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Tabla de Contenidos

BASIC INFORMATION

Country/Region:	Regional
Name of the TC:	Enabling Indigenous Climate Smart Agriculture Resilience in the Latin America and Caribbean Region
Number of TC:	TBD
Team Manager	TBD
Type of Technical Cooperation:	Client Support (CS)
Date of TC authorization:	TBD
Beneficiaries (countries or entities that will participate in the technical cooperation):	Argentina (Instituto Nacional de Tecnología Agropecuaria, INTA). Chile (INIA Chile)
Executing Agency and contact name	Fundación ArgenINTA. Es la organización que
Other Donor	MPI-GRA (US$150,000) FONTAGRO 150.000
Financing Requested FONTAGRO (US$):	150,000
Local Counterpart (in US$):	600000 in kind
Total Financing (in US$)	900000
Execution Period (months):	42 months
Disbursement Period (months):	48 months
Start Date Required:	January, 2023
Types of consultants (firms or individual consultants):	Firms or individual consultants
Unit preparation:	FONTAGRO
Unit Responsible for Disbursements:	
TC included in the Country Strategy (s/n):	N/A
TC included in CPD (s/n):	N/A
Priority Sector GCI-9:	
Prioriuty Secvtor of IICA	Cross-cutting themes that contribute to the five hemispheric programs: "4.3.2. “Innovation and technology”
PMP 2020-2025	This project is aligned with Strategy II.-"Sustainable productive systems, agroecosystems and territories" with its Objective "To

	increase the number of technologies and innovations with high potential for adoption and impact on productive systems, agroecosystems and territories". In addition to the cross-cutting themes: VII.-"Knowledge management and communication", IX.-" New alliances and memberships" and X.-"Digitalization, automation, precision and smart agriculture".
Other comments:	FONTAGRO, through the Bank, will forward the funds to IICA for execution with Fundacion ArgenINTA.

TECHNICAL COOPERATION DESCRIPTION

The scientific community clearly points out that temperatures will increase worldwide due to climate change, and this is likely to negatively affect agricultural productivity significantly. Therefore, climate-smart agriculture is being globally adopted around the world as an approach to transform and protect the agricultural sector. Climate-smart agriculture (CSA) is defined as a strategy to address the challenges of climate change and food security in an integrated manner. It seeks to increase productivity, strengthen resilience, reduce GHG emissions and improve the achievement of national food security and development objectives (FAO, 2010). Thus, CSA seeks to contribute to increase food yields, feed a growing population of nine billion people by 2050, mobilize investments for farmers and reduce GHG emissions (WB, 2010). Agriculture is the predominant economic industry in many countries and is key to meeting basic needs and livelihoods for 70% of the world's poorest people (GCEC, 2014). Thus, adaptation, mitigation and food security (the three pillars of CSA) will have important implications for the world's poorest and most vulnerable farmers.

This Technical Cooperation (TC) **aims to improve the sustainability and food security of indigenous Mapuche smallholder communities and their agricultural systems taking account of the need to adapt to anticipated changes in climate in Argentina and Chile, considering climate change adaptation and mitigation measures.** To this end, it is expected to articulate research capacities and technical cooperation in both countries, measure baseline greenhouses gas emissions from improved production systems; and finally, promote the adoption of technologies and innovations.

Currently, both INTA in Argentina and INIA in Chile have developed and validated with family livestock farmers technology to increase production rates by improving the adaptation of each country's livestock systems. These innovations have been transferred to demonstrator producers with promising results. However, more resources and inter-institutional work are needed to massify adoption. On the other hand, there are no studies on GHG emissions in these systems, nor is the impact of new technologies on reducing them known.

The General Objective of this TC is to increase the adaptive capacity and resilience of the livestock systems of the Mapuche indigenous communities of Argentina and Chile in the face of climate change, innovating towards a CSA. The specific objectives are a) To promote innovations in 5 Mapuche communities in Argentina and Chile, to improve their production and the adaptation of their systems to climate change. b) To extend the experience to other communities that can appropriate the innovations generated. c) To generate a regional platform for the exchange of experiences.

