

## **Ethical, Political, And Economic Conflicts In International Agrobiodiversity Conservation: Potatoes In The Andes**

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### **Abstract**

This paper follows a two-month research expedition through Peru and Bolivia exploring the impacts of climate change on rural potato farming as well as various adaptation strategies. A “Custodian Farmer” movement has arisen as a way for local community leaders to preserve biodiversity in-situ (in the field). However, in the face of climate change, urbanization, and changing market demands, many farmers doubt that in-situ conservation will suffice in protecting biodiversity and cultural heritage. Seed banks and research institutions exist as alternatives, but mistrust of such institutions poses challenges for many communities. These factors are considered alongside case studies of compromise and success.

**Keywords: Agrobiodiversity, Climate, Property**

### **1. Background**

The Quechua and Aymara people have called the high plains (Altiplano) region of the Andes Mountains home for thousands of years. In the Altiplano, survival of rural farmers is intimately linked to the fate of their potatoes. The ancestors of modern potatoes first evolved in the Andes 8,000 years ago near Lake Titicaca, and the Quechua and Aymara people have expertly bred the plant for centuries, resulting in approximately 4,000 domesticated varieties in the region today<sup>26</sup>. Andean potatoes have become an important nutritional staple as well as a critical component of rural economies and cultures.

The Quechua and Aymara people maintained their cultures and livelihoods through both Incan and Spanish conquest, but today they face a new threat: the onset of extreme and early impacts of climate change. These communities lie 3,000-4,000 meters above sea level, and thus have experienced amplified impacts of warming due to altitude<sup>3</sup>. A warming, changing climate threatens the survival of their potatoes – the backbone of their societies. In addition to changes in climate that threaten potato diversity, Andean potato farmers face opposing political and economic forces. Changing markets incentivize growers to cultivate monocultures; at the same time, the world’s research institutions and international governing bodies look to them as having a duty to conserve agricultural biodiversity. The purpose of this research is twofold: 1) to examine this push and pull of external forces upon Andean farmers and 2) to identify solutions for conservation that emphasize the livelihood and autonomy of communities. Andean potato farming is a microcosm for larger global trends in agrobiodiversity conservation in a changing climate. Solutions to diversity in this region will have implications for agriculture around the world.

This study began with a nine-week research trip through Peru and Bolivia, aimed at understanding how rural and indigenous communities are adapting to climate change. It included visits to agricultural communities, agriculture and community health focused nonprofits, and organizations such as the UN’s Food and Agriculture Organization and the International Potato Center (CIP). While the project initially focused on biological strategies for climate change

resilience, interviews with farmers in both countries made clear that most farmers understand the strategies they must take towards resilience, yet are barred by social and political forces. Thus, this paper addresses social-political barriers to conservation.

## 2. The Problem

Farmers in the Altiplano region have cultivated diverse potatoes for thousands of years. Their place-based ecological knowledge has provided them great insight in developing new cultivars. In many communities individual farmers cultivate up to 200 species, knowing each by name and its unique ecological needs (personal interviews, June-July 2014). However, these knowledge systems are being disrupted by changing climatic conditions. Growing seasons have become hotter and drier with more sporadic and extreme flooding events, leaving farmers only 4 growing cycles per year when historically there were 5 or 6 cycles per year<sup>25</sup>. Natural reference points such as flowering seasons for native plants have become increasingly unpredictable, and pests like the Andean potato weevil and potato late blight (*Phytophthora infestans*) have become more common<sup>25</sup>. To avoid increased heat, and the diseases that accompany it, Geographic Information System (GIS) mapping reveals that Andean potato farmers have ascended 150 meters during the last 30 years, which at 3,000-4,000 meters constitutes a significant altitude shift. This strategy is only successful if there are higher altitudes left to reach, and the International Potato Center in Lima estimates that if these trends continue, farmers will reach maximum altitudes in only 30 years<sup>3</sup>. Finally, due to increasing temperatures, farmers have lost their ability to preserve potatoes throughout the year with their traditional freeze-dry practices (personal interviews, June-July 2014). With conditions that prevent farmers both from harvesting and preserving potatoes, their food security is dramatically impacted.

