PUBLIC

Revised Version. Thematic Paper Climate-Smart Agriculture

This paper was prepared by Ana Castillo, Tomas Lopes Teixeira, Alejandro Escobar and Laura Natera.

CONTENTS

ACRONYMS

CSD	Climate and Sustainable Development Sector
CSD	Climate Change and Sustainable Development Sector
CSA	Climate-Smart Agriculture
CSNR	Central Suriname Nature Reserve
CTI	Competitiveness, Technology and Innovation Division
GEF	Global Environmental Fund
GHG	Greenhouse Gases
IDBG	IDB Group
IPO	Initial Public Offering
IVE	Intrinsic Value Exchange
KPI	Key Performance Indicators
LAC	Latin America and the Caribbean
MIF	Multilateral Investment Fund
RES	Department of Research and Chief Economist
RND	Environmental, Rural Development and Disaster Risk Division
SDG	United Nations Sustainable Development Goals
SEP	Social Entrepreneurship Program
SME	Small and Medium Enterprises
STEM	Science, Technology, Engineering and Math

I. Context

1.1 The purpose of this paper is to provide sharper focus and better define opportunities for impacts under the thematic area of Climate-Smart Agriculture (CSA), following the approval of IDB Lab's Business Plan 2019-2021. It is one of four papers that serve as a complement to the Business Plan 2019-2021, approved by the Donors' Committee in 2018. The paper builds on the diagnostic analysis contained in the IDB's sector framework documents: Agriculture and Natural Resources Management (GN-2709-5), Food Security (GN-2825-8), and Climate Change (GN-2835-8). This paper is organized in four sections: first it summarizes key challenges faced by the region in CSA; it then identifies key lessons learned, linking them to the priorities identified in the Business Plan for the next three years; the paper then identifies operational and knowledge priorities within CSA and explains how each of these will advance objectives such as transformational impact and inclusion; and lastly the paper identifies potential areas of collaboration with other parts of the IDBG, and discusses how this collaboration can be leveraged to reach the objectives identified in the Business Plan.

1.2 Climate-Smart Agriculture is defined as "inclusive and sustainable agriculture development approaches that respond to the challenges of climate change". IDB Lab's work on CSA spans agriculture, forestry, water management, livestock, food value chain systems, new food products (e.g. derived from biotech applications), fisheries, oceans, and forms of natural capital. Likewise, IDB Lab's CSA workstream takes climate as a transversal effort, having adaptation, mitigation and environmental sustainability approaches entrenched as a mainstream dimension of all operations, rather than a particular class of projects.

1.3 The agricultural sector in LAC has the potential to play a central role expanding economic opportunities for smallholders while addressing the challenges of climate change. The region also can generate wealth from natural capital, which can transform the extractive perspective of nature to one based on regeneration. The following three challenges are considered the most relevant in achieving this vision of the future:

i. ***The inclusion challenge***. The agriculture and agribusiness industries have one of the highest concentrations of wealth and assets, yet 80% of the food we eat in LAC is produced by smallholder farmers. This disparity reflects a continuing pattern of limited opportunity and vulnerability among most producers. Even as agricultural productivity has increased over the past two decades, particularly in export crops, today 53% of those residing in rural areas in the region still live under the poverty line, with populations such as landless farmers, indigenous peoples, and women and children are particularly vulnerable.[1] Farming and other economic opportunities in rural communities continue to be limited, leading to a now decades-long process of urban migration. Furthermore, volatility in commodity prices, low levels of innovation, and inefficient supply chains all conspire to limit opportunities for smallholders and exacerbate the concentration of income within the supply chain.

ii. ***The productivity challenge***. In a world whose population will reach nearly 9 billion inhabitants in 2050, global food production will have to increase by 60 percent. For LAC to remain as a leading

[1] International Fund for Agricultural Development, Rural Poverty Report 2011, Rome, 2010.

player as a source of food production for the world's population, it will have to address the large productivity gap in agriculture compared to more developed economies, which is estimated today at 22%--a gap that is driven in large part by low-productive small farms[2]. To boost productivity the region will have to leverage its privileged natural endowments by taking advantage of advances in technologies and new business models available today. The region must also address a demographic challenge associated with the ageing of the rural population, and the continued migration of youth to cities—these demographic trends impact the agriculture sector directly, reducing the availability of qualified labor and limiting the degree to which smallholders can innovate. Initiatives to promote increased innovation in the ag sector must be done in a manner so that the benefits of these technologies and business models accrue to smallholders and other vulnerable groups in rural settings.

iii. ***The climate and natural resource challenge***. Agriculture is an activity highly dependent upon weather and climate, and therefore vulnerable to climate change. For each additional degree Celsius of global warming the estimated potential grain crop yield loss is about 5%[3], endangering food stock for the world's growing population, with impacts disproportionately borne by the poor and vulnerable. Islands and the Caribbean are particularly vulnerable to the effects of climate change, particularly those related to global warming, sea level rise, and extreme events. Agriculture and land use, in turn, also constitute the main source of anthropogenic GHG emissions in LAC; and 75% of worldwide agricultural emissions occur in developing countries[4]. In addition to climate change, agriculture is closely linked with natural resources, especially water and land. Agriculture accounts for about 70% of the fresh water withdrawals and 70% of biodiversity loss, and expansion of the agricultural frontier is still the main cause of deforestation in LAC, degrading millions of hectares of pasture land, forests and vital ecosystems such as riparian forests and water springs.

