Indigenous Seed Systems and Biocultural Heritage: The Andean Potato Park's Approach to Seed Governance

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Abstract In the Indigenous worldview, seeds are both biological entities and embodiments of immateriality: knowledge, culture and the sacred. Indigenous seed systems thus codify the human connection to nature. Yet such ‘informal’ systems, whether developed by Indigenous peoples or small-scale farmers, barely surface in policy debates. Krystyna Swiderska and Alejandro Argumedo seek to redress the balance in this detailed study of the principles, values and practices of Indigenous seed systems and governance. While ranging over a number of case studies from Kyrgyzstan to Kenya, their prime focus is the Andean Potato Park in

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Cusco, Peru—a world centre of origin and domestication of crops such as the potato, quinoa and amaranth. Swiderska and Argumedo describe the Park's collective and customary governance structure, and the ways of learning, exchange systems, seed banks and more developed by its Quechua farmers. To safeguard the vital Indigenous contribution to seed security and diversity, they conclude, a biocultural rights-based approach to seed governance is required and needs further support from policy reform, among other measures.

Keywords Indigenous people · Biocultural heritage · Customary seed governance · Territories

4.1 INTRODUCTION

Indigenous peoples' seed systems sustain a rich diversity of underutilised species and varieties, both cultivated and wild, including ancestral populations of crops in centres of origin (i.e. domestication) (Bellon, 1996), based on Indigenous knowledge, values and worldviews (Graddy, 2013; Pilgrim & Pretty, 2010). Many Indigenous territories overlap geographically with centres of origin of crops, known as Vavilov centres (Maxted et al., 2020).

Seeds inevitably combine material and immaterial aspects such as knowledge and culture (Sievers-Glotzbach et al., 2021). This is very clearly seen in Indigenous seed systems. In Andean cultures, for example, seeds are regarded as spiritual beings connected to a landscape where everything, including rocks, has a spiritual dimension. Thus, seeds and seed systems are not only regarded as biological and economic resources, but also as socio-ecological systems governed by ancestral rules and values that emanate from Indigenous ways of understanding the universe, and that codify a deep respect for nature (Graddy, 2013).

Despite their critical importance for food and nutrition security and climate resilience, these so-called “informal” seed systems remain poorly understood (Gill et al., 2013). Thus, the distinct biocultural and normative character of Indigenous seed systems is often overlooked rather than supported by formal seed policies and conservation practices.

This chapter explores the customary principles, values and practices that characterise Indigenous seed systems as biocultural heritage, both

globally and in the Andean Potato Park in Cusco, Peru—or Parque de la Papa—which enshrines a Quechua rights-based biocultural approach to seed governance. Here, the wild and the sacred realms play a greater role in seed governance than humans, and the holistic Andean worldview and values continue to play a critical role in ensuring biodiversity conservation, food security and human wellbeing. The chapter also explores the governance tools developed by Potato Park communities, with support from the NGO Asociación ANDES, to revitalise and conserve the Potato Park seed system as one of the world’s richest in-situ genetic reserves.

4.2 INDIGENOUS SEED SYSTEMS AS BIOCULTURAL HERITAGE

Many Indigenous seed systems are guided by Indigenous core values of sharing and reciprocity, and balance with nature (Swiderska et al., 2009). These core values or principles are a common feature across Indigenous cultures from the Quechua of Peru to the Kuna of Panama, the Himalayan Lepchas, the Naxi of Yunnan, China, and the Mijikenda of coastal Kenya (Swiderska et al., 2011). The obligation to share seeds and related traditional knowledge enhances the diversity of seed each farmer holds, helps to maintain the purity of seed and promotes further diversification through adaptation to different environments (Argumedo et al., 2011). In the Indian Himalayas, for example, exchange of seeds between communities at different altitudes has enabled farmers to adapt to warmer climates (Pant, 2012), while in Southwest China, seeds are exchanged over very large distances (Swiderska et al., 2011). Women play a key role in managing seed systems and transmitting knowledge to younger generations (Swiderska et al., 2018).