The Andean farmers interviewed in this project all stressed that the key to resilience is maintaining diverse potato assemblages. Farmers must at all times maintain potatoes resistant to heat, cold temperatures, drought, flooding, and pests. However, in addition to climate change, Andean farmers face two primary human threats to maintaining diversity: 1) the institutions set up to protect genetic diversity are the institutions that farmers often trust least, and 2) markets have begun to demand more homogenous white potatoes that fit the standard of a westernized diet. Simultaneously, these forces push and pull farmers towards and away from conservation. Understanding these forces in a regional context can provide insight on conflicts and trends occurring throughout the world while providing solutions that have been successful in the Andean context.

### 2.1 International Biodiversity Conservation, Seed Banks, And Property Rights

During the green revolution in the mid-20th century, over 70% of the world's agricultural biodiversity was lost from farming<sup>21</sup>. Agricultural research shifted towards finding cultivars with high yields, nitrogen uptake efficiency, shelf life, and pesticide resistance. While this resulted in much more productive agricultural landscapes, it also led to significant genetic erosion. Beginning in the 1960s and 70s, international concern for biodiversity was raised in summits and conferences such as the Food and Agriculture Organization of the United Nations' series of technical conferences on genetic diversity and the UN Stockholm Conference on the Human Environment<sup>15</sup>. These talks led to the creation of large-scale seed banks dedicated to ex situ (off-site) conservation of genetic resources. By conserving seeds and plant material in climate-controlled depositories, diversity and genetic material could at least remain accessible, even if local communities experienced species loss. The most notable of these efforts was the creation of the CGIAR (Consultative Group for International Agricultural Research) system, which consists of 16 seed banks around the world that contain over 10% of the six million plant variety accessions stored around the world<sup>20</sup>. While there are over 1,300 genebanks across the world, small, local seed banks are frequently understaffed, under-funded, and thus incapable of adequately preserving germplasm<sup>17</sup>. Thus, larger research institutions such as the CGIAR system have made great progress in conserving seeds and germplasm that would have otherwise been lost as biodiversity has eroded.

An unintended consequence of the gene collecting expeditions that led to the creation of such seed banks was the occurrence of numerous cases of biodiversity exploitation throughout the world, most notably in the cases of neem, turmeric, and basmati rice, all of which have been patented<sup>18</sup>. Rather than ending up in public gene banks, these seeds entered private breeding programs and corporate patents. Such exploitation has led to widespread mistrust of gene banks and western research institutions amongst farmers, particularly indigenous communities.

In the Andean countries specifically, ayahuasca, a culturally important tea used as a hallucinogen in ceremonies throughout the Amazon basin was patented by Loren Miller, owner of the International Plant Medicine Corporation

based in the United States<sup>10</sup>. While patents require a novel idea or product and thus theoretically cannot be sought for living specimens, he was able to patent the process of making ayahuasca, which involves boiling the roots of two Amazonian plants. The Coordinating Secretariat of Organizations of Indigenous Peoples from the Amazon (COICA) resolved in its Fifth Congress in Georgetown in 1997 to condemn the issuance of the patent. This condemnation was adopted by 80 delegates representing 400 groups of indigenous peoples throughout the Amazonian countries, emphasizing the offense to indigenous peoples for a single person to appropriate and assert property rights over a plant so sacred. Loren Miller was also unable to prove prior informed consent from the community from which he took the initial ayahuasca sample in Ecuador, and thus the patent was retracted. However, the press brought about by COICA led to widespread public awareness of the possibility for biopiracy<sup>10</sup>.

This fear was again heightened in 2001 when the American company Pure World obtained a patent on maca, a culturally important plant to the Quechua people. The patent was issued for the method of using an alcohol solvent to isolate the plant's active ingredients. In 2002, a coalition of maca producers gathered at the International Potato Center (CIP) in Lima, part of the CGIAR system, to demand that the institution challenge the patent, as the center held 31 accessions of the plant, and farmers suspected that the Pure World had obtained its maca from the CIP<sup>14</sup>. The Quechua communities that bred the plant in the first place received no compensation for maca products sold by the company. No action was taken by the center, and many Quechua farmers lost faith in the institution<sup>14</sup>. In interviews at CIP, researchers and technicians noted hesitancy amongst farmers when working with the center, and multiple farmers expressed distrust of becoming too involved with outside organizations.

