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Potato Production System in the Andean Region of Bolivia: Modern Seed Potato Production, The Use of Agricultural Technology, and Genetic Erosion

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Review Article

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ABSTRACT

The High Andean region of Bolivia lies at the centre of domestication and genetic diversity of the potato (*Solanum tuberosum* L.). Potatoes are cultivated throughout this region, in the Interandean Valleys and the lowland tropics. The former is where the greatest variety of native potatoes is grown (especially in the Depts. of La Paz and Cochabamba), giving rise to microcentres of genetic diversity. It is now, however, immersed in a process of transformation. Technological changes in potato production, especially the shift towards certification seed potato production i.e., use of few varieties, intensive agrochemicals use, etc., are together causing the loss of native potato species and varieties, plus has been accompanied by the loss of traditional cultivation practices, and perhaps the sustainability of potato production in the Andean region.

INTRODUCTION

The Andean region stretches across Bolivia, Peru, Ecuador, Colombia, Venezuela, and part of northern Argentina. In Bolivia, the highest peaks include Mts. Sajama (6542 m), Illampu (6424 m), Illimani (6322 m) and Huayna Potosí (6095 m) [1] **(Figure 1)**, all in the west. The Andean highlands, known in the Aymaran culture as the Kolla (It was here where the Aymarean culture arose (the dominant culture of the Dept. of La Paz). The Quechuan culture became concentrated in the Depts. of Cochabamba, Potosí, Chuquisaca and part of the Dept. of Oruro) **(Figure 1)**, comprises three major areas: 1) the Altiplano (3800-4000 m), which lies between the Western (Azanaques) and Central (Los Frailes) Andean Ranges [1] **(Figure 1)**; this is a land of cold, high plains; 2) the Puna (3000-4500 m), which is composed of more rolling mountains with pronounced abutting slopes; here the climate can be cold and dry or cold and wet; and 3) the Interandean Valleys (2000-3000 m) and mesothermal valleys (1000-2000 m), which lie between the mountain ranges and are irrigated by water descending from them; the climate in these areas is temperate to temperate-hot and notably drier.