In Cusco’s Potato Park, Indigenous practices of saving and sharing seeds to spread risk are embedded in traditional networks that connect farmers across different environments (ANDES, 2016). The Potato Park communities have conserved a very high diversity of cultivated, semi-wild and wild crops, ensuring food security despite significant climate change impacts and the Covid-19 pandemic. This biodiversity exists thanks to their ancestral principles of solidarity, reciprocity and balance between humans, nature and the sacred worlds. As Mariano Sutta, a community expert from the Potato Park explained: “This diversity of food could not

exist without these principles. For us having our food system built on these principles is very important” (Swiderska & Ryan, 2021).

For Indigenous peoples and small-scale farmers, seeds often have spiritual and ritualistic significance (Pilgrim & Pretty, 2010; Samuel & David, 2007). Seeds embody knowledge, practices and beliefs, inextricably linking biodiversity and intangible cultural heritage as “biocultural heritage” (see Box 4.1). In the Potato Park, seeds have souls, form communities, and have a system of rules that humans do not understand. When the International Potato Centre returned native potatoes that had been lost, this revived associated traditional knowledge and beliefs embedded in seeds (Swiderska et al., 2011). In Southwest China, restoring traditional seeds revived associated traditional knowledge and practices (Swiderska et al., 2009).

Even where spiritual beliefs have been weakened, the cultural values and uses of seeds—such as to produce traditional foods for ceremonies and festivals—often play a critical role in preventing the loss of genetic diversity (Swiderska et al., 2009). Across the world, Indigenous elders, and women in particular, continue to conserve traditional seeds and plant them in home gardens (African Biodiversity Network and Gaia Foundation, 2015; Swiderska et al., 2018).

Box 4.1: Indigenous biocultural heritage

The concept of biocultural heritage derives from Indigenous traditions and holistic worldviews. In 2005, Asociación ANDES, IIED and partners developed a definition of biocultural heritage based on decolonising research in the Potato Park, and the concept of Traditional Resources Rights (Argumedo & Pimbert, 2005; Posey et al., 1996). Their aim was to provide a common conceptual framework for research on protecting Indigenous knowledge.

They defined biocultural heritage as

“Knowledge, innovations and practices of Indigenous peoples and local communities, that are collectively held and inextricably linked to traditional resources and territories, local economies, the diversity of genes, species and ecosystems, cultural and spiritual values, and customary laws, shaped within the socio-ecological context of communities” (Swiderska et al., 2009).

Further participatory research with 11 Indigenous groups in the Potato Park Peru, Panama, India, China and Kenya confirmed these interlinkages and interdependencies, both in Indigenous worldviews and in practice. The research characterised biocultural heritage as a complex adaptive system with multiple interlinkages between its components (<https://biocultural.iied.org>).

Indigenous languages are key components of biocultural heritage as a means through which it is expressed and transmitted, along with memory, history, and ways of life within a particular territory and ecological context (Swiderska et al., 2020).

Crop wild relatives (CWRs) are crucially important in Indigenous farming traditions. Many Indigenous farmers still actively encourage the flow of resilient genes from wild to domesticated populations, and domesticate wild food plants to create new crops (Wilson, 2009). In Ethiopia, for example, farmers are finding and bringing into cultivation new strains of wild crops such as coffee and enset, a key root crop. And in Kyrgyzstan, farmers interplant wild apricot trees into their orchards to improve pollination (Wilson, 2009). In the Philippines, India and China, Indigenous farmers plant resilient CWRs to enrich domesticated crops in home gardens (Swiderska & Ryan, 2021). In Kenya, Mijikenda farmers continue to cultivate wild plants from sacred *kaya* forests on-farm (Swiderska et al., 2018).

Wild seeds, nuts, fruits, leaves, bush-meat and fish remain a significant micronutrient source for millions of Indigenous and rural people worldwide (Rowland et al., 2017). Wild food plants tend to be richer in micronutrients than cultivated crops, and more resilient (Borelli et al., 2020; Hunter et al., 2019). The role of Indigenous peoples in sustaining vital evolving gene pools and promoting gene flows to enhance resilience in domesticated crops is often overlooked in state policies. For example, member states participating in the FAO Commission on Genetic Resources for Food and Agriculture have advocated for separate networks for on-farm conservation by farmers, and for in-situ conservation of CWRs by states largely through existing protected areas.¹ Yet the majority of CWRs occur outside protected areas (Hunter & Heywood,

¹ http://www.fao.org/fileadmin/templates/agphome/documents/PGR/Reports/Report-Technical_workshop_131112.pdf.