II. Lessons Learned

2.1 Over the period covering the previous Business Plan, 2016-2018, IDB Lab approved approximately 30% (64) of its operations within the thematic area of CSA. Of the CSA projects approved, 51% were in the area of resilient value chains, 17% were focused in solving farm challenges through the use of technology solutions, 14% in natural capital and 18% were related to green financing. IDB Lab deployed a wide variety of instruments, including grants, VC funds, loans and funds from the Social Entrepreneurship Program (SEP). The lessons learned over the past few years have shaped how IDB Lab's work on CSA has evolved and, moving forward, they will help CSA projects deliver on the transformational impact for the excluded and vulnerable.

2.2 ***Scaling up CSA projects requires addressing specific constraints*.** A key constraint in CSA projects, especially those that introduced within-farm improvements with small producers, has been the challenge of scaling up. Out of the 22 CSA projects completed in 2017, for example, only four have gained scale. Many CSA projects fail to scale-up as they face high costs of replication, do not achieve financial sustainability, or do not gain adequate competitive position in markets. Also,

[2] Productivity gap calculations are based on United States Department of Agriculture (USDA) estimates on Agricultural Total Factor Productivity Growth using Food and Agriculture Organization (FAO) data from FAOSTAT.

[3] IDB, The Next Global Breadbasket – How Latin America and the Caribbean can Feed the World, 2014.

[4] Thornton, Lipper (2013). How does climate change alter agricultural strategies to support food security? Background paper for the conference "Food Security Futures: Research priorities for the 21st Century"11-12 April 2013, Dublin

project may face difficulties in implementing new practices as small farm holders may not see the benefits of these innovations or may lack the technical capacity to implement them. Farm-level CSA projects that overcame such barriers are typically those that: (i) made implementation of new practices viable for smallholders by creating mechanisms to provide farmers with the know-how, education, and technical training necessary to adopt new technologies; (ii) employed financial schemes to mitigate implementation risks, (iii) focused on profitable business models and financial sustainability, (iv) incorporated key players in the value chain (anchor corporates, key aggregators or cooperatives) capable of taking up the scaling efforts, and (v) made use of technology-based solutions to minimize costs of replication.

2.3 ***Engagement of value chain actors is important for success.*** Besides the importance of key value chain actors in the scaling of projects, a key lesson in IDB Lab's work in CSA is that value chain actors can be powerful partners in implementation of CSA projects. The active participation of the key actors of the value chain, including anchor firms, large-scale aggregators, cooperatives enables adequate coordination and monitoring of the interventions. Also, it incentivizes participation from fragmented networks of farmers and rural workers, increases the reach of the programs, and it helps ensure smallholders comply with the practices and standards required to reach global markets and to minimize agriculture's environmental footprint.

2.4 ***Agriculture-specific constraints must be addressed for smallholders to adopt new practices.*** Successful adoption of new practices and technologies by smallholders requires that models internalize the ecological and risk characteristics of the agriculture sector. Approaches must consider the relatively long timeframe required to test innovations in agriculture, where impacts on yields can only be observed after harvest (typically once or twice per year). This is a major challenge to the speed of adoption. The high risks associated with crop failure also constitute a deterrent for smallholders to experimentation with new practices; approaches that can reduce this risk will also increase uptake by smallholders. These risks are exacerbated by climate change, which can further confound the impact that new practices and technologies can have on productivity. Lastly, approaches must specifically develop adoption strategies that take into consideration the aging of producers, as older generations may face additional difficulties or be less willing to adopt new practices.

2.5 ***The CSA innovation ecosystem is embryonic and requires a tailored approach.*** To be successful, approaches to develop the early-stage ecosystem in agriculture must consider the nature of the sector, which present particularities that make it distinct from other sectors where IDB Lab has had more experience in the past. For instance, the agriculture sector requires financial structures with tenors and capitalization volumes to match the unique business cycles of agriculture, which tends to involve a longer-term return profile. Also, the technical knowledge and expertise requirements are very high in agriculture, and this usually requires investing or financing actors (e.g. funds) to either be specialized in agriculture, or to have a dedicated line of business focused on agriculture. Likewise, the nascent nature of agtech will require significant efforts beyond financing to develop the ecosystem, including support to accelerators and company builders, partnerships with technology centers, universities and other research institutions, especially in countries with less developed innovation ecosystems.

