Docusign Envelope ID: 01861719-CB3C-417A-AF99-D8206B1DBF7D

PROJECT PROPOSAL

PEREZ-GUERRERO TRUST FUND FOR SOUTH-SOUTH COOPERATION,
MEMBERS OF THE GROUP OF 77
GOVERNMENT OF PERU

Country/Region/Global: Interregional / Peru

Initiation Plan

Project Title:	**Diagnóstico de precisión basado en el genoma del declive del algarrobo en los bosques ecuatoriales de América del Sur** INT/24/K05 Genome-enabled precision diagnostics of the Algarrobo Carob tree (Neltuna pallida) decline in the equatorial forests of South America
Expected UNSDCF/CPD Outcome 2:	Environment, climate change and disaster risk management.
Expected CPD Output 2.1:	Public, private and civil society stakeholders strengthen their capacities for conservation and value recognition of biodiversity and nature to ensure socio-ecological resilience and sustainable, inclusive and low-emission productive development.
Initiation Plan Start/End Dates:	Julio 2025 – Junio 2026
Implementing Partner:	UN Office of South-South Cooperation (UNOSCC)

Brief Description

Neltuma spp., trees are a key arboreal species that compose the vegetation of South American hyper-arid zones from the equatorial pacific in the north of Perú to Chaco traversing to Bolivia and Argentina. In Perú, the species forms extensive Equatorial Dry Forests on the northern Peruvian coast. Its importance lies in the fact that it is a "multipurpose tree" providing a diverse array of ecosystem services. In recent years, mortality rates of Neltuma spp. have been reported to impact the stability of the dry forest ecosystem and the economy of local populations.

This project will address the decline of the Neltuma forests and provide evidence for their conservation. According to the Conservation Data Center of the Universidad Nacional Agraria "La Molina" and the World Wildlife Fund (WWF-CDC-UNALM) map of ecoregions, the Dry Forest ecosystem comprises 4.5 million hectares, representing 3.54% of the surface of Peru. This ecosystem is important to control the advance of deserts and dunes as well as to regulate the environmental temperature of the local tropical climate. It also contributes to the control of erosion, regulation of the water cycle of river basins, water quality, and the economy of small peasant families (Angulo Pratolongo, n.d.; GORE Piura, 2012).

Programme Period:	Jul. 2025 to Jun. 2026
Quantum Project Number:	**01004602**
Gender Marker:	GEN 1

Total resources required:	USD 79,578
Total allocated resources:	
• UNOSCC / PGTF:	USD 25,000
• Other:	
Unfunded budget:	_____
In-kind Contributions:	
• Internal University Funds	USD 8,000
• In-kind time and equipment	USD 46,578

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Agreed by UNDP Peru, on behalf of the UNOSSC:

DocuSigned by:
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Bettina Woll

Representante Residente

11-jul.-2025

I. PURPOSE AND EXPECTED OUTPUT

Neltuma spp., trees are a key arboreal species that compose the vegetation of South American hyper-arid zones from the equatorial pacific in the north of Perú to Chaco traversing to Bolivia and Argentina. In Perú, the species forms extensive Equatorial Dry Forests on the northern Peruvian coast. Its importance lies in the fact that it is a "multipurpose tree" providing a diverse array of ecosystem services. In recent years, mortality rates of *Neltuma* spp. have been reported to impact the stability of the dry forest ecosystem and the economy of local populations. This project will address the decline of the *Neltuma* forests and provide evidence for their conservation. According to the Conservation Data Center of the Universidad Nacional Agraria “La Molina” and the World Wildlife Fund (WWF-CDC-UNALM) map of ecoregions, the Dry Forest ecosystem comprises 4.5 million hectares, representing 3.54% of the surface of Peru. This ecosystem is important to control the advance of deserts and dunes as well as to regulate the environmental temperature of the local tropical climate. It also contributes to the control of erosion, regulation of the water cycle of river basins, water quality, and the economy of small peasant families (Angulo Pratolongo, n.d.; GORE Piura, 2012).

Within the Dry Forest ecosystem, *Neltuma pallida* is a key species which forms extensive xerophytic forests (Brack, 2005; Mostacero et al., 2007). *Neltuma*, the botanical genus to which the Algarrobo trees belong, is a taxonomic group of approximately 45 species belonging to the Mimosoid Subfamily of the Legume Family (= Fabaceae) (Pasiecznik et al., 2004). Regarding their geographical and ecological distribution, *Neltuma* spp. are widely distributed in arid zones of South America.

