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Peru: Improving the productivity and prosperity of highland farmers through extension services

In the native Quechua language, Peru means ‘the land of abundance,’ which is appropriate for a country filled with diverse cultures, climates, and customs. The Quechua and other indigenous peoples are part of the rich mosaic of cultures in Peru (“Peru”). The array of geographic and climactic differences encompassed in Peru match the stunning cultural diversity.

The country is divided into three main geographic zones: the coastal plains, the jungles, and the mountains (“Rural Poverty”). Rough hills spanning the narrow region from the edge of the Andes Mountains to the shores of the vast Pacific make up the urbanized Costa region. The arid and barren land of the Costa contrasts sharply with the thick vegetation and tropical climate of the Selva, which takes up about 60% of Peru’s total area. Finally, the most dramatic region stretches across the snow-capped peaks of the Andes Mountains. This area, known as the Sierra is inhabited by rural, indigenous, subsistence farmers that farm the often poor, thin soil (“Peru”). These highland agrarian communities suffer from extreme poverty and poor quality of life.

90% of rural impoverished Peruvians living in the Andean highlands are subsistence farmers that typically face many social and economic difficulties. The indigenous peoples rely heavily on agriculture, and the composition and conditions of their families and communities reflect their dependence. The staggering rates of poverty and food insecurity pose chronic problems to these highland communities, with 90% of rural impoverished Peruvians living in the Andean highlands as subsistence farmers. The indigenous population is plagued by the highest rates of poverty, with more than five million Quechua and Aymara communities falling below the poverty line (“Rural Poverty”). These highland farm families are generally two-parent units comprised of about 6.7 members (Vargas 1491).

Societies in the highland communities reflect the entrenchment of traditional gender roles in the region. Although women play an important role in subsistence farming and represent as much as 80% of the family’s labor force (“Rural Poverty”), men typically are the household head and make the major agricultural decisions (*Gender in Agriculture* 276). Women must plant and harvest the potato fields (Warnaars 7) while maintaining the household and raising the children. Because of the required labor and inferior position in society, poverty disproportionately affects women, with nearly 70% of rural women living in extreme poverty (“Rural Poverty”).

The diets of these impoverished families consist largely of potatoes, which offer a fairly inexpensive source of calories and nutrients. Potatoes are consumed in great quantities, averaging about 421 grams per adult equivalent per day and provide the following daily needs: about 16% of protein, 17% of iron, up to 31% of energy, and 97% of vitamin C. (Rose 1). However, with an insufficient supply of potatoes, malnutrition is prevalent. For example, widespread iron deficiency causes detrimental health impacts such as impaired physical and

cognitive development, increased risk of morbidity in children, and stunting (*Annual Report 2010* 16). It also has a negative economic impact as a result of decreased worker productivity and capability. For rural farmers, potatoes offer the most economical foodstuff, providing 1.5-2 times the calories of grains for the same price. Because potatoes are fairly common, inexpensive, and nutritious, rural farmers could help reduce the extensive malnutrition in the highlands with an increase in potato quality and production (Rose 4).

Not only do rural subsistence farmers lack sufficient health services, they also commonly suffer from deficient education. Only 42.5% of the impoverished complete their primary education, and these staggering numbers are due in part to the chronic poverty. However, illiteracy rates for men at only 6.3% while women have 17.5% illiteracy (“Youth and Adult Literacy”). This gender disparity in education represents another instance of the inferior position women hold in the highland farming communities. Furthermore, the access to education in these rural communities will deteriorate further as the burgeoning Peruvian population strains the already-poor educational system (“Peru”).

Many indigenous, subsistence farmers in the highlands grow only staple crops, especially potatoes, on small plots with outdated agronomic practices. About 63% of the highland farms are less than three hectares in size (“Geography”). Farmers plant the vast majority of these small plots with varieties of potatoes (Godtland 4). In general, the small, rural farms require a significant amount of difficult labor (“Peru”), such as planting, weeding, and harvesting, which are activities that the women must play a significant role (*Gender in Agriculture* 275). Also, to combat disease threats like late blight and prevent yield losses, farmers apply high rates of fungicides to their potatoes. (Kaguongo 27). Farmers also extensively use insecticides on their potatoes to control pests like the Andean potato weevil (“Medium Term Plan” 174).