2011), on the lands of Indigenous peoples in centres of crop diversity and domestication (Maxted et al., 2020).

Seed systems often lie at the heart of Indigenous peoples' struggles for self-determination and food sovereignty (Gutierrez, 2016). Maintaining the autonomy of such systems is vital to controlling farming and food decisions, resilience and cultural integrity (African Biodiversity Network and Gaia Foundation, 2015; AFSA & GRAIN, 2018). Many Indigenous peoples have, however, reported aggressive promotion of modern varieties that create dependence on costly external inputs (FAO, 2018).

Another key concern of Indigenous peoples is the privatisation of ancestral seeds through intellectual property rights (IPRs) such as patents and plant variety protection—a practice that goes against customary norms regarding collective custodianship and sharing of seeds to ensure access (Munyi & De Jonge, 2015; Swiderska et al., 2009). According to farmers in Ethiopia, “They [seeds] have personality. Farmers respect them as sacred gifts from nature, so that their seeds cannot be held in custody, privatised or patented by individuals: rather, seeds belong to the entire community” (AFSA & GRAIN, 2018).

African regional intellectual property organisations, representing several countries, have adopted Plant Variety Protection (PVP) protocols modelled on European standards of the International Union for the Protection of New Varieties of Plants (UPOV) Convention 1991. This poses a threat to farmers' rights and seed systems because UPOV'91 limits the possibilities for farmers to use, exchange and trade farm-saved seed of protected varieties (Munyi & De Jonge, 2015). IPRs, as well as non-IPR-related seed laws requiring certification and standardisation, are increasingly criminalising informal seed systems and restricting “seed commons” (Sievers-Glotzbach et al., 2021; Wattnem, 2016).

4.3 THE POTATO PARK'S ANDEAN SEED SYSTEM

The Andean region is one of the world's centres of origin and domestication of food crops including the potato and other tubers (olluco, oca), and the “superfoods” quinoa and amaranth (Sayre et al., 2017). Since 1998, Asociación ANDES has worked with six (now five) Quechua communities to establish the Potato Park.

This biocultural heritage territory in a secondary centre of origin of the potato (CIP, 2008) near Písaq, Cusco, Peru, is collectively managed. Local communities joined their land to form an area of around 9600

hectares, and in 2002 legally registered a collective Potato Park Association. Guided by pre-colonial Andean cosmovision and customary principles, the Potato Park conserves rich biodiversity, including some 1300 native potato cultivars (or, based on Western classification, around 650 varieties), 4 potato wild relatives, and many other Andean tubers, grains, medicinal plants and wildlife (ANDES, 2016).

A single plot can contain 250–300 potato varieties (Jiggins, 2017). Food sovereignty and protection of Indigenous rights are key objectives. As Ricardina, a local expert at the Potato Park explained, the territory “is an example of how communities can come together to defend their land” (Swiderska & Ryan, 2021) (see Box 4.2).

Box 4.2: Governance of the potato park

The Potato Park’s five communities, sitting at an altitude of 3400–4600 metres above sea level, are home to over 6000 Quechua people (ANDES, 2016). The park is collectively governed by a general council composed of the elected leaders of each community. The council oversees local technical experts who are elected by each community, including a Papa Aariwa or Potato Guardians collective, which supports the park’s communal seed system. The Potato Park Association and Council have an administration centre to support the guardians and the park’s economic collectives: Medicinal Plants (herbal teas, shampoos, creams), Gastronomy, Agro-ecotourism and Handicrafts (traditional weaving). These micro-enterprises bring together experts from different communities to produce a range of biocultural products and services (Aniceto Ccoyo, in Swiderska & INMIP, 2017).

Ten per cent of the revenues generated by each micro-enterprise is invested in a communal fund and redistributed annually among the communities in accordance with Andean principles of reciprocity and equilibrium that promote equity, ecological sustainability and solidarity. These principles are set out in an Inter-Community Agreement for Benefit Sharing, or Biocultural Heritage Protocol, which aside from ensuring equitable sharing of benefits provides the basis for collective governance of the park (ANDES et al., 2011). The agreement follows the principles embedded in Andean cosmovision—the Ayllu—where the wild and the sacred realms, embodied in the Apus or mountain Gods, play a key role in governance (Swiderska & INMIP, 2017).

