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PANAMA

BLOCKCHAIN AND PRECISION: INNOVATING WITH FARMERS IN THE RICE CHAIN IN PANAMA

(PN-T1321)

DONORS MEMORANDUM

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PROJECT SUMMARY

BLOCKCHAIN AND PRECISION: INNOVATING WITH FARMERS IN THE RICE CHAIN IN PANAMA

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Rice is the main staple food in Panama, which, in turn, is one of the countries with the highest per capita consumption in the world (154 pounds per year). Its value chain represents a sector that generates US$350 million annually in production and industrial processing revenues. However, the country has been facing a continuous loss of self-sufficiency in domestic rice production, to the point that it imports 50% of its requirements, according to a 2019 study by IICA Panama.

Overall profitability is precarious for most of the 1,400 mechanized rice producers. In an analysis of the productive and economic situation of the top 20 farms in the country, it was determined that several of them would be operating at a loss or without turning a profit without government compensation or subsidies, particularly in the rain-fed mechanized rice system, where 33% of the farms were found to be in this situation, and even some others in the irrigated system where 25% of the farms were located.

The current production model also has an adverse environmental impact. According to the current, ex ante environmental impact assessment using the Leopold Matrix,[1] rain-fed and irrigated rice is negative, given that most of the 1,400 mechanized rice producers in Panama (95% of national supply) that cultivate 80,000 hectares employ poor cultural rice management practices that adversely impact their own profitability and the environment.

This project consists of piloting with 100 mechanized rice producers a “precision” production model based on science, technology, innovation, and the application of good official rice practices (nationally appropriate mitigation actions (NAMAs)) that will: (i) boost the profitability of rain-fed producers, and (ii) reduce greenhouse gas emissions by 40%.

To achieve these results, the solution envisages activities with two complementary areas of work: (i) A farmer field school (FFS) methodology to train and support producers for two years to reconvert their rice farms towards a new sustainable and inclusive model of precision rice cultivation through the application of NAMAs; and (ii) put together a blockchain-based digital ecosystem in collaboration with three partner startups in order to improve production planning, monitoring and traceability, and to generate reliable data for the sale of carbon credits.

The project will be implemented by the Panama office of the Inter-American Institute for Cooperation on Agriculture (IICA), an agency that has been working with rice producers for several years. The project is aligned with the IDB Group’s Vision 2025, which seeks to reactivate the productive sector by promoting digital technology and greater connectivity for rural producers.

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[1] Developed in 1971 in response to the United States National Environmental Policy Act of 1969.

ABBREVIATIONS

ANALMO	Asociación Nacional de Molineros de Arroz [National Rice Millers Association]
ANDIAN	Asociación Nacional de Distribuidores de Insumos Agropecuarios y Maquinaria [National Association of Distributors of Agricultural Supplies and Machinery]
CH_4	Methane
CO_2	Carbon dioxide
CO_2eq	Carbon dioxide equivalent
CPN	Country Office in Panama
CSA	Climate-smart agriculture
CSD	Climate Change and Sustainable Development Sector
DICI	Diagnostic Assessment of Institutional Capacity and Integrity
FCA	Facultad de Ciencias Agropecuarias [Agricultural Science School] of Universidad de Panamá
FEDAGPA	Federación de Productores Arroceros de Panamá [Federation of Rice Producers of Panama]
FFS	Farmer field school
FLAR	Latin American Fund for Irrigated Rice
GHG	Greenhouse gas
Ha	Hectare
IDB Invest	Inter-American Investment Corporation
IDB Lab	Multilateral Investment Fund
IDIAP	Instituto de Desarrollo e Investigación Agropecuaria de Panamá [Institute for Agricultural Research and Development of Panama]
IICA	Inter-American Institute for Cooperation on Agriculture
MIDA	Ministry of Agricultural Development
MRV	Monitoring, review, and validation
MSMEs	Micro, small and medium-sized enterprises
N_2O	Nitrous oxide
NAMA	Nationally appropriate mitigation action
NDS	Nationally determined contributions
PIASI	Sustainable and Inclusive Agricultural Innovation Project (PN-L1166)
SDG	Sustainable Development Goal (of the 2030 Agenda for Sustainable Development)
UNDP	United Nations Development Programme

EXECUTIVE SUMMARY

BLOCKCHAIN AND PRECISION: INNOVATING WITH FARMERS IN THE RICE CHAIN IN PANAMA

(PN-T1321)

Country and geographic location:	Panama, in the provinces of Chiriquí, Veraguas, and Coclé.		
Executing agency:	Inter-American Institute for Cooperation on Agriculture (IICA) in Panama		
Focus area:	Climate-smart agriculture		
Coordination with other donors/Bank operations:	The project complements and is compatible with the Bank's operation PN-L1166 "Sustainable and Inclusive Agricultural Innovation Project" in Panama. In addition, CMF's operation PN-L1179 with Banco Nacional de Panamá seeks to provide financing to priority productive sectors, including Panama's agricultural sector.		
Project beneficiaries:	The project will directly benefit 100 mechanized rice producers and 500 people related to the rice production chain (30% women and 30% young people up to 29 years old). The environment will also be a direct beneficiary through an emissions reduction of at least 5,250 tons of carbon dioxide equivalent		
Financing:	Technical cooperation funding:	US$ 577,000	48%
	Total IDB Lab contribution:	**US$ 577,000**	
	Counterpart contribution:	US$ 633,700	52%
	Total project budget:	**US$1,210,700**	**100%**
Execution and disbursement periods:	Execution period: 30 months; deadline for the last disbursement: 36 months		
Special contractual conditions:	The following will be conditions precedent to the first disbursement: (a) agreement between the executing agency and the three startups in the project's digital blockchain ecosystem detailing the scope of work and intellectual property agreements reflecting what has been agreed in this project; and (b) designation of the project coordinator(s).		
Environmental and social impact review:	The project has been classified as a Category B operation, according to the Bank's Environmental and Social Policy Framework (document GN-2965-21), given that the specific environmental and social impacts that could occur are limited, reversible, and can be resolved with mitigation measures.		
Unit with disbursement responsibility	Bank's Country Office in Panama (COF/CPN)		

