CENTRO INTERNACIONAL DE LA PAPA
CIP
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Biodiverse and Nutritious Potato Improvement Across Peru, Nepal and Bhutan

DECEMBER 5, 2014

The International Treaty on Plant Genetic Resources for Food and Agriculture

INTERNATIONAL POTATO CENTER

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PROJECT PROPOSAL COVER SHEET

Project No. _____(*For Treaty use. Do not write anything here)*

Project Title: Biodiverse and Nutritious Potato Improvement across Peru, Nepal and Bhutan

Project duration: 36 months

Target crops: Potato

Targeted developing country/ies: Peru, Nepal and Bhutan

Other Contracting Party/ies involved:

1. Grupo Yanapai
2. Potato Development Program (BPDP)
3. Local Initiatives for Biodiversity, Research and Development (LI-BIRD)
4. National Potato Research Program (NPRP)
5. Instituto Nacional de Innovación Agraria (INIA)

Project geographic extension (km²): 50 km² direct, 16,000 km² on district level

Total requested funding: US$800,000

Total co-funding: US$450,000

Please select the type of project you are applying for:

☐ Single-country Immediate Action Project (Window 2)

☒ Multi-country Immediate Action Programme (Window 2)

☐ Single-country Co-development and Transfer of Technology project (Window 3)

☐ Multi-country Co-development and Transfer of Technology project (Window 3)

Applicant

Name of Organization: International Potato Center (CIP)

Type of organization: International Organization

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SECTION A: EXECUTIVE SUMMARY

1. Executive summary

In the highland potato growing communities of Peru, Nepal and Bhutan, farmers are disproportionately experiencing stresses caused by climate change. In both the Peruvian Andes and the high Himalayas-Hindu Kush mountainous regions of Nepal and Bhutan, potato is a main staple crop, and in order for these harsh growing environments to continue to sustain their populations, farmers in these regions need to be equipped with adaptable biodiverse and nutritious potato varieties, and the knowledge and capacity to grow them.

Building on established relationships, the International Potato Center (CIP) and its partners across Peru, Nepal and Bhutan, have designed a project aimed at increasing the capacities of national level agricultural research institutions and farmers in each country to access the appropriate genetic resources and develop improved disease resistant, robust, micronutrient dense potato varieties. More and more, the role genetic diversity plays in ensuring productivity and resilience of agriculture in the face of biotic and abiotic threats in changing climates and environments is being recognized. Broadening the range of crop varieties available to farmers, as well as diversifying production, reduces risk and vulnerability to these changes, and is therefore critical to enhancing food security. Our project, entitled, the *Biodiverse and Nutritious Potato Improvement across Peru, Nepal and Bhutan*, hereafter referred to as the Biodiverse and Nutritious Potato project, will increase resilience of the communities in these unfavorable highland environments who are facing threats to food availability and diversity due to increasing temperatures and evapotranspiration rates, accelerating glacial melting, and diminishing water resources. The project team designed a project that is in line with each country's national food strategies and for climate change resilience in high altitude communities. Further, all three countries are Contracting Parties to the International Treaty for Plant Genetic Resources for Food and Agriculture (ITPGRFA) and the project will create a synergy and exchange of knowledge and information between each country in accordance with the Objective of the ITPGRFA (Article 1) and the benefit sharing provisions contained in 13.2 (a,b,c) with CIP serving in a facilitating role, (as an Article 15 International Agricultural Research Center).

The Biodiverse and Nutritious Potato project team has identified resource-poor potato consuming communities with high levels of poverty and food insecurity in the districts of Dolakha and Jumla in Nepal, Bumthang and Trashingang in Bhutan, and the region of Cajamarca and the districts of Pataz, Quilcas and Yauli in Peru. Direct beneficiaries include farming households, researchers, seed producers and extension agents, each with links to the indirect beneficiaries in these regions. The project will collaborate across these target regions in each of the three countries to reduce vulnerability through the exchange, improvement and fast release and dissemination of biodiverse, consumer-accepted, stable yielding, and disease resistant potato varieties with superior nutritional quality. The project is structured around five main outputs, each supported by a set of activities, ultimately leading to the achievement of Millennium Development Goals 1 and 7, respectively, to eradicate extreme poverty and hunger and ensure environmental sustainability. The Biodiverse and Nutritious Potato project's outputs have the following focus: output 1: crop improvement; output 2: decentralized breeding and participatory variety selection; output 3: knowledge management and open access; output 4: capacity building of national level agricultural research systems and farmers; and, output 5: outreach and dissemination. The strategically chosen project partners, each with a defined collaborating role, will be Grupo Yanapai, the Instituto Nacional de Innovación Agraria (INIA) and Asociación Pataz in Peru, the Local Initiatives for Biodiversity, Research and Development (LI-BIRD) and the National Potato Research Program (NPRP) in Nepal, and the Potato Development Program (BPDP) in Bhutan.

SECTION B: PROJECT DESCRIPTION AND CONTENTS

2.1. Problem definition

Himalayan and Andean high mountain environments are disproportionately affected by climate change (Messerli, Viviroli and Weingartner 2004). Adaptability of high-altitude agricultural and livelihood systems are likely to be inadequate to cope with escalating crop plant disease and stress pressures due to climate change, especially global warming scenarios. In these high mountain environments, food availability and diversity are limited by the few crops that thrive under these less than favorable conditions. Potato is a major staple crop across the Peruvian Andean highlands and in the high Himalayas-Hindu Kush regions, particularly in the Dolakha and Jumla districts of Nepal and the Bumthang and Trashigang districts of Bhutan (FAOSTAT 2011), where climate change scenarios have the potential to increase temperatures and evapotranspiration rates, accelerate glacial melting, and diminish water resources. In this scenario, escalation of pest and disease pressures such as late blight (LB) with higher temperatures and less reliable rains will challenge potato production for populations whose livelihoods depend on it. Climate change, particularly extreme weather events and shift in pest and disease pressure, are anticipated to negatively affect crop production output and thus food security.

In the highlands of Peru, Nepal and Bhutan, micronutrient deficiencies are common, with roughly 50, 40 and 30% of the children stunted in each country and more than half of the population of children suffering from anemia (CMSAN 2013, WFP 2011, and Ministry of Health 2009). This highlights the importance of the biofortification approach to crop improvement, i.e., breeding and selecting micronutrient-dense varieties of the major food crops in local diets, as a viable food-based strategy for reducing malnutrition levels in target populations. The primary problem addressed by this project is the low level of food and nutrition security, specifically food availability and food quality, faced by rural highland communities.

The proposed activities address the national and regional strategies of Peru, Bhutan and Nepal. The National Peruvian Strategy for Food and Nutritional Security 2013-2021 highlights the importance of biodiversity to guarantee the availability of food. The Peruvian Plan of Risk Management and Adaptation of the Agriculture Sector to Climate Change (PLANGRACC-A) 2012-2021, emphasizes the importance of adapted crop varieties that can reduce the impact of drought, frost and floods and the development of pests and diseases. The project clearly coincides with Nepal's recent Country Investment Plan (2010) and Bhutan's 11th five-year plan (2013–2018) prioritizing the enhancement of agricultural productivity, reducing micronutrient deficiencies (emphasis on iron in Bhutan to reduce stunting to below 30%), strengthening agricultural research for climate change, and increasing agricultural biodiversity (CIP-Nepal 2010; GNHC 2013).

2.2. Project objectives: Overall and specific objectives

Overall Strategic Objective:

CIP and its partners will collaborate across Peru, Nepal and Bhutan to reduce vulnerability of potato-consuming populations in high mountain areas through the exchange, improvement and fast release and dissemination of biodiverse, consumer-accepted, stable yielding, and disease resistant potato varieties with enhanced nutritional quality. Genetic diversity is increasingly recognized as a means to help ensure productivity and resilience of agriculture vis-à-vis biotic and abiotic threats in changing environments. Widening the genetic base of crops, as well as diversifying production, reduces risk and vulnerability to these changes in climate and environment, and is therefore essential for food security.

Specific objectives:
Specifically, CIP and partners will share new, improved generations of potato genetic diversity with enhanced nutritional quality and key resistance traits (particularly micronutrient density and resistance to potato LB disease). We will build capacity in genetic resources exchange, evaluation and documentation, including the use of open access databases and the Mother & Baby (M&B) trial design for participatory variety selection (PVS) to accelerate variety release nationally and ensure farmers' early access to biodiverse and robust varieties with the characteristics they prefer.

The inter-institutional and cross-disciplinary collaboration will build capacity and awareness, and forge stronger links between breeders and nutritionists to co-develop and test new genetic materials and update knowledge for a food-based-approach to reducing malnutrition in the context of sustainable farming systems of vulnerable households. Intermediate and near end-products of breeding with plant material represented in Annex 1 of the International Treaty for Plant Genetic Resources for Food and Agriculture (ITPGRFA) comprise samples of three improved potato populations to be exchanged among Peru, Nepal and Bhutan and CIP, using the instrument of standard Material Transfer Agreement. Background and new genetic materials generated in the collaboration will be designated PGRFA and thus be available for further international exchange and use in breeding and research programs.

2.3 Targeted outputs, activities and related methodology of implementation
The intended overall outcome of our Biodiverse and Nutritious Potato project will be to improve adaptation to climate change and enhance the food security of poor resource farmers in Peru, Nepal and Bhutan, by strengthening the sustainable management and use of potato genetic resources and crops. Further, the project will contribute to the achievement of Millennium Development Goals one (to eradicate extreme poverty and hunger) and seven (to ensure environmental sustainability).

Since 2012, in an effort to enhance nutrition and reduce vulnerability of rural communities, CIP and its partners, the Instituto Nacional de Innovación Agraria (INIA), Asociación Pataz, Grupo Yanapai in Peru, the National Potato Research Program (NPRP) of Nepal, the Local Initiatives for Biodiversity, Research and Development (LI-BIRD) in Nepal, and the Bhutan Potato Development Program (BPDP) have collaborated on potato diversity assessment and variety selection. Systematic evaluation of disease resistant and nutritionally enhanced Andean landrace-derived potato clones in stress-prone mountain environments has increased information about and access to plant genetic resources, and begun to integrate capacities for the development and participatory selection of more resilient and nutritious varieties into highland production systems.

