

# You Can't Grow Potatoes in the Sky: Building Resilience in the Face of Climate Change in the Potato Park of Cuzco, Peru

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## Abstract

*Although Quechua farmers contribute little to climate change, they are disproportionately experiencing the impacts of rapid changes in the high-altitude environment of the Andes. We describe how Quechua farmers and Association ANDES, a local non-profit organization, are rising to the challenge in Peru, using traditional knowledge and science in community-led research to mitigate and adapt to the impacts of climate change. A globally important food crop, the potato (*Solanum sp.*) originated in the central Andean Mountains. Indigenous farmers collectively manage the Potato Park as a Biocultural Heritage Territory, and together with ANDES, are implementing the Pluriversity for Biocultural Landscapes and Resilient Food Systems to facilitate knowledge exchange and creative solution seeking for complex global problems such as climate change. We describe programs that support community resilience, local biocultural heritage, biocultural products and services, and global policy processes strengthening the rights of Pacha Mama (Mother Earth) and world indigenous peoples. [potato, climate change, Andes, resilience, biocultural heritage, pluriversity]*

## Introduction

Scholars such as Harlan (1992), Piperno and Pearsall (1998), and Smith (1998) have all shown that agriculture arose independently in different regions of the Americas. They describe how, rather than passively accepting agriculture as it spread out from a core area, people were actively involved in the constitution of

their agricultural, food, and economic systems, as well as the inclusion of new crops into their local subsistence regimes. The Andean region is one of the important centers of origin and domestication of food plants, giving to the world crops such as the potato (one of the five most important crops globally), *quinoa* (*Chenopodium quinoa*), *kiwicha* (*Amaranthus caudatus*), *cañihua* (*Chenopodium pallidicaule*), *olluco* (*Ullucus tuberosus*), and *oca* (*Oxalis tuberosa*). The region also harbors the largest diversity of potatoes in the world, where Andean farmers have 8,000 years of experience in adapting potato cultivation to the extreme conditions of high altitude and the variable climate caused by the *El Niño* phenomenon.

Climate change presents a new challenge to traditional agriculture and to the health of the planet. High mountain areas around the world are facing rapid decline in glacier size and number, threatened water sources, unpredictable rainfall patterns, and an increase in extreme weather events such as flooding, drought, hail, and frosts (ESSA 2012; PACC 2012). Indigenous farmers in the Potato Park in Peru are increasing resilience in the face of climate change through collective management of a Biocultural Heritage Territory (BCHT; Tanner et al. 2015).<sup>1</sup> The BCHT model supports efforts to mitigate and adapt to the impacts of climate change using traditional knowledge and science in community-led action research, the conservation of potato diversity, support for sustainable livelihoods based on biocultural heritage, and participation in national and international policy processes to defend the rights of Pacha Mama (Mother Earth), indigenous peoples, and smallholder farmers.

For almost two decades, the Association for Nature and Sustainable Development (ANDES)<sup>2</sup> and Quechua communities have collaborated on the design and implementation of the Potato Park,<sup>3</sup> as well as on community-led action research, policy development, and scaling up and scaling out the Biocultural Heritage Territory model in other parts of Peru and the world.

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ANDES and the Potato Park have been actively sharing their experience in the establishment of Biocultural Heritage Territories with other indigenous communities, policy makers, academics, and scientists. They apply innovative approaches to knowledge exchange that are guided by indigenous worldviews and use complementary indigenous and scientific methods and tools.

This article begins with an overview of traditional Andean agriculture and food systems, highlighting their resilience and current relevance for local and global food security. This is followed by a brief description of the impacts of climate change in the Andes, particularly on potato cultivation. The efforts of Association ANDES and the Potato Park in the implementation of Biocultural Heritage Territories are presented as examples of successful strategies for increasing community resilience in the face of climate change. Finally, the study describes ANDES' initial efforts in establishing a Pluriversity for Biocultural Landscapes and Resilient Food Systems, which bridges knowledge systems in support of creative solution seeking for complex global problems. The authors have all participated in research with farmers in the communities of the Potato Park. Author Argumedo is founder and Program Director of ANDES, and a native Quechua speaker from the Central Andes. Stenner has held diverse leadership roles at ANDES over the past 20 years. Sayre visited and conducted research at the Park between 2011 and 2016.

## **Traditional Andean Agriculture and Food Systems**

### **Sumaq Kawsay or Wellbeing**

There is evidence of human habitation in the Andes from at least 12,000 years ago, and agriculture has been practiced in the Andes for 8,000 years (Dillehay 2017). At the time of Spanish contact (1532) with indigenous peoples in what is now Peru, the Incas ruled a significant portion of western South America and had a population of 12 million people. However, they were only one of many state societies that existed in the region at that time (D'Altroy 2002; Lumbreras 1981; Rowe 1946; Stanish 2001), where as many as 1,200 indigenous languages were spoken (Von Gleich, 1997, 10).