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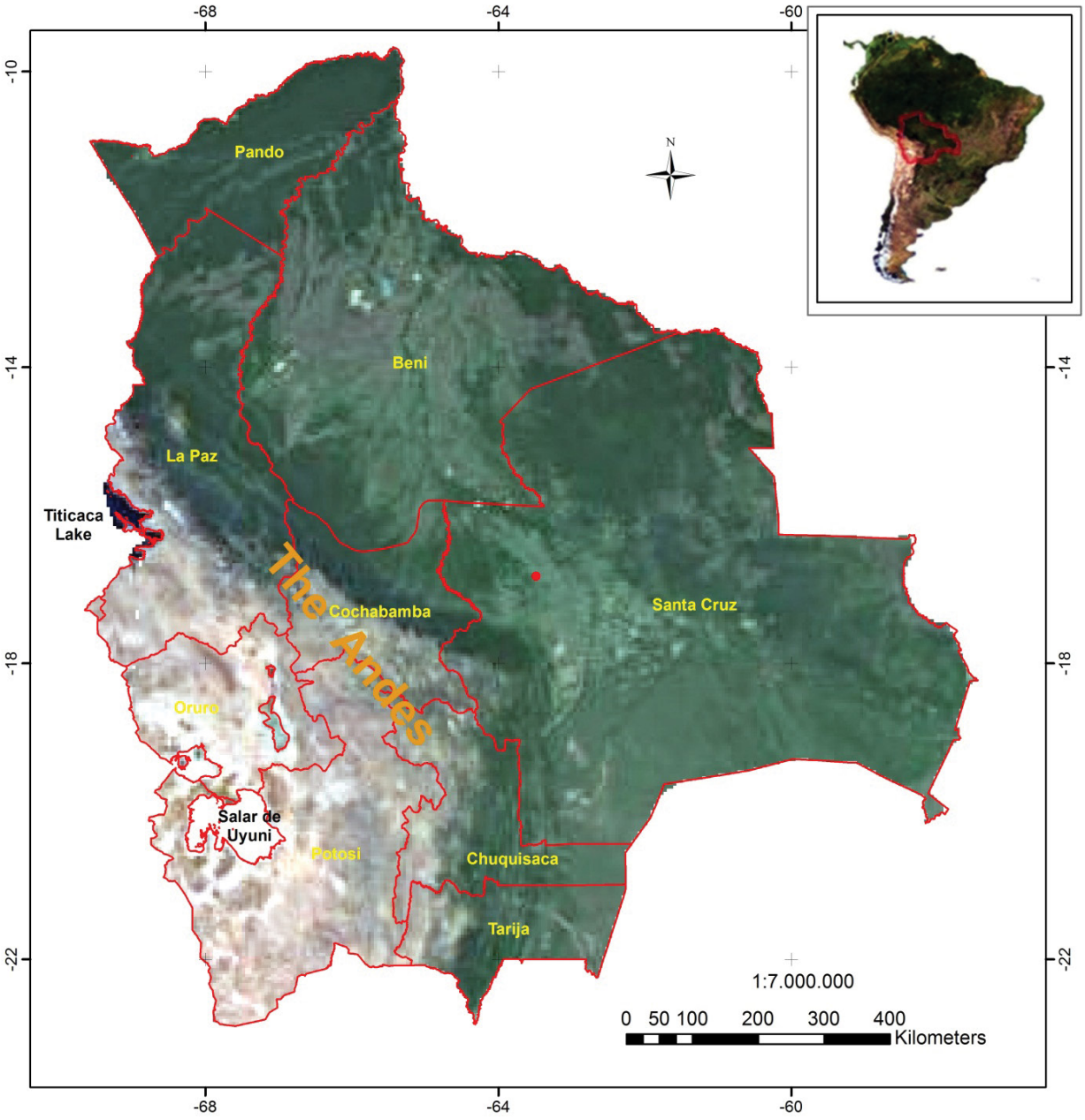

Figure 1. Location of the Andes in Bolivia. To the west: the Andean departments (Oruro and Potosí), and the Andean-Amazonian departments (La Paz, Cochabamba and part of Santa Cruz). To the east: the Depts. of Pando, Beni and part of Santa Cruz, and the departments of the Amazonian-damp tropical region and dry plains (part of the Dept. of Santa Cruz, and those of Chuquisaca and Tarija respectively) (Map prepared by: Centro de Investigaciones y de Servicios en teledeteccion (CISTEL), Dpto. Ingenieria, Facultad de Ciencias Agricolas y Pecuarias, UMSS).

Different types of native potato are cultivated across Bolivia's Andean highlands, with some areas richer in diversity than others. Areas of traditional importance in this respect include the Altiplano, microcentres in the Muñecas and Real de La Paz mountain ranges (both within the Cordillera Real range in the north), and others in the area to the north of Potosí and the Cochabamba–Tapacarí uplands [2]. Cárdenas [3] records that Hawkes establishes the origin of the potato on the shores of Lake Titicaca, and that Salaman and Hawkes believe the mountainous regions of Lake Titicaca and Cuzco were the centre of origin of the potato since it is here where highest indices of species-level and varietal variation are seen. Currently it is believed that, given the diversity of wild and cultivated forms present, the potato evolved and diversified in northern Bolivia-southern Peru [4].

Over the last 30 years, Bolivian potato production has experienced a transformation. Different crop improvement policies have been promoted by the State and as part of international cooperation projects, with funding coming from public and private sources. The modernisation of potato cultivation was a feature of many of these policies, a process requiring the adoption of new technologies, seeds, fertilisers, and crop protection agents, etc. Sadly, little attention was paid to preserving the genetic diversity of Bolivia's native, High Andean potato varieties.