Indigenous peoples formerly employed “sectorial fallowing systems,” which included practices like seven-year crop rotations and raised beds that effectively prevented pests like the Andean potato weevil. However, farmers have moved away from such systems by splitting up the land into small plots, rendering the techniques useless and forcing dependence on potentially harmful pesticides to control pest and disease threats (Ortiz 479). Because of the small plots, ineffective pest and disease control, and outdated agronomic practices, highland farmers cannot reach the production potential of the potato.

Subsistence farmers face many hurdles in potato production including both biotic and abiotic factors. Potential crop loss and weather hazards are the two most pressing concerns for these farmers (Vargas 1490). Understandably, farmers are alarmed by the occurrence of late blight, the most devastating disease for potatoes. In Peru, farmers lose an estimated \$7-\$25 million annually due to late blight damage (Salazar 1). Without effective preventative methods, late blight can wipe out an entire crop of potatoes in a matter of weeks (*Annual Report 2010* 53). These high production losses severely impact the farmer economically, and in a costly and often futile attempt to control late blight, the farmers also heavily apply fungicides. (Salazar 27). Exposure to these chemicals poses a serious health risk to farmers and their families. Farmers rarely use adequate protective equipment, and highland potato growers and their families have the highest pesticide poisoning levels ever recorded (Forbes 3). Many of these chemicals break

down into carcinogens, which negatively impact health, resulting in another economic blow to farmers as a result of their decreased work capacity and cost of treatment. These medical issues are difficult to rectify due to inadequate health services (*Annual Report 2009* 33).

Second only to late blight in total impact on farmers, Andean potato weevils cause the most production losses for subsistence farmers and their potato crops.. The infestations result in severe economic losses, with mildly damaged potatoes selling for less than 50% of the typical market price. Farmers often lack an adequate understanding of the life cycle of the weevils and unintentionally continue to re-introduce the pests into their fields and crops (Cisneros “Integrated Pest Management”). Similarly to the attempts to control late blight, farmers apply heavy doses of highly toxic insecticides to their fields, therefore incurring the financial burden the chemicals, the health problems stemming from exposure, and the environmental degradation from the continued application of the toxic chemicals (“Medium Term Plan” 118). The rural subsistence farmers cannot cope with such losses; they usually accept the damage from the weevils as inevitable, and they either stay and suffer the economic and health losses, or simply move on and abandon the infested fields (Cisneros “Controlling the Andean Potato Weevil”).

Climate change and environmental factors also affect potato production and threaten farming activities in the highlands. All Peruvians, but specifically highland farmers and communities, rely on the water that originates from the glaciers in the snow-capped Andes. With the rising temperatures of global warming, the pace of glacial melting increases rapidly and threatens the long-term availability of water to highland farmers. Because the accessibility of water is essential to farming and survival for the highland communities, the changes in the glacial melting threaten agriculture and development (Ferm 15). Furthermore, the ineffective land and water management is causing erosion that increases the sediment in the dwindling water supplies, thus affecting both the quantity and quality of the water (Vuille 9). Also, these glaciers feed rivers that flow from the Andes - the rivers that provide essential generation of hydroelectric power which accounts for about 75% of Peru’s total electricity generated. Therefore, the threat of diminishing water supply cripples not only the highland, agrarian communities, but also the entire country of Peru (“Peru”). Climate change increases the range and threat of insect species including the Andean potato weevil (“Medium Term Plan” 118) and accelerates the risk and recurrence of late blight in the Andean highlands exacerbating the already devastating impacts of each pestilence (*Annual Report 2009* 33).

Therefore, to improve food security for subsistence farmers and their families in the Andean highlands of Peru, the International Potato Center (CIP) should collaborate with the Peruvian government and local non-governmental organizations (NGOs) to implement a network of farmer extension programs. Following model utilized in Africa by the One Acre Fund, these initiatives will focus on the distribution and use of improved potato varieties and other new agronomic practices and provide enhanced access to supplies and markets. This program model has four main steps: farm inputs on credit, delivery, training, and harvest sales (One Acre Fund). In this program, smallholder farmers are adequately equipped with the necessary tools for success (Cavalieri). As a result of these programs, subsistence farmers will be equipped with the knowledge and tools to effectively combat problems and increase productivity.