Cases of biopiracy have led to extensive scholarly debate on the roles and interactions of traditional knowledge, indigenous sovereignty, and property rights. Two primary schools of thought have emerged: the Common Heritage Principle, and the development of property rights or intellectual property protection for indigenous farmers. The first, the Common Heritage Principle, states that traditional agriculture is a critical source of genetic resources with the potential to benefit all of humanity. Under this principle, ecologists must work with indigenous communities to help them preserve such resources, which could ultimately hold valuable genes for pest or drought resistance or even a cure for cancer<sup>4</sup>. In this principle lies also an inherent sentiment that indigenous communities have an obligation to remain static in order to preserve that which the rest of the world requires. In other words, in order to preserve plants, communities must maintain their cultural identities and practices, even if doing so is not optimal or natural for them<sup>24</sup>. Placing the duty of conservation for the greater good of humanity onto indigenous farmers is a continuation of the colonialist exploitation that the Quechua and Aymara peoples have faced for centuries unless significant emphasis is placed on farmer self-determination and support to communities.

The second approach, establishing property rights for farmers is a frequently discussed topic in scholarly literature<sup>11, 18, 19, 23, 31 8, 10, 16, 27, 29, 30, 32</sup>. Such analysis often ignores cultural ethics in relation to seeds. Many cultures view seeds as sacred living beings that cannot be owned. Imposing ownership systems on indigenous farmers in order to protect them from exploitation ignores the fact that in multiple cultures, to own a seed, even if for the sake of protection, is immoral or impossible<sup>23</sup>. Quechua farmers specifically have freely exchanged knowledge and varieties between villages for centuries, and thus seeking property rights over their potatoes is an alien concept<sup>14</sup>. Efforts to protect communities that do not address their true needs and values are not likely to be effective. Thus, understanding the customary laws and practices already in place surrounding traditional knowledge and plants is critical to truly protecting such systems<sup>31</sup>.

In 2002, the Convention on Biological Diversity came into force, and with it Article 15 was implemented, which allows sovereign states to determine the dissemination of germplasm rather than indigenous nations and peoples<sup>20</sup>. Since most genetic material is circulated amidst gene banks rather than from field collections, this policy makes sense from a logistics perspective, yet it removes a level of autonomy from farmers and farming communities. Herein lie a series of paradoxes: farmers in the region wish to gain royalties if their plants are patented and sold such as in the case of maca, yet do not believe in intellectual property rights, which could serve as a means of determining access to their seeds and plants. By allowing the state to decide who gains access to plants stored in genebanks, the interests of farming communities are not necessarily protected. Communities could theoretically stop collaborating with genebanks and government research institutions, yet due to the impacts of climate change farmers have become more dependent on them.

Given this complex ethical dilemma, scholarly debates on the topic have focused intently on the questions of ownership and the rights to disseminate germplasm. However, there is a lack of focus on access to genetic resources stored in seed banks. There exists a flawed assumption that because indigenous communities hold much of the world's biodiversity, the flow of genetic resources must be questioned from the perspective of seeds flowing from the global South to the global North. However, as already depicted in the case of Andean potatoes, the impacts of climate change have brought about a renewed need for indigenous communities to access the storage technologies as well as the stored

potato varieties that seed banks offer. This requires better policy focused on how indigenous communities can access germplasm and benefits from research institutions.

Dr. Virginia Nazarea's work in the Potato Park, a conglomerate of six farming communities in the Sacred Valley near Cusco, Peru beautifully depicts how these two approaches and their complexities have played out. Her interviews with potato farmers in the six communities revealed that farmers do wish to preserve as many potatoes as possible and are strongly connected to the potatoes they breed. However, when varieties disappear farmers expect to either find them in other farmers' fields or growing wildly, or accept that those potatoes can no longer serve their people. One farmer pragmatically stated, "I don't think about bringing the seeds back. They do not produce anymore because the worms finish them off and conditions are different now"<sup>24</sup>. Similarly, farmers I interviewed throughout Peru and Bolivia stressed that while there is some degree of mistrust for scientific institutions, if the CIP provides a potato that can withstand various conditions, there would be no problem in integrating such species and ceasing to cultivate varieties that no longer serve them. The actual survival of farmers is far more critical to cultural preservation than holding onto species no longer adaptable to their environment, even if those species could prove valuable for research.

