock suppliers to Minerva and Athena Foods.
The objective is to ensure that the meat produced and marketed by the private company complies with the Sustainability protocols, such as the standards of the International Finance Corporation, in order to address climate change and protect ecosystems. Nicaragua is piloting the Sistema Segregado de Producción Bovina (SSPB) that promotes the implementation of good practices and technologies for bovine production related to animal welfare, traceability, biosecurity, food and animal health, in order to comply with 43 parameters established in the respective standards. This system will support the certification of livestock products and offers producers access to higher value markets.  

[Case study 20: Uruguay – Public-private sector driven investment in a technology-based traceability system for cattle and beef] [Case study 21: Brazil and Paraguay – Geospatial monitoring platform for beef supply chains] [Case study 22: Nicaragua – Sistema Segregado de Producción Bovina (SSPB)]

f) Digital financial technologies/services (FinTech). While a rapidly evolving technological landscape is opening up new possibilities to expand productivity, many obstacles faced by livestock producers are not technological, so it is important to look for strategic places where policy and investment can help to improve outcomes for the sector. Without greater and strategic investment, the sector will not be able to succeed in its critical role and will continue to underperform. The finance sector has a key role to play in allowing the sector to contribute to economic growth and poverty reduction. FinTech building upon the rapid growth of digital and mobile telephone infrastructure has the potential to disrupt food systems in LAC by removing many barriers traditionally faced by smallholder producers in rural areas in accessing financial products and services. In the CSL project of Ecuador, web-based tools for monitoring of on-farm impacts have been instrumental in catalyzing access to credit at convenient interest rates for smallholder dairy producers. On the other hand, the Grenada Goat Dairy Project, a non-profit organization dedicated to sustainable agricultural production, was launched using a virtual platform to source crowd-funding.  

[Case study 23: Ecuador – Línea de crédito verde para una ganadería climáticamente inteligente]  
[Case study 24: Grenada – Kick starting the Goat Dairy Project]

The transformation of the food system will not be purely technological. At the heart of this process is a form of innovation involving deep changes in the various parts of the food system (technologies, infrastructure, and skills and capability) and a fundamental reformatting of regulations, policies, markets and governance surrounding it. This view of transformation as a complex and systemic process implies that food system transformations must be accompanied by a wide range of social and institutional factors that enable their deployment.

Institutional Innovation. Institutional innovations are equally as important as technologies in dealing with the complex challenges facing agriculture in general and rural development. Institutional innovations may include new ways of organizing production, input management, marketing, or sharing common resources. It may include the development of a new supply chains, new partnerships or networks e.g. public-private partnerships, inclusive, competitive and sustainable associative models, or a new way of providing extension support. A few examples follow:

a) Innovations in marketing. An example are smallholder producers’ organizations, as aggregators, bringing smallholders together to draw upon their collective capacity and allowing them to take advantage of economies of scale and larger value chain systems that would otherwise be unavailable to a single farmer. Producers’ organizations can empower smallholders by: reducing the costs associated with production, providing access to higher quality inputs, equipping them with capital funding, and providing access to information, marketplaces and marketing services to improve their value proposition and competitiveness within the value chain. La Canasta is a Colombian network of small-scale farmers, active in the region of Bogota, producing dairy and eggs based on agro-ecological principles. With a strong focus on sustainability and product quality, the cooperative has developed an integral approach that aims to reinforce the competitiveness and
wellbeing of its small-scale members within the livestock value chain by improving market access. This type of business dynamic linking producers applying agro-ecological or climate smart farming practices with markets for sustainably produced livestock products. In Costa Rica, the Ministry of Agriculture and Livestock, the National Chamber of Milk Producers, the National Council of Production, Corporación Ganadera (CORFOGA), SENASA and 3 supermarket chains have joined efforts to devise a market mechanism for the 1,800 producers linked to the Livestock NAMA with the objective of generating an economic incentive in favor of producers implementing sustainable livestock practices. In Chile and Costa Rica, the public and private sector are designing a strategy to incentivize livestock producers to adopt sustainable production practices. The incentive will include access to bonuses to adopt sustainable practices, access to credit and differentiated prices for their products. 