Despite a brutal process of colonization by the Spanish, indigenous peoples' resistance supported the survival of Quechua culture and language (Mar-

Moliner 2000; Stenner 2011; Wright 1992). Andean cosmovision, customary laws, and a rich traditional knowledge of place and of wild and cultivated species are embodied in the Quechua language, which is still used to pass cultural practices and agricultural knowledge on to future generations.

One of the central concepts of Andean cosmovision not only survived, but also recently gained prominence in public discourse in Latin America. *Sumaq kawsay* (roughly translated as *buen vivir* in Spanish or well-being in English) reflects reciprocal relationships between the various elements of the landscape, where the ideal conditions of *sumaq kawsay* can only be achieved when there is harmony and balance among the three *ayllus*. As farmers in the Potato Park have described to authors, *sumaq kawsay* is a way of living and working together in community, where *runa ayllu* is the community of people and domesticated plants and animals. Here, the physical, mental, and spiritual health of the people is connected to the landscape, food, and the other *ayllus*. *Auki ayllu* is the community of sacred things. *Apus* or sacred mountaintops and high points, *Pachamama* or Mother Earth, rainbows, and other phenomena are considered aspects of this community. While the sacred points and relationships change over time, these connections between *ayllu* communities and sacred places are considered to be of great importance. In this case, ceremonies and local customary laws are applied in conjunction with national laws. *Sallka ayllu* is the community of wild things. It is composed of wild animals, the high landscapes, and non-domesticated plants. Finally, *ayni*, or reciprocity, is what ties together the distinct *ayllus* (Walshe and Argumedo 2016; Argumedo and Yun Loong Wong, 2010; Dávalos 2008; Lajo 2010; Mayer and Alberti 1974).

The concept of *sumaq kawsay* has been formally integrated into the policies of two Andean nation states, Ecuador and Bolivia, whose governments issued statements arguing that we are living in a time of ecological and philosophical crisis, and that the rights of our Mother Earth need protection (Choquehuanca 2009; Ministry of Foreign Relations, 1995–2010; Mutuberria Lazrini and Henry Chiroque 2011). Evo Morales Ayma reflected this understanding in an inaugural speech as president of Bolivia, when he spoke of his vision of living together on the basis of *buen vivir*, noting that

... (*'vivir bien'*) is to think, not only in terms of per capita income, but also of identity, culture,

community, harmony amongst ourselves and with our *pachamama*. . . . We don't believe in linear progress and unlimited 'development' at the cost of the other and of nature. . . . we must balance each other, we should share. (in Lajo 2010, 4)

However, the Peruvian government has not adopted these traditional concepts, which faced notable resistance by the previous President of Peru, Alan Garcia (2006–2011 in this instance), when he described attempts to modernize rural Quechua people (de la Cadena 2015, 169).

### Potato Diversity, Knowledge, and Practices

About 90% of the world's 1.5 billion hectares of farmland is under industrial monoculture models, and dependent upon external inputs and energy (Brush, Carney, and Humán 1981; Dransfield et al. 2009; Tapia 1996; Third World Network 2015). In contrast, traditional agriculture is based largely on landraces, or field crops which are highly valued for their agroecological variability and differentiated morphological appearance (Harlan 1992, 147–8), and for requiring few or no external inputs. The cultivated potato (*Solanum tuberosum*, *Solanum* sp.) is commonly associated with Ireland and other European countries, but actually originated in the Andean region of South America. Recent research places its likely center of domestication in southern Peru (Brush et al. 1995; Smith 1998; Spooner et al. 2005), but the high-altitude origins of the potato have not prevented its success in a wide range of environments across the globe (Dransfield et al. 2009).

While many landraces do not produce high yields compared to industrially farmed row crops, the diversity that is present in potato landraces is a source of pride and a symbol of the maintenance of tradition in Andean agricultural communities. The relatively small differences among landraces have accumulated over time, due to the interaction between people, plants, soil, climate, and agricultural practices, including through plant breeding and selection for culturally desired traits. Landraces are often resilient in the face of changing weather patterns, can grow in poor soils, and have distinct culinary and cultural uses (Harlan 1992, 148; Villa et al. 2005).

Andean farmers maintain a rich body of traditional knowledge associated with this diversity, including origin, names, and characteristics of the crops and their many varieties; the conditions under which they grow; culinary, medicinal, and other cultural uses; and

preservation methods (ANDES 2016; Zimmerer 1994). Over generations of observation and experimentation, Andean farmers have developed an agricultural calendar for rain-fed agriculture that is sophisticated enough to account for multi-year cycles, such as the extreme variations caused by *El Niño*. Farmers make significant use of biocultural indicators, including observation of the Pleiades star constellation and of wild plants and animals, to determine precise dates for rituals, planting, and harvest.