2.6 ***Addressing gender and diversity gaps in agriculture requires an ecosystem approach.*** Women, afro-descendants and indigenous populations play a fundamental role in agriculture, yet the sector continues to have one of the largest gender and diversity gaps, where these populations

are at a disadvantage in terms of access to productive resources, access to finance, land tenure and influence (they are underrepresented in cooperatives, farmer organizations, and other decision-making groups). These gaps can be addressed, but they require an ecosystem approach, which often goes beyond an individual project. Areas of action include: (i) breaking down rigid gender roles at the farm-level; (ii) encouraging the participation of such groups in Science, Technology, engineering and Mathematics (STEM) and in the agricultural sector; (iii) building networks to facilitate growth opportunities for entrepreneurs from such populations, both in terms of business coaching and finance, among others; (iv) promoting greater influence, voice, and decision-making by women and traditionally excluded populations by working with cooperatives and other collective groups. Many gender and diversity gaps can be addressed at the project-level, and the application of gender mainstreaming at that level is fundamental; however, addressing gaps at the industry and market-level requires leveraging the presence of the IDBG across different sectors.

2.7 **The impact of innovation in Agriculture depends on enabling conditions outside the sector**. Even as this paper addresses innovations in Agriculture and Natural Capital, the potential for impact and scale depends on the development of enabling conditions that are determined outside the sector. This is the case for information technology infrastructure, for instance. Most digital solutions require some degree of connectivity to take advantage of innovation. To the extent that these can be rolled out they will greatly facilitate the take-up and scaling of several of the opportunities for impact identified below. Likewise, improvements in productivity at the farm level or improvements in the functioning of value chains will depend on the sustained demand that resides essentially in cities or in export markets. These interdependencies call for a sustained coordinated agenda across IDB Lab's three thematic areas and more importantly, across the IDB Group.

III. Opportunities for Impact

3.1 IDB Lab will focus its activities according to the principles identified in its strategic guidance documents, and most specifically the Business Plan for the period 2019-2021. This focus will be achieved by applying screening and selection criteria to all operations, by focusing on: (i) poor and vulnerable and on inclusion; (ii) deploying innovative solutions that can deliver disproportional impact; (iii) creating sound business models with scaling potential; and (iv) aligning with IDBG strategic priorities. In addition, projects under the CSA thematic area will contribute to two thematic-specific challenges. The first is to **increase incomes, sustainability and climate resilience of smallholders**, and the second is to **regenerate the environment and address the climate crisis**.

3.2 Subject to the criteria defined above, currently we have identified two main sub areas which hold the greatest potential for impact within CSA, one at the value chain level—**Transform value chains**—and one at the farm or establishment level—**Improve livelihoods at the Farm**. Additionally, one strategic co-creation domain will be jointly developed with CSD, **Natural Capital**. These areas are not meant to be exhaustive, as IDB Lab will continue to explore other sub areas, but they describe where most projects will be concentrated.

3.3 IDB Lab will partner and codevelop solutions with key actors in different parts of the CSA space, including: entrepreneurs, startups, and supporting institutions (such as company accelerators and venture capital funds); foundations, industry associations and non-profits; aggregators such as cooperatives, and farmer's associations and anchor companies; research centers, universities and innovation centers and other public sector entities specialized in research and development. IDB Lab will use its convening power to partner up with different actors that can individually bring best-in-class expertise in capacity to deliver on its CSA objectives and collectively add the diverse set of skills and capacity required to address the multifaced challenges of the agricultural sector.

3.4 The main constituencies who will benefit from these impacts are expected to be: smallholders, particularly those excluded or who are in a vulnerable context[5]; rural workers and households; small and medium-scale agribusinesses in the food value chain (small input retailers and service providers); consumers of food products and services, and the environment.

A. Transform Value Chains

3.5 Value chains are made up of the core producers, farmers, and all the other actors involved in the purchasing of farm products, traders, input suppliers, retailers and even finance suppliers. Given the complex and often non-inclusive structure of agricultural value chains in many regions in LAC, vulnerable farmers and rural populations normally face limited possibilities of fully and fairly participating in these markets. Smallholders typically capture a low share of the final value of its products and encounter non-transparent commercialization markets and difficulties in buying inputs and selling their products at fair prices. On top of that, small farm holders typically face limited access to export to new markets and unfavorable prices in international trade, and they are particularly vulnerable to volatility in commodity prices.

3.6 Innovation can reshape values chains making them more inclusive to those with less resources (land, financing, capability), more resilient to the effects of climate change, and less intense in carbon emissions. Some key innovation trends which bring opportunities for high impact are presented below.