As poverty and malnutrition continue to worsen in the highland regions, especially in contrast to the improved livelihoods in urban centers, the Peruvian government must take a more active role in supporting smallholder agricultural programs. In recognition of this pressing social responsibility, President Humala has voiced support for small-scale farmers in Peru, declaring 2013 to be “the year of rural development and food security.” President Humala has shown his political commitment to reducing the widespread malnutrition in the Andean highlands by increasing the Ministry of Agriculture’s budget to 2.5 billion soles, or about one billion U.S. dollars in order to continue Peru’s progress towards the Millennium Development Goal of eradicating extreme poverty and hunger (“Peru on the Right Path”). Thus, the Ministry of Agriculture should invest a portion of this augmented budget in the proposed program of farmer extension programs targeting rural, smallholder farmers.

A portion of this invested capital would be directed to CIP to spearhead research into improved potato varieties and agronomic techniques. CIP could distribute the products and information through NGOs along with the crucial technical knowledge that NGOs often lack (Cavaliere). CIP will continue to develop improved potato varieties that have a higher resistance to pests, disease, and climactic shifts; and when paired with updated agronomic practices, they will better the food security for subsistence farmers. Furthermore, the production of these potatoes provide only more available food, but also enhanced nutrition and health of the farmers and their families (Godtland 4).

Although potatoes comprise a large portion of the rural farmers’ diets, the nutritional advantages of potatoes are not currently exploited. Improved potato varieties capitalize on the bioavailability of iron and ascorbic acid, which stimulates iron absorption in humans. The products of CIP’s selective potato breeding programs that target these essential nutrients will dramatically reduce the malnutrition in the highland communities. By diminishing the impact of malnutrition, overall health will improve, which will result in increased work productivity throughout the community (*Annual Report 2010* 16).

Not only do the new crops improve the overall health of the indigenous highland farming communities, but they also decrease pesticide use because the extension services will distribute potatoes varieties that are less susceptible to late blight, Andean potato weevils and other pests (Salazar 27). Varieties of potatoes, like the blight-resistant Amarilis potato, could halt the destruction of this disease and decrease fungicide use by 24% per hectare, reducing farmers’ pesticide exposure and improving potato production. The Amarilis crops have a shorter growing season and offer a 9% yield increase. As a result of all of these positive aspects of the Amarilis, farmers would receive a long-term economic benefit of \$3.7-\$20 million (*Annual Report 2010* 53). However, even if the indigenous farmers reject the new potato varieties, participation in such extension programs alone has been shown to drastically increase potato production by about 32% (Godtland 4).

Finally, the largest portion of the invested money will go to the local network of NGOs to carry out the dissemination of products, education, and practices to the farmers at a community level. These NGOs will bring the improved potato varieties and micro-doses of fertilizers to the village centers and to distribute on credit to the farmers. This practice will be a significant expense.

However, absent this financing, these impoverished farmers could not afford the upfront costs. At harvest, the farmers can repay the loan with their improved yields (One Acre Fund).

The NGOs will hold educational sessions in the villages with the participating farmers, building their human capital through hands-on learning to foster their experimentation, growth, and innovation. The utilization of such participatory methods teaches the farmers to discover their own solutions to problems as the educators guide participants and act as facilitators along the way. These methods “help farmers develop analytical skills, critical thinking, and creativity,” which are crucial to address the various issues affecting communities (Godtland 2). This dialogue between the facilitators and the farmers combines their respective ideas through a two-way flow of information resulting in joint solutions. These locally adapted solutions are necessary in the constantly changing environment and climate of the Andes (*Gender in Agriculture* 300). Through the participation of area farmers in this vital exchange of information, the communities are better equipped for successful farming.

Ultimately, the participating farmers will be skilled enough to become employed by CIP to be managers of their regions, eliminating the need of the NGOs for these programs and making the model more sustainable. This is similar to the *Kamayoq* schools, but on a larger scale with a focus on improving crop production. In the *Kamayoq* model, participants are selected from different highland agrarian communities, and after they complete the training program, they return and share their expertise and resources with other farmers in the area. This reduces the need for a multitude of educational extension locations, which in turn decreases the stress on budgets and personnel (Hellin 34). Furthermore, this network will focus on cooperation with farmers, with other NGOs, and with government officials. This will avoid oft-experienced lack of cohesion and direction, the disregard for the severe limitations that the subsistence farmers face (Ortiz 484), and the “top-down” approaches that ignore the key steps of education and building farmers’ capacity (*Gender in Agriculture* 277) that plague current attempts to solve this Andean food crisis.