The Biodiverse and Nutritious Potato project will build on recent initiatives oriented to the strategic incorporation of well-characterized genetic resources into breeding programs for the generation and diffusion of diverse improved varieties to provide food security and incomes for the resource poor farmers of the highlands of Peru, Nepal and Bhutan. In the course of evaluation of enhanced genetic resources, collaborators will improve their understanding of targeted production environments and users' preferences to adapt and refine current and future breeding and delivery strategies.

Decentralized, collaborative and participatory breeding and selection of robust, adapted genetic resources and varieties with stable yields will facilitate smallholders' early access to new technological options and thereby ensure that diverse, resilient crop varieties are available and adapted to local conditions and preferences.

Conservation, access and the sustainable use of PGRFA to this end are often poorly articulated. Limited information on genetic resources and isolated capacities for genetic

enhancement, product development and dissemination constrain the efficient exchange and use of PGRFA required for rapid and equitable response to the needs of poor and marginalized farmers. Varietal diversity can help reduce vulnerability and food insecurity of resource-poor communities. It can also provide resilience to unpredictable risk factors and in the case of potato should include options for resistance to disease as well as episodes of frost and drought. The outputs, activities and the methodology are detailed below. Indicators for each output are indicated in the logical framework in appendix 2.

Output 1 (crop improvement): New biodiverse bred parental lines, segregating progenies and selected advanced clones combining elevated micronutrient content with resistance to disease successfully introduced, evaluated, conserved and used by national breeding programs and non-governmental organizations (NGOs) in furtherance of Article 13.2.(b) of the International Treaty.

Activity 1: Introduce parental lines and segregating progenies that combine elevated micronutrient content with resistance to LB and viruses to national breeding programs.

Activity 2: Evaluate and select Andean-derived clones from the segregating progenies for LB and virus resistance, drought tolerance, marketable yield and high micronutrient content and document the results.

Activity 3: Multiply promising Andean-derived clones and candidate varieties for larger scale on-station trials and fast transfer to on-farm and decentralized district-level trialing.

Activity 4: Analyze iron (Fe), zinc (Zn), and vitamin C concentration and evaluate antioxidant activity in predominant and newly selected genetic resources, including segregating progenies grown and evaluated across different sites and management practices.

Output 2 (participatory selection): Decentralized breeding and participatory variety selection methodologies to improve end-user involvement in the co-development of new genetic resources strengthened across countries.

Activity 1: Strengthen new and existing decentralized multi-stakeholder consortia for participatory variety selection with the M&B trial design involving food insecure rural highland communities in each country.

Activity 2: Implement participatory selection trials in remote and food insecure mountain villages to identify best-bet micronutrient-dense candidate varieties together with value chain actors.

Activity 3: Organize annual country level meetings between the different consortia to share results between researchers and farmers as to set priorities for the following planting season.

Activity 4: Systematically evaluate the sensorial properties of the commonly consumed, preferred and newly selected candidate potato varieties with local women and men farmers and consumers toward improved understanding of users' preferences for traditional and new types of potato.

Output 3 (knowledge management): A knowledge management system for open access documentation and tracking of genetic resources provenance, characteristics and use, including databases and web interface, developed in furtherance of Article 13.2.(a) of the International Treaty.

Activity 1: Pilot level information system and database that links traits and properties to genetic resources in genebanks and breeding programs developed.

Activity 2: Global Trial Data Management tool updated to include farmer preference data and gender differentiated user feedback.

Output 4 (capacity building): Increased capacity of National Agricultural Research Systems (NARS) and farmers in Peru, Nepal and Bhutan to access genetic resources and develop

improved disease resistant and micronutrient dense varieties in furtherance of the objectives of Article 13.2.(c) of the International Treaty.

Activity 1: Conduct regional capacity strengthening for standardized breeding procedures and micronutrient concentration evaluation and disease and stress resistance evaluation and documentation procedures.

Activity 2: Conduct NARS and farmers capacity strengthening for enhanced awareness about and knowledge of how to access appropriate genetic resources for use in breeding and variety development.

Activity 3: Coordinate and facilitate international exchange visits among Peru, Nepal and Bhutan to promote mutual learning in participatory variety selection and partnerships for decentralized variety development, knowledge and benefit sharing.

Activity 4: Co-develop a training manual and a multilingual training video on participatory variety selection using the M&B trial design based on practical experience and best practices.

Activity 5: Implement consortium level training course for facilitators (trainers-of-trainers) in the application of participatory variety selection.

Activity 6: Train NARS and extension workers on LB management using the new resistant genotypes

Output 5 (outreach and dissemination): Widespread access by resource poor mountain farmers to research results through innovative dissemination approaches.

Activity 1: Produce high quality mini-tubers and pre-basic seed of candidate varieties for dissemination and provision to resource poor farmers.

Activity 2: Identify at least one business model for varietal dissemination with potential replicability for effective smallholder uptake among project partners.

Activity 3: Development of communication materials to explain the concepts underlying genetic resources use in crop improvement for biofortification and resistance to disease and stress.

Methodology of implementation

CIP's Quality and Nutrition Laboratory has seven years of experience in sampling, sample processing and mineral analysis in Root and Tuber Crops. We work worldwide and have installed sample processing facilities in more than ten countries including Nepal, Bhutan and Peru. Dried and milled samples of the hundreds of genotypes from the new population developed will be prepared in each country and sent to CIP headquarters (HQ) for fast analysis by X-ray Fluorescence Spectroscopy (XRF). Capacities for sample preparation have been previously developed in each project country, but will be strengthened as part of the Biodiverse and Nutritious Potato project. Selected samples with high Fe and Zn concentration tested in the multi-environment trials (METs) will be submitted to inductively coupled plasma-optical emission spectroscopy (ICP) for confirmation of the high concentrations. Vitamin C, a promoter of Fe uptake in the human body, and antioxidant activity, will be evaluated using spectrophotometry.

CIP has developed and supplied breeding populations to institutions in Peru, Nepal and Bhutan with elevated micronutrient concentrations and resistance traits for local breeding and selection. Segregating progenies from crosses between tetraploid progenitors of disease and stress resistance and diploid products of pre-breeding for micronutrient density will be evaluated to select heterotic hybrid families and clones with high levels of these desirable traits. Diploid potato population improvement will be conducted in parallel with inter-ploid crossing of PGRFA to maximize genetic gains for resilience and nutritional characteristics.

CIP together with partners in Nepal and Bhutan will co-develop and consolidate regional strategies for selection of elite clones and progenitors with LB resistance and high concentrations of Fe, Zn, and vitamin C and a new generation of productive clones for variety selection will be developed. LB resistance will be assessed under high endemic pressure, using percent foliage infection to evaluate disease severity, summarized over the season with the area under the disease progress curve (Campbell and Madden 1990; Forbes and Korva 1994) and transferred to a susceptibility index making results comparable across years and locations. Local susceptible and moderately resistant genotypes will be included in the trials.

In each country, more than 40 selected clones will be submitted to METs in at least three contrasting sites, in the second year of the project. Trials will be installed using a randomized complete block design and statistical analysis will use the additive main effects and multiplicative Interaction model (AMMI) (Gauch 1992, Crossa, Cornelius and Yan 2002). In the case of Peru, CIP will provide our project partners INIA, Grupo Yanapai and Asociación Pataz with selected clones with elevated micronutrient concentration and resistance traits for local evaluation and selection.

Rapid seed production will be conducted for early generation, MET, adaptive, and participatory variety selection trials with elite micronutrient-dense, disease resistant clones and best-bet candidate varieties already under selection in each country. Rapid seed production will rely on conventional and innovative methods, such as in-vitro multiplication, minituber production in sand hydroponics (including use of in-vitro plantlets, cuttings, and sprouts), and open field multiplication in seed-plots.

Multi-stakeholder PVS will use the M&B trial design adapted by CIP for simultaneous evaluation by farmers and research programs (Snapp 1999). Researcher-led mother trials will test and demonstrate the value of disease resistance, and farmer-led baby trials will expose candidate varieties to farmers' management practices. The project will build on CIP's and LI-BIRD's extensive experience with decentralized PVS. Participatory selection has a high potential to effect successful co-selection of varieties between farmers and researchers and, at the same time, to disseminate adapted biodiverse options in areas where potential impact is highest (Almekinders and Hardon 2006). Male and female representatives from target consumer groups and value chain actors will evaluate clones for local acceptability and value-adding potential. Information on nutritional value and gender balanced preferences for potato type and quality will be integrated into breeding and selection schemes aimed at the identification and acceptance of new, more nutritious and disease-resistant varieties in each country.

Training and development of staff from national research institutions are integral to the Biodiverse and Nutritious Potato project. Strategies to strengthen knowledge and skills of extension workers and empower both male and female farmers will include their involvement in PVS, farmers' field days, consumer focus groups and farmer-to-farmer visits (between districts and countries). Partners will share innovative strategies for benefit sharing, such as the licensing of new varieties, to engage seed producers in dissemination for impact, an outward communication on genetic resources and value added through breeding in the multilateral system. Recognizing that consumer preference and farmer uptake of new varieties often run along gender lines, the Biodiverse and Nutritious Potato project will ensure representation of both men and women throughout each step of the crop improvement and PVS processes and subsequent variety release and training.