We will work with 5 indigenous communities of the Mapuche ethnic group in Argentina and Chile where we will establish CSA innovation units. At the end of the first year, it is expected to have a baseline of the main indicators of the productive systems of the communities and at the end of the project it is expected to have increased these in terms of productivity, adaptation and mitigation and reduced the intensity of GHG emissions.

During the project, other countries such as Panama and Peru will be invited as observers' countries to promote this collaboration in future opportunities. The New Zealand Ministry of Primary Industries and the Grass Resources Alliance will also provide expertise based on their worldwide experience, especially with Maori communities.

ABSTRACT

The initiative **aims to improve the sustainability and food security of indigenous Mapuche smallholder communities and their agricultural systems taking account of the need to adapt to anticipated changes in climate in Argentina and Chile, considering climate change adaptation and mitigation measures.** Since 2017, FONTAGRO has cofinanced a project that focuses on identifying new knowledge technologies and innovations for Argentina (Patagonia) and Peru, with a focus on the traditional livestock production system in indigenous smallholders. From the results obtained from this initiative, a group of scientists and extensionists from Argentina, Chile, and New Zealand decided to propose a scale-up new initiative that brings benefits to other countries. This initiative looks at fostering technology and innovation adoption in Latin American indigenous communities, which is considered crucial but also collaborating with Maori communities to contribute to the creation of a global network to share this knowledge and experiences. In Argentina, the proposed study area is located in northern Patagonia, where indigenous peoples are almost three times the national average. Climate change projections for Patagonia indicate a decrease in precipitation and an increase in temperatures. This is already placing considerable pressure on agricultural systems and livelihoods that are already subject to climate constraints. These types of impacts are also expected in Chile. Given the problems identified, this TC intends to follow a landscape approach focused on climate-smart agriculture that encompasses the following three main characteristics: 1. climate-smart practices at the field and farm scale; 2. land-use diversity in the landscape to provide resilience; and 3. management of land-use interactions at the landscape scale to achieve social, economic, and ecological impacts. The challenges posed by the UN Sustainable Development Goals can be met by promoting the adoption of innovative technologies. The research institutes (INIAS and the collaboration with New Zealand) have sufficient capabilities and technical experience, as well as the capacity to build bridges and generate the necessary alliances to achieve a positive impact on the territory. Therefore, the creation of the exchange platform, as well as the implementation of the project agreed upon during a regional workshop, will facilitate the maximization of the use of the already installed capacities (laboratories, field experiments, etc.) of the participating institutions, in order to generate an innovative scientific-productive and extension-dissemination experience that will provide solutions to the communities within the framework of climate-smart agriculture for indigenous communities.

OBJECTIVE AND JUSTIFICATION OF THE TC

The objective of the initiative is **to follow a participatory research approach aimed at improving the sustainability and food security of indigenous Mapuche smallholder communities while adapting to and mitigating climate change in Argentina and Chile**. Since 2017, FONTAGRO has cofinanced a project that focuses on identifying new knowledge technologies and innovations for Argentina (Patagonia) and Peru, with a focus on the traditional livestock production system in indigenous smallholders. From the results obtained from this initiative, a group of scientists and extensionists from Argentina, Chile, and New Zealand decided to propose a scale-up new initiative that brings benefits to other countries. This initiative is the first in fostering technology and innovation adoption in Latin American indigenous communities, which is considered crucial.