I. THE PROBLEM

A. Context and description

1.1 Rice is the main staple food in Panama, which, in turn, is one of the countries with the highest per capita consumption in the world (154 pounds per year). Its value chain represents a sector that generates US$350 million annually in production and industrial processing revenues. However, according to the Ministry of Agricultural Development (MIDA), the country has been facing a continuous loss of self-sufficiency in domestic rice production, to the point that it imports 50% of its requirements.

1.2 **Overall profitability is precarious for most of the 1,400 mechanized rice producers.** In an analysis of the productive and economic situation of the top 20 farms in the country conducted by IICA in 2019, it was concluded that several of them would be operating at a loss or without turning a profit without government compensation or subsidies, particularly in the rain-fed mechanized rice system, where 33% of the farms were found in this situation, and even some others in the irrigated system where 25% of the farms were located. Overall, 25% of the 20 farms would be losing money were it not for the government subsidy.

1.3 **The current model also has an adverse environmental impact.** Although Panama has a low climate risk index of over 100,[2] there are regions within the country with a higher degree of vulnerability to climate change, including the project intervention areas. In this context, according to EUROCLIMA+ 2021, the main greenhouse gas (GHG) emitting activities in the agricultural sector in Panama are livestock and agricultural soils, where rice is in fourth place. Overall, rice production is a major source of anthropogenic GHGs, accounting for up to 55% of total GHG emissions from agricultural soils (IPCC, 2013). In addition, the current, ex ante environmental impact assessment using the Leopold Matrix[3] concludes that the impact of rain-fed and irrigated rice production is negative, given that most of the 1,400 mechanized rice producers in Panama (95% of national supply) that cultivate 80,000 hectares employ poor cultural rice management practices that adversely impact their own profitability and the environment.

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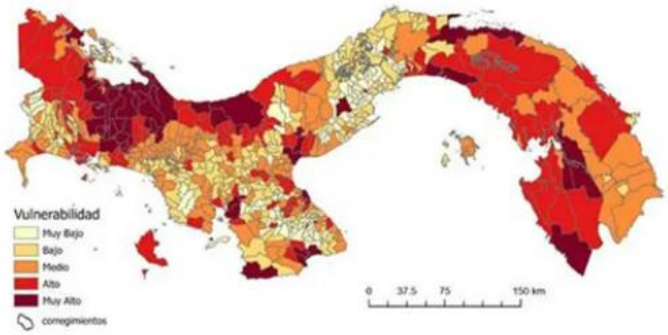
2 Global Climate Risk Index, 2000–2019 Ranking.

3 Developed in 1971 in response to the United States National Environmental Policy Act of 1969.

Climate Change Vulnerability Index in Panama



1.4 These poor practices are grouped into seven activities, as revealed by work on a sample of 300 rice producers between 2020 and 2021 in the framework of the EUROCLIMA+ project co-executed by IICA and MIDA Panama with support from the European Union:

- **Deficient soil preparation:** Almost all mechanized producers fail to start soil preparation activities in a sufficiently timely manner and most carry out rapid and imperfect soil preparation, including leveling, which affects production yields and wastes inputs (seed, water, fertilizers, etc.).
- **Absence of soil sampling and analysis:** This is due to a lack of understanding of its importance—it is erroneously considered an expense; there is also a dearth of expeditious and timely laboratory services. This leads to over- or under-application of fertilizer without knowledge of the actual needs of the plant and its absorption, resulting in increased costs, vulnerable plants due to being poorly nourished (under- or over-fed), and pest, insect and weed problems.
- **Poor-quality seed or over-application:** Producers tend to use poor-quality seed drawn from their own harvests, bought without certification, or of dubious origin. This occurs due to (i) a misunderstanding of the importance of using quality seed suited to the local conditions and soil characteristics, (ii) a lack of good seed, and/or (iii) the high price of certified seed. This leads to problems of poor germination and weak crop growth, making it susceptible to pests and diseases, which in turn will require the use of pesticides, correctors, fertilizers, and other inputs. In addition, the overseeding exceeds the correct density per hectare, which not only causes unnecessary expense, but also makes them compete for nutrients, weakening yields and production volumes.
- **Incorrect fertilization:** As a result of no soil analysis and incorrect fertilization plans, not having good soil preparation, not using good quality seed, not seeding with a hopper for broadcast planting, and exceeding the planting density per hectare, farmers are unaware of their crops' nutritional needs and resort to fertilization—either too little or too much—resulting in low yields and high costs. In addition, excessive fertilizer use has negative environmental impacts, including eutrophication of water bodies (when they fill with algae that in some cases are toxic), since the excess fertilizers are usually washed by rain into

rivers, streams, and lakes. At the same time, the use of synthetic nitrogen fertilizers to increase crop yields produces nitrous oxide (N_2O), a greenhouse gas (GHG) 300 times more potent than carbon dioxide (CO_2).