## 2.2 In-Trust Agreements As A Possible Solution

In Peru, the International Potato Center (CIP) has taken great strides toward facilitating more equitable public access to germplasm. The first of these steps towards equitable access occurred in 1994, when CGIAR changed their legal status to prevent biopiracy by eliminating the possibility for direct patents on germplasm. Agreements with the United Nations Food and Agriculture Organization (FAO) formalized the legal status of ex-situ germplasm collections held by the CGIAR genebanks. These agreements secured the status of ex-situ gene collections within the CGIAR genebanks as being held "in-trust", making CGIAR centers trustees rather than owners for ex-situ collections. Thus, with no ability to grant rights to germplasm that the centers do not legally own, no intellectual property rights over any germplasm obtained from these genebanks can be sought. The International Treaty on Plant Genetic Resources confirmed this status in 2004, bringing the CGIAR collections under the auspices of the treaty<sup>20</sup>. Thus, with this system in place, germplasm is held in publicly available collections and is accessible to researchers throughout the world. However, while the material can be used in breeding programs, direct patents cannot be sought, limiting the possibility of biopiracy.

The 2004 confirmation of this in-trust status opened collections maintained and managed under the terms of the treaty to plant breeders worldwide. Following the confirmation, Asociación ANDES, a nonprofit representing the Potato Park communities, approached the CIP regarding equitable access to germplasm. The organization, founded by Alejandro Argumedo, a Quechuan agronomist and world leader in indigenous rights, aims to uphold the sovereignty and viability of the Potato Park communities<sup>14</sup>. ANDES made the case to CIP that the farmers in the Potato Park communities are indeed plant breeders, and as providers of the germplasm held in the banks, the Potato Park's farmers deserved access to the genebank accessions. The result was a Native Potato Repatriation agreement in which nearly 250 varieties, many of which had been lost from the park's communities, were repatriated from the CIP accessions and are now grown by local farmers<sup>20</sup>. The agreement was the first of its kind, providing indigenous communities with genetic resources historically accessed by plant breeders in university settings<sup>14</sup>.

While the varieties are still publicly available from the CIP genebank, all parties seeking germplasm must sign a Standard Materials Transfer Agreement. This requires that if a patent is sought over the progeny of any variety derived from the CIP, the party seeking the patent must pay a contribution to the benefit sharing fund of the ITPGRFA, which prevents private companies from seeking patents<sup>9</sup>. In 2011, the Potato Park opened their own storeroom for potatoes and seeds called "Papa Taneka Wasi" or "Keep Home the Potatoes," better enabling the community to store varieties from year to year<sup>25</sup>. The communities have also continued to work with the CIP, sending data and occasionally new varieties to the center, which the center cleans from viruses, duplicates, includes in their collection, and sends back to the communities. This allows the center to maintain potatoes for more long-term storage in case of natural disasters or multiple years of unfavorable conditions<sup>9</sup>. Finally, the Potato Park communities, with the assistance of ANDES, have begun to document their traditional knowledge through video<sup>14</sup>. Documenting this knowledge protects the communities from biopiracy, as they are better able to prove their cultural knowledge when patents over "novel innovations" of their traditional plants are sought.

The repatriation agreement and the local initiatives that followed are important for two reasons. First, they highlight the possibility of more equitable benefit sharing by empowering indigenous communities with adequate resources and representation. Second, they highlight the need for participatory plant breeding. By making farmers a part of the process, it not only empowers communities and provides them with vital technology to save and breed seed, it allows seeds to continue evolving in a changing climate. When seeds are kept in a vault, there is little opportunity to continue selection. Thus, as the climate of the Andes changes rapidly and drastically, giving farmers license as breeders allows

a mutually beneficial system in which farmers continue to breed more resilient lines or varieties, and technology access is more equitably shared.