In Argentina, the proposed study area is located in northern Patagonia, where indigenous peoples occupy parts of the provinces of Río Negro and Neuquén. In Río Negro, 7.1% of the population is recognized as indigenous (according to the 2010 census). This represents 45,375 people out of a total of 638,645 inhabitants. This percentage of indigenous people is almost three times the national average of 2.4% (INDEC, 2010)[1]. In Neuquén, there are more than 60 Mapuche communities (and many others in Río Negro). These communities are organized in zonal councils, with five in Neuquén. These zonal councils have their own organization by law and have direct dialogue with the provincial authorities. These organizations are grouped into a single regional organization, the "COM", which also has a permanent dialogue with the provincial and national authorities and is in charge of transmitting the needs of the Mapuche people. Within this framework, different laws have been passed, such as the Law for the Improvement of the Educational Quality of Aboriginal Peoples. However, each community is autonomous and has its own authorities, called "Lonko" (chief), and an assembly that makes decisions. The relationship between INTA and the Mapuche communities is always based on the approval of the Lonko and the assembly to move forward with joint work. Every project that is carried out must have the approval of the community. This guarantees that everyone, or at least the majority, agrees with the work proposals. At the moment, the Mapuche communities Hauiquillan, from the Colipilli area, and the Huaiquillan community from the Barda Negra area, both in the province of Neuquén, have been confirmed to participate and it is expected that the other two communities from the province of Río Negro will be selected before the end of October 2022. During the project, it is also expected to interact with tribal and indigenous communities from New Zealand.

In Argentina, the proposed study area covers half of the province of Río Negro (approximately 100,000 km2) and the northern half of the province of Neuquén, where there are transhumant

[1] INDEC, 2010. Censo Nacional De Población, Hogares Y Viviendas.

systems, covering approximately 50,000 km2 (Caballero et al., 2022)[2]. The vegetation in the area is dominated by grasslands, shrub steppes, scrublands, and semi-deserts (León et al., 1998)[3]. Sheep grazing is the most widespread agricultural use in the aridest zone of the province of Río Negro, followed by goat production and to a lesser extent cattle (Villagra et al., 2013)[4]. In the province of Neuquén, the most important agricultural activity carried out by indigenous communities and smallholders is goat rearing, followed by cattle. Although cattle represent a low number of animals, in terms of stocking rate they are high. Both goats and cattle have nutritional difficulties that result in low productivity and this problem increases with climate change (Caballero et al., 2022; Bruzzone et al., 2022)[5]. The dominant soils have sandy and silty textures and belong mainly to the Aridisols and Entisols orders (Del Valle, 1998)[6]. The average annual precipitation is approximately 200 mm, with even less precipitation in recent years (90 mm in 2021).

Climate change projections for Patagonia indicate a decrease in precipitation and an increase in temperatures (Barros and Camilloni, 2016)[7]. This will place considerable pressure on agricultural systems and livelihoods that are already subject to climate constraints. Key impacts include reduced availability of feed and water for livestock; decreased livestock condition and increased mortality rates; increased risk of wildfires. According to a study by Castillo et al. (2020)[8], sheep systems in northern Patagonia will be affected by a decrease in primary productivity, as well as in live weight and lambing percentage, as they are positively associated with rainfall and negatively associated with temperature. Management measures needed to mitigate these effects could be the use of strategic supplements to increase ewe weights or the protection of ewes from high temperatures during the lambing season through shaded infrastructure such as sheds. These measures could have a positive effect on increasing lamb survival and, therefore, total farm income (Villagra et al., 2015)[9].

Greenhouse gas emissions from the study area are relatively low due to the extensive nature of the livestock systems. The regional total C footprint in Patagonia has been reported as 10 to 41

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[2] Caballero V, Romero Martinez, J.Borrelli, L. Castillo D., Mikuc, J.P, Villar, L, Villagra, E.S. (2022) Are winter rangelands enough to satisfy the nutritional requirements of late-gestation transhumant goats?.Pastoralism 12, 31. https://doi.org/10.1186/s13570-022-00249-1

[3] León, J.C.R., Bran, D., Collantes, M., Paruelo, J., Soriano, A., 1998. Grandes unidades
de vegetación de la Patagonia extrandina. Ecología Austral 8, 125-144.