- **Excessive pesticide use:** Producers generally do not implement an effective integrated pest and disease management plan, are vulnerable due to failing to employ good practices, tend to make chemical-based responses in urgent situations that lead them to apply excessive amounts of chemicals that are often restricted or even prohibited, while following the recommendations of commercial companies that do not conduct a proper entomological inspection of their land to measure the economic threshold of the need for timely application. Producers currently apply pesticides based on technological packages supported by assumptions, resulting in ineffective controls, contamination of the environment and humans, high production costs, and low yields.
- **Poor harvest and post-harvest planning** in relation to equipment availability and mill intake capacity, resulting in grain loss at harvest due to overripening of the grain, which in turn affects the final yield of the crop and reduces the producer's profits.
- **Lack of accurate land leveling** due to lack of expertise, high cost, or lack of available machinery. The less ground leveling done, the greater the inefficiency in the use of water, nutrients, and pesticides, and the greater the occurrence of pests and diseases. The result is higher production costs per unit produced and higher greenhouse gas emissions. In flooded soils, methane (CH_4) emissions can be up to 90% higher than in cases where water is used differently.

1.5 In short, the negative impacts on the environment and on the bottom line of producers are multiplied by lack of planning of the phenological cycle of rice, and by a lack of real and accurate data to help producers make decisions based on technology and best practices (prior soil analysis, accurate determination of macro- and micronutrient requirements, application of fertilizers in inadequate proportions, seed use, planting density, etc.). This is compounded by the lack of transparent traceability of information on production in the value chain, which presents a barrier to financial support and insurance institutions for the agricultural sector.

II. THE INNOVATION PROPOSAL

A. Project description

2.1 The **main objective of the project** is to increase profitability and reduce greenhouse gas emissions of mechanized rice producers through a pilot with 100 producers that promotes the adoption of a precision production model based on science, technology, and innovation. **Specifically, the project seeks** the adoption of new rice production nationally appropriate mitigation action (NAMA) practices and reliable digital traceability in their implementation in production to: (i) increase the profitability of rain-fed farmers from US$0.06/dollar invested to a minimum of US$0.35/dollar invested (400% increase) and irrigated farmers from US$0.25/dollar invested to US$0.75/dollar invested (200% increase), in both cases as a result of the combined effect of reduced costs and increased output/hectare (ha); and (ii) reduce greenhouse gas emissions by 40% and capture between 5,250 tons of

carbon dioxide equivalent (CO_2eq),[4] which can be turned into carbon credits as additional income to producers (US$5.5/hectare in the voluntary market) and as part of the nationally determined contributions (NDS).

2.2 **To achieve these results, the solution envisages an intervention with two complementary areas of work:** (1) A farmer field school (FFS) methodology to train and support producers for two years to reconvert their rice farms towards a new sustainable model of precision rice cultivation through the application of NAMAs; and (2) put together a blockchain-based[5] digital ecosystem in collaboration with three partner startups in order to improve production planning, monitoring and traceability, and to generate reliable data for the sale of carbon credits. Although there are some initiatives in the region that use blockchain technology for agriculture, few, if any, have focused their efforts on combining the elements of traceability, farm monitoring, and its use for issuing carbon credit certificates, as the project proposes.[6]

2.3 **Nationally appropriate mitigation actions (NAMAs).** NAMAs are policies, regulations, programs, and other types of measures that reduce GHG emissions from their trend or "business as usual" levels and that, in turn, contribute to achieving the sustainable development goals of the countries in which they are implemented. The Panama rice production NAMA has been registered in the NAMA Registry with ID number NR-338 under the type "NAMAs seeking support for implementation."[7] This means that the rice production NAMA has been analyzed and made official by the Directorate for Climate Change of the Ministry of Environment in Panama and that the country is seeking funds to support producers in its implementation.[8] NAMAs will form the basis of the curricular content on new production practices in the project's FFS.

2.4 **Farmer field schools (FFS).** In this context, the Inter-American Institute for Cooperation on Agriculture (IICA) has applied the FFS methodology in several crops and countries, and specifically in the case of Panama, it has done so with rice in 2020 and 2021. In the country as a whole, it has developed 15 FFSs encompassing 300 rain-fed and irrigated mechanized rice producers. In 80% of cases, the profit/cost of the plots increased as a result of applying good practices, and a significant reduction (around 40%) in GHG emissions was achieved.[9] Using the FFS methodology within the framework of the project, five groups of 20 producers distributed around three geographical production hubs will be formed (one group per region of the country: Chiriquí, Veraguas, Coclé); they will work together to build capacities over a period of two years, applying improvements in rice production in

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4 Carbon dioxide equivalent is a universal measure used to indicate, in terms of CO_2, the equivalent of each greenhouse gas (GHG) in terms of its global-warming potential. GHGs other than CO_2 that are generated by agricultural activity include N_2O, and CH_4 (with diesel machinery alone). All this translates into CO_2eq.

5 Blockchain is a set of technologies that allow a secure, decentralized, synchronized, distributed record of digital transactions, without the need for third party intermediation.

6 *Mapeo de Casos de Uso de Blockchain para las Cadenas Agropecuarias en América Latina*, IDB Lab, March 2022, Internal document.

7 https://www4.unfccc.int/sites/publicnama/SitePages/Home.aspx.

8 According to note DM-0947-2022 of 25 May 2022 from the Ministry of Environment.

9 *Reporte de mediación de la emisión de Gases Efecto Invernadero*, Pontificia Universidad Católica de Valparaiso-Núcleo Biotecnología Curauma-IICA, 2021.

seven main areas that make up the NAMA: Soil analysis, fertilization plan based on soil analysis, use of certified seeds, optimal planting density (2qq/ha), insect prevention and monitoring, and pest and disease prevention.