Most Quechua farmers consume close to 90% of the food they produce, and have a vast amount of culinary knowledge that is connected to food production (Argumedo and Pimbert 2010). Potatoes are categorized according to four basic uses (ANDES 2016): (1) cooking whole—varieties that should never be cut with a knife, but can be boiled or cooked in the earth in *watya* and *pachamanka*; (2) cutting—these varieties can be cut, and serve multiple purposes, including frying, soups, and stews; (3) *chuño*—high-altitude varieties of bitter potatoes, suitable for freeze-drying and long-term storage; (4) *moraya*—similar to *chuño*, but these spend time soaking in streams after freeze-drying.

The sustainability and adaptability of Andean agriculture depends on farmers having the right to freely save and exchange seeds, develop new varieties, and maintain rights over their traditional varieties. At harvest time, Andean potato farmers select tubers for seed before selecting for any other use. Seeds are selected by women and men based on criteria such as color, size, eyes, etc. (Bellon 1996). As one farmer stated, "the seeds are our future."

While most tubers for planting the following year are selected from the harvest, potato seeds are also exchanged informally with neighbors and in seed markets. In addition, seeds are traditionally gifted to young couples setting up a household, whereby couples receive varieties from both families, and each variety brings with it a history and stories related to the significance of the name, or to special characteristics and uses (Walshe and Argumedo 2016).

### Climate Change and Potato Cultivation

The Andes region is home to 98% of the world's tropical glaciers, of which 70% are located in Peru (Perez et al. 2010). This makes the rapid retreat and disappearance of glaciers in this region a global threat, as a crucial source of fresh water dries up. One illustration of the rapid disappearance of glaciers is the Mount

Huascarán glacier in Peru, which has lost 40% of its area in a 30-year period (Perez et al. 2010). The Andes is also experiencing warming air and soil temperatures; unpredictable weather patterns; and upward migration of crops, pests, and diseases (Altieri et al. 2015; ANDES 2016). The study that we conducted, detailed below, focused on how farmers are moving their frost-tolerant varieties of potatoes further upslope to partially mitigate the effects of climate change.

While indigenous peoples are not primarily responsible for the climate crisis, they often disproportionately experience the consequences of climate change. Indigenous communities in the Andes live in areas that are undergoing rapid ecological and climatic change, and agriculture is one of the activities that is most vulnerable. Indigenous communities with rich knowledge of the local conditions and biocultural heritage, and who are facing the challenges of climate change head-on, are at the forefront of the discussion on how to confront a rapidly changing social and ecological landscape.

### **Building Resilience: ANDES, the Potato Park, and the Biocultural Heritage Territory Model**

Resilience refers to the capacity of a system to continue to function despite disturbances, either by recovery to its original condition, or by some degree of transformation that changes components in a system or the relationships between components in a system (Adger, 2000 in Vasseur 2015). Andean agricultural and food systems are resilient; they have developed over thousands of years and are able to function effectively in the context of extreme geography and variable weather conditions. These systems are creative, adaptive, and based on continuous experimentation, observation, and a deep respect for Pachamama. As these agricultural and food systems face threats from changing global economic systems and social and environmental conditions, Association ANDES and the Potato Park are attempting to increase resilience in indigenous communities, through conservation of cultural and biological diversity, support for sustainable livelihoods, and participation in global policy processes.

#### **Association ANDES**

ANDES is a non-governmental organization that has been working with indigenous communities in the Andes since 1995. It seeks to advance a rights-based

approach to well-being, based on the ancient Andean principle and philosophy of *sumaq kawsay*, where harmony is achieved through reciprocal relations among humans, nature, and the sacred (Argumedo and Stenner 2008). ANDES has become well-known for its role in the implementation of Biocultural Heritage Territories, a model that creatively brings together traditional knowledge and modern science and research methodologies to nurture resilient agrobiodiversity systems and foster endogenous development and poverty reduction.<sup>4</sup>

#### **The Potato Park**

Since 1998, the Association ANDES has worked hand in hand with the six Quechua communities of Amaru, Chawaytire, Cuyo Grande, Pampallaqta, Paru Paru, and Sacaca, near Písaq, Cuzco, Peru, to establish the Potato Park as a community-managed Biocultural Heritage Territory. Located near the Sacred Valley of the Incas, the Potato Park celebrates and protects a unique traditional mountain agroecosystem and its indigenous biocultural heritage and institutions. The potato, an Andean biocultural expression, was chosen as a 'flagship species' because of its importance in the lives of Andean people. It was placed at the forefront of the implementation of a holistic and rights-based integrated landscape management approach based on the Andean *ayllu* system and the promotion of *sumaq kawsay*.

The Potato Park has been able to create local and global benefits. Local benefits include food and seed security; vibrant income-generating, biodiversity-based microenterprises; higher productivity through distribution of disease-free seeds; governance based on customary laws; policy and legislation supportive of indigenous peoples' rights (such as ordinances against transgenic crops and biopiracy); and knowledge platforms and networks. Global benefits include the preservation and recovery of potentially useful genetic variation, which is important to the capacity of global agricultural and food systems to adapt to change, particularly climate change.