The Apus “are the highest authority in the governance of the Potato Park”, notes Mariano Sutta (community expert, Swiderska & Ryan, 2021).

In this context, Aniseto Ccoy, community expert of the Saccaca Community has noted: “It is their laws we have to follow because they are older than humans and because our customary laws are based on how these ‘big heads’ think. One mountain has been elected as ‘mayor’, the head of the whole land. The other Apus are councillors of water, medicinal plants and so on” (Swiderska & INMIP, 2017).

Potato Park farmers use only native seeds because “modern varieties don’t produce well” in the territory (Potato Park expert, in Swiderska & Ryan, 2021). Native potatoes are not grown commercially, but for food, using traditional agroecological practices. While many landraces, or local cultivars, do not produce high yields compared to industrially farmed crops, their diversity ensures resilience to shocks, stable productivity and nutrition. The diversity of native potatoes is also a source of pride and a symbol of the maintenance of tradition in Andean communities (Sayre et al., 2017).

Different types of native potatoes have different cultural significance. Qachun Huaccachi—which translates as “makes the bride cry”, as it is very difficult to peel—is considered a symbol of love (Swiderska & INMIP, 2017). Native potato seeds are traditionally gifted to young couples by both families, disseminating varieties and related history, stories and knowledge about their uses and special characteristics (Walshe & Argumedo, 2016). The tubers are nurtured by Quechua women as “children” (see Box 4.3). The Potato Park has revived a number of rituals and festivals linked to native potatoes, e.g. offering gifts to the spirit of the potato, and tying a rope around harvested potatoes to keep the spirit tied to the earth—“we have to keep the spirit inside so the potatoes are better and stronger” (Potato Park expert, Swiderska & INMIP, 2017) (see Fig. 4.1).

Box 4.3. Andean learning and nurturing values that shape seed governance

In the Andean model, there are three distinct kinds of learning or knowledge:

- *yachay* is knowledge or wisdom that is processed mentally and learned through reflection, discussion and analysis;

- *ruway* (or *llankay*) is practical learning, for instance of skills related to agriculture or food preparation;
- *munay* is emotional learning, signifying love between people, and between people and nature, and refers to social connections, intuition, desire and the capacity to think and feel with the heart (Swiderska & Stenner, 2020).

This way of understanding knowledge creation can be applied to seed systems, and is situated within a place-based context—the wisdom relates to the landscape and its components. Feeling and rituals related to people’s deep respect for nature are codified in customary laws for seed governance. Western science, by contrast, has forgotten this element of “feeling”, which has allowed people to go against nature.

The Quechua concept of “Uyway” or “crianza”, which can be understood as mutual caring (Allen, 2017) or reciprocal nurturing applies strongly to seeds, but is broader than seeds (also applies to animals, land, rocks, etc.). The term means both nurturing seeds and being nurtured or

Fig. 4.1 Quechua farmers in the Potato Park Peru celebrate the spirit of the potato. Asociación ANDES

nourished by seeds, in a circular way, encompassing the concept of reciprocity or *ayni*. These are normative principles that people continue to use. Seeds are viewed as children: nourished, protected and treated as part of the family, who will help the family when they grow; and when plants are fully grown they are respected as elders.

In the Potato Park, native seeds are mainly accessed through seed saving, exchange with other farmers or local barter (ANDES, 2016). The sustainability and adaptability of farming and food system depends on farmers having the right to freely exchange seeds, develop new varieties and maintain their rights over traditional varieties (Sayre et al., 2017). When potatoes are harvested, tubers are first selected for use as seed (Sayre et al., 2017). Women play a key role in selection, conservation, storage and management of native seeds, using techniques learned from their mothers; they participate in local seed fairs and have extensive knowledge about the uses and properties of native varieties (ANDES, 2016).

Andean farmers also make significant use of biocultural indicators such as observations of stars, wild plants and animals, interpreted to determine precise dates for planting, harvesting and rituals (Sayre et al., 2017). As Potato Park seed expert Lino Mamani has explained,

we have indicators from wildlife so we can do forecasting to know when we can plant; we do seed selection when wildlife such as a fox, or the sky, tells us – this is very important for seed selection. We have experts that read the signs and farmers have their own knowledge. When we do planting neighbours help each other, so it is collective. (Swiderska & Ryan, 2021).