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Potato genetic diversity

In 1944, Cárdenas [3] helped focus attention on Bolivia's importance as a centre of genetic resources, including those of the potato. Until then, neither Bolivia nor Peru understood their importance as the centre of origin of this crop. Rural communities linked by ancestral culture, climate and geography cultivate different varieties, forming microcentres of genetic diversity in Bolivia, especially in the Depts. of La Paz (the most important), Cochabamba and Potosí. These include:

1. Microcentres dispersed across the Province of Pacajes in the central Altiplano in the Dept. of La Paz, where the *Pacajes* culture developed, and where bitter (*S. xjuzepzukii*), semi-bitter (*S. curtilobum* and *S. stenotonum*) and sweet (*S.* subsp. *andingena*) potatoes are cultivated. This microcentre is home to the Lahuachaca community (Cantón-Pujarni-Lahuachaca, Primera Sección Municipal de Province Aroma, Dept. of La Paz), where one of the major Altiplano rural fairs is held. The strategic location of the site between the south of the Altiplano (Dept. of Oruro), the southwest of the high mountains of the Dept. of Potosí, and the cold, wet mountains of the Dept. of Cochabamba, has for centuries made this place and its fair a dissemination hub for most of the domesticated potato types grown in the region north of La Paz.

2. Microcentres dispersed to the north of La Paz. Isolated between the Muñecas and Real de La Paz mountain ranges, traditional communities such as those of the Kallahuayas people still exist. In this region, close to the shores of Lake Titicaca, Escoma (Province of Camacho, Dept. of La Paz) is home to one of the most important rural fairs north of La Paz. A diversity of native potatoes cultivated in Pelechuco, Humanata, Charazani, Chulina, Italaque, Mocomoco and Cotusi, etc., converge at this fair. The ancestral importance of this meeting has rendered it an important dissemination hub for native potatoes from the mountainous north towards the northern and central parts of the Altiplano and beyond.

3. Microcentres around Lake Titicaca. Mentioned by Cárdenas [5] and Hawkes [4], these are found from the north of the peaks of the Cordillera Real range to the area of the Valle de Sorata, the seat of the Laripata culture (the current province of Province Larecaja, the capital of which is Sorata), taking in the areas around Murumamani, Pacollo, Humanata, Chojchoni and Millipaya, etc.

The characteristics and distribution of the species-level and varietal variation of native potatoes has been described by Cárdenas [5], Hawkes and Hjerting [4], Ochoa [1] and Hawkes [6]. These authors record diploid, triploid, tetraploid and pentaploid forms with high levels of intraspecific variation. The different varieties also have different climatic preferences, and different centres of dispersion.

1. Diploids (2n) (*Solanum stenotomum* Juz et Buk., *Solanum phureja* Juz et Buk, and *Solanum* x *ajanhuiri* Juz et Buk.). The most widely known go by the native names of *Qhoyllupapas*, *Pitiquillas* and *Qhenis* **(Figure 2)**. Intraspecific variation is notable, with differences in colour and shape (though they are all normally elongated). Similarly, *Phurejas*-type potatoes, mainly grown to the north of La Paz and Cochabamba in mountainous and transition areas, also show a range of colour, but are generally round. *Ajahuiris*-type potatoes, which include the *Ajahuiris*, *Kaisalla* and *Laram-ajahuiri* varieties, are grown only on the Altiplano.

2. Triploids (*Solanum Juzepczukii* Buk.) are grown mainly on the Altiplano or at altitudes of over 4000 m. These frost-resistant, bitter potatoes, known locally as *Luk'ys Ch'oqhepitus*, and Morok luk'y, etc., are almost exclusively used for the preparation of *chuño* (dried potatoes).

3. The tetraploids (*Solanum tuberosum* subsp. *andigena* Buk.) form the largest group and show the greatest intraspecific variation. These are grown in the High Andean region. Some varieties are widely cultivated. Such is the case of the *Imillas* group of potato varieties, including *Ch'iar imilla* (also known as *Yana imilla* in the Quechua region, and as *Imilla negra),* and *Jank'o imilla* (or *Imilla Blanca*), *Sani imilla* and *Waych'a* **(Figure 2)**. Other varieties are grown more regionally. For example, *Malcacho* is cultivated mainly in the potato-growing area of the Dept. of Potosí (Pampas de Lequezana) and Chuquisaca (the microcenter of Culpina), while the *Runas* varieties **(Figure 2)** are preferentially grown in certain microcentres of Cochabamba, e.g., in Vacas and Rakaypampa, and in all of the Valle Alto de Cochabamba (especially Cliza). The variety *Sani negra* is grown mainly in the Aracas area of La Paz.