[Case study 19: Colombia, La Canasta] [Case study 25: Costa Rica, Marketing mechanism for low emissions livestock products] [Case study 26: Chile and Costa Rica, Voucher to promote sustainable livestock production]

b) Innovations in delivery of advisory services. Livestock production is characterized by diversity in biophysical conditions, input use, objectives, and other dimensions. Extension services need to address this diversity, which can be achieved by delivering advisory messages tailored to different farmers. This is challenging with conventional extension services that often aim at broad adoption of standardized technologies. In addition, many agricultural advisory services view farmers as recipients, not originators, of advisory contents. In the region, FAO pilots two participatory approaches in the CSL projects in which producers are actively involved in identifying, prioritizing and analyzing problems, making action plans to address the problems, implementing and monitoring the activities: co-innovation in Uruguay and Participatory Rural Appraisal in farmer field schools in Ecuador. The Balde Cheio programme in Brazil develops and adapts production processes and administrative tools for small dairy farmers and extension service technicians. Launched in 1999 in São Paulo state, the programme has gradually spread, reaching more than three thousand family dairy farmers in all regions of the country. The programme focuses on continuous training of technicians using small family-owned dairy farms as a “practical classroom”, where the interventions are identified, discussed and adapted to the particular situation of that farm and, finally, implemented.

[Case study 27: Uruguay, Co-innovation, an innovative approach to accelerate the pace of practice change] [Case study 28: Brazil, Full Bucket Programme – Innovative approach in technological and knowledge transfer in dairy systems]

c) Gender mainstreaming as an institutional innovation. There is consensus that empowering the millions of women who live in poverty is essential for their intrinsic human rights and broad benefits for development and economic growth. There are examples of how FAO is working to mainstream gender and empower women in LAC through its projects in Ecuador, Uruguay and the Dominican Republic. Of note are the efforts in “gender transformative” investments. FAO adopts gender lens in its investments and increasingly seeks to intentionally and measurably address gender disparities and/or examine gender dynamics to better inform investment decisions. The key idea is that investments can simultaneously generate financial return and advance gender equality. Innovations in policies that disrupt “business as usual” are increasingly recognized as a way to accelerate the achievement of gender equality and empowerment. The National Gender Plan in Uruguay is an example of how policy is addressing gender inequality in the agriculture.

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20 FAO produces a gender analysis and gender action for each project. This enables countries to promote gender equality to be defined at an early stage. It also enables project teams to identify and address undesired negative effects. It has also supported the mainstreaming of gender in climate smart livestock approach (Ecuador, Dominican Republic and Uruguay) and inclusion of gender dimensions within the National Adaptation plans for the agricultural sector e.g. in Uruguay.

The plan aims to reduce gender-based inequalities in access to resources and recognition in rural areas and the agricultural and fishing sectors. It is the first initiative in the region applying a gender lens within agriculture policy and institutions at all levels addressing gender inequality holistically across the agriculture sector and proposing the mainstreaming of gender policies and the institutionalization of the gender approach.

[Case study 29: Uruguay, Institutionalizing gender in policy - National Plan for Gender in Agricultural Policies]

d) **Innovative partnerships between innovation ecosystem actors.** It has become more and more recognized that solving the persistent and complex problems facing the livestock sector is beyond the reach of a single actor alone. Partnerships are not only key in R&D, access to finance, technical expertise, technology, but can also support in bringing tested and tried innovations in the pipeline to the market. As an example, in Ecuador, Telefónica has teamed with FAO to develop an App for monitoring of sustainability indicators on smallholder dairy farms. While Telefónica brought the technology, data analytics and connectivity to the project, it would not have achieved the same results without the FAO’s knowledge and expertise in livestock value chains, relationships with stakeholders (cooperatives and farmers, extension officers) and capacity training capabilities.