Extension workers (i.e., trainers) in the target areas will be trained (training of trainers) on the management of potato LB including the adjustment of fungicide application according to weather conditions and degree of varietal resistance. The training will consist of a course of one week's duration in one to two locations per country where field trials will be established

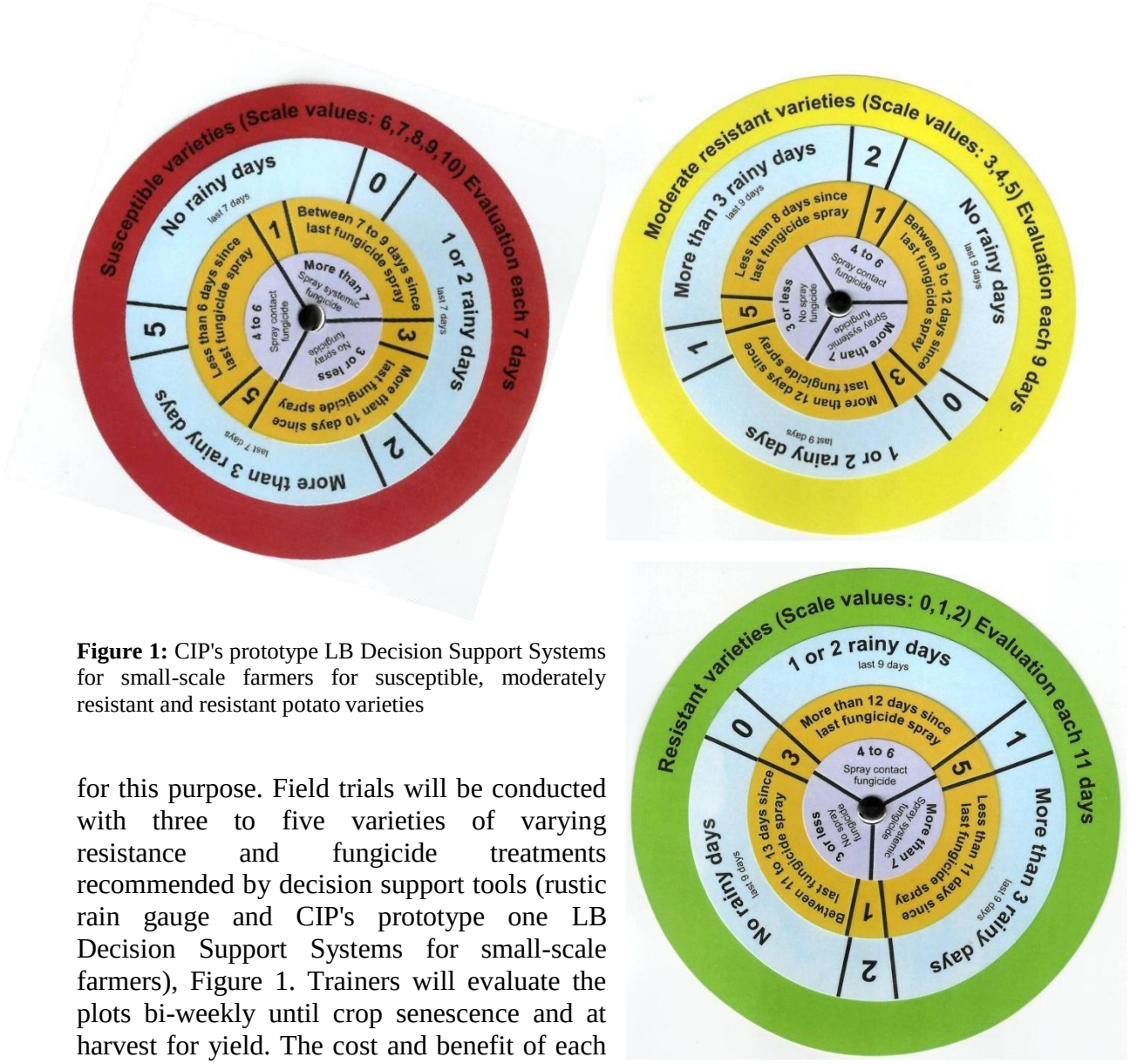

Figure 1: CIP's prototype LB Decision Support Systems for small-scale farmers for susceptible, moderately resistant and resistant potato varieties

for this purpose. Field trials will be conducted with three to five varieties of varying resistance and fungicide treatments recommended by decision support tools (rustic rain gauge and CIP's prototype one LB Decision Support Systems for small-scale farmers), Figure 1. Trainers will evaluate the plots bi-weekly until crop senescence and at harvest for yield. The cost and benefit of each treatment will also be analyzed.

2.4. Targeted PGRFA

The majority of the plant genetic resources to be used in the Biodiverse and Nutritious Potato project are pre-breeding materials and promising and advanced clonal selections of potato populations bred at CIP and selected in interdisciplinary collaborations that address the Center's sustainability and food security goals. CIP's breeding program actively evaluates and has made extensive use of ex-situ genebank samples comprising crop wild relative species collections, particularly to broaden the base of resistance to LB, and has incorporated wild and landrace diversity into dynamic improved populations with enhanced adaptive, quality and nutritional traits. Research lines are published and corresponding stocks are made available as PGRFA under development through CIP's catalogue of *Advanced Potato Clones* (https://research.cip.cgiar.org/redlatinpapa/pages/home.php) it's on line nursery of candidate varieties, and through collaborative projects. The Biodiverse and Nutritious Potato project will make use of four groups of plant material sampled from three stages of CIP's breeding program which is oriented to climate change resilience and nutritional enhancement objectives.

First, 46, 48 and 15 candidate varieties from CIP's broad-based advanced disease resistant and stress tolerant breeding populations B3, LTVR and B1 in Bhutan and Nepal will be

complemented by 21 additional candidate varieties of which 20,000 minitubers will be imported to Nepal. In Peru, the project partners will further avail five LB resistant candidate varieties of the Andean landrace-derived population B1.

Secondly, partners in Nepal and Bhutan will implement breeding, evaluation and selection with samples from CIP's biofortified population of Andean landrace-derived potatoes. Identified from 2nd and 3rd cycles of pre-breeding to enhance Fe, Zn and vitamin C in Peru, 19 and 20 pre-bred selections, respectively will be used in breeding and selection by NPRP, LI-BIRD and BPDP. INIA, Yanapai and Asociación Pataz will evaluate the same material in Peru and will use 40 advanced clonal selections from population B3 that are bred for multiple disease resistance and vigor, with emphasis on those that present top ranges of micronutrient concentrations, as well as 40 promising pigmented and yellow flesh clones with health-enhancing (antioxidant) properties.

Third and simultaneously, multi-site and participatory selection by CIP and partners in Peru will use 300 diverse, new hybrid combinations between broad-based advanced disease resistant selections and Andean-type pre-bred biofortified population cycles 2 and 3 to identify robust, disease resistant and nutritious advanced selections that will be categorized as PGRFA and made available to Nepal and Bhutan by the end of year 2 of the project.

The above-mentioned PGRFA material from advanced, mid-phase and newest stages of multi-trait selection by CIP and partners in Peru will be made available to Nepal, Bhutan and others according to the terms and conditions of the Multilateral System. Information on the type, provenance and characteristics of the materials developed in the project will be made available in open-access databases and publications within one year of the project's termination.

Annex 2, entitled PGRFA Release Schemes, contains selection schemes for project partners in Peru and Nepal/Bhutan.

2.5. Target groups and beneficiaries

The Biodiverse and Nutritious Potato project will focus on resource-poor potato consuming communities in high altitude regions of Peru, Nepal and Bhutan. Areas with high levels of poverty include the food insecure highland districts of Dolakha and Jumla in Nepal, and Bumthang and Trashingang in Bhutan. In the case of Peru, districts included are the highlands of Cajamarca and the district of Pataz in La Libertad, the district of Quilcas in the central highlands of Junín and Yauli district in the department of Huancavelica, which have particularly high levels of poverty and malnutrition, as well as significant potato production and consumption.

With the uptake of improved varieties from our Biodiverse and Nutritious Potato Project, more than 2,000 farming households in each target country will benefit from more stable potato yields under climate change and a reduced need for external inputs. Among the farming households, women and children will benefit with higher intake of Fe and Zn from more nutritious potato varieties.

Gender balanced stakeholders groups, including researchers and extension workers will benefit from training on enhanced production technologies, LB management and selection of high yielding, locally adapted, Fe and Zn dense varieties through participatory trials at different periods of crop growth. Approximately 500 stakeholders will be trained on participatory methods of variety selection in each target country. The use of PVS will ensure a direct dialogue and selection of new productive and biodiverse varieties and with farmers will indirectly benefit retailers, processors and seed producers.

National breeders and nutritionists will have access to advanced breeding materials (PGRFA), new knowledge and strengthened research and development capacities for addressing local agricultural and household needs.

- **Farming households** (direct 1500, indirect 4500, >50% women participation), through (i) more stable potato yields with improved Fe and Zn concentration (ii) participation in training on enhanced production technologies and participatory varietal selection.
- **Researchers** (direct 30, indirect 90), through trainings to increase capacity to develop and evaluate varieties.
- **Seed producers** (direct 6, indirect 36), through rapid seed production
- **Extension agents** (direct 90) through training on LB management for varieties with intermediate to high levels of resistance

2.6. Impact and impact pathways

The NARS and NGO partners of Nepal, Bhutan and Peru involved in the project play a main role in testing, dissemination and further use of improved potato germplasm. The project will increase capacities of NARS and farmers in Peru, Nepal and Bhutan to access genetic resources and develop improved disease resistant, robust, micronutrient dense potato varieties in line with national food strategies and for climate change resilience of high altitude communities.

2.6.1. Food security and poverty alleviation

With potato is a major food crop in the highland regions of Peru, Nepal and Bhutan, the Biodiverse and Nutritious Potato project has great potential to positively affect food security in these rural, resource poor mountain communities. The project's activities will increase access to and availability of stable yielding, disease resistant, robust and nutrient dense potato varieties. It is expected that by the end of this project in 2018, potato production in these areas increase 20% from the actual level. Vulnerable communities and farmers will have enhanced food security as a consequence of successful and fast release of new potato varieties, particularly as a consequence of access to enhanced diverse, reliable-yielding, disease resistant, robust and nutrient dense varieties. The project will particularly strengthen farmer's capacity to confront threats (e.g. pests, diseases, and abiotic stresses due to climate change scenarios) through improved awareness of benefits offered by diverse varietal options and informed management strategies.

In addition to being a staple crop for resource poor communities, potato has the potential to serve as a cash crop for farm households. The Biodiverse and Nutritious Potato project is expected to contribute to poverty alleviation by generating increased farm income, including reduced dependence on external inputs to sustain productivity. Intrinsic characteristics as LB and virus resistance will enable reliable yields with reduced use of fungicides or crop loss due to LB, and less frequent need to replace seed as a benefit of virus resistance with attendant slow degeneration rates as compared to predominant commercial varieties. Highland communities and especially women of childbearing age and children often suffer from high levels of Fe and Zn deficiencies. These communities will benefit through the increased access to biofortified potato varieties with higher Fe and Zn concentration and consequently improve their physical and mental health status that permits higher productivity, in turn contributing to poverty alleviation. It is expected that by 2020, 70% of the effected communities include biofortified potatoes as part of their diet.