2.5 As initiatives to facilitate the adoption and replication of the knowledge acquired in the FFSs: (i) technical instructors will complement the instruction with mentoring and supervision of producers in planned visits to their farms, (ii) the executing agency will create connections to credit sources (Banco Nacional, BDA, and others) for producers to obtain working capital, and (iii) for soil analysis, agreements for participation in the project with good prices, as well as for priority analysis and results delivery, will be negotiated with the laboratories of the Facultad de Ciencias Agropecuarias [Agricultural Science School] (FCA) of Universidad de Panamá, Cooperativa de Servicios Múltiples de Productores de Leche de Panamá [Panama Milk Producers Services Cooperative] (COOLECHE), and Instituto de Desarrollo e Investigación Agropecuaria de Panamá [Institute for Agricultural Research and Development of Panama] (IDIAP).[10]

2.6 **Digitalization and use of blockchain.** The second focus of the project will be activated with three international project partners based in Panama; it entails the integration of a blockchain-based digital ecosystem that will become part of the day-to-day activities of the producers. Given the immutable nature of blockchain technology, it is the ideal means for recording every instance of food production. At the same time, it can be audited by any actor in the chain from any location.[11] Activities will proceed as follows:

2.7 **Yttrium (alerts and monitoring)** will assign a digital identity to the farms[12] and develop an open source application with a specific algorithm to be developed for the rice chain that will send early alerts to producers' mobile phones,[13] for purposes of monitoring and alerts on variables such as water stress, fertilization, identification of insect, pest and disease manifestations, to be specified "on the ground" in direct relation to the NAMAs, using satellite information and artificial intelligence for the analysis of data crossed with atmospheric variables from the United States National Oceanic and Atmospheric Administration (NOAA). The project will finance the development and definition of the business model for the sustainability and accessibility of this solution.

2.8 **Foodchain (Planning and traceability NAMAs)** will, for the two years of project implementation, provide free of charge its blockchain-based platform for operational traceability of production, as well as incorporating monitoring, review, and validation (MRV) of rice production NAMA implementation by producers. The platform has already been successfully tested in pilots as well as in beta tests carried out in Uruguay in the case of bone-in sheep meat for export to the United States and in

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10 Priority will be given to work with IDIAP where project PN-L1166 will promote infrared spectrometry technology for soil analysis, which is more cost-effective than conventional techniques.

11 *Mapeo de casos de uso de Blockchain en las cadenas de valor agropecuarias, América Latina y El Caribe*, Diego Grasso for IDB Lab, March 2022.

12 This activity will be coordinated with MIDA to make the use of the information compatible with Panama's Integrated Agricultural Management System.

13 The project will be able to identify all the rice farms in the country, thus helping to offset the need for a rice producers census, which the country does not have.

the case of seedless table grapes in Peru. The project will finance the adaptation of the nomenclature for the rice chain and the NAMA. After the pilot, the annual subscription will be offered for one year at no additional cost (to be fine-tuned), ranging from US$50 to US$1,000 per year depending on the size of the farm, but will remain free for producers with farms of 10 hectares or less.

2.9 **Climate Trade (carbon credits)**[14] will participate in the certification of the reduced environmental impact of farms that will already possess a digital identity and blockchain-certified evidence of NAMA compliance to offset the reduction of CO_2 emissions for sale on the voluntary global carbon credit market. Currently the market price is approximately US$5.5/ha. Climate Trade's business model is based on charging a fee for trade transactions.

2.10 **The direct beneficiaries of the project will be the 100 mechanized rice producers in the pilot project and 500 people involved in their production chain.** Producers are defined as people who devote 60% of their activity to rice production in order to generate at least 50% of their income (since it is common for them also engage in livestock farming) and make rice production a way of life. The project beneficiaries will be selected from the universe of 1,400 mechanized rice producers in Panama who cultivate 80,000 hectares to produce 95% of the country's rice.[15] This universe has the following characteristics:

Mechanized rice producers Panama

Size	Number (%)	Farms	Net Income* (USD)
Micro	112 (8%)	< 10 ha	$1,500
Small	238 (17%)	10 - 30 ha	$4,500
Medium	770 (55%)	30 -150 ha	$15,000
Large	280 (20%)	> 150 ha	$70,000
Total		**80,000 ha total**	

Water system		Gender	
Rain-fed	86%	Women	210 (15%)
Irrigation	14%	Men	104 (76%)
		Entities	126 (9%)

Geographic hubs	
Chiriquí	41%
Coclé	16%
Veraguas	12%
Panamá Este	12%
Los Santos	9%
Other	10%

* The estimate of net income corresponds to 1 production cycle per year and is based on the application of a benefit-cost rate of 6% on an average investment of US$2,500/ha.

2.11 **The final selection criteria for the 100 producers** participating in the project will be agreed upon by the strategic partners and key stakeholders considering factors including: (i) representation of small producers (<10 ha), medium

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14 https://climatetrade.com/: Climate Trade operates by offering innovative carbon offset and management services using digital tracing technologies. It has more than 500 companies that are clients of its services, as well as important partners such as Alastria, the International Chamber of Commerce of Spain, and the Climate Chain Coalition.

15 ANALMO, 2021 data.

producers (10–30 ha), and large producers (30–150 ha); (ii) producers located in at least three rice-growing regions of the country (Chiriquí, Veraguas, and Coclé), (iii) use of the two water systems (rain-fed and irrigation);[16] (iv) land tenure: owners (with at least a title of ownership) or tenants, and (v) producers who are creditworthy (formal or informal), preferably a high percentage who are already banked to facilitate obtaining working capital loans to replicate the NAMAs on their farms. For the selection of the plots that will act as field schools, priority will be given to regions where there are producers who own precision planting machinery and are willing to share with other producers.

2.12 **The 500 people involved in the rice production chain** will be members of the immediate family and/or people in the producers' close social circle who are consistently involved in production.