The Potato Park is located in a center of origin and diversity of the potato, and harbors 1,343 cultivars/landraces of potatoes, including five wild relatives, in continuing co-evolution with the local culture. In support of biodiversity conservation, the Potato Park collaborates with the International Potato Centre, the National Institute for Agricultural Innovation, other NGOs, government bodies, and universities to bridge

knowledge systems through participatory action research, dynamic conservation activities combining in situ and ex situ strategies, repatriation of lost potato varieties, and policy development. Communities from the Potato Park sent seed samples to the International Seed Bank in Svalbard, Norway, to preserve their bio-cultural knowledge for perpetuity. The communities are making an explicit connection between their customs and traditional knowledge and the scientific attempts to preserve and document genetic variety (Gonzales 2000; Graddy 2014).

### **Biocultural Heritage Territory Model**

The BCHT model evolved from the two decades-long collaboration between ANDES and the Potato Park. It was designed to support the integrity of indigenous territories, which are under siege from a variety of forces and actors in a rapidly changing world. BCHTs are founded on indigenous peoples' cosmologies and socio-economic principles, such as reciprocity and solidarity, which have often guided these landscapes in the past, leading to an emphasis on local markets, solidarity economy, and collective institutions. They have been defined as "land use mosaics encompassing indigenous and traditional land tenure, production and exchange systems, cultural identity, community organization and simultaneous goals of endogenous development and biodiversity conservation" (Argumedo and Swiderska 2014, 1).

While the international conservation and development community increasingly recognizes BCHTs, they have not yet been adopted legally. However, BCHT's informal self-designation provides legal and political strength to indigenous communities by providing a platform from which to reclaim biocultural rights that already exist under national and international law. Future recognition of BCHTs at the national level could provide countries with a way to ensure that their policies and legislation respect, protect, and fulfill indigenous peoples' rights to endogenous development.

The Potato Park is a functioning example of the BCHT model. The Park is governed by an Association of Communities, where each community is represented by their elected president. In community assemblies, participating communities select local experts to work with Association ANDES and to learn research methodologies. This has resulted in a team of well-qualified local researchers, known as *técnicos locales*, who are part of ANDES staff, have led many research projects in the Potato Park, and have carried out training

programs in Peru and around the world. Training programs have focused on learning about the BCHT model based on the Potato Park communities' experience, while considering the bio-cultural assets of the target areas, particularly emblematic species that originate in these areas. The BCHT model is also being adapted to diverse social and political contexts, as it is implemented in other countries, including Tajikistan, China, and India.

The work of the communities that compose the Potato Park is important in preserving the diversity that is an inherent part of traditional Andean agriculture. However, there can be a danger in solely protecting these islands of diversity (Bebbington 1997), rather than entire regions. The lack of broad connections between regional centers of traditional agriculture limits the impact of the work of these communities. For instance, if the landraces are only maintained in small islands of traditional farming communities, they will not receive the valuable inputs of new genetic crosses and new field regimes that would be possible if they were more widely distributed. It is for this reason that the communities of the Potato Park are reaching out to other communities in the region, including Lares, Q'eros, and Apurimac, where BCHTs are being implemented, to formalize long-term connections and establish a proposed cultural pathway and biological corridor, which would be called the Ruta Condor (Argumedo 2008, 57). This project has encountered obstacles and is still in development.

### **Building a Pluriversity**

Over the last 10 years, the Potato Park and Association ANDES have created a functioning mechanism, called a Pluriversity, for a rights-based approach to participatory research and development, which enables synergies between science and traditional knowledge for creating more sustainable and just ways into the future. The model also offers the potential to scale up this knowledge infrastructure and systematize it. Pluriversity here is conceived of as a learning space where knowledge production and structures are aimed at generating decolonized interventions in conservation and development. Language is one step in this process; meetings at the Potato Park are held predominantly in Quechua and then translated into Spanish, so that community members can voice their concerns in the clearest terms. The traditional assemblies debate

practices; they meet without the presence of the NGO or other outside groups and then advise them afterward. The communities always have the option of leaving the co-operative, and vote on how to spend proceeds gained from tourism. These proceeds are generally spent on community projects such as schools, healthcare centers, and greenhouses.

Community meetings to discuss the Pluriversity have been managed with the purpose of constructing bottom-up knowledge. Community members of the Potato Park determine the information they would like research to collect, and then discussions are held to determine which information should be shared with outsiders. However, the ability to write grant proposals to international agencies for grants is still limited to formally educated people.