[4] Villagra, E.S.; Pelliza, A.; Willems, P.; Siffredi, G. 2013. What does domestic livestock eat in Northern Patagonian rangelands?. Animal Production Science Vol. 53 No 4 pp.360-367

[5] Bruzzone, O.; Castillo, D. A.; Villagra, E. S. (2022). Growth curve of early-weaned Hereford calves in a semidesert temperate zone (Patagonia, Argentina). Livestock Science. 104908,ISSN 1871-1413,https://doi.org/10.1016/j.livsci.2022.104908.

Caballero V, Romero Martinez, J.Borrelli, L. Castillo D., Mikuc, J.P, Villar, L, Villagra, E.S. (2022) Are winter rangelands enough to satisfy the nutritional requirements of late-gestation transhumant goats?.Pastoralism 12, 31. https://doi.org/10.1186/s13570-022-00249-1

[6] Del Valle, H.F. Patagonian soils: a regional synthesis. Ecología Austral 8 (02), 103-123.

[7] Barros, V.R., Camilloni, I., 2016. La Argentina y el cambio climático: de la física a la política. Eudeba.

[8] Castillo, D.A., Gaitán, J.J., Villagra, E.S. 2021. Direct and indirect effects of climate and vegetation on sheep production across Patagonian rangelands (Argentina),Ecological Indicators, Volume 124, ,107417, ISSN 1470-160X, https://doi.org/10.1016/j.ecolind.2021.107417.

[9] Villagra E.S.; Easdale, M. H., Giraudo C.G , Bonvissuto, G.L. 2015. Productive and income contributions of sheep, goat and cattle, and different diversification schemes in smallholder production systems of Northern Patagonia, Argentina. Tropical Animal Health and Production. Vol. 47, Issue 7, pp 1373-1380.

$kgCO_2$-eq kg_1 for lamb meat (carcass), and 8 to 19 $kgCO_2$-eq kg_1 for fine-grade wool. The highest footprints were found in ecologically degraded sites with lower plant productivity (Peri et al., 2020)[10]. On the other hand, soils of the Patagonian steppe store large amounts of carbon, mainly due to their large surface area (FAO and ITPS, 2018)[11]. Due to the low above- and below-ground biomass, the potential for carbon sequestration is low. However, there is a risk, especially with projected climate changes, that carbon emissions may increase with the consequence of further desertification. Maintaining livestock stocking rates within the carrying capacity of the land is a key challenge, especially when balanced with the need to maintain livelihoods.

The main problems expressed by farmers (FONTAGRO Project ATN-RF 16680-RG) are: i) lack of water and lower forage production; ii) low survival of young animals (due to malnutrition, extreme cold, and heat, and predation), and iii) the lack of access to local markets. These opinions are expressed through the request for training and funding for water collection and distribution, training in the strategic use of feed for pregnant females and young growing animals, predation control, and the use of sheds for protection from the cold in winter and heat in summer. They also express the need for more resilient animals. Many express the need to join together to sell their products (wool, mohair, and meat) and thus obtain better prices.

Given the nature of the proposed study area, the relative uniformity of indigenous communities' farming systems, and the common problems identified, this TC intends to follow a landscape approach focused on climate-smart agriculture. According to Scherr et al. (2012)[12], a landscape approach to addressing climate change encompasses the following three main characteristics: 1. climate-smart practices at the field and farm scale; 2. land-use diversity in the landscape to provide resilience; and 3. management of land-use interactions at the landscape scale to achieve social, economic, and ecological impacts. In the context of the proposed study area in Patagonia, the focus will be on items 1 and 3 above. Introducing diversity (point 2) into the very harsh steppe environment of Patagonia is a major challenge, but possibilities can be explored. Two possible future scenarios have been identified: Scenario 1: Business as usual, continuing with existing farming systems and practices and farmers adapting as best they can to changing conditions. In some cases, this could include abandoning the land over time. Scenario 2: Transition to circular agriculture/circular economy, supported by a participatory research and extension program that explicitly addresses climate change adaptation and mitigation in an integrated manner.