[Case study 30: Ecuador, FAO-Telefónica partnership to develop digital solutions for smallholder dairy producers]

**Social innovation. Most of the long-term challenges faced by the region bring major social consequences.** Innovation solutions can drive large-scale social changes resulting in equitable outcomes. In this context, grass-root innovation play an essential role in directing innovation and knowledge diffusion to promote social inclusion. Social innovation can improve society – in terms of equity, inclusion, and capabilities, among others – rather than only sustain economic growth and productivity. It focuses on advancing social and economic progress, as well as addressing the needs and well-being of the excluded or underserved and engaging them, directly in innovation processes. Countries can use the opportunities created by innovation and technological advances to tackle emerging social challenges – exclusion and diversity, geographical disparities. Examples include:

a) **Innovations to promote sustainably produced livestock products as an alternative.** Alternative agro-food networks’ has been one of the promoted spaces for a sustainable food system. These kinds of initiatives may build inclusive and equitable supply chains and more engaged and responsible consumers and producers. This may include support in: finding appropriate and long-term financing of the solutions or creating a business model that provides solution that are economically, ecologically and socially sustainable. For example, establishing direct connections between producers and consumers through farmers’ markets, farm shops, subscriptions, organic buying groups and food cooperatives. These can be used as an alternative to an unsustainable food system, characterized by adverse environmental impact. Social innovations are oriented to promoting solutions to social needs and problems. From this approach, sustainable buying groups may be considered as initiatives that are contributing towards building a new model that is environmentally sustainable. La Canasta, in Colombia an initiative launched in 2012 as a connection between rural producers and urban consumers, based on sustainable food production as a generator of good living. It promotes agroecology, protection of biodiversity and its ecosystems, conscious, local consumption of sustainably produced livestock products.

[Case study 19: Colombia, La Canasta]

b) **Youth empowerment through social innovation.** Youth are an indispensable yet underutilized force in tackling global poverty and inequality. Innovative approaches can be applied to tackle rural unemployment and promote social inclusion of young people with fewer opportunities. The social innovation action can aim to create new local networks, develop the entrepreneurial potential of local young people and financially support start-up and initial training programmes. These programmes may combine social innovation workshops, mentorship, incubation and seed funding, to equip young people with the skills and resources they need to identify challenges in their own communities and design solutions for them. FAO’s Integrated Country Approach (ICA) programme for boosting decent jobs for youth in the agri-food system in Guatemala is an example
of an initiative that aims to support capacity development and coaching for established rural youth-led enterprises. The programme supports the use of ICTs for accessing information and marketing, and generates knowledge on rural youth financial inclusion, including provision of technical assistance to pilot innovations. Other international and regional organizations such as IFAD and IICA\textsuperscript{22}, BID-LAB\textsuperscript{23} are also taking the lead in incentivizing youth involvement in agri-food systems.

[Case study 31: Guatemala, Rural youth employment]

c) Inclusive participatory approaches to foster uptake of innovative solutions. To facilitate participation and uptake of innovative approaches and technologies, the application of participatory approaches that are inclusive are some dimensions of social innovation that can help realize transformation. This would include: (i) acknowledging and harnessing different perspectives, values and competences when identifying needs, developing solutions and creating value for people and communities; (ii) identifying relevant needs and challenges among different groups of people; and (iii) co-creating new solutions with the concerned groups of people. The climate smart livestock project in Ecuador adopted a participatory approach in the design and implementation of a capacity-building program. The programme developed with clear learning objectives and focused on developing the skills of the target producers through the learning-by-doing approach has allowed the practices implemented at the farm level to be sustained even after project closure. The generation of networks through the Farmer Field Schools, allow the exchange between producers, generating a process of dissemination of knowledge within the community.