## 2.3 Markets Shifts: Threats To The Profitability Of Biodiversity

While outstanding initiatives have worked to help Andean farmers cultivate biodiversity by limiting biopiracy and facilitating better access to genetic resources, farmers still face the omnipresent struggle of attaining markets for diverse potatoes. The potatoes with the highest market demand are easy to peel, chop, and fry, meaning they must be fairly round with thin skin<sup>3</sup>. While most farmers sell at a local level<sup>28</sup> even local market trends have led to a demand for fewer and fewer varieties. In the summer of 2014 as this research was being conducted, it was noted that bus stops and street corners were lined with stands selling fried chicken western-style with French fries, even in rural, small communities. In most markets, few varieties of potato were sold, usually 5-10 at maximum. Ortiz<sup>25</sup> noted that even within the potato park, people are struggling to maintain traditional diets due to competition with industrially processed foods. Though people recognize that biodiversity is critical and value their traditional varieties, many are turning to cash crops like onion and peas or potatoes that can more reliably be sold in local markets<sup>33</sup>. Farmers interviewed both in the Potato Park and near Lake Titicaca in Bolivia expressed concern that in addition to these changes, youth are moving more frequently to urban areas and forgetting the farming skills of their parents' generation. One woman stated in a focus group that because their children are leaving, God and the Pachamama (the mother earth) are punishing them with extreme weather events, to which the rest of the group nodded in agreement. This migration of youth is backed by statistics - nearly all immigrants to La Paz, Bolivia's largest metropolitan area are from farming communities in the Andean Altiplano<sup>5</sup>. Thus, both potato diversity and the knowledge system that has fostered it are eroding.

A number of market-based solutions have emerged to combat these challenges ranging from culturally based education within farming communities to the intervention of larger research institutions in promoting and redefining desirable diets. While none of these solutions will be successful on their own, together they offer a "silver buckshot" approach with great potential to shift markets back towards diversity by reinforcing cultural value on traditional products and practices.

### 2.3.1 local efforts

The first of these solutions begins on the farm. Bioversity International, a research and development institute stemming from the CGIAR system, has begun to experiment with a program called Agricultural Custodians. The basic model for the program is that technicians trained by research institutions venture to agricultural communities and identify individual farmers already invested in conservation practices. Often these technicians are from local communities and already have connections to farmers. The technicians work with these individuals to provide resources and training to help farmers in the field and provide funding for them to educate their own communities. Such education could range from seed festivals and fairs to seed education days in local<sup>12</sup>. These people have localized knowledge as well as a deep understanding of their own cultures, and thus are in an ideal position to educate youth and excite their neighbors about maintaining traditional practices and varieties. By maintaining diverse lines of potatoes and other Andean species, these farmers conserve and adapt their varieties in the field, and can continue the process of selection and evolution in a changing climate. By enrolling in the program, they more easily gain access to grants and resources for construction of greenhouses and better seed storage facilities, and access to funds for public education that allow them to focus more time on conservation efforts<sup>12</sup>. Bioversity International has partnered with PROINPA (a Bolivian research institute similar to CIP that connects farmers to seed banks and technicians) and multiple nonprofits including CETHA Tupac Katari, CARE Bolivia, Zeta Corpa, Samaritan's Purse, and the Bolivian National Institute of Agricultural and Forestry Innovation. These partnerships have helped farmers connect to grant funding as well as better markets. For example, Samaritan's Purse has worked to direct the potatoes and produce of custodian farmers to local schools, creating local markets for diverse potatoes<sup>22</sup>. In Peru, the International Institute for Environment and Development has paired with ANDES to create a similar program called Barefoot Technicians, but in this case the entire community elects to participate and each community elects its own custodian farmers. This approach is slightly more ground-up, but requires an overall engaged community<sup>7</sup>. In either case, farmers already invested in maintaining biodiversity are provided the tools to succeed. The world may benefit from germplasm that these farmers develop, but germplasm is kept in public banks under in-trust agreements to prevent exploitation, and the breeding that occurs in research institutes can be better tailored to the needs of local peoples.