2.6.2. Adaptation to climate change and environmental sustainability

Himalayan and Andean high mountain environments and farmer communities are disproportionately affected by the changing climate. Adaptability of high-altitude agricultural and livelihood systems are likely to be inadequate to cope with escalating disease and stress pressures due to climate change, especially global warming scenarios. In order to ensure food

security, livelihood resilience and natural resource management under climate change conditions, adaptive measures to improve land and water management and develop appropriate crop varieties is necessary. The Biodiverse and Nutritious Potato project will provide poor mountain communities potato germplasm adapted to current local conditions and robust against new biotic and abiotic stresses related with the changing climates. Farm households will be more resilient to face climate change, specifically as consequence of increased yield stability through the use of new robust varieties in light of extreme weather events as well as enhanced capacity to confront stresses attributed to climate change.

Evidence suggests that small-scale farmers will accrue significant benefits from LB resistant varieties. There are few studies that attempt to quantify these benefits of potato cultivars resistant to LB, however anecdotal and indirect evidence would indicate that the potential benefits are large. Fry (1978) attempted to quantify the effect of host resistance by looking at fungicide reduction with a regular spray schedule. In this study, the most resistant cultivar used approximately half as much fungicide in weekly sprays as did the susceptible. More recently, Grunwald et al (2002) compared resistant and susceptible cultivars in Mexico and found that host resistance allowed for disease control with between 1/3 to 1/2 the number of sprays needed for a susceptible cultivar. These results are generally consistent with those of Kromann et al (2009) who found that in Peru and Ecuador, sprays could be reduced to about one half or one third by using resistant cultivars und reduce environmental impact accordingly.

2.6.3. Scientific impact

The breeding and PVS methodologies utilized under this project to develop and evaluate varieties will be transferred and implemented by participating NARS and NGOs in each country. Strategies to strengthen extension workers and empower male and female farmers in breeding will include their involvement in decentralized PVS, farmers' field days, and farmer-to-farmer visits between districts and countries. Additionally, technology dissemination will be based on a diversified strategy involving catalogues, demonstration plots, and links to the national extension service, among others. Information about micronutrient concentrations and sensorial properties of commonly consumed potato varieties and candidate varieties in each of the three countries will be collected using standard procedures for documenting and monitoring and disseminated under open access conditions before the end of the project.

All project outputs will be subject to cross-country (Peru-Nepal–Bhutan) and sector (agriculture–nutrition) comparative analysis. Output results will be published in international and national scientific journals and public media to inform the general public and policy makers of the current development and the potential of breeding for micronutrient-density and yield stability for food security and human nutrition especially under climate change scenarios. Project outcomes including the incorporation of Fe- and Zn biofortified potato varieties into diets, when accompanied by anthropomorphic household studies will contribute to the growing body of scientific evidence for the effectiveness of biofortification as a viable food-based strategy to help reduce micronutrient malnutrition.

2.6.4. Capacity development and empowerment

Researchers/extension workers, NARS and farmers from each country will be trained in evaluation of new candidate clones and varieties, breeding and PVS. The capacity developed will permit them to apply new knowledge to request, manage, select and breed new disease resistant, micronutrient dense and robust potato varieties in response to new demands and opportunities. In particular, extension workers in the target areas will be trained (training of trainers) on the management of potato LB including the adjustment of fungicide application according to weather conditions and degree of varietal resistance. In addition, laboratory

capacities of NARS will be strengthened to assure correct micronutrient evaluation of candidate varieties to support biofortification efforts in potato in all 3 project countries.

These capacities are anticipated to be expanded to additional research communities including those addressing root and tuber crops after the project is completed.

2.7. Relevance to national or regional priorities in its plans and programs for PGRFA

In Peru, the plan for risk management and adaptation of the agriculture sector to climate change (PLANGRACC-A) for the period 2012-2021 emphasizes the importance of adapted crop varieties that can reduce the impact of drought, frost and floods and the development of pests and diseases. Similarly, Nepal and the Kingdom of Bhutan's National Adaptation Programme of Action plans (NAPA) express the need for agro biodiversity conservation and the development of robust cultivars adapted to the conditions altered by climate change. CIP will provide highland farmers in Peru, Nepal and Bhutan with selected potato genetic resources and candidate varieties and varieties with LB resistance and abiotic stress tolerance.

Food-based approaches to combat food insecurity in Peru, Nepal and Bhutan have been prioritized by the government, including in Peru's 2013 Strategy for Food Security and Nutrition (2013-2021), Nepal's Agriculture and Food Security Country Investment Plan and the 2009 Nutrition Assessment and Gap Analysis (NAGA), and the Kingdom of Bhutan's 2012 Food and Nutrition Policy. Several non-governmental multi-stakeholder platforms are supporting the implementation of national priorities. For example, development initiatives in Western Nepal in which LI-BIRD participates (see: www.hdihumla.org.np/) and through associations, such as Grupo Yanapai and Asociación Pataz in Peru, who promote participatory processes for the development of sustainable family farming in the Andes, aimed at improving nutrition and income generation.

In recent annual reviews and planning meetings of the potato research programs in Nepal and Bhutan, the development of superior varieties with high micronutrient densities were identified as key priorities. The Biodiverse and Nutritious Potato project will provide farmers with selected clones and varieties with elevated micronutrient concentrations. Grupo Yanapai-Peru, Asociación Pataz-Peru, INIA-Peru, NPRP-Nepal, LI-BIRD-Nepal, and BPDP-Bhutan have regularly expressed interest in strengthening collaborating with CIP on biofortification, participatory-decentralized varietal selection and on capacity strengthening support for breeding.

SECTION C: OPERATIONS

3.1. Methodology of project implementation

The Biodiverse and Nutritious Potato project's design are the result of previous collaborations between CIP and each of the participating countries and institutions. Although the exposure of Peruvian institutions and farmers to those of Nepal and Bhutan will be new in this project, CIP and all of the partners in Bhutan and Nepal have been associated in a number of potato commodity sector, innovation and development projects. Most recently, this collaboration occurred in the "Improving food security and nutrition of rural people in Nepal and Bhutan through collaborative potato breeding for yield stability and micronutrient density" project supported by the Austrian Development Agency, through CIP. The Science and Technology Commission of the Peruvian Government is also supporting the "Improvement of potato and wheat production systems through stress tolerant varieties" and "Innovation and Capacity Building for Genetic Improvement of Potato in light of Adverse Factors of Increased Regional Importance" projects involving CIP, INIA Peru and Asociación Pataz. Meanwhile, the McKnight Foundation supports the "Planting the Andean Diet: scaling-up the use of agro biodiversity to improve child nutrition in communities in Huancavelica" project in which enhanced potato genetic resources from CIP's program are evaluated by Grupo Yanapai in the communities this project will target.

In the above related activities, problems including limited knowledge of plant genetic resources for accessing needed traits and how to use them in breeding and to the time required for results of genetic enhancement to reach intended beneficiaries have been identified. Further, the frequent low acceptability of final products of formal breeding programs by marginalized communities has led to the following five needs for concerted efforts that the project will address: (i) assess and document PGRFA for genetic diversity and key nutritional and climate change traits; (ii) develop user-friendly information systems to relate trait and accession data and to inform breeding programs on their use; (iii) develop capacity and efficient means for incorporating new sources of disease resistance and stress tolerance into nutritious cultivars to facilitate crop adaptation to impacts of increasing climate diversity; (iv) document local preferences for sensory and other intrinsic properties of traditional and landrace varieties and incorporate these into breeding programs; and (v) fast track the exchange of PGRFA and identification of locally-adapted farmer-preferred improved varieties through participatory action research.

CIP, headquartered in Peru, with support of the office in Katmandu (Nepal) and the regional office in New Delhi (India), will coordinate the overall project including planning, implementation, evaluation, communication and reporting. Collaboration between CIP and partners will be managed through annual meetings, virtual coordination meetings (e.g., by Skype), shared workplans and a common management system. CIP scientist will visit the project target areas regularly and coordinate training and exchange visits among Peru, Nepal and Bhutan to promote mutual learning.

CIP will provide continuous technical backstopping to assure that standard procedures are adequately applied and adapted if necessary. CIP will facilitate collaboration, the use of common methods and metrics, database construction and design of web-based interfaces as well as publications. We will use mechanisms of consultation, information sharing, and feedback, as well as capacity-building activities to ensure transparency and accountability of research activities for national and non-governmental institutions. CIP's Intellectual Assets Manager will advise the project on information management and its Grants and Contracts Office will support agreements on institutional roles and responsibilities. This office together

with its counterparts in each institution will support the collection and submission of technical and financial reports to the donor.

3.2. Partnerships and collaboration arrangements

The multi-lateral system for access to plant genetic resources is key in order for the project to facilitate the exchange of genetic materials and management experiences between the center of origin and homologous mountain regions of the developing world. Partnerships among CIP, national programs and NGOs have been designed to help reach final beneficiaries, i.e., farmers and consumers for whom potato is an important crop and food.

CIP will coordinate with the partners of Peru, Nepal and Bhutan all the activities planned in the Biodiverse and Nutritious Potato project. CIP is an international research center with expertise in potato breeding, social science, crop management, and participatory variety development. Its Disciplinary Center of Excellence on Genetics Genomics and Crop Improvement has worked for decades developing potato varieties with resistances to biotic and abiotic stresses and currently offers potato populations with better resistance to diseases and heat and drought stress, with an increased level of Fe and Zn. CIP shares samples of native and improved potato genetic resources from the ex-situ collection housed at its HQ in Peru in association with the ITPGRFA.

Partners in Peru

Instituto Nacional de Innovación Agraria (INIA) is a national research institution responsible for designing and implementing the national agricultural strategy for the public good. INIA has **expertise** in varietal selection, setting-up decentralized consortia for PVS. **Role**: seed production and exchange, linkage building with nutrition and dissemination community, knowledge sharing and transfer, and national project coordination.

Grupo Yanapai is a non-governmental organi-zation (NGO) with **expertise** in participatory research, gender, nutrition and benefit sharing. **Role**: participatory clone evaluation and selection in rural communities of Huancavelica.