[Case study 32: Ecuador, Enfoques participativos e incluyentes para el fortalecimiento de capacidades]

The innovation and the digital transformation for livestock supply chains is still at an early stage in LAC, and the major transformational impact of these changes is yet to been seen. The innovations cases long livestock value chain reveal important features:

- **There is considerable variation in the readiness of countries in regards to innovation and a clear innovation divide exists in the region that needs to be bridged. Currently, there is a concentration of innovations in some countries, in particular, digital technologies in South America compared to the Andean and Central American regions.**

- **A new scenario of innovation priorities that goes beyond productivity and economic growth is emerging in response to demand for a broader agenda, to integrate issues related to sustainability along the entire supply chain value, quality, nutrition, human health and use of biomass and resources.**

- **Technological, social, organizational and institutional innovations usually occur in combination. In the majority of the cases, dissemination of the technological innovations was enabled by social, institutional or organizational innovations occurring simultaneously.**

- **The livestock innovation ecosystem includes a wide array of actors including government, NGOs, development agencies, multilateral investment funds, research and academia, and private sector, each playing different roles: research, incubators and accelerators, finance, facilitators, aggregators.**

- **Many of the innovations are in initial stages (research stage, piloting or proof of concept), or are being applied at small-scale. The evidence base on scaling-up (or out) of innovations for livestock is still relatively immature in the region.**

- **The experience in Brazil (case study 28) offers some insights that can guide scaling to contribute to sustainable agri-food system outcomes. These include: (i) understand the context well and the specific challenges or needs of the target population, (ii) consider strategic scaling up pathways that can reach the intended audience and answer to local conditions, (iii) choose appropriate partners (public, private sector or civil society) to implement scaling up activities, (iv) foster**

\textsuperscript{22} IFAD Rural Youth Innovation Award in Latin America and the Caribbean

\textsuperscript{23} IDB Lab https://bidlab.org/en
processes of community engagement that build a sense of ownership, (v) plan for long-term development funding cycles to enable sustainable system change.

- **Accelerators are critical to the innovation process including finance, access to markets, and policy.** In addition, successful innovation depends on multiple ingredients one of which is requisite knowledge and skills needed to take up the innovation.
- **It is possible to generate economic, social, and environmental benefits simultaneously, as several of the case studies demonstrate.**
- **In smallholder systems, organization is vital for success.** It is clear that one of the major difficulties faced by small producers in accessing inputs, services and markets for their product is the scale of their operations. It is through collective organization that these producers can achieve the volumes required by markets and thus become more empowered in negotiations with buyers or other institutions.

3. **Recommendations**

3.1. **Actions to accelerate innovation-led transformation of livestock supply chains**

To address the challenges of agri-food systems and rural transformation, new development approaches are needed, that combine innovative policies, technologies and organizational processes and practices, and use of digital and other types of innovation for the improvement of livestock supply chains. The suite of innovations and digital solutions in the region is increasing. Harnessing the full potential benefits of innovations and technologies in the agrifood sector will require several push and pull factors:

- **Investment in digital literacy and infrastructure.** Digital skills and e-literacy remain a significant constraint to the use of new technologies and are particularly lacking in rural areas. Livestock production by its very nature is mostly conducted in rural areas that are poorly connected. The sector is therefore highly impacted by the so-called digital divide. This current state of inadequate connectivity limits the full deployment of digital technologies in most rural areas, including broadband access for information communication; mobile (cellular) coverage and data transmission speeds. Mobile internet penetration in the region is limited: only about 50 percent of the population has access to the internet, and this figure is projected to grow to only 66 percent by 2025.成功

Successfully navigating the digital transformation is as much about technology and infrastructure policy as it is about social welfare and education policy – ensuring that opportunities are accessible to communities at all socio-economic levels and that they contribute to development objectives. Investments in human capital by building capacities is required. It is central that the labor supply responds to the new labor demand that will result from the new technologies and innovation to make the process more inclusive. Readiness of producers and other actors with digital skills including improved access to infrastructure are also key enablers for scaling and sustainability.

- **Advisory services should have a revised mandate.** The emphasis of extension should shift away from primarily emphasizing technology transfer and must evolve and develop new programmes with new objectives. The focus should be on: (i) programmes targeting extension agents and specialists oriented towards raising awareness on data-driven decision support systems and digital tools that can be used to support their work; (ii) new training strategies used by extension agents when engaging producers on the use of data-driven solutions; (iii) designing and evaluating the impact of new methods of farmers’ advisory services (e.g. data-driven advisory services), and (iv) promoting user-centric extension that take into account novel social and institutional models of extension.