1. Pentaploid potatoes (*Solanum curtilobum* Juz et Buk.) are grown only on the Altiplano and at high altitudes. These frost-resistant forms include some bitter potatoes such as the *Monda luk'y*, *Sipancachi* and *Mojotoro* varieties etc.

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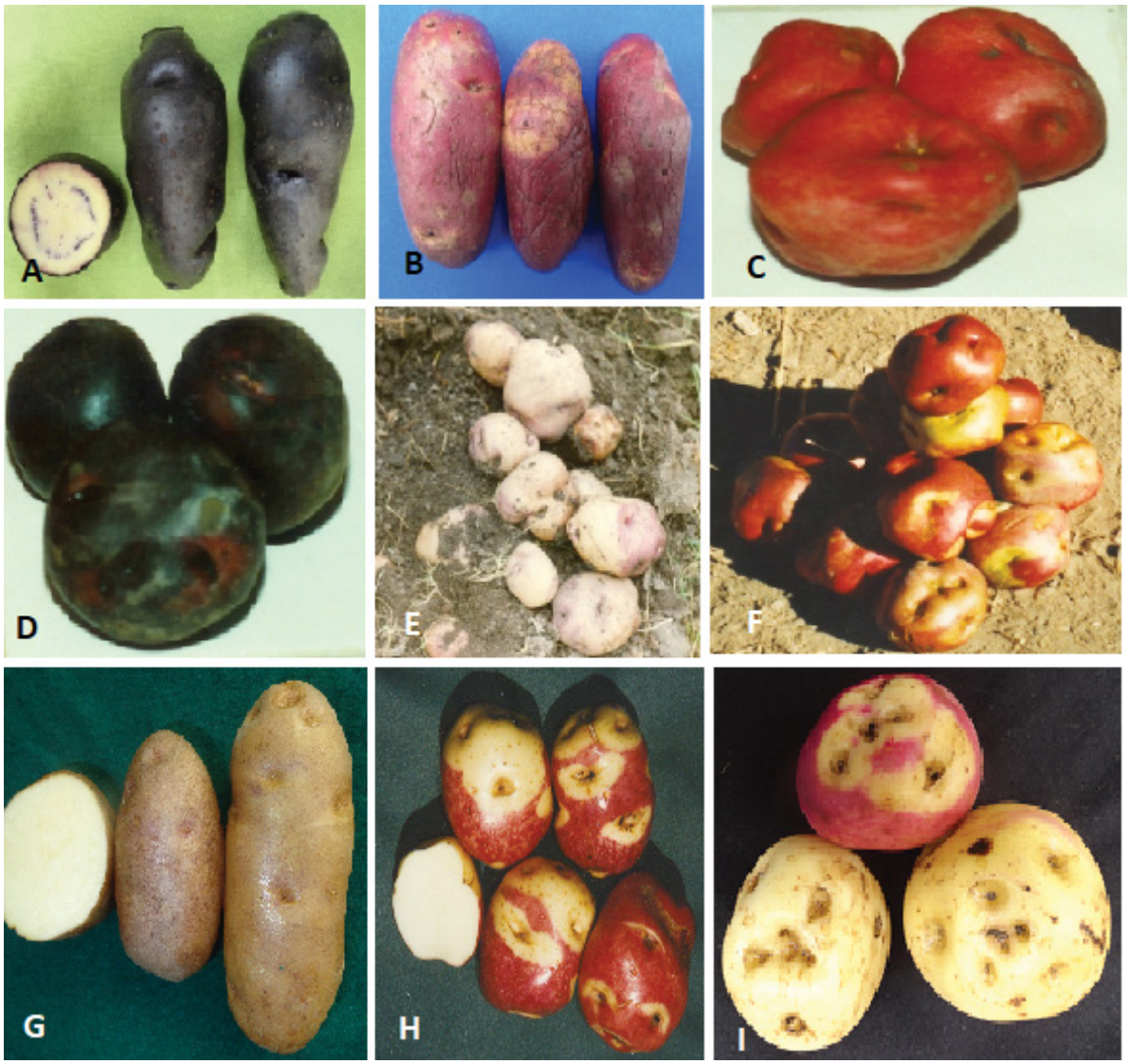