One of the research projects carried out within the Pluriversity is “Biocultural Indicators for Indigenous Food Sovereignty”, supported by the Open Society Foundation. This project involved the development of biocultural indicators for monitoring and evaluation of indigenous food sovereignty within the Traditional Resource Rights (TRR) framework. TRR refers to a bundle of rights that support indigenous peoples, including human rights and rights to environmental justice, food, climate justice, and local biocultural heritage. Conventional monitoring and evaluation practices are based on indicators identified by scientists and policy makers, not by the communities themselves. In this project, community researchers developed indicators based on traditional knowledge and biocultural heritage, in collaboration with academics and scientists, to create culturally sensitive monitoring tools. Formally trained experts worked with indigenous communities to create capacity to implement the research, while new methods and tools were developed for community use in the monitoring of food sovereignty and related issues, such as climate change impacts.

Initial meetings of the Pluriversity program also led to a desire to conduct a research project documenting the relative resilience of food systems in the park. The técnicos were to gather all data through a community survey. Survey questions were pre-approved by community members, who suggested the majority of them. The surveys were conducted in Quechua and all results were recorded on tablet computers; georeferenced photos were taken of survey locations. Results were exported into spreadsheet forms and all identifying information was removed. This protects community members’ identities and allows for

community-wide interpretations to be made. The data are still being interpreted, and all results are being shared with the community members as they are analyzed. This project will continue to inform local community decision-making in regards to which crops are most susceptible to damage or loss due to changing environmental conditions.

The philosophy of *sumaq kawsay* is also central to the Pluriversity. Research by ANDES and the Potato Park has explored the concept and its application to current social and environmental issues through literature review (e.g., Apffel-Marglin 1998; Lajo 2010) and interviews with farmers. *Sumaq kawsay* represents a true departure from the ‘development’ paradigm, which is not only foreign to indigenous worldviews but is also dangerous for the world (Lajo 2010), and is a viable local alternative to improve well-being, living conditions, rights, livelihoods, and the environment.

### **Climate Change Research—Mitigation and Adaptation**

As the world has warmed, farmers in the park have been forced to seek cooler regions on higher ground, in order to cultivate their frost-tolerant potatoes. Recent plantings near 4500 masl (ANDES 2016) are likely the highest recorded elevations for a planted potato. This landscape contains abundant evidence of past agriculture, yet there is no evidence that fields this high have previously been used for planting potatoes.

In the summer of 2016, Sayre, an academic partner (Joshua Samuels), and a *técnico*/guide from the Potato Park, conducted a survey project focused on documenting cultural/agricultural changes that are occurring in the park as a result of climate change. We viewed fields where local farmers have worked with researchers from the International Potato Center in Lima to construct experimental cultivations across a variety of ecological zones. As farmers move their fields higher upslope in an attempt to preserve their cold weather-adapted varieties of potatoes, they have to contend with a variety of issues, such as less fertile soils, greater stone concentrations, increased frost damage, and difficulty of accessing fields for laborers, among other issues.

The farmers of the Potato Park take part in these experiments, as they have been confronting the impacts of climate change for well over three decades. As the

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**Figure 1.**  
**Location of high-altitude potato field. Source: Matthew Sayre and Joshua Samuels. [This figure appears in color in the online issue.]**



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glaciers and snowcaps have retreated, water flow and irrigation patterns have become less consistent and pest loads have increased. This reality prompted the title quote from a local farmer. Figure 1 shows the location of one of the highest potato fields in the world, between 4,400 and 4,500 masl. It is located near Lake Kinsaqocha in the Potato Park. The image shows that there is a limited amount of cultivatable land above this field. The high points of the peak are extremely rocky. Farmers in the park are reaching the edge of local cultivation zones for preserving the cold weather-adapted landraces that they and their ancestors created over thousands of years.

The project has been focused on the impacts of climate change on farmers' lives. The local community has shaped the questions that are being asked and we have attempted to address both broad and narrow questions. Some of the issues being considered include: How is the planting of different varieties of potatoes changing over time and space? How are pest loads changing over time and space and is this change predictable? What is the nature of the relationships between people and the earth, and is Pachamama sick? Why?

Climate change does impact these communities in significant ways. Yet, Association ANDES and the Potato Park are also focused on documenting cultural resilience and community-based means of protecting and maintaining biodiversity. This work has a strong intellectual background that benefits from the work of other researchers investigating food sovereignty,

conservation, and cultural resilience (Altieri 2009; Binimelis et al. 2014; Graddy 2013, 2014; Mamen et al. 2005; Pimbert 2008; Woodley et al. 2006).

## Conclusion

The significant agricultural biodiversity and heterogeneity of the landscape in the Potato Park will allow its members to maintain diverse local food sources. The significant training and collaboration opportunities in which the community engages may permit them to adapt and react to changing conditions in a more rapid fashion than many other communities. Finally, the strong communal ties and the local emphasis on *ayni*, or reciprocity, means that these communities are accustomed to sharing seeds, food supplies, and knowledge with one another. These ties that bind have been tested in the past and will be tested in the future.