[10] Peri, P.L., Rosas, Y.M., Ladd, B., Díaz-delgado, R., Pastur, G.M., 2020. Carbon footprint of lamb and wool production at farm gate and the regional scale in southern Patagonia. Sustainability 12 (3077), 1–25. https://doi.org/10.3390/su12083077.

[11] FAO and ITPS. 2018. Global Soil Organic Carbon Map (GSOCmap) Technical Report. Rome. 162 pp. [online] http://www.fao.org/3/I8891EN/i8891en.pdf

[12] Scherr et al. (2012), Scherr, S.J., Shames, S., Friedman, R. 2012. From climate-smart agriculture to climate-smart landscapes. Agriculture & Food Security 2012, 1:12 http://www.agricultureandfoodsecurity.com/content/1/1/12

In Chile, the proposed study area wil be in the Araucanía Region.The indigenous population in Chile was counted in the 2002 Census at 692,192 inhabitants, which corresponds to 4.6% of the national population. Of the total national indigenous population, the Mapuche population is the majority with a share of 87.3%, followed by Aymara (7%) and Atacameño (3%).

In New Zealand/Aotearoa, a parallel project is being developed with funding sought through the recently announced Pūtea Rangahau – Tuku Haurehu a Ahuwhenua fund, administered by the New Zealand Agricultural Greenhouse Gas Research Centre (NZAGRC). The geographic focus for this project is the east coast of the North Island, in particular in Opotiki District, Bay of Plenty (*Te Moana-a-Toi)* and Ruatoria in the Gisborne District (*Te Tairāwhiti).* The Māori communities in these áreas have many social and economic challenges, which stem from colonisation and loss of land. Their current land holdings are disaggregated and are generally of poorer quality for agricultural production. Increasingly they are exposed to extreme weather conditions, including drought and flooding. Land uses include remnant native forest, pasture based livestock production, and land leased for continual maize production which has led to soil degradation. The two communities being targeted are at different stages of development but a common approach is proposed for both which will have a strong focus towards climate smart agriculture (or low carbon, climate resilient, development) with strong participation from the communities. A landscape approach, similar to that proposed for Patagonia, will be followed. This will focus on broadscale planning for larger wáter catchment áreas, with specific land use planning for Māori owned land. The latter will focus on climate smart practices that enhance resilience to climate extremes and result in reduced greenhouse gas emissions. Links are also being fostered with the Agri-Nature Foundation in Thailand, and potentially with emerging initiatives in Pacific Island Countries.

During the project, other countries from Latin America and the Caribbean (LAC) region will join the initiative as observers, such as Panama and Peru. **Panama**, for example, is made up of 10 provinces and three indigenous comarcas with provincial status (Guna Yala, Emberá, and Ngäbe Buglé), since they have a comarca governor; and two comarcas with corregimiento status (Kuna de Madungandí and Kuna de Wargandí) (INEC, 2020)[13]. The Ngäbe-Buglé Comarca (CNB), located in the western region of the Republic, between the provinces of Bocas del Toro, Chiriquí, and Veraguas, is proposed as the study area. It is crossed from west to east by the Cordillera Central or Serranía de Tabasará, which separates two geographic regions: the Atlantic or Caribbean region, 40% of which is covered by primary forest with short, fast-flowing rivers, and the Pacific region, which is deforested and has rivers that run more towards the sea. The relief is dominated by a mountainous area that covers 60% of the surface, belonging to the Cordillera Central, and lithography represented by igneous rocks (Proyecto Ngäbe-Buglè, 2008)[14]. The agrological

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[13] Instituto Nacional de Estadísticas y Censos (INEC). (2020). Contraloría General de la República de Panamá. Panamá en cifra año 2016-20. Recuperado en https://www.inec.gob.pa/archivos/P0289562520220531114848Panam%C3%A1%20en%20Cifras%20final.pdf