Figure 2. Commercial varieties of native potatoes: A: *Qhoyllupapa* (*S. stenotonum*), widely grown in Cochabamba; B: *Qhenipapa* (*S. andigena*), grown mainly on the shores of Lake Titicaca; C: *Wila imilla* (*S. andigena*), cultivated mainly around Lake Titicaca; D: *Chiar Imilla* or *Yana Imilla* (*S. tuberosum* subsp. *andigena*); E: *Sani imilla* (*S. andigena*), cultivated in only a few high Andean areas; F: *Huaych'a* (*S. andigena*), one of the most commonly cultivated varieties in the High Andean region; G: *Runapapa* (*S. andigena*), grown widely in the Cochabamba Valley and around Vacas micro region of Andes, Cochabamba, but undergoing a process of genetic erosion; H: *Phureja roja* (*S. phureja*), grown mainly in the communities of Pacollo and Humanata of Sorata municipality, Province of Larecaja, Dept. of La Paz; I: *Yuraj imilla* (*S. andigena*) (Quechuan word) or *Jank'o imilla (Aymarian word)*, grown mainly in the microcentres of genetic diversity of Colomi (Cochabamba) and Humanata (Province of Camacho, Dept. of La Paz).

Potato production areas

Until the 1950s or 1960s, potatoes were grown only in the High Andes of Bolivia. Their cultivation then gradually spread to the Interandean Valleys (2000-3000 m), the mesothermal valleys (1000-2000 m) of the Dept. of Santa Cruz, the Andean-Amazonian transition zone (1000-2000 m), and the eastern plains (200-500 m). However, they remain an archetypal Andean crop, and the country's statistics for it are always drawn from the Andean region. Some 182,675 ha are now given over to potato production in Bolivia **(Figure 3)**. These are distributed over six Andean departments (La Paz, Cochabamba, Potosí, Oruro, and parts of Chuquisaca and Tarija), but particularly those of La Paz (54, 900 ha), Cochabamba (39, 200 ha) and Potosí (30, 260 ha) (INE 2017) (i.e., largely in the High Andean and Altiplano regions).

In all these departments, potatoes are grown in the traditional fashion. Generally the climate is determined by proximity to the Andean-Amazonian transition zone; the closer the wetter the climate, and the more organic the soil.

1. In the Dept. of La Paz, the northern Altiplano (3980 m) is damp and cold, the product of its proximity to the La Paz mountain range and the Puna (3900-4300 m) (which includes the areas around Murumamani [Province of Omasuyos], Pacollo [Province of Larecaja], Humanata [Province of Camacho], and Charazani [Province of Bautista Saavedra]). This is the most strongly agricultural area, where conditions for growing phurejas potatoes are good. The central Altiplano (3890 m) is drier and more suited to the cultivation of quinoa (*Chenopodium quinoa*), cañahua (*Chenopodium*

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pallidicaule) and bitter potatoes (*S. xjuzepzukii*). The climate here is influenced by the Western Cordillera. This territory covers the areas around Patacamaya [Province of Aroma], the Province of Pacajes, and the micro centre of Araca (the potatoes from which are well known in the markets of La Paz).