When potatoes are harvested, some tubers are put in the Potato Park's community seed bank, where seeds are stored "using a type of selection which reflects our taxonomy" (Potato Park expert, in Swiderska & Ryan, 2021). The seed bank enables farmers to access seeds when they lose a particular variety (ANDES, 2016). The seed diversity is also conserved for the future and for sharing with other communities (Swiderska & INMIP, 2017). The Potato Park is planning to establish a new community seed enterprise to support its seed conservation work; this will focus on botanical (i.e. in vitro) seed that is disease-free and can be stored in the seed bank for 50 years (Swiderska & INMIP, 2017). Guided by the Andean

principle of reciprocity, the enterprise will focus on multiplying seeds for distribution to communities, rather than selling large quantities for profit.

CWRs and other semi-wild and wild plants are widely distributed throughout the Potato Park and grow naturally among cultivated varieties. The farmers know that wild potatoes growing near cultivated fields improve the resilience and yield of cultivated varieties (Swiderska & INMIP, 2017). They know the importance of “combining them with domesticated potatoes so they can converse”, (Lino Mamani, in Swiderska & Ryan, 2021). As Nasario Quispe, another Potato Park expert, explained, wild potatoes “produce their own tribe – some produce potatoes good for drying, others for other uses. Keeping all this diversity ensures we have enough food” (Swiderska & Ryan, 2021).

Elderly Quechua women, who take care of livestock grazing, plant potatoes in animal corrals where the seeds of wild potatoes germinate in animal dung, so that CWRs can fortify their domesticated varieties through cross-breeding (Swiderska & INMIP, 2017). CWRs are also used for rituals and food in times of famine, and to make freeze-dried potatoes for long-term storage. The Potato Park also has wild populations of *oca* tubers (*Oxalis tuberosa*), *tarwai* (lupins), *mashua* (similar to turnip) and passion fruit (Swiderska & INMIP, 2017).

Box 4.4: The potato park as genetic reserve for in-situ conservation

The Potato Park genetic reserve for in-situ conservation of CWRs was launched by the international non-profit Crop Trust and the government of Peru in 2017. CWRs are vital for use as fuel, medicine, food and fodder, and as a source of climate-adaptive traits, as they can respond much faster to climate change than cultivated varieties and have higher genetic diversity.

The Potato Park genetic reserve covers the whole landscape, especially the areas of higher elevation. Its main objective is to maintain genetic diversity in wild populations so they can keep evolving. Wild relatives are regarded as the grandparents of domesticated species, but there is still “communication” between wild and domesticated varieties. Two of the wild potato species known to occur in the Park are very closely related to domesticated species, and can be crossed with domesticated potatoes to produce offspring that have improved tolerance to pests, frost, high temperatures and drought.

To create the genetic reserve, the Potato Park collected baseline data by mapping CWRs and hotspots of genetic diversity at high altitude in all five communities, with support from Asociación ANDES. Farmers collected information on the range and population density of CWRs, and how frequently cultivated potatoes are planted near wild populations. Laboratory analysis has also been done, for instance on germination potential, which helps in understanding pollination and whether CWR populations are viable sizes. Three wild potato species in the Potato Park—*Solanum bukasovii*, *S. acaule* and *S. raphanifolium*—grow naturally in a range of environments. Populations of *S. acaule* are found in high densities where livestock graze, indicating dispersal by animals.

Ancestral knowledge of farmers about CWRs has also been collected, and used to develop management plans for the genetic reserve alongside Western science. Rules for conservation and management of wild relatives already exist in the Quechua normative principles of the Potato Park communities, and in many Indigenous communities, and so do not need to be re-invented by conservationists.

Source Presentation by Eve Allen, INMIP Exchange 2017 (Swiderska & INMIP, 2017)

4.4 THE AYLLU SYSTEM OF ANDEAN SEED GOVERNANCE

The governance of the Potato Park landscape and seed system is based on the Andean pre-colonial concept of *sumaq causay*, or the holistic wellbeing of both people and nature (Sayre et al., 2017; Swiderska et al., 2020). In the Quechua and Aymara holistic worldview, the world is made up of three communities or Ayllus (Aniseto Ccoyo, Saccaca Community, in Swiderska & INMIP, 2017; Marisol de la Cadena, 2015):

- Runa Ayllu: humanity and all domesticated elements (plants, animals, water)
- Sallka Ayllu: wild animals and plants, and all elements outside human control
- Auki Ayllu: the sacred and the ancestors.