- **Foster catalytic partnerships.** Efforts to improve food systems outcomes need to be inclusive of a wide range of stakeholders. While governments, the private sector, and civil society each have their strengths and resources to address the challenges faced by the sector in the LAC region, to-date, and no single actor has had the ability to tackle the complexity of development challenges in isolation. The multifaceted nature of the issues requires multi-stakeholder partnerships and cross-sector approaches. Collaboration between the public and private sectors is indispensable, not only throughout the innovation process, but especially when considering the scalability of the solution. Stakeholders will

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24 GSMA Mobile for Development - GSMA (2019)
need to engage in a dialogue on how best to accelerate the innovation agenda, including identifying innovations to be scaled, enabling innovations in policy and business models and determining geographies and markets where pilots can be designed and implemented. It will also be important to identify existing initiatives that can provide experimental platforms for these innovations.

- **Scale-up agricultural finance.** The constraint of finance continues to loom large amongst all the obstacles and should be given close attention by particularly promoting appropriate and innovative incentive structures, strengthening stakeholder capacities and promoting de-risking (or more effective risk management) of livestock value chains to unlock finance for the under-served and financially excluded groups. To promote knowledge-intensive agriculture, there is a need to promote innovative financing mechanisms to support producers regardless of their scale and location. More creative investment solutions such as increased deployment of accelerators or innovative finance for diffusion, and longer-term finance for innovation development may be needed to drive transformational shifts.

- **Scaling up finance also implies supporting capacity building for financial institutions.** Capacity building is critical to provide necessary skill transfer to financial institutions to better understand the needs of the livestock sector, analyze risks, develop appropriate and innovative lending and other financial products, identify cost-effective distribution channels to reach smallholder farmers, and develop the skills to forge value chain partnerships.

- **Promote sustainable innovations.** Simply introducing technologies is not enough to generate the transformation sought. Disparities in access to innovations and technologies, infrastructure and services mean there is a risk of entrenching the already existing divide. Smallholder farmers and others in rural areas are particularly at risk of being left behind, in terms of not only e-literacy and access to digital resources but also in terms of productivity and aspects of economic and social integration. Social, economic and policy systems will need to provide the basic conditions and enablers for transformation. In addition, understanding user needs is an important step in developing sustainable solutions. This requires the involvement of the final beneficiaries in the process of innovation and scalability. This will ensure that solutions are relevant and sustainable.

- **Need for tailored innovative solutions specific to each context.** Food systems have a unique set of needs that vary from market to market, and even by value-chain. Consequently, it is relevant to that innovative solutions respond to local needs and context. Latin America is a vast and diverse region where a one-size-fits-all approach will not work. Livestock producers are not homogeneous and, therefore, face differing challenges that vary from one community and country to another. Solutions that work well in Southern Cone markets where large-scale farming dominates may not be transferable to countries in Central America or the Andean region where smallholder farmers play a bigger role. Agritech companies, development community, research, investors and donors can enhance their impact by understanding the key features of each market and evaluate how this can influence the choice of business models.

- **Increase investment in R&D.** Even if innovation is inherently complex, it is clear that a major driver of innovation is research and development system. The record across the region is far from uniform. Countries such as Argentina, Brazil, Colombia, Mexico, and Uruguay boast excellent research capacity, but this contrasts sharply with the situation in many Central American countries, Caribbean island nations, and some Andean countries, where agricultural research systems are suffering from underinvestment. Lower R&D spending is partly behind the R&D and, consequently, the innovation divide in the region.