3.7 *Increase the share value captured by smallholders through the digital transformation of value chains and disintermediation.* A large share of the final value of agricultural products (up to 70%) sold by smallholders is typically captured by different intermediaries through the value chain, which in some cases represent important market inefficiencies and oligopolistic structures. Agricultural value chains can become more efficient and inclusive by reducing the number of unnecessary intermediaries and thus the costs involved in the transportation and processing of the products from origin to final markets. Digital platforms that directly link producers and consumers, for example, can compress the costs of inefficient intermediation schemes, thereby increasing the share of value captured by small agricultural producers while making food prices more accessible to final consumers. It can also enable smallholders who are excluded from high-value markets due to barriers of entry to participate in those markets and incentivize adoption of practices to make the value chain more resilient to the threats of climate change.

[5] Vulnerable context can be defined as "A household is vulnerable to poverty if it is likely to be poor in the future. Since vulnerability is a forward looking concept, it measures "exposure to poverty rather than the poverty outcome itself" (Poverty and Inequality Report, World Bank, 2012, available here).

Productivity enhancement and resilience for small coffee producers: Aldea Global.
Aldea Global is one of the largest specialty coffee exporter association in Nicaragua, with over 5,000 members. IDB Lab has partnered with Aldea Global (project NI-T1231 & NI-L1142) to develop and pilot new agroforestry coffee systems, using machine learning and climate modelling to guide the farm's crop management and business decisions. The project combined technical assistance and financing to ensure farmers had both knowledge and financial resources to implement the technologies and practices included in the program. The project has raised productivity and built resilience for more than 1,000 smallholders in a year and has the potential to scale to another 25,000. This project is part of the IDB Lab's Regional SAFE Platform (www.safeplatform.org).

3.8 *Create fair and trusted markets for smallholders through enhanced transparency, leveraging traceability to comply to market requirements and access premium markets.* Smallholder farmers often face difficulties related to environmental standards. Those who need to transition to better sustainable practices typically do not have access to easy-to-adopt control systems to comply to market standards, and those which already have adequate environmental performance – often superior to those of large producers – are not financially compensated for it. Innovations related to computing, and remote and digital technologies, such as blockchain or internet of things, make it possible to track the trajectory of products through supply chains and control the transportation and storage environments in real time. They can also provide greater transparency, by ensuring that transactions conducted throughout the value chain are done with full information and consent by all parties, preventing unfair or illegal practices. Traceability creates incentives for food value chain players to adopt ethical and sustainable sourcing of agricultural products (e.g. sourcing from deforestation-free land) while allowing smallholders to comply with growing requirements from environmental regulation and consumers, and thus increase their income by accessing premium markets.

Transforming the market for fresh fish: Shellcatch
FrescaPesca is a technological application created by the company ShellCatch, currently operating out of Santiago – Chile. It allows final costumers to directly order fresh seafood from artisanal fishermen. Clients using the platform – usually individuals, restaurants or hotels – receive at their locations a high-quality product that has been traced from origin (full traceability) and verified for sustainable fishing practices. FrescaPesca eliminates up to three instances of market intermediation; increases the income of artisanal fishermen by as much as 50%; and reduces the price for end-consumers by 30% on average. In 2017 IDB Lab made a 1.5-million-dollar investment in ShellCatch (project RG-L1120). FrescaPesca is currently reaching over 2,000 clients.

3.9 *Improve performance of ag markets, using new marketplace solutions to reduce transaction costs and expand the reach of products and services for smallholders.* Small-scale farmers, rural SMEs and workers typically incur high transaction costs and information asymmetries both in buying inputs (seed, fertilizers, machinery), which compose up to two thirds of its production costs, as well as selling their products. Such asymmetries can be overcome with innovative commercialization arrangements, such as digital marketplaces, to promote increased transparency and competition in the relation between producers, input providers, trading companies and retailers. These new arrangements can also make additional clients available to small market participants, by lowering barriers to entry and exit, while ensuring small agribusiness and farmers to have access to real-time information about the fair price of their products and

have the opportunity to reach small rural SMEs with different products and services, including financing, insurance, as well as technical solutions.

A new way to do business: Rural.Uy
Rural.Uy is a marketplace founded by two Uruguayan entrepreneurs that is now the leading platform in Uruguay and Argentina for selling and buying cattle. The platform offers synchronized data, marketing services, virtual sales 24/7 and the possibility to participate in virtual auctions. After 3 years of being in the market it has reached over 6,000 active clients, with 100% of retention. IDB Lab has supported them through NXTP's Acceleration Program in Agtech and Fintech (project number RG-T2966).