The work of ANDES and the Potato Park to establish a Pluriversity for Biocultural Landscapes and Resilient Food Systems highlights the need to continue discussions about the importance of long-term biocultural heritage and in situ conservation of plant resources. The communities of the Potato Park are engaged in an effort to preserve and protect the efforts of their ancestors and present-day communities. The 8,000 years that the potato and its great diversity of landraces have been grown in this region of the Andes have led to a complex and intertwined relationship between people and plants. The potato is a diverse and resilient crop, but also one that is threatened in its homeland. The damages of climate change, such as glacial retreat, shifting precipitation patterns, and increased pest loads, are felt with particular force in this area. Although indigenous farmers did not prompt the current ecological crisis, they are feeling its impacts disproportionately relative to the countries that produced the crisis. As such, it is worth acknowledging the importance of local responses to climate change. The resilience of strongly interconnected communities permits the people of the Potato Park to be at the forefront of developing indigenous technological responses to a changing planet. The Pluriversity for Biocultural Landscapes and Resilient Food Systems aims to support climate change adaptation and mitigation strategies, by sharing the experiences of ANDES and the Potato Park, lessons from traditional knowledge and practices, and working closely with scientists, policy makers, and academics.

## Notes

1. Biocultural Heritage Territories (BCHTs) are founded on indigenous peoples' cosmologies and socio-economic principles, and encompass indigenous and traditional land tenure, production and exchange systems, cultural identity, community organization, and simultaneous goals of endogenous development and biodiversity conservation.
2. The Association ANDES (<http://www.andes.org.pe/>) seeks to advance a rights-based approach to human development by creatively using *sumaq kawsay* (buen vivir), the ancient Andean principle of well-being, to merge lessons from the past with those of the present to build holistic and resilient communities and biodiverse food and agricultural systems of the future. ANDES carries out independent participatory action research and local-global networking and alliance building, and is actively scaling up and scaling out its innovations through south-south knowledge exchanges.
3. The Potato Park ([www.parquedelapapa.org](http://www.parquedelapapa.org)), located in an area of origin and diversity of potatoes, involves about 6,000 people in six Quechua communities. The potato, one of the world's major food crops, has been protected for centuries by Andean farmers and their deeply rooted local food systems.
4. <http://www.andes.org.pe/>.