Asociación Pataz is an NGO that works in cooperation with the public and private sector including active participation of the beneficiaries and promoting projects for human and social development with a proper use of natural resources. They have **expertise** in working with rural communities and in participatory varietal selection of potato. **Role**: clonal evaluation, varietal selection, seed production and rapid dissemination in the provinces of Pataz and Sanchez Carrion, La Libertad

Partners in Nepal

Local Initiatives for Biodiversity, Research and Development (LI-BIRD) is an NGO committed to capitalizing on local initiatives for the sustainable management of renewable natural resources and to improving the livelihoods of resource-poor and marginalized people. LI-BIRD has **expertise** in varietal selection through participatory variety selection approach and linkage building with nutrition and dissemination community, knowledge sharing and transfer, private sector model development **Role**: varietal selection, PVS, seed production, exchange, linkage building with nutrition and dissemination community, knowledge sharing and transfer, public-private sector model development.

National Potato Research Program (NPRP) is a national research institution that directs and coordinates all the activities with potato. It has **expertise** in variety improvement, disease management, organic potato production, introducing and multiplying new germplasm, breeding and varietal selection, decentralized consortia for PVS, basic potato seed production and distribution to farmers and department of Agriculture, capacity building on integrated crop management (ICM), linkage building with nutrition and dissemination community. **Role**: varietal selection, decentralized consortia for PVS, seed production and exchange, linkage building with nutrition and dissemination community, national project coordination.

Partner in Bhutan

Bhutan Potato Development Program (BPDP) is a national potato program aimed at facilitating, developing, and providing leadership on potato production to achieve food security and enhance sustainable rural livelihoods through increased productivity and income generation. BPDP has **expertise** in varietal selection, decentralized consortia for PVS, capacity building on ICM, developing and supporting sustainable seed production and dissemination to farmers, developing and disseminating strategies to increase, maintain yields. **Role**: introducing, multiplying and evaluating new and existing biofortified, abiotic and biotic stress tolerant germplasm through PVS, linkages with nutrition and dissemination community, knowledge sharing, transfer, and project coordination.

3.3. Project management team

CIP in Lima, Peru, in coordination with our regional office in New Delhi, India, will be responsible for overall project coordination and implementation. Dr. Merideth Bonierbale and Dr. Thomas zum Felde will supervise, backstop, and monitor the overall implementation of the project with regard to the development of potato lines with elevated micronutrient and resistance traits, as well as sample preparation and micronutrient evaluation in each country. Dr. Mohinder Kadian, based in New Delhi, will coordinate the project research and training activities and interchanges with all partner organizations in Nepal and Bhutan. This includes coordination of subcontracts with partners and training. CIP's new Asia Potato Breeder in Bangladesh will coordinate documentation of material performance and analysis and communication to guide in country use of plant genetic resources in Nepal and Bhutan. This breeder will support the application of standard procedures for experimentation, data collection and sharing, and dissemination activities to accelerate varietal selection procedures at the national level and promote varietal uptake together with national program partners.

3.4. Sustainability

The biodiverse and nutritious potato clones that will be provided to NARS and NGOs in Peru, Bhutan and Nepal will be incorporated into their breeding programs. Teams involving rural highland communities will be established for fast multiplication of the selected elite clones and will be consolidated independently of the existence of this project. More than 5 metric tons of the candidate varieties (best micronutrient dense / disease-resistant clones) identified in adaptation and participatory varietal selection trials and by involving consumers and value chain actors will be produced for dissemination in each country by the end of the project period. Training of extension workers in target districts will disseminate knowledge and practices among additional farmer groups beyond those participating directly in project activities. Intrinsic rusticity characteristics of the project's new varieties (virus resistance; LB resistance) and understanding of management practices will contribute to manageability of genetic resources on farm and enhance the success of ware and seed producers with minimal infrastructure and access to external inputs.

The partner institutions participating in the Biodiverse and Nutritious Potato project will propose the participants for international exchange visits conducted to promote mutual learning in participatory varietal selection and breeding. Each partner institution will assure that the suggested participant transfer knowledge and experience to their partners when back to their country. The project directly addresses CIP's strategic objectives Enhancing Food Security in Asia through the Intensification of Local Cereal based Systems with Early-Maturing Agile Potato and Addressing the Food Security Challenge through Roots and Tubers: Transforming Vulnerability to Resilience of its new ten year Strategy and Corporate Plan and will therefore benefit from institutional monitoring and evaluation in conjunction with the CGIAR Research Program on Roots Tubers and Bananas.

SECTION D: APPENDIXES

By signing this submission form for full proposal, the applicant confirms that all the above statements, including the attached Appendixes, are true to the best of his/her knowledge. Any deliberately untruthful response will lead to the automatic exclusion from the further screening and appraisal process, and may lead to the denial of awarded grants from the Benefit-sharing Fund.

Thomas zum Felde

Signature of contact person

2014, 5. Dez., Lima / Peru

Date and location

Barbara Wilde

Signature of Director General

December 5, 2014

Date and location

SECTION D: APPENDIXES

Appendix 1: Information on the applicant
Appendix 2: Logical Framework
Appendix 3: Workplan
Appendix 4: Budget
Appendix 5: Disbursement information

Annex 1: Partners Letter
Annex 2: PGRFA Release Schemes
Annex 3: References

APPENDIX 1: INFORMATION ON THE APPLICANT

Organization: International Potato Center (CIP)

Type of organization: International Organization

Address: Apartado 1558

P.O. Box:

Telephone Number: +51 1 349 6017

Fax Number: +51 1 317-5326

Country and city: Lima 12, Peru

Web page: www.cipotato.org

Contact Person

Mr ☐ Mrs ☒ Ms ☐

Name: Dr. Barbara H. Wells

Position: Director General

Address: Apartado 1558

P.O. Box:

Country and city: Lima 12, Peru

Telephone Number: +51 1 349 6017

Fax Number: +51 1 317-5326

E-mail address: cip-dg@cgiar.org

APPENDIX 2: LOGICAL FRAMEWORK

Project title: Biodiverse and Nutritious Potato Improvement across Peru, Nepal and Bhutan				
	Intervention logic	**Indicators/targets**	**Sources and means of verification**	**Assumptions**
Impact	To contribute to the achievement of Millennium Development Goals 1 and 7: • *To eradicate extreme poverty and hunger* • *Ensure environmental*			
Outcome	To improve adaptation to climate change and enhance the food security of resource-poor farmers in Peru, Nepal and Bhutan, by strengthening the sustainable management and use of plant genetic resources for food and agriculture (PGRFA).	**1.** Potato yield of at least 6000 smallholders increased by 20% and climate change attributable losses reduced by 10% by 2018 in project target regions through use of new robust clones and varieties. **2.** Contribution of Fe and Zn to the diet coming from potato increased by 10% for at least 6000 households. **3.** Profit margin from potato production increased to 20% for at least 750 households.	• Statistics from regional governmental organizations in project locations • Registers of project beneficiaries • Potato survey consumption	• National and regional governments provide policy supports for food-based strategies for nutrition improvement
Output 1 (crop improvement)	New biodiverse bred parental lines, segregating progenies and selected advanced clones combining elevated micronutrient content with resistance to disease successfully introduced, evaluated, conserved and used by national breeding programs and NGO's in furtherance of Article 13.2.(b) of	**1.1** 10 parental lines with medium Fe and Zn concentration (above 25 and 20 ppm, respectively) introduced and tested per country. **1.2** 30 true seed families from biofortified breeding populations selected, documented and introduced in each country. **1.3** >50 promising clones from true seed families selected in each country and introduced to multi-locational trials. **1.4** >20 promising clones selected per country.	• Partnership agreements and action plans with NARS in each country. • Peer-reviewed publication of parental value of potato genetic material	• NARS staff stable (no turnover) • Support from long-term breeding efforts and objectives

	the International Treaty.		• Database of progeny performance in Nepal, Bhutan and Peru.	
Output 2 (participatory selection)	Decentralized breeding and participatory variety selection methodologies to improve end-user involvement in the co-development of new genetic resources strengthened across countries.	**2.1** A network with at least 6 decentralized multi-stakeholder consortia and 15 on-farm PVS trials per country running by year 2 of the project. **2.2** >500 resource-poor farmers participating in and directly benefitting from varietal development. **2.3** Participatory variety selection methodology using the M&B trial design strengthened in each country. **2.4** >2 candidate varieties (best micronutrient dense / disease-resistant clones) identified in adaptation and PVS trials and by involving value chain actors proposed for release in each country. **2.5** Sensorial information used to orient the breeding programs and inform future development and deployment of germplasm.	• Reports about multilocation + on-farm trials • Field books • Database	• Active participation of diverse non-farming stakeholders (village authorities and private sector)
Output 3 (knowledge management)	A knowledge management system for open access documentation and tracking of genetic resources provenance, characteristics and use, including databases and web interface, developed in furtherance of Article 13.2.(a) of the International Treaty.	**3.1** One online information system (database) linking back 100% of the traits measured during the project to accession-based documentation. **3.2** Global Trail Data Management database with farmer preference and gender differentiated data.	• Web-based databases	• All partners systematically document and share minimal data sets
Output 4 (capacity building)	Increased capacity of National Agricultural Research Systems (NARS) and farmers in Peru,	**4.1** > 12 training events conducted for breeders (3), trainers-of-trainers (3) and farmers (6).	• Training reports, participants lists and certificates.	• Trained staff will remain in their institutions (low

	Nepal and Bhutan to access genetic resources and develop improved disease resistant and micronutrient dense varieties in furtherance of the objectives of Article 13.2.(c) of the International Treaty.	on practical experience and best practice. **4.3** 2 international exchange visits among Peru, Nepal and Bhutan with 6 to 8 participants each conducted to promote mutual learning about participatory variety selection and benefit sharing. **4.4** Methods for potato tuber sample preparation and micronutrient analysis transferred.	• Protocols shared • Publications • Education materials	staff turnover)
Output 5 (outreach and dissemination)	Widespread access by resource poor mountain farmers to research results through innovative dissemination approaches.	**5.1** > 500 mini-tubers per candidate variety and 5 metric tons of tuber seed of the candidate varieties produced for dissemination at country level. **5.2** At least 1 business model for varietal dissemination with potential replicability identified for effective smallholder uptake tested and shared among project partners. **5.3** At least 2 didactic communications materials explaining the biofortification and	• Seed production registers • Publications • Business case documentation	• Market-based demands for new varieties exists