B. Farm-level Solutions to Improve Livelihoods

3.10 The adoption of innovative business models and technologies at the farm level have the potential to increase incomes, raise productivity and boost farmer resilience to climate change. When cost-accessible and accompanied by appropriate capacity building, the use of digital and physical technologies applied to agriculture (known as agtech), can play an important role in improving productivity, lowering costs, optimizing resource use and lowering the capital intensity of small-scale farming, and increasing incomes. In addition to digital innovation, advances in life sciences, materials and energy, are driving innovation in agriculture and food systems. However, today the benefits accruing from agtech innovations are concentrated among large establishments. The following are the clearest opportunities today to accelerate the beneficial impacts that agtech can have on smallholders, vulnerable groups, and the environment.

3.11 *Improve decision making of smallholders using precision agriculture and digital farm tools; reduce resource footprint by introducing biological alternatives to agrochemicals.* Small-scale farmers typically face limited information in running the management of their crops and business, making farmers take suboptimal decisions. Precision agriculture could sharply increase production and diminish the farmer's costs, increasing producer incomes. However, data and actionable information is generally not available to the farmer or the rural technical assistance providers (extensionists). New innovations in precision agriculture, such as digital applications that combine data with agronomical modelling, can connect farmers with valuable information to guide decision making, making a farmer's information management system just as important a tool as a farmer's machinery. Common digital applications include drones and satellites for monitoring soil and plantations remotely, enhancing crop management, new forms of precision irrigation capable of substantially reducing the consumption of water by agriculture; sensors for plant growth and nutrition control; and electronic chips for monitoring and localized disease detection in animals. Such applications can help farmers manage their crops and adopt climate-smart measures that optimize the timing of planting, irrigation and harvest, reduce the use of costly fertilizers, fungicides and pesticides, and have a positive impact in the environment by reducing the intensity of use of natural resources, especially water, land and energy. These increases can impact on costs, profitability, and can do so in a manner that lowers risk and income volatility.

3.12 *Expand ag insurance and financial services to underserved smallholders, improving business performance***.** Drought and flooding are the most harmful extreme climate events in LAC, having caused nearly USD 20 billion losses in the last ten years, particularly impacting the agricultural sector and smallholders, who are more vulnerable to extreme weather events and have less capital to withstand abrupt losses. New data collection technologies (such as imagery from

satellites, radars and drones combined with computing data analytics) are lowering the costs of collecting and processing data and raising the accuracy of actuarial risk models. For both index and conventional insurance applications, these technologies can reduce the final cost of insurance, making it accessible to smallholders. This is key to stabilize their income and create safety nets in the occurrence of extreme weather events and at the same time more transparent both for insurance companies and the farmers.

New class of ag insurance in LAC: S4

S4 is a startup developing climate-risk technologies that will benefit smallholders with cheaper and better insurance products. Using satellite imagery and a proprietary computing platform that combines advanced analytics and machine learning, S4 has developed a new class of climate-risk coverage that track the effects of climate events on agricultural yield with a six-hectare precision. S4's product allows smallholders to protect against losses resulting from droughts or flooding, which represent their main climate vulnerability. This new climate coverage product brings additional transparency to the insurance market with clearly disclosed costs and payoffs that do not demand audit/on-the-ground verification, enables direct purchase from small and medium-sized farmers (without multiple intermediaries as traditional insurance), and is up to 40% cheaper than traditional multiperil insurance. Over a thousand smallholders already benefited in Argentina. S4 received a USD 1.5M equity investment from IDB Lab in 2018 (project number RG-Q0048).

3.13 Another key constraint for farm livelihoods and sustained productivity increases in the agricultural sector is access to finance. Smallholder farmers, rural workers and SMEs generally have limited access to financing, an indispensable resource in the running of agricultural activity given its seasonality and often long payback periods of productive upgrade interventions. As traditional banking often does not meet the needs of smallholder farmers, a wide array of finance providers participates in the ag credit markets (such as credit unions, cooperatives, anchor companies and input providers and trading companies). However, when available, credit oftentimes comes at very high costs, rigid financial conditions that do not suit to the farmer's production cycle and needs, or with strings attached to other commercial arrangements (e.g. purchase of inputs or sale of products to a particular player at a given price). Innovative financial products developed by startups, innovative small financial institutions and online credit cooperatives are creating new forms of financing for smallholders. By leveraging advanced analytics and digital platforms, these new financial solutions have the potential to improve the efficiency in the provision of such services, with low-cost online operations and enhanced credit scoring systems capable of assessing credit risk with more flexible data than traditional methods. Such applications have the potential to bring financial services and financing to previously unbaked farmers, greatly reducing their financing costs.

Cash flow for the unbanked: Pago Rural

Pago Rural is a lend and pay online platform specially designed for underserved farmers and agriculture SMEs. Through the platform, smallholders can finance the purchase of their inputs – such as seeds, agrochemicals, fertilizers and supplies – in a simpler and more agile manner while facing lower interest rates and more flexible repayment conditions. For many unbanked producers Pago Rural provided access to much more favorable financing conditions. The company was founded in 2014 and received a seed capital investment through IDB Lab's project RG-Q0019. By 2018 Pago Rural has reached over 17,600 clients.