The *N. pallida* tree is very useful and economically significant, as it maintains a combination of humid vegetation and temperature in the desert that permits the survival of animals and humans (OSINFOR, n.d.). Its ecological importance is due to its role in environmental conservation, protection of hydrographic basins, protection against soil erosion, degradation and sedimentation, improvement of soil fertility in terms of quality and availability, provision as a resource for wildlife, and contribution to the microclimate (Mostacero et al., 2002). It also forms extensive woods with abundant wildlife. Avoiding habitat fragmentation is of particular importance as the number of zoonotic human diseases have quadrupled over the last 50 years largely due to land use changes, habitat fragmentation, and climate change. Today, 60% of emerging human infectious diseases are zoonotic and more than 2/3 of these originate in wildlife. Regarding its importance in the rural economy, *N. pallida* serves as a source of food and fodder, wood for construction and carpentry, firewood and charcoal, agroforestry, and beekeeping (Juárez et al., 2016; MINAM, 2019).

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Recent studies on the Dry Forest ecosystem commissioned by the Peruvian Ministry of the Environment (MINAM), examined the evolution of the Dry Forest surface from 1975 to 2018 in the north of Perú. These studies concluded that between 1995 and 2018, a reduction of 13.7% in dry forest cover occurred, with a direct relationship between the El Niño phenomenon and changes in the surface of dry forests (Unpublished data, MINAM, 2019). An increase in *N. pallida* tree mortality rate was also reported, affecting the stability of the ecosystem and the economy of local populations.

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In an inventory of national forest and wildlife (INFFS, 2019), the Peruvian National Forestry and Wildlife Service (SERFOR) found that 40% of the *N. pallida* trees on the north coast were dead and of those alive, 27% exhibited damage. Of this 27%, 17% had severe damage, 18% moderate damage, and 65% mild damage; this decline affected three large regions of the northern coast of Peru close to Ecuador.

In the north coast of Peru, the largest *Neltuma* forests, have undergone a substantial transformation in the last 40 years due to the expansion of agroindustry. In recent years the Lambayeque region alone produces 27 times more asparagus, 58 times more grapes, 12 times more mangoes, 16 times more avocados, 3 times more limes and 26 times more rice than 40 years ago. This has been at the expense of dry woodlands and habitat fragmentation. Considering only these crops, the land required in Lambayeque for these increases has risen from 5 739 Ha to 63 896 Ha (Serie de Estadísticas de Producción Agrícola (SEPA) MINAGRI). Since 1980, for the same crops mentioned above, the land required in the three northern regions involved in this study, has risen from 38 000 Ha to near 185 000 Ha. This dry forest deforestation is true not only to Peru. According to Whaley et al. (2020), most *Neltuma* rich forests in Peru, Chile and Chaco, continue to be deforested for fuel and agricultural expansion.

There are few studies on insect pests of *N. pallida*. In 2019, the “IncaBiotec”, a biotechnology company commissioned by the Peruvian Ministry of the Environment, evaluated 200 *N. pallida* trees distributed in the Tumbes, Piura and Lambayeque departments. Using a descriptive analytical epidemiology approach with proteomics, viral coat proteins primarily from Closteroviridae, a family of viruses to which the citrus tristeza virus (CTV) and the grape leaf roll virus belong, were detected. This study provided the first indication of viral infection but is merely correlative as many trees are coinfected by several viruses; many of these viruses are transmitted by insects. Our hypothesis is that viruses were vectored by entomofauna from the nearby production areas of agricultural export crops such as lime and grapes. The expansion of agricultural export crops in these regions, coupled with climate change which favors the viral vectors, may amplify elements of Neltuma decline.

Our hypothesis is that there is a decline caused by viruses belonging to the Closteroviridae family of plant virus. The main objective of this proposal is to provide evidence on the probable cause of the Algarrobo forests decline, and transfer those results to environmental authorities so they may structure new conservation public policies such as improving reforestation programs promoting virus-free seedlings. We will work in the largest protected woodland of *Neltuma* in the Americas, the Historical Sanctuary Bosque de Pomac (SHBP) in the desertic coast of Lambayeque, Peru that has nearly 6,000 protected hectares by the National Service of state Protected Areas in Peru (SERNANP). More than 35,000 families living from the dry forests will be impacted.

For doing the above, it is necessary to create genetic and genomic resources to come up with sound conservation strategies for *Neltuma*. The San Marcos team has already generated a chromosome-scale de novo reference genome assembly using a combination of Illumina, Nanopore and Hi-C technologies, and are in the process of annotating the genome. They have also collected and sequenced the bacterial microbiome of the soil, rhizosphere and endomicrobiome of diseased and healthy trees. They have already collected leaves of 96 trees from the Pomac forest, a protected area in the north of Peru that is showing a rapid decline, in order to study its genetic diversity and population structure by Genotyping by sequencing. The Chilean team is expert in bioinformatics, machine learning, and data analysis and their contribution will be in this line of work. The Uruguayan team is an expert in Citrus Tristeza virus, a member of the Closteroviridae family and the main object of our hypothesis. This virus exists in our three countries and its control is a challenge.