2.13 **Gender and diversity:** The participation of at least 30% women and 30% young people up to 29 years of age in the group of people involved in the rice production chain will be sought. Communication and awareness campaigns will be developed with the aim of attracting young people and women, who will receive virtual training from rice production NAMA FFSs, as well as in the use of blockchain digital ecosystem platforms (WebGIS, Foodchain, and Climate Trade). This will encourage greater participation of these groups in income-generating activities in the rice chain with differentiated roles and a focus on digital skills.

2.14 The environment will also benefit from the achievement of an emissions reduction of at least 5,250 tons of CO_2eq within the framework of the project, which is expected to continue and increase over time.

2.15 **Ethical and responsible use of technology and data.** The project will promote the ethical and responsible use of personal data and will use IDB-documented best practices as a reference. At the same time, it will be framed by fAIr LAC partnership criteria with respect to technology use, as well as the Principles for Digital Development.

B. Components and activities

Component 1. Digital blockchain ecosystem (IDB Lab: US$269,510; Counterpart contribution: US$99,600)

2.16 This component consists of providing the 100 producers in the pilot with planning tools for the rice phenological cycle, as well as real and accurate data to help them make technology-based decisions. Specifically, the executing agency will support producers in the implementation of preventive alerts with satellite information on the behavior of the crop for each participating producer, to trace the activities carried out in the course of the phenological cycle of each rice crop plot and have an MRV record of GHG reduction, as well as the placement of carbon credits on the Climate Trade platform for their offer on the international voluntary market, making all the information interoperable between the Foodchain, Yttrium, and Climate Trade platforms, whose activities will be carried out on the LACChain blockchain network led by IDB Lab.

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[16] Rain-fed agriculture is a method of cultivation that relies exclusively on rainwater, without any artificial irrigation (irrigated agriculture).

2.17 To achieve the objectives of this component, financing will be provided for the following activities: (i) incorporation of artificial intelligence into the Yttrium platform; (ii) system adaptations of the existing Foodchain and Yttrium platforms to incorporate categories of records for rice activity and MRV and artificial intelligence records, respectively; (ii) field testing of the platforms and launch of the systems; (iii) support for the implementation of the traceability of rice phenological cycle activities with Foodchain and issuance of alert reports with Yttrium; (iv) training for producers participating in the pilot and other indirect stakeholders; (v) travel costs to rural areas.

2.18 The outcomes of this component include: (i) at least 75% of the producers participating in the rice pilot use the new digital blockchain platforms on their farms: (a) Foodchain system to develop rice traceability and NAMA MRV records; (b) identification of their plots on Yttrium's WebGIS platform and receipt of weekly reports of indicators of health, moisture, the behavior of their crop throughout the phenological cycle, and compromised areas; and (ii) 12,000 weekly crop index reports for producers from the Yttrium platform.

Component 2. Field school training (IDB Lab: US$231,990; Counterpart contribution: US$287,500)

2.19 The second component aims to train the 100 producers in the pilot on how to apply the rice production NAMA on their farms to achieve a reduction in CO_2 of at least 5,250 tons and offer them on the international voluntary market, while increasing the producers' profitability from US$0.06 to US$0.36 per dollar invested. In addition, it will provide virtual training at FFSs to 500 people involved in the rice production chain on the rice NAMA and use of the WebGIS, Foodchain, and Climate Trade platforms.

2.20 The main partners for this component are the executing agency through its field schools; Yttrium, Foodchain, and Climate Trade; and members of Asociación Nacional de Molineros de Arroz [National Rice Millers Association] (ANALMO), Asociación Nacional de Distribuidores de Insumos Agropecuarios y Maquinaria [National Association of Distributors of Agricultural Supplies and Machinery] (ANDIAN), Federación de Productores Arroceros de Panamá [Federation of Rice Producers of Panama] (FEDAGPA), MIDA, IDIAP, Banco Nacional, Banco Delta, the Latin American Fund for Irrigated Rice (FLAR), and the FCA of Universidad de Panamá. With all of them, the executing agency will sign cooperation agreements or appropriate contracts that support this collaboration, both in this component and in the others in which they will be involved.

2.21 Financing will be provided for the following activities, which will be coordinated and directed by the executing agency: (i) preparation of the field schools, which includes the physical and digital curriculum integration, new materials, selection of farm schools, and technician training; (ii) invitation and selection of producers, including development of campaigns and attraction of young people and women, field inspections, and selection of producers; (iii) deployment of training, which includes development of five field schools with two production cycles each and monitoring and evaluation of knowledge acquisition by producers; and (iv) individualized technical and supervisory support for each producer and their plots.

2.22 The expected outcome of this component is that at least 75% of producers apply the rice production NAMA on their farms.

Component 3. Knowledge management and dissemination (IDB Lab: US$10,000; Counterpart contribution: US$47,000)

2.23 The objectives of this component are to: (i) achieve the implementation of the NAMA and demonstrate its benefits with a view to its scalability for all rice producers; (ii) establish a usable MRV system for GHG emissions; (iii) establish satellite identification (artificial intelligence) of all rice farms in the country; (iv) develop national capacities for scientific measurement of the GHG emissions and application of the Leopold methodology; (v) raise awareness among actors involved in the rice chain (institutions, producer organizations, young people, and women).

2.24 The main activities of this component to be implemented by the executing agency are to: (i) systematize and disseminate the experience; (ii) develop an MRV system; (iii) provide training in GHG measurement; and (iv) develop virtual and theoretical training courses for other actors in the rice chain.