### 2.3.2 regional approaches

The second set of solutions approaches the problem of conservation from a market-based perspective. By creating a market for diverse potatoes, farmers can more easily grow them. This approach has been taken all the way from sales at local farmers markets to large-scale commercial ventures to produce potato chips sold in supermarkets. Pusionyu in Bolivia and FOVIDA in Peru are two nonprofits that I interviewed that work on a regional level. FOVIDA's research in Junín and Huancavelica Peru indicates that over 90% of potatoes stay either on the farm or in local markets<sup>28</sup>. Due mostly to poor vehicle infrastructure, most farmers grow potatoes for self-consumption and sell only one or two towns away. Reaching further markets often requires middlemen that decrease profitability, and thus local solutions are perhaps the most critical to maintaining diversity on smallholder farms. Both FOVIDA and Pusionyu focused their efforts on yearly seed festivals to encourage excitement about diverse seeds as well as frequent stands at local markets teaching non-farmers how to cook with Andean potatoes<sup>6,28</sup>. Each nonprofit printed colorful literature, posters, and bookmarks, which were handed out in schools and at fairs, often with recipes and fun facts printed under photos of individual varieties. FOVIDA's work takes this approach a step further by helping farmers to establish agricultural cooperatives, allowing them to sell at larger markets while maintaining profitability and generating regional pride in local products and practices. Using the same educational materials and approaches as in regional markets, FOVIDA is working to engage larger national audiences in appreciation of Andean potatoes while providing local farmers a means of reaching such markets. Between 2012 and 2013, their efforts proved successful. In the 2011-2012 season, only 45% of potatoes produced in surveyed communities were sold in regional markets. This jumped to 63.9% in the 2012-2013 season. Percent sold in national supermarkets rose slightly from 0 to .2%<sup>28</sup>. While no long-term data has been collected, the seed fairs and farmers markets have continued to generate interest in large cities including Lima.

At a much larger scale, it is worth highlighting Papa Andina. Papa Andina is a market-chain based project started in 1998 by the Swiss Agency for Development and Cooperation and hosted by the International Potato Center. The project consists of a network of around 30 partners in Bolivia, Peru, and Ecuador all aimed at connecting nearly 4,000 resource poor rural farmers to larger, more stable markets. By identifying stakeholders willing to invest in native potato products and working to build trust and stable market chain connections to farmers, it is now possible to find native potatoes in supermarkets with labels like "fresh, gourmet Andean potatoes" as well as products like Andean potato chips. One initiative in Peru stemming from the project resulted in T'ikapapa, a brand of fresh, native potatoes sold in leading supermarkets throughout the country. From its inception in 2004 to 2006, sales more than quadrupled to 70 tons, resulting in 300 families throughout the Altiplano region obtaining 10-20% higher market prices for their native potatoes<sup>13</sup>. Approaches to market innovation on both large and small scales is critical. While the Papa Andina initiative has done innovative work to bring native potatoes into the urban public eye, the majority of farmers still sell in highly localized markets. Thus, to achieve better market stability for small farmers, a combination of approaches must be taken ranging from seed fairs and education events in communities, to strengthening and establishing growers associations and cooperatives in order to cater to larger markets, to international initiatives aimed at experimental new products like potato chips in order to reach even larger markets.

## 3. GUSTU: A Culinary Approach To Conservation

GUSTU, this paper's final case study, combines components of the Custodian Farmer and market-chain approaches. A socially-driven culinary school and high-end restaurant, GUSTU helps support conservation-focused farmers by creating a market for diverse products while training youth to become forces for conservation through the culinary arts. GUSTU is a restaurant in La Paz, Bolivia, created with the premise that Bolivia's natural, cultural, and geographical diversity provides infinite opportunities for culinary creativity. Its founder, Claus Meyer, also co-founded the restaurant NOMA, a Danish two Michelin Star restaurant named "Best Restaurant in the World" four times by the World's Best 50 Restaurants List<sup>2</sup>. NOMA experiments with local foods to reinvent Nordic cuisine, and following the restaurant's success, Meyer looked to Bolivia to create a new restaurant and school based on the same principles. GUSTU Restaurant applies the 'Kilometer 0' philosophy, working exclusively with native products grown and processed in Bolivia. This helps to boost employment and development in the country, place value on products threatened by biodiversity loss and deforestation, and showcase Bolivia's natural and cultural diversity.

By making diverse products gourmet, Meyer hopes to create markets and incentives for conservation. Meyer established GUSTU Restaurant in 2013 alongside GUSTU School – a cooking school associated with the restaurant, and a food lab dedicated entirely to experimenting with Bolivian plants and animal products<sup>1</sup>. While it's doubtful that

a single restaurant serving gourmet meals at gourmet prices could truly impact regional market forces, the restaurant's focus on education is worth celebrating and considering as a model to be followed elsewhere.