[14] PROYECTO NGÄBE BUGLÉ. (2008). Plan estratégico de Desarrollo de la Comarca Ngäbe-Buglé. Grupo para el Desarrollo Empresarial S.A. Panamá.

capacity of the soils is available in classes VI, VII, and VIII, which cover almost 85% of the territory (not arable, with severe or very severe limitations for use in the production of commercial crops, suitable for forests or reserve lands) (Proyecto Agroforestal Ngäbe Buglé, 1997)[15]. The CNB is divided into three regions (Ködriri, Nedrini, and Ñö Kribo), with a total area of approximately 6,968.0 km2 and a population of approximately 208,481 inhabitants, divided into two ethnic groups; the Ngäbe and the Buglè, of which 91.64% is dominated by the Ngäbe ethnic group (INEC, 2019)[16]. Social indicators show that the percentage of illiteracy is 30.82% and child malnutrition in children under five years of 62.0%, while nationally it is 5.5% and 19.1% respectively (González-Dufau, et al., 2019)[17]. In the CNB, there is limited access to basic food requirements for the population, reflected in malnutrition rates with multidimensional poverty of 59.3% (Prosperi, 2019)[18]. The economy is based on three components: the agricultural sector, where most of the production is for self-consumption; the production of handicrafts, which is difficult to market; and the exploitation of human resources as unskilled salaried labor (Proyecto Ngäbe-Buglè, 2008)[19]. Families tend to be large (5-12 people), and marriage and family relationships play an important role in determining land ownership and collective use rights. The daily diet of the Ngäbe family consists mainly of rice, plantain, maize and beans, yucca, yams, and coffee (Coffea spp), products obtained from rather weak and low-yielding plants planted in small plots. Other products such as yams, bodá (Chamaedorea tepejilote), and fruits such as guineo, pixbae, mango (Mangifera indica), orange (Citrus X sinensis), avocado (Persea americana), corozo (Acrocomia aculeata) and cashew (Anacardium occidentale), depend on the season of the year (Torres-Vargas, 2022)[20]. The techniques used in the production systems are very rudimentary: the method of slashing, cutting or clearing, burning, planting, and harvesting - for consumption rather than for sale - occurs with a four-year rotation cycle; as soil fertility is lost, there is migration to other plots. Family plots can be 1.0 to 1.5 ha-1 and the labor used is family labor; yields do not cover the food needs of the population (Alvarado et al., 2010)[21]. The precarious economic situation forces them to work on farms outside the CNB in the production of bananas, sugarcane, horticultural systems, and,

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[15] PROYECTO AGROFORESTAL NGÄBE BUGLÉ. (1997). Sistemas y Combinaciones Agroforestales Tradicionales. PAN-ANAM-GTZ. Tomo XIII. San Félix, Panamá. 77 p.

[16] Instituto Nacional de Estadísticas y Censos (INEC). (2019). Contraloría General de la República de Panamá. Panamá en cifra año 2013-17. Recuperado en https://www.inec.gob.pa/archivos/P9361pcresumen.pdf

[17] González-Dufau, G., Santamaría Guerra, J., y Mesa, J. (2019). Soberanía y seguridad alimentaria y nutricional en la Comarca Ngäbe-Buglé, Panamá Escalamiento de la agricultura agroecológica para aumentar la producción de alimentos. Instituto de Investigación Agropecuaria de Panamá (IDIAP).

[18] Prosperi J. (2019). Problema de salud pública: actualización (en línea). Recuperado en https://elblogdejorgeprosperi.com/2019/10/desnutricion-infantil-en-panama/

[19] PROYECTO NGÄBE BUGLÉ. (2008). Plan estratégico de Desarrollo de la Comarca Ngäbe-Buglé. Grupo para el Desarrollo Empresarial S.A. Panamá.