## References

- Altieri, Miguel A. 2009. "Agroecology, Small Farms, and Food Sovereignty." *Monthly Review* 61(3): 102.
- Altieri, Miguel, Clara Nicholls, Alejandro Henao, and Marcos Lana. 2015. "Agroecology and the Design of Climate Change-resilient Farming Systems." *Agronomy for Sustainable Development* 35: 869–890. <https://doi.org/10.1007/s13593-015-0285-2>. <https://link.springer.com/content/pdf/10.1007%2Fs13593-015-0285-2.pdf>
- ANDES. 2016. *Resilient Farming Systems in Times of Uncertainty: Biocultural Innovations in the Potato Park, Peru*. London: IIED. <http://pubs.iied.org/pdfs/14663IIED.pdf>
- Apffel-Marglin, Frédérique. 1998. *The Spirit of Regeneration: Andean Culture Confronting Western Notions of Development*. London: Zed Books.
- Argumedo, Alejandro. 2008. The Potato Park, Peru: Conserving Agrobiodiversity in an Andean Indigenous Biocultural Heritage Area. *Protected Landscapes and Agrobiodiversity Values. Volume 1 in the series, Protected Landscapes and Seascapes, IUCN & GTZ*: 45.
- Argumedo, Alejandro, and Bernard Yun Loong Wong. 2010. "The Ayllu System of the Potato Park (Peru)." *Sustainable Use of Biological Diversity in Socio-ecological Production Landscapes* 52: 84.
- Argumedo, Alejandro, and Michel Pimbert. 2010. "Bypassing Globalization: Barter Markets as a New Indigenous Economy in Peru." *Development* 53(3): 343–349.
- Argumedo, Alejandro, and Tammy Stenner. 2008. *Association ANDES: Conserving Indigenous Biocultural Heritage in Peru Gatekeeper*, Vol. 137a, London: IIED.
- Argumedo, Alejandro, and Krystyna Swiderska. 2014. *Biocultural Heritage Territories*. London: IIED. <http://pubs.iied.org/G03843.html>.
- Bebbington, Anthony. 1997. "Social Capital and Rural Intensification: Local Organizations and Islands of Sustainability in the Rural Andes." *Geographical Journal* 163: 189–197.
- Bellon, Mauricio R. 1996. "The Dynamics of Crop Intraspecific Diversity: A Conceptual Framework at the Farmer Level 1." *Economic Botany* 50(1): 26–39.
- Binimelis, Rosa, Marta Guadalupe Rivera-Ferre, Guillem Tendero, Marc Badal, María Heras, Gonzalo Gamboa, and Miquel Ortega. 2014. "Adapting Established Instruments to Build Useful Food Sovereignty Indicators." *Development Studies Research. An Open Access Journal* 1(1): 324–339.
- Brush, Stephen B., Heath J. Carney, and Zósimo Humán. 1981. "Dynamics of Andean Potato Agriculture." *Economic Botany* 35(1): 70–88.
- Brush, Stephen, Rick Kesseli, Ramiro Ortega, Pedro Cisneros, Karl Zimmerer, and Carlos Quiros. 1995. "Potato Diversity in the Andean Center of Crop Domestication." *Conservation Biology* 9(5): 1189–1198.
- Choquehuanca, David. 2009. *Sumaq Kawsay-Buen Vivir*. In *El vivir bien como respuesta a la crisis global*, produced by Ministry of Foreign Relations, Plurinational State of Bolivia, pp. 74–92. <http://www.cancilleria.gob.bo/webmre/sites/default/files/libros/el%20vivir%20bien%20como%20respuesta%20a%20la%20crisis%20global.pdf>
- d'Altroy, Terence N. 2002. *The Incas. The Peoples of America*. Malden, MA: Blackwell Publishing.
- Dávalos, P. 2008. El "Sumak Kawsay" ("Buen vivir") y las cesuras del desarrollo. In *América Latina en Movimiento*. <http://alainet.org/active/23920>.
- de la Cadena, Marisol. 2015. *Earth Beings: Ecologies of Practice Across Andean Worlds*. Durham, NC: Duke University Press.
- Dillehay, T.D. (ed.). 2017. *Where the Land Meets the Sea: Fourteen Millennia of Human History at Huaca Prieta, Peru*. Austin, TX: University of Texas Press.
- Dransfield, J., F.O. Tesoro, N. Manokaran, F. Cabieses, L.O. Chauvin, L.M. Glave, L.G. Lumbreras, et al. 2009. *International Year of the Potato 2008: New Light on a Hidden Treasure. An End-of-year Review. Année Internationale de la pomme de terre 2008: éclairage sur un trésor enfoui. Compte rendu de fin d'année. Año internacional de la papa 2008: nueva luz sobre un tesoro enterrado. Reseña de fin de año*. No. FAO 635.21 A615. Roma (Italia): FAO.
- ESSA Technologies. 2012. *Latin American Regional Study: Impacts of Climate Change on Indigenous and Traditional Knowledge*. Ottawa: ESSA Technologies.
- Gonzales, Tirso A. 2000. "The Cultures of the Seed in the Peruvian Andes." In *Genes in the Field: On-farm Conservation of Crop Diversity* (Chapter 8): 193–216.
- Graddy, T Garrett. 2013. "Regarding Biocultural Heritage: In Situ Political Ecology of Agricultural Biodiversity in the Peruvian Andes." *Agriculture and Human Values* 30(4): 587–604.
- . 2014. "Situating in Situ: A Critical Geography of Agricultural Biodiversity Conservation in the Peruvian Andes and Beyond." *Antipode* 46(2): 426–454.
- Harlan, Jack. 1992. *Crops and Man*, 2nd edn. Madison, WI: American Society of Agronomy and Crop Science Society of America.
- Lajo, J. 2010. *Sumaq Kawsay—ninchik o nuestro vivir bien*. *Revista de la Integración no. 5: Políticas Culturales in la Región Andina*. San Isidro, Peru: Secretaria General de la Comunidad Andina.
- Lumbreras, Luis Guillermo, and Carlos Milla Batres. 1981. *Arqueología de la América andina*. Lima: Milla Batres.
- Mamen, K., G. Feenstra, C. Jaramillo, S. McGrath, and A.N. Grunnel. 2005. "Proposed Indicators for Sustainable Food Systems." *The Vivid Picture Project*. [www.vividpicture.net/documents/16\\_Proposed\\_Indicators.pdf](http://www.vividpicture.net/documents/16_Proposed_Indicators.pdf).
- Mar-Molinero, C. (2000). *The Politics of language in the Spanish speaking world: From colonisation to globalization*. New York: Routledge.