APPENDIX 3: WORK PLAN (Gantt Chart)

Project title: Biodiverse and Nutritious Potato Improvement across Peru, Nepal and Bhutan

A = CIP (International Organizer); **B** = INIA (Peru); **C** = Grupo Yanapai (Peru); **D** = Asociación Pataz (Peru); **E** = BPDP (Bhutan); **F** = LI-BIRD (Nepal) **G** = NPRP (Nepal)

Activity	Who?							1st Year						2nd Year						3th Year					
								Months						Months						Months					
	A	B	C	D	E	F	G	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2
OUTPUT 1 crop improvement																									
Act. 1.1 Introduce parental lines and segregating progenies that combine elevated micronutrient content with resistance to late blight and viruses to national breeding programs.	*	*	*	*	*		*																		
Act. 1.2 Evaluate and select Andean-derived clones from the segregating progenies for late blight and virus resistance, drought tolerance, marketable yield and high micronutrient content	*	*	*	*	*	*	*																		
Act. 1.3 Multiply promising Andean-derived clones and candidate varieties for larger scale on-station trials and fast transfer to on-farm and decentralized district-level trialing.	*	*	*	*	*		*																		
Act. 1.4 Analyze iron (Fe), zinc (Zn), and vitamin C concentration and evaluate antioxidant Act. in predominant and newly selected genetic resources, including segregating progenies grown and evaluated across different sites and management practices.	*																								
OUTPUT 2 participatory selection																									
Act. 2.1 Strengthen new and existing decentralized multi-stakeholder consortia for participatory variety selection with the Mother and Baby trial design involving food insecure rural highland communities	*		*	*	*	*	*																		
Act. 2.2 Implement participatory selection trials in remote and food insecure mountain villages to identify best-bet micronutrient-dense candidate varieties together with value chain actors.	*	*	*	*	*	*	*																		
Act. 2.3 Organize annual country level meetings between the different consortia to share results between researchers and farmers as to set priorities for the following planting season.	*				*	*																			
Act. 2.4 Systematically evaluate the sensorial properties of the commonly consumed, preferred and newly selected candidate potato varieties with local women and men farmers and consumers toward improved understanding of users' preferences.	*	*	*	*	*	*	*																		
OUTPUT 3 knowledge management																									

Act. 3.1 Pilot level information system and database that links traits and properties to genetic resources in genebanks and breeding programs developed.	*	*			*	*	*																		
Act. 3.2 Global Trial Data Management tool updated to include farmer preference data and gender differentiated user feedback.	*	*			*	*	*																		
OUTPUT 4 capacity building																									
Act. 4.1 Conduct regional capacity strengthening for standardized breeding procedures and micronutrient concentration evaluation and disease and stress resistance evaluation and documentation procedures	*				*		*																		
Act. 4.2 Conduct NARS and farmers capacity strengthening for enhanced awareness about and knowledge of how to access appropriate genetic resources for use in breeding	*				*		*																		
Act. 4.3 Coordinate and facilitate international exchange visits among Peru, Nepal and Bhutan to promote mutual learning in participatory variety selection and partnerships for decentralized variety development, knowledge and benefit sharing.	*				*	*	*																		
Act. 4.4 Co-develop a training manual and a multilingual training video on participatory variety selection using the Mother and Baby trial design based on practical experience and best practices.	*				*	*	*																		
Act. 4.5 Implement consortium level training course for facilitators (trainers-of-trainers) in the application of participatory variety selection.	*	*	*	*	*	*	*																		
Act. 4.6 Train NARS and extension workers on late blight management using the new resistant genotypes	*	*	*	*	*	*	*																		
OUTPUT 5 outreach and dissemination																									
Act. 5.1 Produce high quality mini-tubers and pre-basic seed of candidate varieties for dissemination and provision to resource poor farmers.	*	*	*	*	*		*																		
Act. 5.2 Identify at least one business model for varietal dissemination with potential replicability for effective smallholder uptake among project partners.	*					*																			
Act. 5.3 Development of communication materials to explain the concepts underlying genetic resources use in crop improvement for biofortification and resistance to disease and stress.	*																								

APPENDIX 4: BUDGET

APPENDIX 4: BUDGET

Project title: Biodiverse and Nutritious Potato Improvement across Peru, Nepal and Bhutan					
Project management costs					
Staff		**Unit**	**Quantity (no.of units)**	**Unit Cost USD**	**Total Cost USD**
Full time staff					
	Project coordinator	person-month			
					0
Part time staff [1]					
	Project Coordinator (10%)	person-month	3.6	7,830	28,189
	Asia Potato Breeder (5%)	person-month	1.8	8,407	15,133
	Breeder HQ (5%)	person-month	1.8	13,291	23,924
	Nutritional Quality Specialist (10%)	person-month	3.6	7,830	28,189
	Dissemination Specialist (5%)	person-month	1.8	7,830	14,095
	Research Assistant (25%)	person-month	9	1,760	15,841
	Technician (100%0	person-month	36	1,288	46,364
					171,733
Consultants					
		person-month			
					0
Subtotal: Staff					**171,733**

Notes:/ [1] Unit cost (cost per month) reflects part-time work (i.e. 25% or 30%) on project activities.

Allocation of budget by outputs

	Total Budget Cost (USD)
Output 1:	
Staff	79,425
Travel	3,017
Training and Workshops	2,250
Materials and/or Equipment	23,838
Logistical Support	17,925
Field Activities/Farmers and rural communities	35,500
Other	960
Total Cost Output 1:	***162,916***
Output 2:	
Staff	20,384
Travel	42,579
Training and Workshops	7,500
Materials and/or Equipment	4,954
Logistical Support	22,718
Field Activities/Farmers and rural communities	146,000
Other	960
Total Cost Output 2:	***245,096***

Output 3:	
Staff	14,809
Travel	9,990
Training and Workshops	1,500
Materials and/or Equipment	129
Logistical Support	7,761
Field Activities/Farmers and rural communities	0
Other	21,960
Total Cost Output 3:	***56,149***
Output 4:	
Staff	31,990
Travel	17,077
Training and Workshops	3,750
Materials and/or Equipment	279
Logistical Support	16,208
Field Activities/Farmers and rural communities	87,600
Other	960
Total Cost Output 4:	***157,864***
Output 5:	
Staff	25,125
Travel	9,990
Training and Workshops	0
Materials and/or Equipment	219
Logistical Support	12,008
Field Activities/Farmers and rural communities	58,400
Other	960
Total Cost Output 5:	***106,703***
Indirect costs (%) [2]	71,273
Total amount requested to the Benefit-sharing Fund	***800,000***

CO-FINANCING:	
(Institution)	**Total**
CIP	**150,000**
NEPAL NPRP	**40,000**
NEPAL LI-BIRD	**70,000**
BUTHAN BPDP	**40,000**
Peru - INIA	**50,000**
Peru - Grupo Yanapai	**30,000**
Peru -Asociación Pataz	**70,000**
Total co-funding	**450,000**
Grand Total	**1,250,000**

Staff	Unit	Quantity (no.of units)	Unit Cost USD	Total Cost USD
Full time staff				
	person-month			
				0
Part time staff				
Project Coordinator (10%)	person-month	3.6	7,830	28,189
Asia Potato Breeder (5%)	person-month	1.8	8,407	15,133
Breeder HQ (5%)	person-month	1.8	13,291	23,924
Nutritional Quality Specialist (10%)	person-month	3.6	7,830	28,189
Dissemination Specialist (5%)	person-month	1.8	7,830	14,095
Research Assistant (25%)	person-month	9	1,760	15,841
Technician (100%0	person-month	36	1,288	46,364
				171,733
Consultants				
				0
				0
Subtotal: Staff				**171,733**

Notes:

Travel	Unit	Quantity (no.of units)	Unit Cost USD	Total Cost USD
Local Travel				
Peru - Huancavelica, La Libertad, Cajamarca, Junin	round-trip			-
Duration (1 persons x 5 days x 24 trips)	person-day	120		-
Travel (1 persons x 40 trips x 3 years)	round-trip	120		-
Daily Subsistence Allowance (DSA)	DSA	120	50	6,058
Subtotal: Local Travel				6,058
Regional/International Travel				
Lima (Peru) - Nepal/Bhutan	round-trip			
Duration (3 persons x 9 days x 1 trip)	person-day	81		-
Travel (3 person x 3 flights)	round-trip	9	2,800	25,200
Daily expense allowance	person-day	81	343	27,815
Bhutan/Nepal - Lima (Peru)	round-trip			
Duration (3 persons x 9 days x 1 trip)	person-day	27		-
Travel (1 person x 3 flights)	round-trip	3	2,800	8,400
Daily expense allowance	person-day	27	340	9,180
Regional Travel (Bhutan/Nepal)	round-trip			
Duration (2 persons x 5 days x 6 trip)	person-day	60		-
Travel (2 person x 6 flights)	round-trip	6	500	3,000
Daily expense allowance	person-day	60	50	3,000
Subtotal: Regional/International Travel				76,595
Subtotal: Travel				**82,654**

Notes:

Training and Workshops	Unit	Quantity (no.of units)	Unit Cost USD	Total Cost USD
Workshops A	workshop			
Participants (40 persons x 3 day x 1 workshops)	person-day	120	125	15,000
Local Travel (persons x workshops)	round-trip			0
Food (lunch and tea breaks)	person-day			0
Venue	day			
Materials	per person			
Subtotal: Training and Workshops				**15,000**

Notes:

Materials and/or Equipment	Unit	Quantity (no.of units)	Unit Cost USD	Total Cost USD
Office Supplies & Materials	year	3	500	1,500
Research Supplies	year	3	3474	10,421
Laboratory Supplies	year	3	4000	12,000
Farm Supplies & Materials	year	3	1833	5,500
Subtotal: Materials and/or Equipment				**29,421**

Notes:

Logistical Support (12 months)	Unit	Quantity (no.of units)	Unit Cost USD	Total Cost USD
Office Space	months	36	46	1,662
Bank Fees: (Partners)	Unit	24	26	618
IT Services/Connectivity	months	36	70	2,504
Project Research support costs	months	36	1,551	55,836
CG System Cost Fee	year	3	5,333	16,000
Subtotal: Logistical Support				**76,619**