2.25 The main partners of this component and their main activities are: The University of Valparaiso in Chile will provide measurements and training; the FCA will provide an FFS on its campus and certified seeds; FLAR will train technicians from the FFS team and offer professional services to producers participating in the pilot; Agrosilos will provide its technological capabilities and various resources; and the platforms of the companies Yttrium, Foodchain, Climate Trade, and IICA will offer their training to other actors in the rice chain.

C. Project measurement, monitoring, and evaluation

2.26 The project indicators are aligned with the Bank's Corporate Results Framework and climate-smart agriculture (CSA) indicators. The project is expected to achieve the following outcomes by the end of the three-year execution period: (i) at least 75% of the producers will have improved their profitability per dollar invested from US$0.06 to US$0.36; (ii) at least 70% of the producers will have reduced their GHG emissions by at least 5,250 tons of CO_2; (iii) 4,725 tons of CO_2 are offered on the Climate Trade platform as carbon credits for the voluntary market.

2.27 **Monitoring and evaluation system.** Given that the executing agency and the digital platforms manage a database of participants digitally and in a blockchain, as well as a system of periodic reports, it will be possible to determine compliance or noncompliance with the established indicators and planned activities.

2.28 The information from the different systems and digital platform to be developed for the production phases will enable real-time monitoring and evaluation of results. The executing agency will also conduct surveys and visits to the plots to monitor compliance with the application and replication of the rice production NAMA, enabling the project objectives to be achieved and learning experiences to be systematized with a view to being shared with partners and stakeholders for their information and scalability.

2.29 As part of the environmental and social due diligence required by the Bank's Environmental and Social Policy Framework, the IDB Lab team has reviewed the project for consistency with the Bank's Environmental and Social Performance Standards. Based on this review, the project has been classified as a Category B

operation, according to the Bank's Environmental and Social Policy Framework, given that the specific environmental and social impacts that could occur are limited, reversible, and can be resolved with mitigation measures.

2.30 The principles of the relevant Performance Standards have been applied to the project design and the environmental and social risks will continue to be monitored throughout the project's life cycle. In this regard, the executing agency will establish baselines (for NAMAs) and report annually to IDB Lab the results of monitoring: (i) reduction in GHG emissions; (ii) reduction in the use of WHO Class 1a/1b and Class 2 pesticides; (iii) nutrient management and reduction of fertilizer use; (iv) water consumption; (vi) increased productivity in yield/ha; (v) external complaints concerning the project (if any); (vi) number of young people and percentage of women trained in the use of digital monitoring technologies; (vii) number of women taking up supervision roles in project implementation; (viii) incidence of child labor (if any); (ix) number of trainings on environmental and social issues; and (x) adoption of integrated pest and disease management on farms (number of farms and hectares).

2.31 As part of the IDB Lab project supervision model, resources will be allocated to conduct an evaluation of the project's results, should IDB Lab determine learning, sustainability, and scaling needs.

2.32 **Assessments and agenda of knowledge:** In the project, assessments will be conducted based on implementation needs, challenges, and results achieved, with priority given to the effectiveness of the model and the replicability of the experience in terms of implementing technologies among small cocoa producers.

2.33 The project could contribute answers to the key knowledge questions defined in the thematic paper on CSA in its bid to test innovations in business models and technologies with the greatest potential to benefit people and the environment. These include: (i) Was the project effective and to what extent were the results achieved? (ii) How can innovation in the value chain be scaled up? Data and information will continue to transform agriculture and all agricultural supply chains and will increasingly become part of the reality of small producers. (iii) What mechanisms can accelerate technology adoption? One of the most useful advances of the last 20 years in economics has been a better understanding of how humans integrate information into decision-making. These advances in behavioral economics are especially important in agriculture for the adoption of technologies that can improve people's lives. (iv) What are the major constraints to addressing gender and diversity gaps? The gender gap is one of the most prevalent challenges in agriculture, a sector in which women are at a disadvantage in terms of access to financing, land titles, productive inputs, and networks.

III. Alignment with the IDB Group, Scalability, and Project Risks

A. Alignment with the IDB Group

3.1 The project is aligned with the IDB Group's Vision 2025, which seeks to reactivate the productive sector by promoting digital technology and greater connectivity for rural producers. The project offers a technological solution and an opportunity for this productive sector to increase its profitability and resilience to climate change. It is also aligned with the Agriculture and Natural Resources Management Sector

Framework Document, the Climate Change Sector Framework Document (document GN-2835-8), and the Bank's Strategy for Climate Change Adaptation and Mitigation, and Sustainable and Renewable Energy.

3.2 The project contributes to the Bank's country strategy with Panama 2021-2024 (document GN-3055), specifically with the priority of reigniting and diversifying productive activity by strengthening agriculture-specific services to boost their competitiveness, paying particular attention to the management, promotion, and sustainable utilization of cultural and natural heritage, environmental sustainability, climate change adaptation, access to markets, and public-private coordination.

3.3 The project complements and is compatible with the Bank's operation PN-L1166 "Sustainable and Inclusive Agricultural Innovation Project" (PIASI) in Panama, led by the Environment, Rural Development, and Risk Management Division (RND), in that the public institutions involved in the project are coexecuting agencies of PIASI, and the general objectives of the project are similar to PIASI's specific objectives to: (i) increase farm profitability; (ii) improve resilience of the farms to shocks (climate, pests, and diseases); and (iii) increase the environmental sustainability of the farms'agricultural activities. Within this framework, opportunities for learning exchange and a coordinated approach to the country's public institutions will be sought, recognizing that the target beneficiaries and the strategic approach of the operations are different.[17] In addition, Connectivity, Markets, and Finance Division's (CMF) operation PN-L1179 with Banco Nacional de Panamá seeks to provide financing to priority productive sectors, including Panama's agricultural sector.