Through the farmer extension schools, the interactions and solutions will open up the space to alternative methods and show the cultural respect for the indigenous subsistence farmers by including various aspects of their propositions. The inclusion of local voices also facilitates a positive relationship and helps to encourage the adaptation of the new techniques and varieties (Ortiz 485). The *Kamayoq* agriculture extension initiative achieved such a high level of participation and success because it recognized the importance of including the marginalized and undervalued voices of the indigenous peoples, even teaching in lessons the native Quechua tongue. The respect for the local culture and the emphasis on farmer participation promotes the joint problem solving and results in the confidence and acceptance of the indigenous population (Hellin 32-33). The CIP farmer extension services will implement a similar model of cultural acceptance, while also focusing on the importance of women. By focusing on women and integrating their insights and concerns into the propositions, this program will help to prevent the continuation of a social stigma against women in these traditional settings, and highlight the important role of women in agriculture. Furthermore, the education will enable women to address their hunger and malnutrition and will equip them with a way to free themselves from the constraints of poverty and gender norms (*Gender in Agriculture* 275). Also, a better

understanding of improved crop management techniques and more equal household roles for women correlate with lower use of pesticides, thus limiting the negative health and economic impacts of such ineffective chemicals (Cole 3).

Also, the farmers receive information from the NGOs about other practices that they can implement to prevent pests and disease, which will result in a decrease in pesticides and higher overall yields. The extension services can inform farmers of practices such as early planting, timely harvest, the use of healthy potatoes, and the destruction of volunteer potato plants in the rotation fields to specifically target the Andean weevil infestations (Cisneros “Controlling the Andean Potato Weevil”). The implementation of such practices results in the reduction of damage of the weevils and savings for farmers of about \$241 per hectare (Cisneros “Integrated Pest Management”). In addition to the improved practices, the critical thinking skills that the farmers attain with the participatory research enable them to more effectively manage pests and weather shocks, improving their responses to the changing climate (Godtland 3). And although the subsistence farmers will not be able to reverse the effects of the more rapid glacial melting, the extension services help to educate communities on ways to adapt their changing environment. Through the educational programs, farmers and communities learn about their vulnerability to climate change and the various effects it will have, especially the increasing water scarcity. These programs also equip farmers with various practices to adapt, such as preserving natural systems by planting trees that conserve water (Ferm 15) and planting stress-resistant crops while utilizing techniques like mulching and water management (*Annual Report 2009* 15). The reduction of fungicides and pesticides because of the improved varieties also reduces the negative impact farmers inflict on the environment (Salazar 27)

Finally, following the harvest, the smallholder farmers will be assisted in selling their excess of potatoes at market. CIP will capitalize on its connections through its Papa Andina program and the Participatory Market Chain Approach (PMCA) to facilitate ties between the producers and the markets. The Papa Andina program helped to improve the marketability of potatoes produced by the indigenous peoples, raising them from “a poor man’s food to a point of national pride.” Thus, the strategy improved the demand and raised the profits for smallholder farmers (*Annual Report 2011* 26). This continues to benefit the smallholder potato farmers in this proposed program, and the connections between farmers and markets could again be reinvigorated through an investment of social capital to facilitate such cooperation. The NGOs could initially provide the necessary transportation for the products to market, until the farmers were financially stable enough to pay for the service themselves. These connections will allow the farmers to earn a profit from their excess potatoes, similarly to the success of the Africans who participated in the One Acre Fund program (One Acre Fund), thus allowing them to break the cycle of poverty perpetuated by subsistence farming.

Obviously, there is a substantial need for improved productivity for subsistence farmers in the Andean highlands who face food insecurity and its detrimental effects. Because of the outdated techniques and varieties, farmers are hurting their productivity and harming themselves and their environment. Thus, the plan equips farmers with the skills and materials to effectively combat the issues they face and adapt solutions for their communities. The financial investment by the Peruvian government supports research at CIP and the dissemination of the best potato varieties

and agronomic practices. These inputs are distributed on credit through the participating communities by NGOs, who provide the education necessary to the farmers, enabling them to capitalize on the improved productivity of their potato harvests. And finally, the farmers are connected to markets for their excess product would enable them to pay back their loan. This model is largely sustainable as the only overhead costs are CIP's research, the transportation of the inputs, and the original loans given to farmers. Thus, the program could be expanded to more highland communities, overseen by regional farmer managers. Therefore, the proposed program of cooperation between the government, CIP, and local NGOs to bring the necessary inputs and education to rural subsistence farmers would equip them with the tools to break free from poverty alleviate hunger and malnutrition in the highlands of Peru.

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