Notes:

OTHER COSTS

Field activities	Unit	Quantity (no.of units)	Unit Cost USD	Total Cost USD
Field Space	year	3	3,333	10,000
Laboratory Serv - Quality and Nutrition Lab	year	3	8,500	25,500
	price per sample			0
Subtotal: Field Activities				**35,500**

Notes:

Community Works	Unit	Quantity (no.of units)	Unit Cost USD	Total Cost USD

Subtotal: Community works **0**

Notes:

Subcontracts	Unit	Quantity (no.of units)	Unit Cost USD	Total Cost USD
Subontract A				
NEPAL NPRP	years	3	20,667	62,000
NEPAL LI-BIRD	years	3	28,000	84,000
BUTHAN BPDP	years	3	20,667	62,000
Peru - INIA	years	3	20,000	60,000
Peru - GrupoYanapai	years	3	8,000	24,000
Peru -Asociación Pataz	years			0

Subtotal: FieldActivities **292,000**

Notes:

Visibility Plan	Unit	Quantity (no.of units)	Unit Cost USD	Total Cost USD
Data Base	year	3	7000	21,000
Catalogues, and other publications	lump sum	3	1600	4,800

Subtotal: Visibility Plan (1-3 % total project budget) **25,800**

Notes:

ndirect Costs (≤10 % of total budget) **71,273**

Notes: *provide indicative list of indirect costs to be included*

TOTAL PROJECT BUDGET **800,000**

APPENDIX 5: DISBURSEMENT INFORMATION

Bank Name: JPMorgan Chase Bank, N.A.

Bank address: 277 Park Ave/23rd Floor, New York, New York 10172-0003

Branch :

Country : New York, NY

Beneficiary : International Potato Center

Account number: 957117760

Account currency: US$

IBAN Code:

SWIFT Code: CHASUS33

ANNEX 1: Partner Letters

1. Grupo Yanapai
2. Potato Development Program (BPDP)
3. Local Initiatives for Biodiversity, Research and Development (LI-BIRD)
4. National Potato Research Program (NPRP)
5. Instituto Nacional de Innovación Agraria (INIA)
6. Asociación Pataz

December 3, 2014

International Potato Center (CIP)
Av. La Molina 1895
La Molina, Apartado 1558
Lima, Perú

Ref.: ITPGRFA/BSF CFP 2014

Dear Dr. Wells,

This letter is to confirm GRUPO YANAPAI´s support to the International Potato Center (CIP), as a partner, in the development and submission of their proposal for the project entitled, "**Exchanging and Developing Biodiverse Potato Varieties in Peru, Nepal and Bhutan**." This proposal will be submitted to the third Call for Proposals of the Benefit-sharing Fund of the International Treaty for Genetic Resources for Food and Agriculture (ITGRFA).

GRUPO YANAPAI

YANAPAI is a non-profit organization which has worked for over 30 years in the highlands of Central Peru, to enhance skills and develop technologies for farming families and farmers' organizations with emphasis through participatory action research, to promote innovation in highland communities where potato is a key crop.

Our role within the proposed project will be to implement participatory varietal selection production and dissemination with highland communities to benefit food insecure communities in Huancavelica, Peru.

We look forward to a fruitful and successful collaboration to strengthen food security and improve the living conditions especially of female farmers. We are excited to contribute to the fast release and dissemination of new, diverse, consumer-accepted, stable yielding, disease resistant potato varieties with enhanced nutritional quality in Peru.

Sincerely,

Edith Fernández-Baca

Dr. Edith Cristina Fernandez-Baca Pacheco
President Group YANAPAI

Dirección Junín/ Atahualpa 297. Concepción Junín. Perú **Teléfono/** 064-581334,
Dirección Lima/ Trípoli 365 (801) Miraflores, Lima , Perú **Teléfono/** 01 4427065

yanapaihyo@yahoo.com / scurrah@gmail.com

NATIONAL POTATO PROGRAM
DEPARTMENT OF AGRICULTURE
MINISTRY OF AGRICULTURE AND FORESTS
YUSIPANG, THIMPHU

25th November 2014

International Potato Center (CIP)
Av. La Molina 1895
La Molina, Apartado 1558
Lima, Peru

Ref.: ITPGRFA/BSF CFP 2014

Dear Dr. Barbara H. Wells,

With this letter,the Bhutan Potato Development Program (BPDP)would like to confirm our support to the International Potato Center (CIP),as a partner, in the development and submission of their proposal for the project entitled, "Exchanging and Developing Biodiverse Potato Varieties in Peru, Nepal and Bhutan".This proposal will be submitted to the third Call for Proposals of the Benefit-sharing fund of the International Treaty for Genetic Resources for Food and Agriculture (ITGRFA).

The purpose of this letter is to confirm our commitment to the project team. We are eager to contribute to the fast release and dissemination of new, diverse, consumer-accepted, stable yielding, disease resistant potato varieties with enhanced nutritional qualityin Bhutan.

The role of theBPDP will be varietal selection in Bhutan, the organization of decentralized consortia for participatory varietal selection, seed production and exchange, linkage building with nutrition and dissemination communities, knowledge sharing and transfer, and the national project coordination in Bhutan.

We thank you for including us in this proposal, and look forward to a fruitful and successful collaboration during implementation of the "Exchanging and Developing Biodiverse Potato Varieties in Peru, Nepal and Bhutan." project.

Sincerely,

Pema Wangchuk
Program Leader

C/O Horticulture Division, Thimphu; Tel: 02-323183, Fax: 02-325837

LI-BIRD

Regd. No. 217/052/053, Kaski

Local Initiatives for Biodiversity, Research and Development

November 28, 2014

International Potato Center (CIP)
Av. La Molina 1895
La Molina, Apartado 1558
Lima, Peru

Ref.: ITPGRFA/BSF CFP 2014

Dear Dr. Barbara H. Wells,

With this letter, the Local Initiatives for Biodiversity, Research and Development (LI-BIRD) in Nepal would like to confirm our support to the International Potato Center (CIP), as a partner, in the development and submission of their proposal for the project entitled, "Exchanging and Developing Biodiverse Potato Varieties in Peru, Nepal and Bhutan". This proposal will be submitted to the third Call for Proposals of the Benefit-sharing fund of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA).

The purpose of this letter is to confirm our commitment to the project team. We are eager to contribute to the fast release and dissemination of new, diverse, consumer-accepted, stable yielding, disease resistant potato varieties with enhanced nutritional quality in Nepal.

The role of LI-BIRD will be varietal selection in Nepal, the organization of decentralized consortia for participatory varietal selection, seed production and exchange, linkage building with nutrition and dissemination communities, knowledge sharing and transfer, and the private sector model development.

We thank you for including us in this proposal, and look forward to a fruitful and successful collaboration during implementation of the "Exchanging and Developing Biodiverse Potato Varieties in Peru, Nepal and Bhutan." project.

Sincerely,

Balaram

Estd. 1995 AD
LI-BIRD
Head Office, Pokhara, Nepal

Balaram Thapa, PhD
Executive Director,
LI-BIRD

Government of Nepal
NEPAL AGRICULTURAL RESEARCH COUNCIL
(Established by the Government of Nepal under the Nepal Agricultural Research Council Act. 2048 B.S.)
NATIONAL POTATO RESEARCH PROGRAMME

Ref. No.: 071/072
Dispatch No.: 185

Nepal Agricultural Research Council
National Potato Research Programme
Khumaltar, Lalitpur, Nepal
2049

Khumaltar, Lalitpur
NEPAL
25th November, 2014

International Potato Center (CIP)
Av. La Molina 1895
La Molina, Apartado 1558
Lima, Peru

Ref.: ITPGRFA/BSF CFP 2014

Dear Dr. Barbara H. Wells,

With this letter, the National Potato Research Program (NPRP) would like to confirm our support to the International Potato Center (CIP), as a partner, in the development and submission of their proposal for the project entitled, "**Exchanging and Developing Biodiverse Potato Varieties in Peru, Nepal and Bhutan**". This proposal will be submitted to the third Call for Proposals of the Benefit-sharing fund of the International Treaty for Genetic Resources for Food and Agriculture (ITGRFA).

The purpose of this letter is to confirm our commitment to the project team. We are eager to contribute to the fast release and dissemination of new, diverse, consumer-accepted, stable yielding, disease resistant potato varieties with enhanced nutritional quality in Nepal.

The role of NPRP will be in participatory varietal selection, seed production and exchange, linkage building with nutrition and dissemination communities and coordination in Nepal. As in our previous projects with CIP, Dr. Bhim Bahadur Khatri, senior scientist, NPRP/NARC will be our focal person in this project
We thank you for including us as a partner in this proposal, and look forward to a fruitful and successful collaboration in the proposed project.

Sincerely,

Buddhi Prakash Sharma, PhD
Coordinator
National Potato Research Program (NPRP)
Nepal Agricultural Research Council (NARC)
Khumaltar, Lalitpur
Nepal

Mailing Address: P.O.Box No.: 246, Kathmandu, Nepal
Phone: (+977-1) 5522114 / 5538005, Fax: (+977-1) 5538005
E-mail: prp@narc.gov.np, Website: http://www.narc.gov.np

Cajamarca, November 27 - 2014

International Potato Center (CIP)
Av. La Molina 1895
La Molina, Apartado 1558
Lima, Peru

Ref.: ITPGRFA/BSF CFP 2014

Dear Dr. Barbara H. Wells,

With this letter, the "Instituto Nacional de Innovación Agraria" (INIA), Programa Nacional de Innovación Agraria en Raices y Tuberosas, would like to confirm our support to the International Potato Center (CIP), as a partner, in the development and submission of their proposal for the project entitled, "Exchanging and Developing Biodiverse Potato Varieties in Peru, Nepal and Bhutan". This proposal will be submitted to the third Call for Proposals of the Benefit-sharing fund of the International Treaty for Genetic Resources for Food and Agriculture (ITGRFA).

The purpose of this letter is to confirm our commitment to the project team. We are excited to contribute to the fast release and dissemination of new, diverse, consumer-accepted, stable yielding, disease resistant potato varieties with enhanced nutritional quality in Peru.