While the GUSTU restaurant is located in Zona Sur, an area known for high end shopping and foreign embassies, the restaurant is staffed by a team of youth from La Paz 'laderas' El Alto, La Paz's neighbor city that is home to the country's largest Aymara migrant population. These young people are enrolled in an 18-month culinary school program in which they are taught by the world's best chefs to cook using diverse, local ingredients as well as the economics and management skills needed to run a successful restaurant. The program is able to pay its students for transportation and a small salary. Initially made possible by the Claus Meyer's foundation Melting Pot Bolivia and IBIS Denmark, in 2016 the program will be funded entirely by restaurant profits. Students learn the ropes of locating sustainable producers of local products throughout the country and developing business relations that can provide stable support for such producers. The program trains around 20 students every 18 months, meaning Bolivia will consistently gain new young chefs, eager to start restaurants that place value on indigenous products that are produced sustainably<sup>1</sup>. In interviews with youth in the program, many of the young chefs emphasized their dedication to return to the rural areas of their parents and grandparents to start their own restaurants in smaller regional metropolises. The first class graduated in September 2014 and thus it is too early to gather long term data following graduates. However, it is indeed significant to find a dedicated group of youth trained by the best chefs in the world, passionate about bringing the foods of their ancestors back to their communities. Beyond the culinary school, Meyers' Melting Pot Bolivia has also begun establishing community gardens throughout the city of La Paz as well as a 5-month training program called Manq'a, which focuses on nutrition, sanitation, and business skills to further empower youth. The program's plan includes 12 schools built over 3 years that will engage over 740 students. Melting Pot Bolivia has also started a program with street vendors to promote better hygiene and marketing of their dishes as well as a system that informs consumers of street food options, allowing vendors to specialize and market their products to broader audiences<sup>1</sup>.

Finally, the restaurant has also partnered with an initiative called LatinCrop, which aims to introduce protein rich Andean crops with the ability to grow in extreme climates to other marginalized areas throughout the world. By experimenting with these crops at the restaurant, LatinCrop provides a market for local producers as well as the ability to experiment with different food uses for the crops. Altogether, GUSTU and its associated initiatives takes a diverse approach to changing the food culture of Bolivia in a way that incentivizes sustainable production of diverse products, trains youth to value and create market value for diverse products, all the while supporting local chefs and entrepreneurs.

The Custodian Farmers movement, Papa Andina initiative, GUSTU restaurant, and its associated programs provide very different approaches to conservation and farmer support. However, all do so in ways that support farmer self-determination and market access, and all three provide niche solutions with the potential to benefit one another. These programs show the value of taking multiple innovative approaches to market-based conservation.

## 4. Conclusions

The Quechua and Aymara peoples of the Andean Altiplano face a period of vast transition. The diverse potatoes they have bred and maintained for centuries are no longer surviving in their native environments due to early impacts of climate change. While diversity is a key resilience strategy, markets pull farmers away from diversity and towards cash crops. These trends can be seen worldwide, and thus studying approaches taken in this region towards supporting local farmers, economies, and ecosystems can provide valuable insights for agricultural development and climate change resilience elsewhere. The approaches and conflicts highlighted here can be divided into two primary categories: ex-situ conservation and market based approaches to conservation. First, efforts to conserve germplasm outside of communities has led to the preservation of species that would have otherwise been lost entirely, yet these efforts have also historically led to exploitation of biodiversity. This has resulted in mistrust of international research institutions amongst indigenous peoples and has inspired many scholarly debates on the role of property rights in conservation. Despite this mistrust, climate change has forced farmers to become more dependent on the services and technologies that such systems can provide. Thus, in order for such institutions to be truly effective, conversation must shift from biopiracy prevention to also include resource access and participatory plant breeding that allows farmers to not only become a part of the scientific process, but to steer research in directions that benefits local communities. Second, as markets throughout the Andes shift to demand more homogenous, processed foods, innovative solutions to diversify markets are needed to support farmers in their conservation efforts. Such solutions must be multifaceted: educating and inspiring future farmers, enabling rural farmers to sell at larger markets and equitable prices, redefining

what constitutes gourmet or desirable food, and exploring new culinary ventures. Overall, the efforts that have proven most successful throughout the Andes are those that support farmer self-determination, grant broader access to public resources and research, utilize local organizers with deep understandings of their own cultures and communities, and are diverse and creative in their approaches to conservation.

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