These three Ayllus must be in balance to achieve holistic wellbeing (see Fig. 4.1). Balance is achieved through reciprocity between the Ayllus,

which “glues the three communities together”, notes Aniseto Ccoyo of the park’s Saccaca Community (in Swiderska & INMIP, 2017). Ccoyo went on to say: “Good living only happens when there is harmony between the three Ayllus. The most sacred element of all this is the Pachamama (Mother Earth). This way of organising the three Ayllus is very old. It is very much alive in many communities, but they do not use it to organise their space as we are doing here” (in Swiderska & INMIP, 2017). Many native scholars define Ayllu as an “enlarged community” encompassing all the living and non-living organisms located in a given territory.²

The Ayllu system means that seed governance in the Potato Park is not based on human exceptionality—humans are not the only or the highest authority. As described above, other elements—the wild and the sacred (such as the sacred mountains)—also have souls and identities, and play an institutional role in the governance of seeds and crops. All elements, not just humans and food-producing habitats, contribute to creating rules for seed governance and conservation. Humans are part of a larger community and have to negotiate with the other members, the sacred and the wild. Thus, governance is not a human-centric approach, but is also guided by nature and spirituality.

This holistic worldview is similar in other Indigenous cultures, for instance in Asia and Africa. The common element is that people are not separated from nature—this is what distinguishes a biocultural heritage approach to seed governance. Seeds are part of biocultural heritage, embodying the indivisibility of nature and culture. But in other communities that are already immersed in the Western worldview, only humans play a role in governance, and this allows economic goals to dominate. IPRs that allow private ownership of seeds arise from the separation of humans and nature, and run counter to Indigenous peoples’ holistic governance which includes non-humans in the larger construct of society (Fig. 4.2).

² <https://incayllu.blogspot.com/p/blog.html>.

Fig. 4.2 Holistic wellbeing (*sumaq causay*) as balance between the three communities, or Ayllus, of the Andean worldview

4.5 ENRICHING SEED HERITAGE: POTATO REPATRIATION AND THE INTER-COMMUNITY AGREEMENT

In 2004, the Potato Park Association, ANDES and the International Potato Centre in Lima (CIP) signed the Agreement for the Repatriation, Restoration and Monitoring of Agrobiodiversity of Native Potato and Associated Community Knowledge Systems. Under this historic five-year agreement, the CIP gene bank returned 410 germ-free native potato cultivars to the Potato Park communities, for food security and in-situ conservation. CIP scientists had collected the varieties from Potato Park communities in the 1960s; subsequently the cultivars had disappeared from the communities through genetic erosion.

This repatriation agreement, probably the first from a gene bank to communities, recognised the importance of in-situ–ex-situ linkages for food security and climate adaptation (Stenner et al., 2016). A second five-year agreement, signed in 2010, involved collaborative research activities

to monitor and test the repatriated potato varieties, linking traditional knowledge and science.

The agreement helped restore seed diversity as well as associated Indigenous knowledge and beliefs embedded in the seeds. It enhanced food security, resilience to climate change and livelihoods. It also contributed to the protection of Potato Park communities' rights over their native potato varieties and ancestral knowledge—a key objective is ensuring that genetic resources and knowledge remain under the custody of the communities and do not become subject to IPRs. Through this agreement, communities' understanding of their rights has grown, along with their capacity to protect those rights through community knowledge registers, developed with support from ANDES. The agreement also led to the development of the Potato Park's inter-community agreement for benefit sharing (Stenner et al., 2016).

The Inter-Community Agreement (see Box 4.2) provides the foundation for collective decision-making, good governance and social cohesion among the five communities of the Potato Park. It recognises collective custodianship over Indigenous knowledge and seeds. Everyone has the right to freely access knowledge (barring sacred knowledge) and seeds, and the obligation to maintain their free flow among Potato Park and neighbouring communities, as well as to transmit them to future generations (ANDES et al., 2011).