The role of INIA - Programa Nacional de Innovación Agraria en Raices y Tuberosas, will be varietal selection in Peru, the set-up of decentralized consortia for participatory varietal selection, seed production and exchange, linkage building with nutrition and dissemination communities, knowledge sharing and transfer.

We thank you for including us in this proposal, and look forward to a fruitful and successful collaboration during implementation of the "Exchanging and Developing Biodiverse Potato Varieties in Peru, Nepal and Bhutan." project.

Sincerely,

INSTITUTO NACIONAL DE INNOVACIÓN AGRARIA
Programa Nacional de Innovación Agraria en Raices y Tuberosas

Ing. M.Sc. Hector A. Cabrera Hoyos
JEFE

Asociación Pataz

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Trujillo november 27, 2014

LETTER Nº 120-2014- AP

International Potato Center (CIP)
Av. La Molina 1895
La Molina, Apartado 1558
Lima, Peru

Ref.: ITPGRFA/BSF CFP 2014

Dear Dr. Barbara H. Wells,

With this letter, the "Asociación Pataz" would like to confirm our support to the International Potato Center (CIP), as a partner, in the development and submission of their proposal for the project entitled, "Exchanging and Developing Biodiverse Potato Varieties in Peru, Nepal and Bhutan". This proposal will be submitted to the third Call for Proposals of the Benefit-sharing fund of the International Treaty for Genetic Resources for Food and Agriculture (ITGRFA).

The purpose of this letter is to confirm our commitment to the project team. We are excited to contribute to the evaluation, fast release and dissemination of new, diverse, consumer-accepted, stable yielding, disease resistant potato varieties with enhanced nutritional quality in Peru.

The role of "Pataz Association" will be the evaluation of up to 30 clones and selection of varieties in the provinces of Pataz and Sanchez Carrion, La Libertad region, seed production and rapid dissemination.

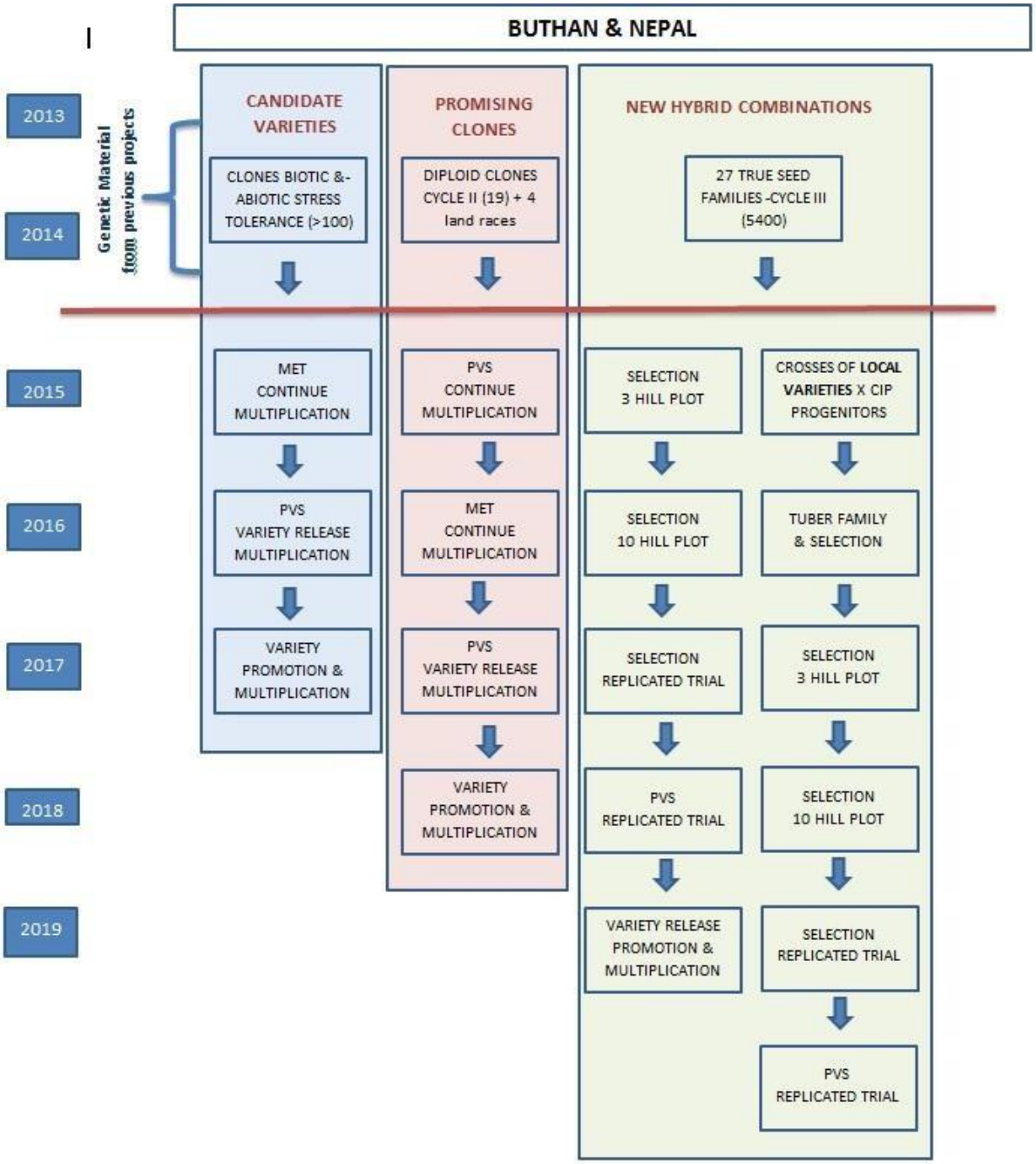
We thank you for including us in this proposal, and look forward to a fruitful and successful collaboration during implementation of the "Exchanging and Developing Biodiverse Potato Varieties in Peru, Nepal and Bhutan." project.

Sincerely,

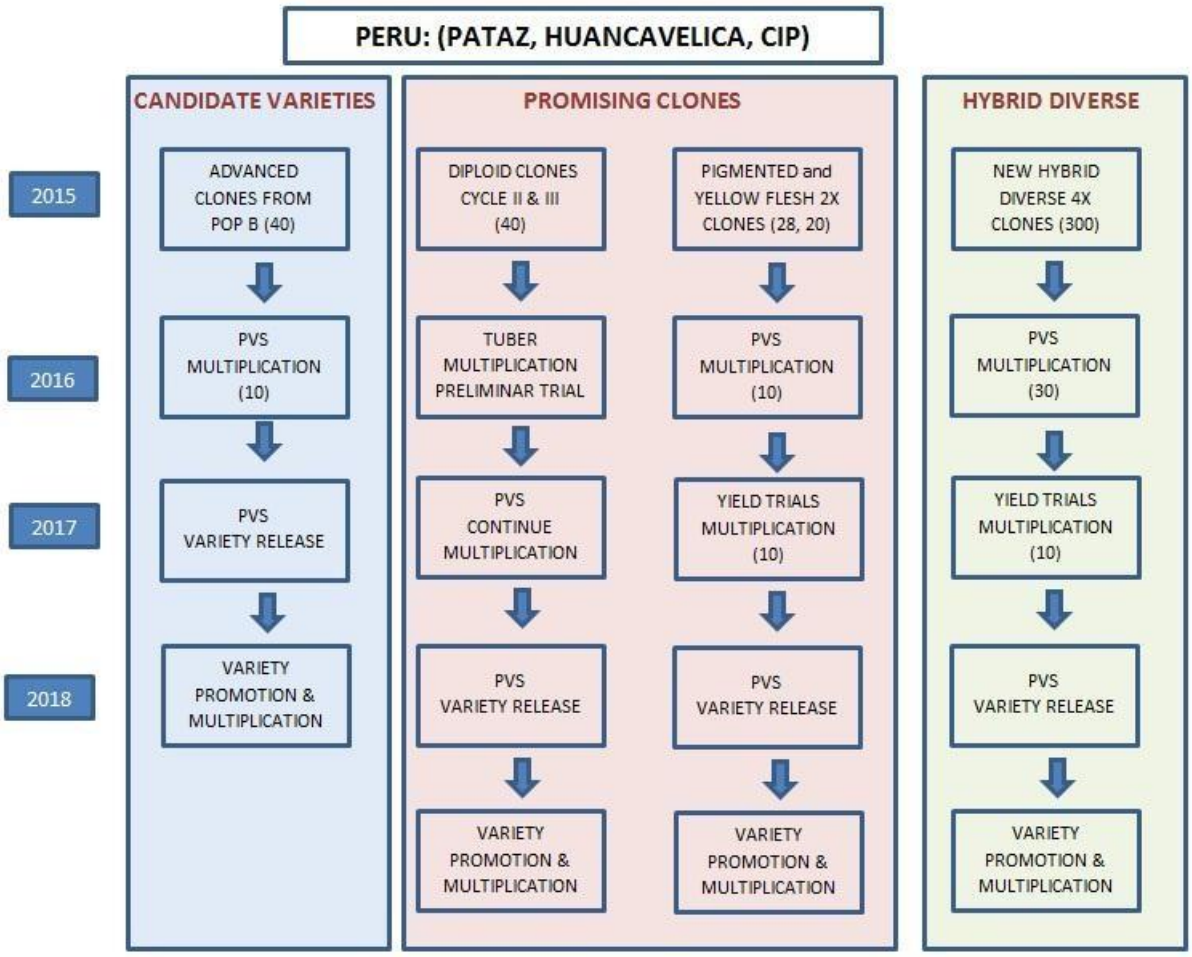
ING. JUAN MIGUEL PÉREZ VÁSQUEZ
Secretario Ejecutivo
ASOCIACIÓN PATAZ

ANNEX 2: PGRFA Release Schemes

Schemes for generation, management and release of PGRFA in Nepal and Bhutan



Schemes for generation, management and release of PGRFA in Peru



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The International Potato Center (known by its Spanish acronym CIP) is a research-for-development organization with a focus on potato, sweetpotato, and Andean roots and tubers. CIP is dedicated to delivering sustainable science-based solutions to the pressing world issues of hunger, poverty, gender equity, climate change and the preservation of our Earth's fragile biodiversity and natural resources.
www.cipotato.org

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A member of the CGIAR Consortium

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