- <http://aupac.lib.athabasca.ca/search~S0?/aMarTMolinero/amar+molinero/1,1,3,B/1856~b1227040&FF=amar+molinero+clare+1948&1,,3,1,0>!!!>
- Mayer, Enrique, and Georgio Alberti. 1974. *Reciprocidad e intercambio en los Andes peruanos*. Lima: IEP.
- Ministry of Foreign Relations, Plurinational State of Bolivia. 1995–2010. Vivir Bien. [http://www.bivica.org/upload/diplomacia-vida\\_tres.pdf](http://www.bivica.org/upload/diplomacia-vida_tres.pdf)
- Mutuberría Lazrini, Valeria, and Henry Chiroque, Solano. 2011. "Perspectivas y aportes desde la economía comunitaria como alternativa para el desarrollo de 'otra economía' en Latinoamérica." *La Revista del CCC* 11, January/April. [http://www.centrocultural.coop/revista/articulo/211/perspectivas\\_y\\_aportes\\_desde\\_la\\_economia\\_comunitaria\\_como\\_alternativa\\_para\\_el\\_desarrollo\\_de\\_%93otra\\_economia%94\\_en\\_latinoamerica.html](http://www.centrocultural.coop/revista/articulo/211/perspectivas_y_aportes_desde_la_economia_comunitaria_como_alternativa_para_el_desarrollo_de_%93otra_economia%94_en_latinoamerica.html)
- PACC. 2012. *Caracterización climática de las regiones Apurímac y Cusco*. PACC: Apurímac. Análisis de eventos extremos en las regiones de Cusco y Apurímac. <http://www.paccperu.org.pe/es/publicaciones/5/>.
- Perez, Carlos, Claire Nicklin, Olivier Dangles, Steven Vanek, Stephen Sherwood, Stephan Halloy, K. Garrett, and Gregory, Forbes. 2010. "Climate Change in the High Andes: Implications and Adaptation Strategies for Small-scale Farmers." *International Journal of Environmental, Cultural, Economic and Social Sustainability* 6: 71–88.
- Pimbert, Michel P. 2008. *Towards Food Sovereignty: Reclaiming Autonomous Food Systems*. London: International Institute for Environment and Development (IIED).
- Piperno, Dolores, and Deborah Pearsall. 1998. *The Origins of Agriculture in the Lowland Neotropics*. New York: Academic Press.
- Rowe, John Howland. 1946. *Inca Culture at the Time of the Spanish Conquest*. Washington, D.C.: US Government Printing Office.
- Smith, Bruce D. 1998. *The Emergence of Agriculture*. New York: Scientific American.
- Spooner, David M, Karen McLean, Gavin Ramsay, Robbie Waugh, and Glenn J. Bryan. 2005. "A Single Domestication for Potato Based on Multilocus Amplified Fragment Length Polymorphism Genotyping." *Proceedings of the National Academy of Sciences of the United States of America* 102(41): 14694–14699.
- Stanish, Charles. 2001. "The Origin of State Societies in South America." *Annual Review of Anthropology* 30: 41–64.
- Stenner, T. 2011. "A Historical Overview of Linguistic Imperialism and Resistance in Peru." *Journal of Integrated Studies* 1: 2. Athabasca University: Athabasca, CA. <http://jis.athabasca.ca/index.php/jis/article/view/30/67>
- Tanner, T., D. Lewis, D. Wrathall, R. Bronen, N. Cradock-Henry, S. Huq, C. Lawless, R. Nawrotzki, V Prasad, Md A. Rahman, R. Alaniz, K. King, K. McNamara, Md Nasiruzzaman, S. Henly-Shepard, and F. Thomalla. 2015. "Livelihood Resilience in the Face of Climate Change." *Nature Climate Change* 1: 23–26.
- Tapia, Mario E. 1996. *Ecodesarrollo en los Andes Altos*. Lima, Peru: Fundación Friedrich Ebert.
- Third World Network & Sociedad Científica Latinoamericana de Agroecología. (2015). *Agroecology: Key concepts, principles and practices*. (Main learning points from training courses on agroecology in Solo, Indonesia (5-9 June 2013) and Lusaka, Zambia (20-24 April 2015).
- Vasseur, Liette. (2015). (IUCN, Climate change adaptation group leader/Brock University) and Mikes Jones (IUCN, Resilience group leader/Swedish Biodiversity Centre) \* Brief for GSDR 2015 Adaptation and resilience in the face of climate change: protecting the conditions of emergence through good governance.
- Villa, Tania Carolina, Nigel Maxted Camacho, Maria Scholten, and Brian Ford-Lloyd. 2005. "Defining and Identifying Crop Landraces." *Plant Genetic Resources* 3(3): 373–384. <https://doi.org/10.1079/PGR200591>.
- Von Gleich, U. 1997. "Democratización de la política cultural para los pueblos indígenas de América Latina." In *Pueblos Indígenas y Educación*. Quito: Ediciones Abya Ayala.
- Walshe, Rory, and Alejandro Argumedo. 2016. "Ayni, Ayllu, Yanantin and Chanincha: The Cultural Values Enabling Adaptation to Climate Change in Communities of the Potato Park, in the Peruvian Andes." *GAIA – Ecological Perspectives for Science and Society* 25(3): 166–173(8). <https://doi.org/10.14512/gaia.25.3.7>.
- Woodley, E., E. Crowley, J. Dey de Pryck, and A. Carmen. 2006. *Cultural Indicators of Indigenous Peoples' Food and Agro-ecological Systems*. Rome: Food and Agriculture Organization and International Indian Treaty Council.
- Wright, R. 1992. *Stolen Continents: 500 Years of Conquest and Resistance in the Americas*. Boston: Houghton Mifflin Company.
- Zimmerer, Karl S. 1994. "Human Geography and the "New Ecology": The Prospect and Promise of Integration." *Annals of the Association of American Geographers* 84(1): 108–125.