The Potato Guardians collective (see Box 4.2) was established to manage potato repatriation. The *in vitro* seeds are treated in a small lab before being multiplied in a greenhouse, where the whole Potato Park collection is stored. The seedlings then go to a net-house and are distributed to the communities, which can request particular varieties. Farmers manage the potatoes in their fields, and each community has their own potato collection (Representative of Potato Guardians Collective, in Swiderska & INMIP, 2017).

4.6 CONCLUSIONS AND RECOMMENDATIONS

Indigenous peoples have domesticated, conserved and improved much of the world's genetic diversity, adapting seeds to changing environmental conditions through their knowledge and cultural values. In this way, they have ensured food security and biodiversity conservation for millennia. Their seed systems are at the forefront of genetic evolution and adaptation to climate change, sustaining CWRs that are the first to develop resilient

properties, and actively harnessing these properties to enrich domesticated crops.

Safeguarding this genetic diversity is crucial for global food security, particularly given the increasing homogenisation of agri-food systems and growing climatic extremes and unpredictability. Genetic diversity is also crucial for Indigenous peoples' own food security, to reduce the risk of crop failure, and ensure stable production, dietary diversity and nutrition. Perhaps even more importantly, it is a key source of cultural identity, pride, social cohesion and spiritual wellbeing.

Across the world, so-called "informal" Indigenous seed systems are in fact actively governed through customary laws, principles and beliefs. Key common principles across continents include sharing and reciprocity (the obligation to share and exchange seeds), balance with nature, and solidarity (the obligation to help those in need). The sacredness of seeds as givers of life is also enshrined in many Indigenous cultures. But the role of Indigenous principles, values and cosmovision in sustaining genetic diversity is largely overlooked in, and often undermined by, formal seed policies (Graddy, 2013; Wattnem, 2016). Analysis of farmers' and formal seed systems shows important complementarity between the two, but very few countries reflect that in their seed policies (Almekinders & Louwaars, 2002).

The integrity of seeds as biocultural heritage is best protected through a biocultural rights-based approach to seed governance. Biocultural rights are a community's long-established right, in accordance with its customary laws, to steward its lands, waters and resources. They are not simply claims to property, but the collective rights of communities to carry out traditional stewardship roles, as conceived of by Indigenous ontologies (Bavikatte & Bennett, 2015). An approach based on these rights goes beyond the concepts of food or seed sovereignty by explicitly recognising the cultural and spiritual nature of Indigenous seed governance.

Increasingly, biocultural rights are being recognised in international environmental law (Bavikatte & Bennett, 2015). Recognising these rights in national and international law means recognising concepts like biocultural heritage and protecting customary legal systems. In Indigenous cultures, biocultural rights include the rights of Mother Earth, rivers or lakes—which have been formally recognised in a few cases—and the rights of seeds.

Protecting Indigenous seed systems and implementing a biocultural rights-based approach demands:

- reforming national seed policies to remove the threats to Indigenous seed systems (IPR and non-IPR related) and promote mutually supportive formal and informal seed systems, and reforming other mainstream policies that threaten Indigenous seed systems and biocultural heritage;
- actively engaging Indigenous peoples in defining policies and laws for seed governance, so that these recognise and reinforce existing customary laws that seek to preserve genetic diversity and ensure seed access;
- establishing a global network of Biocultural Heritage Territories for effective long-term protection of Indigenous seed systems in centres of origin and diversity of crops, linking wild and domesticated gene pools, through decolonising action-research processes, building on the successful Potato Park model;
- supporting the establishment of community seed banks based on Indigenous peoples' knowledge and rules for storing and accessing seeds, which are diverse and adapted to local cultures and ecologies (such as traditions for maize seed storage in Mexico and China, which predate scientific methods);
- supporting Indigenous plant breeding systems which have existed for millennia and are similar to evolutionary plant breeding, along with "farmer field schools" based on Indigenous cosmovision and ways of knowing, going beyond farmers' fields or particular technologies.

The Covid-19 pandemic has shown the critical importance of Indigenous seed and knowledge systems for resilience to shocks: they have proved far more resilient than those based on Western science and global markets. This points to an opportunity to re-evaluate seed governance and promote more pluralistic governance systems.

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