2. In the Dept. of Cochabamba, the main potato microcentres (Independencia–Morochata and Cocapata [Province of Ayopaya], Colomi-Candelaria [Province of Chapare], Lope Mendoza [Province of Carrasco] and Vacas [Province of Arani]) are influenced by the Andean-Amazonian transitioning spurs of the Eastern Cordillera (3000-4000 m). The climate here is very damp and cold. The Province of Tapacarí is also an important growing area, but it is much drier since it lays beyond the influence of the latter transition area.
3. In the Dept. of Potosí, the potato-cultivating microcentres lie at latitudes beyond the influence of the Eastern Cordillera; they are therefore drier. The major sowing time is summer (October to November, also called the yearly sowing); at other times water is lacking. Among these microcentres are those to the north of Potosí (Provinces of Bustillo, Chayanta, Alonso de Ibáñez, Charcas and Bilbao Rioja), the Pampas de Lequezana, and the Province of Cornelio Saavedra (at the frontier between Potosí and Chuquisaca). To the south lies the microcentre of Villazón in the Province of Modesto Omiste (on the Pampas de Mojos), which has been producing potatoes since 1980.
4. In the Dept. of Chuquisaca, the production microcentres lie far from the transitioning mountains. The climate is therefore much drier. The most traditional include the areas around Culpina (approx. 3100 m), Padilla (in the Province of Tomina) and Tarabuco (Province of Yamparaes). Culpina (Province of Sur Cinti), with its high production figures, is the best known. An irrigation system has allowed a larger area to come under cultivation, and for production to be diversified.
5. In the Dept. of Tarija, most cultivation occurs in the Interandean Valleys, the High Andean areas of the pampas, and the area around Iscayachi (3800 m).
6. In the Dept. of Santa Cruz, the 1960s saw the start of winter cultivation in the mesothermic valleys (1000-2000 m), i.e., around the villages known as the Valle de Comarapa, Valle de Saipina, Valle Grande and Valle de Mairana. In 2000, *S. tuberosum* (Desiree variety) production was begun in the tropical north (550 m) of Santa Cruz.

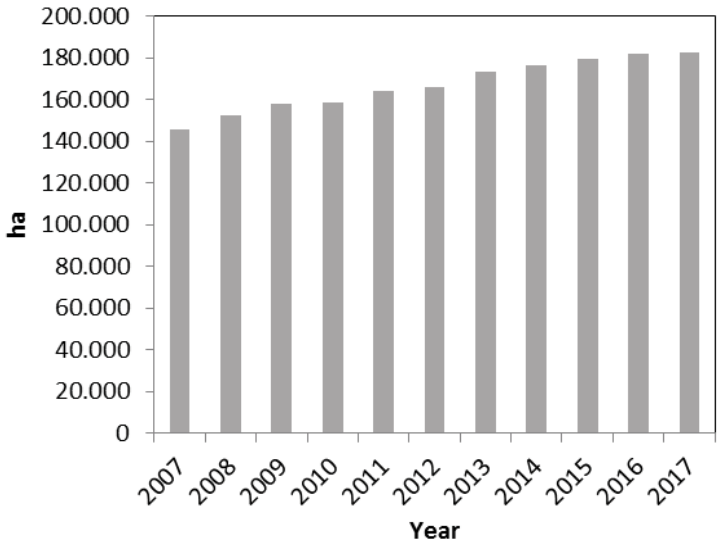

Figure 3. Change in area (ha) devoted to potato cultivation in Bolivia (INE, 2017).

Technology and its effect on productivity and genetic diversity

In Andean Bolivia, potatoes are commonly grown using traditional technology, although some modern elements may be incorporated. In general, the *Yunta* (Yunta: Quechuan word meaning two oxen yoked together for ploughing fields, etc.) remains essential for preparing the land for sowing, etc. In some microcentres, however, the use of agricultural machinery, seeds and agrochemicals, can be quite intense. In the traditional growing areas of Cochabamba and La Paz, fungicides are now widely used to control late blight (caused by *Phytophthora infestans*), while insecticides are needed to deal with thrips (*Frankliniella* spp.), aphids (*Myzus persicae*) and weevils (*Premnotrypes* spp. and *Rhygopsidius* spp.) **(Figure 4)**. Fungicides and insecticides are used intensively in wetter, colder areas. Granular and liquid fertilizers are commonly employed, although chicken manure has been introduced to accompany/replace them. Machinery for preparing soils, cultivation practices and harvesting is used extensively in the microcentres of the Altiplano around La Paz, the Interandean Valleys and even in high mountain areas where slopes permit. Where slopes are too steep, the *Yunta* or ancestral manual instruments such as the *Chakit'ajlla* (a tool for preparing the ground) remain current.