[20] Torres-Vargas, L. (2022). Transición agroecológica de sistemas tradicionales/indígenas de arroz (Oryza sativa L.) y plantas medicinales en la Comarca Ngäbe-Buglè, Panamá. Tesis doctoral. Universidad Nacional Agraria de Nicaragua (UNA). 123 pg. Enlace: https://repositorio.una.edu.ni/4321/

[21] Alvarado, P., Bieberach, C., Aguilar, A., Camargo, I., y Santamaría-Guerra, J. (2010). Segundo Informe Nacional Estado de los Recursos Fitogenéticos para la alimentación y la Agricultura en Panamá. Instituto de Investigación Agropecuario de Panamá (IDIAP). PA.

especially, coffee cultivation (De Gracia, 2013; Torres-Vargas, 2022)[22]. **Peru** has diverse agroecosystems in coastal, Andean and Amazonian areas, where different forms of traditional and small-scale agriculture are being practiced and preserved. INIA-Peru has registered this type of agriculture on more than 88,000 hectares, involving at least 150 peasant communities in the regions of Puno, Cusco, Apurímac, and Junín; these areas have been recognized as areas of agrobiodiversity, as they have records of native agrobiodiversity. The development of technologies that lead to climate-smart agriculture in these communities would provide them with sustainable use of their local resources of crops such as potato, corn, oca, olluco, quinoa, beans, and fruit trees, oriented to the food security of the communities. Thus promoting the local conservation of these crops, as well as their local and national valuation.

Based on the described characteristics and problems of the indigenous communities chosen by the participating countries, we believe that the challenges posed by the UN Sustainable Development Goals can be solved by promoting the adoption of technologies. The institutions involved in this initiative are aware of the risk that small and medium-sized producers and the most vulnerable sectors, such as rural women and young people, will be left behind or even on the margins of the adoption of these technologies. The research institutes (INIAS and with the collaboration of New Zealand) have sufficient capabilities and technical experience, as well as the capacity to build bridges and generate the necessary alliances to achieve a positive impact on the territory. The research groups of the proponent countries have highly complementary capabilities and have the potential to strengthen and extend the scope of ongoing research and work, mainly through cooperation. Therefore, the creation of the exchange platform, as well as the implementation of the project agreed upon during a regional workshop, will facilitate the maximization of the use of the already installed capacities (laboratories, field experiments, etc.) of the participating institutions, in order to generate an innovative scientific-productive and extension-dissemination experience that will provide solutions to the communities within the framework of climate-smart agriculture. The installation of demonstrative plots or intelligent productive fields, together with participatory research and transfer activities will enable the scaling up of small-scale agricultural innovations adapted to climate change. These activities could include evaluating the adaptation of local crops, including those generated by INIA-Peru, so that they can be adapted to different altitudinal levels (inter-Andean valleys), recording their agronomic performance.

Finally, these demonstration plots could be disseminated as successful cases to other rural communities to scale up their dissemination and adoption nationally and internationally. Likewise, as it is culturally diverse agriculture, it could have the opportunity to be valued through

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[22] De Gracia, Z. (2013). Ngäbe-Buglé-Cultura aborigen de Panamá. (Monografía). Recuperado de https://www.monografias.com/trabajos96/ngabe-bugle-cultura-aborigen-panama/ngabe-bugle-cultura-aborigen-panama.shtml
Torres-Vargas, L. (2022). Transición agroecológica de sistemas tradicionales/indígenas de arroz (Oryza sativa L.) y plantas medicinales en la Comarca Ngäbe-Buglè, Panamá. Tesis doctoral. Universidad Nacional Agraria de Nicaragua (UNA). 123 pg. Enlace: https://repositorio.una.edu.ni/4321/

rural agro-tourism and local gastronomy. FONTAGRO and the Government of New Zealand agreed to fund a TC to work on adaptation technologies for climate-smart agriculture in indigenous communities in Argentina, Chile, Peru and Panama.

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