3.4 The project responds to the IDB Lab priority area, CSA, and the agriculture and natural capital vertical, as it represents a way to address the two established thematic challenges of increasing the income, sustainability, and climate resilience of small farmers, and regenerating the environment and mitigating climate change.

3.5 More than 80% (US$501,500) of the operation's resources (total of components 1 and 2) are invested in climate change mitigation and/or adaptation activities, according to the multilateral development banks' joint methodology. These resources contribute to the IDB climate finance goal of 30% of the annual volume of approvals.

3.6 The project is also aligned with the following Sustainable Development Goals (SDGs) adopted by the United Nations General Assembly: (i) SDG 8 - Decent work and economic growth; Target 8.2: achieve higher levels of productivity through an increased supply of skilled workers; (ii) SDG 12 - Responsible Production and Consumption; Target 12.2: achieve the sustainable management and efficient use of natural resources. And lastly, (iii) SDG 13 - Climate Action: Target 13.1: strengthen resilience and adaptive capacity to climate-related hazards and natural disasters.

B. Scalability

3.7 The Project contemplates a scalability strategy initially in Panama and then in the region. In Panama it would be scaled up on two levels. First, in the expansion of the intervention model and the implementation of the NAMA with traceability to

[17] The sole beneficiaries of PIASI are small family farmers, and the strategic vision is not to promote a particular crop.

encompass the remaining 1,300 mechanized rice producers in the country with leadership. Second, by using the model as a general framework, adjusted to other value chains in Panama, which should already have the corresponding NAMAs defined. Scalability in the rice chain in Panama requires the involvement of MIDA, the private rice sector, and banks as three key actors in the process, as well as the three strategic partners in the digital blockchain ecosystem created within the project's framework. Accordingly, following the design of the project, IICA has begun to mobilize resources in parallel with an ongoing request for US$4.9 million from the Green Fund in Korea.

3.8 At the regional level, IICA could take the lead in scaling up the rice chain in other countries with similar conditions and adapting it to each situation. This will require the existence of the corresponding NAMA or its inclusion as a goal to be developed, along with local resource mobilization in each country.

C. Project and institutional risks

3.9 **Risk of low uptake by producers:** That fewer than 75% of producers replicate the NAMAs or use the digital tools in rice cultivation on their farms. **Mitigation:** (i) Apply individual on-site technical assistance on each farmer's farm between each training module; (ii) establish bridging partnerships with funding sources to operationalize the NAMAs; (iii) consider the inclusion of five replacement farmers at each FFS.

3.10 **Technological risk:** Unexpected failures in technical interoperability between platforms in the digital blockchain ecosystem. **Mitigation:** (i) IICA will continue to facilitate the ongoing weekly dialogue among the three startups to achieve the collaborative and technical integration that began in the project design phase; (ii) as a last resort, operation would be undertaken on an individual basis.

3.11 **Governance risk:** Inadequate coordination or participation among stakeholders or institutions. **Mitigation:** (i) Use IICA's existing framework agreements with participating institutions to establish formal, project-specific collaboration agreements with clearly defined responsibilities and operational processes; (ii) IICA will lead the implementation of the overall governance structure established in the project design.

3.12 **Climate externality risk:** Presence of force majeure events (e.g., natural disasters or extreme weather events). **Mitigation:** (i) there will be insurance coverage with ISA that includes catastrophic and climate-change effects, (ii) implement corrective measures or reschedule activities.

IV. Instrument and Budget Proposal

4.1 The project has a total cost of US$1,210,700. Of that amount, US$577,000 (48%) will be contributed by IDB Lab as nonreimbursable technical-cooperation funding. The counterpart contribution of US$633,700 (52%) will be provided by IICA Panama and the organizations participating in the project in cash and in kind. IDB Lab resources will be used to finance technical assistance, training activities, installation of the digital blockchain platform ecosystem for the rice chain, and project coordination costs.

Components	IDB Lab	Total local counterpart contribution		Total
		Counterpart Cash	Counterpart In kind	
Component 1. [Digital blockchain ecosystem]	269,510	10,000	89,600	369,110
Component 2. [Field school training]	231,990	171,500	116,000	519,490
Component 3. [Knowledge management and dissemination]	10,000	22,000	25,000	57,000
Administrative costs	35,500	79,100	78,500	193,100
Evaluations, audits and contingencies	30,000	15,000	27,000	72,000
Total	**577,000**	**297,600**	**336,100**	**1,210,700**
	48%	**25%**	**27%**	

* Indicates resources that may be disbursed and used by the Bank without the requirement of a disbursement request from the executing agency.

V. EXECUTING AGENCY AND IMPLEMENTATION STRUCTURE

A. Description of the project executing agency

5.1 The Inter-American Institute for Cooperation on Agriculture (IICA) Panama will be the project executing agency and will carry out the contracting and monitoring processes, contributing its high managerial, technical, operational, and administrative capacity to coordinating the actors and ensuring the harmonious implementation of each component and the achievement of the established objective and targets. The executing agency will also be responsible and accountable to the Bank for coordinating the implementation of the activities performed by the organizations taking part in the project.

5.2 IICA is an 80-year-old public international organization created by the 34 member countries of the Organization of American States as well as being part of the Inter-American system. It has a broad presence in the member countries with offices in each one. It has a staff of technicians and specialists in strategic areas related to trade and regional integration, territorial development and family agriculture, agricultural health and food safety, climate change and environment, innovation and technology, and, notably, digitalization, Fab Lab and blockchain. The executing agency has extensive experience in training and knowledge management.