3.14 Develop *an agriculture entrepreneurship ecosystem in LAC to enable the generation of new high-impact solutions to smallholders, leveraging digital and life sciences technologies*. As seen in other sectors, the impact of innovative solutions in agriculture depends on the development of a dynamic entrepreneurship ecosystem that can support the creation and adoption of new products that advance the livelihoods of vulnerable populations. The development of agtech ecosystem in LAC, with specialized incubator, accelerators, tech centers, and venture capital funds, as well as the provision of basic digital infrastructure, is instrumental to provide entrepreneurs with: (i) access to different forms of capital, from grants and seed funding to venture capital, (ii) technological infrastructure, especially internet connectivity, and training in digital applications, (iii) technical and managerial talent, (iv) mentoring and strategic guidance in relation to the development of technologies and business model, and (v) adapting regulations and policies and (vi) access to networks, including not only potential clients and investors, but also to international players that can support technological transfer from other geographies, and (vii) spaces for pre-competitive models that allow entrepreneurs to co-create with other startups, corporates, research institutions as well as to test their solutions in practice (e.g. in real crops).

C. Natural Capital for Regeneration and Sustainability

3.15 Besides the two IDB Lab areas of focus, IDB Lab is working jointly with IDB on the topic of natural capital, through the recently created Natural Capital Lab, an IDB Lab-CSD partnership. IDB Lab's projects in natural capital will be also aligned with IDB's Climate Change Framework.

3.16 Although it represents only 16% of the planet's land, Latin America and the Caribbean (LAC) holds 40% of the world's biological diversity and contains almost 50% of Earth's tropical forests and more than 30% of its available fresh water. The region also holds 11 of the 14 terrestrial biomes and has the second largest reef system worldwide. This unique source of capital – natural capital – generates important life-supporting benefits for people, usually referred to as ecosystem services. However, natural resources and biodiversity are under threat: South and Central America have lost 89% of their populations of mammals, birds, fish, reptiles, and amphibians. Since 1970[6], mangrove and terrestrial deforestation rates are relatively stable and are yet to be sharply reduced. In our oceans, 90% of fish stocks are either fully fished or over-fished, and plastic pollution has been detected in all major marine environments. Some key trends and opportunities are present in LAC to tackle these challenges are presented below.

3.17 *Develop new natural capital markets that have high potential to conserve/restore ecosystems.* Over $300 billion is needed each year to preserve and restore ecosystems, but conservation projects receive just $52 billion, mostly from public and philanthropic sources[7]. There is a growing, but still largely untapped, interest from corporations, financial institutions and private investment groups towards conservation and restoration projects, especially those that already perceive climate change and loss of natural capital as a serious risk and/or a business opportunity. Such interest can be leveraged, for example, with the use of blended finance mechanisms to de-risk and incentivize private actors to invest in less tested or new-to-the-market solutions that have high potential to conserve/restore ecosystems and protect biodiversity at the same time as they can provide income and job generation to the vulnerable population of rural communities. There is also space to link innovative projects to international funding sources (such as the GEF), and to

[6] World Wide Fund for Nature, 2014
[7] McKinsey & Co, 2014

use those innovative natural capital approaches to address the specific challenges faced by Islands and the Caribbean, especially towards increasing its resilience to adapt to the effects of climate change.

3.18 *Promote restorative economic solutions for vulnerable populations, through the valuing of ecosystem services.* By quantifying and valuing natural capital in economic terms and structure new ways of monetizing such value, corporate, entrepreneurs, civil society and the public sector can create economic incentives for conservation and restoration. New payment mechanisms for ecosystem services, such as such as forest bonds, nature stock exchanges, or risk-mitigation instruments such as natural infrastructure insurance are examples of this. These innovations can enable the extraction of monetary value from practices that increase both investor's and ecosystem returns, in effect making untradeable ecosystem service values monetizable. This, in turn, can provide the economic inventive for the inclusion of vulnerable populations and traditionally excluded groups (such as women, afro descendants, indigenous populations) in sustainable extraction of value from natural ecosystems, such as sustainable intensification, agroforestry and silvo-pastoral systems.[8]

Monetizing natural capital assets: IVE project in Suriname.
One promising example of monetization of ecosystem services is the Intrinsic Value Exchange (IVE). The goal of the project supported by the IDB Lab (SU-T1096) with a contribution of US$ 218,000, is to develop, with the largest stock exchanges globally, an exchange mechanism for a new asset class – natural capital IPOs. The project received the authorization from the government of Suriname to create, manage, and capitalize a company to commercialize the value of all the natural resources and economic rights that are originated in the Central Suriname Natural Reserve (CSNR) through a local company (the "CSNR Company"). The primary mission of the company is to value and price the environmental benefits derived from the natural assets of the CSNR and to convert those rights to financial capital using an exchange mechanism developed by IVE. These natural assets rights can be claims on benefit flows that produce private returns (e.g. water, genetic material, pharmaceutical, ecotourism), and public returns (e.g. carbon, biodiversity). An initial review by IVE identified 237 categories of services in the CSNR that can potentially be developed and monetized. Of these 237 services, IVE has identified three which already have demonstrated revenue streams, estimated at $40 million annually.