- **Developing innovation pathways.** The ‘how’ of achieving the planned change is critical towards realizing the transformation of agri-food systems. Innovation transition pathways include understanding of the innovation and its impact, identification of winners and losers, strategies to minimize adverse effects of the innovation (socially, economically and environmentally), its costs, mapping of roles and steps to be taken by different actors, institutional reframing (public and private), as well as the systemic innovation required to achieve the expected impact and subsequent transformation.
3.2 Niches for FAO’s work in innovations for inclusive, sustainable, resilient and low emissions livestock supply chains

Innovation is fundamental to moving from incremental to transformational change and unlocking the potential in more resilient agrifood systems to achieve sustainable development goals. The 2030 Agenda explicitly refers to innovation as a critical means of implementation, acknowledging its role in accelerating the achievement of the SDGs. It calls for enhanced cooperation and knowledge sharing to improve access to technology and innovation; underlines the urgency for the development, transfer, dissemination and diffusion of environmentally sound technologies; and points to the need for capacity building mechanisms for developing economies.

Taking into consideration the current regional landscape briefly summarized above, and in the framework of the priority themes approved by FAO 36th Session of the Regional Conference for Latin America and the Caribbean, the Technical Secretariat of CODEGALAC proposes to focus efforts and work in the following niches:

- **FAO can play a key role in expanding the scale of innovations through the establishment of a regional livestock innovation hub.** Innovative practices and technologies are already changing the dynamics of the livestock sector in LAC but the process has so far not been systematic. Realizing the full potential of these innovations will require collaboration of all players in the value chain. There is a need for a clear overview on the part of actors working in livestock agrifood systems – including private sector, research, governments and other agencies – on how to better exploit the opportunities of innovation and digital technologies for sustainable, resilient and low emissions livestock supply chains. At the same time, donors, impact investors, and agriculture financiers need a common infrastructure that can allow them to unlock and combine their respective funding streams. Achieving this also implies, facilitating the collection of better data and information about the current application of innovations and technologies in the region and coordination with stakeholders, actors and partners across the region, among others. This will implemented within the overarching scope of FAO’s Hand-in-Hand initiative and the regional programme on innovations in livestock systems. The hub will function as an accelerator for digital, social and institutional innovation and experimentation in the region, and strengthen skill development in the region with the following objectives:
  - supporting the dissemination of innovations and business models;
  - strengthening country capacities and improving the knowledgebase on innovations and digital solutions;
  - fostering new partnerships at regional and national level to strengthen the innovation ecosystem and its finance;
  - enhancing the enabling environment for innovations through advocacy and capacity building activities;
  - strengthen capacities of marginalized and excluded groups (youth and women engagement) in food systems, enabling them to learn and acquire new knowledge and skills;
  - support training on digital skills for smallholder farmers and other actors in the agri-food system;
  - act as a platform for public-private collaboration to generate coordinated efforts aimed at strengthening the uptake of innovation and digital solutions for livestock;
  - support the strengthening of institutional capacities for innovation policy design; and
  - accelerating the exchange of experiences on the local, regional and global level.

- **FAO can support in-depth analysis and identification of actions to overcome the barriers that stunt proven innovations from reaching maximum impact, with a focus on small-scale producers.** Scaling up of innovation stands as a key lever to support the transformation of the sector and offers solutions to the climate change crisis by developing and deploying practices and technologies at scale, as well as providing the knowledge and evidence that respond to the needs of farmers and countries. However, many innovative solutions do not move beyond the piloting phase despite the reported benefits. This is due to several factors including the poor understanding of the targeted end users, high

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cost of implementation, absence of sustainable business models, identified partnerships to roll out the innovations, inadequate funds for growth, fragmented nature of the innovation ecosystem, etc. However, a strategic approach is needed to harness the potential of innovation to accelerate the transformation of the sector and ensure a coordinated response to the needs of countries. To address this, a synthesis of lessons learned from application of technological, institutional and social innovations livestock agri-food systems would be useful. Such a synthesis could lead to the understanding of barriers to scaling up and the identification of key priorities for its member countries. This would also include the identification of innovation ecosystem support mechanisms, such as policy, scaling-up pathways, a strategy that allows better coordination between public - private, science, and with actors in the livestock supply chain.

- **Innovation is critical to enable FAO to deliver on its mandate to reach Zero Hunger.** FAO will continue to support the incorporation of technical, institutional and social innovation in its livestock portfolio by promoting access to innovation and its use in sustainable livestock production through its investments.