5.3 IICA's main strengths for purposes of the project include:

- Broad convening power, multi-stakeholder coordination, and credibility among the country's rice sectors and public and private institutions.
- Institutional agreements with digital technology developers, including Microsoft, Bayer, Foodchain, Yttrium Technology, and Climate Trade, etc. The experience of its joint implementation with Foodchain of pilot projects in Uruguay and Peru for the traceability of agricultural products and management of carbon credits based on blockchain (soon to be set up in LACChain) is noteworthy.

- Extensive knowledge and successful implementation of FFS, specifically in the rice chain throughout the country, with the participation of 300 producers and the formulation of NAMAs and their approval, as well as the development and application of technical curricula for irrigated and rain-fed rice.
- A team experienced in similar efforts and specifically in the rice chain and in technical components for both the operational coordination of the project, and transparent administration of resources, in addition to a technical team highly experienced in the development of FFS, which will be implemented in the field during the pilot.
- Implementation of a rice project (EUROCLIMA+) that involved extensive field work (including during the pandemic) and the participation of multiple actors in the rice chain, which was technically successful and administratively accurate.

5.4 IICA will work closely with the three most important organizations in the rice value chain, which will jointly contribute resources to the project for the benefit of their members: FEDAGPA, ANALMO, and ANDIAN. These partners are the main stakeholders in the continuity of the project's solution.

5.5 For the development and implementation of the blockchain ecosystem, the executing agency will directly contract the services of three pre-identified companies for the amounts disclosed in the budget, since they will bring their expertise to meet the project's targets. The companies will be contracted for the application of technologies and digital solutions in the agricultural and climate sector as follows:

- **Yttrium.** A company established in Panama, specializing in digital solutions based on artificial intelligence that operates in different countries and areas of expertise: mining, oil, human health, and agriculture.
- **Foodchain.** A blockchain traceability developer based in Panama and operating in several countries, including Panama, Mexico, Peru, Uruguay, and others. It specializes in agricultural and food activities. It is a partner in LACChain and an ally of the executing agency under a collaboration agreement, with both promoting the platform in several countries.
- **Climate Trade.** A company specializing in trading carbon credits on the voluntary market and using the blockchain platform. It is established in Panama and operates internationally. It has partnered with the executing agency under a collaboration agreement.

5.6 The Ministry of Agricultural Development (MIDA) will also collaborate and provide in-kind contributions of the time of qualified technicians; collaboration will also be received from IDIAP and the FCA of Universidad de Panamá. Knowledge and learning will be exchanged with both institutions.

5.7 The project team, with the assistance of the Bank's Office of Institutional Integrity (OII), conducted integrity due diligence on the executing agency and key project actors in accordance with the Guidelines on Integrity Due Diligence (document OP-474-1). The project was not found to have any indicators of integrity or reputational risk in this process.

B. Structure and implementation mechanism

5.8 The management and administration of the project will be under the responsibility of the executing agency, for which it will create a project technical execution unit, which will report operationally to the Country Management, which, in turn, will supervise the unit. The unit will consist of a project coordinator, a technical coordinator of technological innovation and productivity, and a technical-administrative assistant. The project coordinator and technical-administrative assistant will be cofinanced with resources from IDB Lab and the executing agency. In addition, the executing agency in Panama will be in charge of the management of the agreement and the project governance structure for coordinating the activities and commitments of the multiple stakeholders and will submit to IDB Lab Operating Regulations for the project, detailing how resources will be managed.

5.9 The other three main project stakeholders will be hired by the executing agency to perform the tasks specifically described in the various components. Those entities will be contracted directly.

VI. Fulfillment of Milestones and Special Fiduciary Arrangements

6.1 **Results-based disbursements and fiduciary arrangements.** The executing agency will agree to IDB Lab's standard arrangements relating to results-based disbursements, procurement policies, financial management policies applicable to the private sector, and the specifications contained in the "Guide for Milestone-based Management and Financial Supervision of IDB Lab and SEP Technical Cooperation Projects." This is consistent with the results of the DICI, which shows that IICA's financial management system is acceptable to IDB Lab and that it has a monitoring and accountability structure in place for the annual submission of its institutional financial statements to the Bank.

6.2 **Risk- and performance-based project management.** Project disbursement amounts will be determined in accordance with the estimated liquidity needs of the project for a maximum period of six months. These needs will be agreed between IDB Lab and the executing agency and will reflect the activities and costs programmed in the annual planning exercise.

6.3 **Disbursements.** The first disbursement will be subject to the fulfillment of conditions precedent, and subsequent disbursements will be made provided that the following two conditions are met: (i) verification by IDB Lab that the milestones have been met, as agreed in the annual planning; and (ii) that the executing agency has justified at least 80% of the cumulative advanced funds. The second disbursement will be subject to the execution of the contracts approved by the Bank with the three technology companies. In the event that disbursement milestones are not met, the executing agency will submit, for the Bank's no objection, an action plan for meeting the milestones. In the event that the action plan does not have the intended effects, the Bank may cancel the undisbursed balance of the project.

VII. Access to Information and Intellectual Property

7.1 **Access to information.** This document is public under the Bank's Access to Information Policy.

7.2 **Intellectual property.** The intellectual property of the digital platform and all the works and results obtained under the project belong to the executing agency or to its original owner as the case may be and in accordance with the agreements entered into with each entity to be contracted by the executing agency for the implementation of the project. The executing agency will grant the Bank an irrevocable, worldwide, perpetual, royalty-free, nonexclusive license to use, copy, distribute, reproduce, display, and publicly perform any outputs owned by the executing agency arising from the execution of the project, as well as to develop derivative works. The Bank may grant sublicenses to third parties without requiring new authorizations or licenses from the executing agency.