3.19 *Bring monitoring of environmental conditions to the digital world, sharply reducing its costs while expanding the geographical coverage.* A key challenge for governments, corporations, financial institutions and farmers has been the process of monitoring environmental practices. It often involves large operating costs and on-the-ground verification. Artificial intelligence, remote sensing, and blockchain are opening new paths for the development of technological solutions that can bring the monitoring of environmental conditions to the digital world, sharply reducing its cost while expanding the geographical coverage. Typical uses include the identification of deforestation (current and past) and of pollution in rivers or water springs, as well as the early detection of natural hazards in forests (such as fires and hail). Such solutions can be a tool in the scaling up of conservation and restoration initiatives, which often demanded on-the-ground

[8] One example is the recent valuation of the ecosystem service benefits of Farmland LPs activities in the US, which shows a double bottom line return of 7.3% annual ecosystem gain on top of 10.5% annualized net economic gain for investors. http://www.farmlandlp.com/2018/09/organic-regenerative-agriculture-study-funded-usda-demonstrates-21-4-million-ecosystem-benefit-6011-acres-5-years/

enforcement with large operating costs. Also, linking such monitoring tools with economic incentives (such as access to financing or to premium markets), can increase both sustainable practices as well as compliance with environmental norms[9].

IV. Key Knowledge questions for focus areas

4.1 A knowledge agenda is fundamental for the IDB Lab to successfully test the innovations in business models and technologies with the greatest potential to benefit people and the environment. The knowledge agenda thus closely tracks the opportunities for impact identified in this overview. The agenda will draw heavily on operations as the main mechanisms to generate data and insights needed to better test hypothesis. This knowledge agenda will be conducted in close coordination with the other parts of the IDBG.

4.2 For CSA there are **four** knowledge priority questions:

i. ***How to scale innovation in an inclusive manner in the value chain?*** Data and information will continue to transform agricultural supply chains and will increasingly become part of the smallholder's reality. IDB Lab will focus efforts in working with partners in the value chain—established and new entrants—to understand how innovations in the value chain can be scaled in an inclusive manner, where producers are able to share in the benefits of a more dynamic value chain. This agenda will expand on work already underway in segments such as coffee and cocoa, where the SAFE Platform is increasingly producing high-quality data on the value chain and will also include a strong push to gain insights from information coming from marketplace platforms and financial intermediaries.

ii. ***What mechanisms can best accelerate the translation of R&D to innovation?*** One of the most significant barriers for LAC to realize the benefits of a more productive and dynamic agriculture is the speed at which technologies are developed and deployed in markets. IDB Lab will collaborate closely with CTI in efforts to better understand how technology can best be converted into innovation that benefits people and the environment. The agenda includes a deeper understanding of the role of technology transfers between R&D and the entrepreneurial ecosystem. This knowledge agenda will also include efforts to better understand the rapidly changing early-stage innovation ecosystem in agtech, building on the recent work by IDB Lab to map out agtech ecosystem players.

iii. ***What mechanisms can accelerate adoption of technology among the excluded and vulnerable?*** One of the most useful developments in economics over the past two decades has been a better understanding of how human integrate information in decision-making. These advances in behavioral economics hold specific significance in agriculture for the adoption of technologies that can improve the lives of people. IDB Lab will collaborate with RES and RND to better understand how this behavior is shaped. By coordinating analytic activity with data and results coming out of operations, the agenda will test new models that integrate principles from behavioral economics in products and services with the potential to raise incomes and build resilience.

[9] Examples include applications using satellite imagery to detect deforestation in the Amazon region (for example Terras App, which detects deforestation in the Amazon, and is used to condition the sale of cattle from the region in Brazil), or Sintecsys, which developed a computing system to early detect fire in forests.

iv. ***What are the most binding constraints to address gender and diversity gaps?*** One of the most pervasive challenges in agriculture is the gender gap, where women are at a disadvantage in access to finance, land titles, productive inputs, and networks. In addition, rural contexts are where some of the most poignant gaps are found among indigenous and afro-decedents. IDB Lab will undertake a review of the magnitude of these gaps in the sector, charting their secular trends, and identifying the main bottlenecks today. IDB Lab will also look prospectively at how the changes that we see in the sector, such as automation, digitalization, and the availability of new technologies, may narrow or exacerbate these gaps.