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In this project the specific components are: **Virome characterization:** To characterize the pathogenic virome of algarrobo trees in the Bosque de Pomac Historic Sanctuary **(implies RNA extraction, sequencing and Bioinformatics).** 2. To compare the viral diversity between healthy and diseased algarrobo trees in the Bosque de Pomac Historic Sanctuary. (**Implies Bioinformatics**). 3. **Training** of a talented student from the Tacna province in Peru to improve capacities in the region and establish collaborative liaison between Tacna and Chile.

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To do these activities, we need to collect leaves from 2 healthy and 2 diseased trees as a complementary project is funding the collection of 3 other trees of each class. Trees will be georeferenced, photographed and described for symptoms. Training of young scientists in diagnostic methods, collecting, entomology, bioinformatics, genomics and population genetics will be a fundamental component of this project with multiple undergraduate students and at least one graduate student doing their research projects with us. We will reach a wider scientific audience by participating in an annual scientific congress and we will reach by popularization activities related to our activities and the importance of Neltuma woodlands.

II. MANAGEMENT ARRANGEMENTS

This project of the UN Office of South-South Cooperation (UNOSCC) uses the direct implementation modality (DIM) and will provide a low-value grant to the Universidad Nacional Mayor de San Marcos, Perú (UNMSM) for the implementation of the activities. The project coordinator will be Dr. Gisella Orjeda, Responsible for the Genomics and Bioinformatics for Biodiversity Research laboratory at UNMSM.

The partners from Universidad de la República (UR) Uruguay and from Universidad de las Americas (UDLA) Chile, will help with all the phases of the implementation and decision making. There will be at least one responsible scientist in each participating country: Dr. Rodney Colina from UR in Uruguay with the Citrus Tristeza virus diagnostics and virtual training of students; Dr. Dante Travisany in UDLA from Chile with the Bioinformatics analysis; Gisella Orjeda, from Universidad Nacional Mayor de San Marcos (UNMSM) in Peru with the collecting and genomics component assisted independently by Dr. Luis Salazar and Segundo Fuentes (virologists).

The whole project aims to increase relevant and precise information on an acute problem and give this information to relevant authorities in our countries.

UNDP Peru will, on request by SU-TCDC, release an advance equivalent to 90 % of budget resources after project approval. The Universidad Nacional Mayor de San Marcos (UNMSM) will produce a report to be submitted to UNDP Peru and forwarded to SU-TCDC. SU-TCDC will recommend the release of the remaining 10% of the budget by UNDP Peru. The role of the Country Office will be to facilitate the signature of the project document, disbursement of 90 % of resources, forwarding the report to SU-TCDC, and disbursing the final 10 % of project funds.

III. MONITORING

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Progress monitoring will be done by the Universidad Nacional Mayor de San Marcos, Perú (UNMSM). However, any staff from UNDP Peru, the UNOSSC or Perez-Guerrero Trust Fund may undertake monitoring activities in line with managerial roles above.

The project may be audited by UNDP/UNOSCC, the Perez-Guerrero Trust Fund.

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IV. PROJECT RESULTS AND RESOURCES FRAMEWORK

* In kind contributions; ** complementary project with university funds already allocated

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V. WORK PLAN

PRODUCTOS	ACTIVIDADES	TAREAS	2025		2026		Fuente de Financiamiento			PRESUPUESTO	
			T3	T4	T1	T2	Fund	Donor	Activity	Descripción del presupuesto	Presupuesto
Producto (Output) 1 Virome of at least 10 trees sequenced.	1.1 Identification of 5 healthy and 5 diseased trees extraction of RNA for sequencing	Action 0: Purchase of consumables and small equipment	x				59020	000012	Activity 1.1	72600 - Acuerdo de subvención de bajo valor	14,553.00
			x				59020	000012	Activity 1.1	75100 - Gastos de servicio de gestión	145.53
		Action 1: two Collection trips and GPS markdown OF TREES in SHBP		x	x		59020	000012	Activity 1.1	72600 - Acuerdo de subvención de bajo valor	3,219.48
							59020	000012	Activity 1.1	75100 - Gastos de servicio de gestión	32.19
	1.2 Processing of samples for RNA	Action1. Lab work		x	x		59020	000012	Activity 1.2	72600 - Acuerdo de subvención de bajo valor	990.00
							59020	000012	Activity 1.2	75100 - Gastos de servicio de gestión	9.90
	1.3 Sequencing	Action 1. LabWork		x	x		59020	000012	Activity 1.3	72600 - Acuerdo de subvención de bajo valor	990.00
							59020	000012	Activity 1.3	75100 - Gastos de servicio de gestión	9.90
										Sub Total	**19,950.00**