V. Measuring our impact

5.1 IDB Lab will employ indicators specific to the CSA thematic area, as proposed below, related to smallholder incomes and resilience. These indicators complement IDB Lab Key Performance Indicators (KPIs) used to report on corporate performance and impact. These KPIs—which cover areas such as poverty and vulnerability, gender and diversity, degree of innovation, strategic alignment and scalability—are defined and monitored at the corporate level (not specifically to CSA projects) and therefore are not included in this list.

5.2 The four main objectives and their corresponding indicators for the CSA area are the following:

CSA thematic indicators

Objective	SDG	Indicator
Increased smallholder incomes	SDG 2	Number of smallholders that see increases in incomes
Inclusive economic opportunities	SDG 1 and 2	Number of poor and vulnerable benefiting from IDB Lab's CSA projects
Increase resilience among smallholder producers	SDG 1 and 2	Number of firms that adopt climate-smart adaptation practices and technologies
Contribute to the mitigation agenda	SDG 14 and 15	GHG emissions avoided, reduced or captured

5.3 The proposed indicators are aligned with the overall IDB Lab and IDB Group strategies, and with the broader set of the United Nations Sustainable Development Goals (UN SDGs) to which many companies and institutions of the public domain and civil society have already committed. In particular, CSA indicators are aligned with SDG goal 1 ("No Poverty"), SDG goal 2 ("End hunger, achieve food security and improved nutrition and promote sustainable agriculture"), and SDG goals 14 and 15 (Life on land and life below water).

VI. Working as a Group

6.1 The CSA thematic area will leverage IDBG experience and assets in agriculture, science and technology, natural capital, sustainability, gender and diversity, among others. The IDB Lab Business Plan 2019-2021 emphasizes the need for IDB Lab to align with other parts of the IDBG in order to scale innovation that can address exclusion and vulnerability, as well as environmental challenges, and in order to take advantage of sector expertise, the IDBG financial presence, and the IDBG's public and private links. Given the role of Knowledge in promoting IDB Lab's objectives, collaboration will span both operations and analytic collaboration with other parts of the IDBG.

6.2 IDB Lab can collaborate with CSD and RND in the development of natural capital. The natural capital agenda should be conducted jointly with the CSD and the Natural Capital Lab—a joint initiative with IDB Lab—where IDB Lab will bring its expertise on entrepreneurship, investment and funds, while the Natural Capital Lab and CSD will bring sector-thematic expertise, as well as a close link with public policy and regulation. The Natural Capital Lab will also help connect IDB Lab with global expertise, whereas IDB Lab will provide access to ground-level actors, who are part of its network of partners. This collaboration will likely cut across different IDB Lab thematic areas, as challenges in Natural Capital can be found in all three thematic areas.

6.3 IDB Lab can also work with IDB Invest and RND in developing smarter and more inclusive value chains. IDB Invest's work with anchor companies, cooperatives, and other demand consolidators can serve as a vehicle to scale successful innovations tested, specifically those innovations that generate benefits for smallholders and other vulnerable members of the value chain. IDB Invest can also work closely in developing agtech solutions, as IDB Lab focuses on early-stage firms and ventures, and IDB Invest focuses on later-stages, such as growth. Given the public sector's presence in extension work, as well as financing of the Ag sector, RND's presence can also be important to maximize the benefits of public policy programs for the inclusive development of value chains. In that regard, IDB Lab also plans on working with INT to leverage its convening power and its network of local and international actors in the agriculture world to contribute to discussions on fair trade, international prices management and access of LAC's agricultural products to new export markets.

6.4 IDB Lab can also work with CTI, IDB Invest and RND (including FONTAGRO), in working with the science, technology and innovation ecosystem in agriculture. CTI in particularly has a public sector dialogue, and a broad experience with R+D and with national innovation ecosystems, both of which are fundamental for R+D to translate to innovation in an inclusive manner. RND also has a strong presence with national centers for Ag research and innovation, which can be important partners in the CSA thematic area. IDB Lab is also collaborating with RND in the update of IDB's Agriculture Sector Framework. Also, IDB Lab can work with CTI to help addressing a key constraint for the adoption of inclusive innovation in rural settings: internet connectivity. Also, collaboration with SCL is key to ensure that populations severely affected by poverty, climate change or excluded populations have access to social policies and safety nets. IDB Invest can also be an important partner in the agtech innovation ecosystem through their participation in later-stage funds, and later-rounds of investment in companies in the agtech space. Finally, IDB Invest and IDB Lab could collaborate, together with RES and RND in a joint knowledge agenda to better understand farmer's decision making in the context of technology adoption.