PRODUCTOS	ACTIVIDADES	TAREAS	2025		2026		Fuente de Financiamiento			PRESUPUESTO	
			T3	T4	T1	T2	Fund	Donor	Activity	Descripción del presupuesto	Presupuesto
Producto (Output) 2 Virome of 10 trees analyzed and characterized using bioinformatics	Activity 2.1: Setting up the bioinformatic analysis pipeline	Action 1.final Bioinformtic analysis -Virtual meeting for discussion and report			x		Internal University Funds / In-kind time and equipment		Activity 2.2	Fnal Bioinformtic analysis -Virtual meeting for discussion and report	-
	Activity 2.2 Data analysis	Action 1. use of High performance computer			x		Internal University Funds / In-kind time and equipment		Activity 2.2	Use of High performance computer	-
Producto (Output) 3 Bioinformatics training	Activity 3.1 Bioinformatics training	Action 1. travel Coordination and program	x				Internal University Funds / In-kind time and equipment		Activity 2.1	Travel Coordination and program	-
		Action 2 Bioinformatics training		x			59020	000012	Activity 2.1	72600 - Acuerdo de subvención de bajo valor	5,000.00
							59020	000012	Activity 2.1	75100 - Gastos de servicio de gestión	50.00
		Action 3. Testing pipline		x			Internal University Funds / In-kind time and equipment		Activity 2.1	Testing pipline	-
										Sub Total	**5,050.00**
										TOTAL	**25,000.00**

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Products	Activities and Management Actions	jul-25	Aug-25	sept-25	oct-25	nov-25	Dec-25	Jan-26	feb-26	mar-26	abr-26	may-26
Product 1 Virome of at least 10 trees sequenced.	Activity 1.1 **Identification of 5 healthy and 5 diseased trees**											
	Action 0: Purchase of consumables and small equipment	xxx										
	Responsibility: Gisella Orjeda											
	Action 1: Collecting **t**ravel to Woodland SHBP					xxx				xxx		
	Responsibility: Gisella Orjeda											
	Action 2. leaf collection and GPS markdown OF TREES					xxx						
	Responsibility: Gisella Orjeda											
	Activity 1.2. **Processing of samples** RNA Extraction, processing and sequencing					xxx	xxx				xxx	
	Responsibility: Gisella Orjeda											
	Activity 1.3. **Sequencing**						xxx				xxx	
	Responsibility: Gisella Orjeda											
Products	**Activities and Management Actions**	**jul-25**	**Aug-25**	**sept-25**	**oct-25**	**nov-25**	**Dec-25**	**Jan-26**	**feb-26**	**mar-26**	**abr-26**	**may-26**
Product 2 Virome of 10 trees analyzed and characterized using bioinformatics	Activity 2.1 Setting **up the Bioinformatics analysis pipeline**											
	Responsibility: Dante Travisany											
	Action 1. final Bioinformatic analysis -Virtual meeting for discussion and report											xxx
	Responsibility: Dante Travisany/ Gisella Orjeda/ Rodney Colina/Segundo Fuentes											
	Activity 2.2: **Data analysis**											
	Action 1. Use of high-performance computer				xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
	Responsibility: Gisella Orjeda/ Dante Travisany											
Products	**Activities and Management Actions**	**jul-25**	**Aug-25**	**sept-25**	**oct-25**	**nov-25**	**Dec-25**	**Jan-26**	**feb-26**	**mar-26**	**abr-26**	**may-26**
Product 3 Bioinformtics Training	Activity 3.1 **Bioinformatics training**											
	Action 1. travel Coordination and program	xxx	xxx									
	Responsibility: Dante Travisany											
	Action 2. Bioinformatics training				xxx							
	Responsibility: Dante Travisany											
	Activity 3.2 **Setting up the Bioinformatics analysis pipeline**											
	Action 3 Testing pipeline				xxx	xxx	xxx					
	Responsibility: Dante Travisany											

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VI. LEGAL CONTEXT

The project document shall be the instrument envisaged and defined in the Supplemental Provisions to the Project Document, attached hereto and forming an integral part hereof, as "the Project Document".

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This project will be implemented by the UN Office of South-South Cooperation in accordance with its financial regulations, rules, practices and procedures only to the extent that they do not contravene the principles of the Financial Regulations and Rules of UNDP. Where the financial governance of an Implementing Partner does not provide the required guidance to ensure best value for money, fairness, integrity, transparency, and effective international competition, the financial governance of UNDP shall apply.

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