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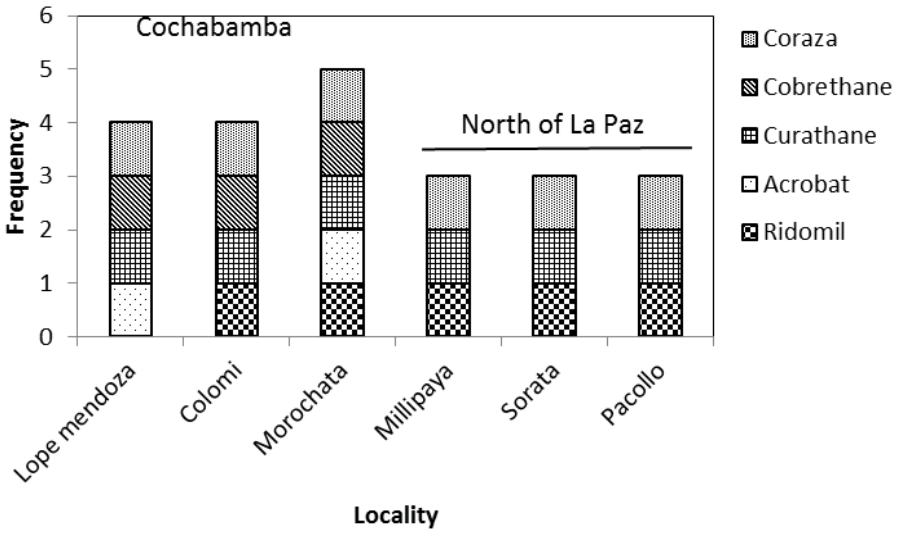

Figure 4. Use of systemic fungicides for the control of late blight caused by *P. infestans* in different parts of the Depts. of Cochabamba and La Paz. (Ridomil=Metalaxyl+Mancozeb; Acrobat = Dimetomorf+Metiram; Curathane = Cymoxanil+Mancozeb; Cobrethane = copper oxychlorate+Mancozeb; Coraza = Dimetomorph+Mancozeb) (Coca Morante and Torrez 2012).

Irrigation is a traditional practice in the High Andean microcentres, but modern irrigation systems are only incipient. In some microcentres of Cochabamba, La Paz and elsewhere, however, sprinklers are being used for winter sowings. In the past, the water that flows from the mountains was little used by those living at high altitude. Since the 1980s, however, attempts have been in made to better employ it. Originally these efforts were part of international cooperation projects run by non-governmental organisations; later the State took over, becoming the main promoter of infrastructure in this respect.

Mean national potato yields are about 5-6 t.ha^{-1} [7] **(Figure 5),** although these figures hardly represent those of the High Andean region. Indeed, regional and microcentre differences in production exist between the High Andean areas of La Paz **(Figure 6A)** and Cochabamba **(Figure 6B)**. The use of certified seed potatoes for native varieties, and of different fungicides to control leaf disease, has led to yields exceeding those traditionally obtained **(Figure 7)**. In turn this has had a positive impact on the living conditions of potato producers. However, fewer native varieties are now being cultivated in the microcentres of diversity; a general trend exists towards the cultivation of just one native variety (*Waych'a* [*S. andigena*]), introduced varieties of *S. tuberosum*, and improved forms of *Solanum* x **(Table 1)**. Indeed, of the 7-15 varieties of *Imillas*-type potatoes grown since 1888 in the microcentres of Colomi and Cochabamba, only *Yuraj imilla* and *Yana imilla* are now cultivated, and in the microcentres north of La Paz, such as those of Pacollo, the Provinces of Larecaja, Humanata and Camacho, only four are now grown (*Jank'o imilla, Chiar imilla, Wila imilla*) **(Figure 8)**.

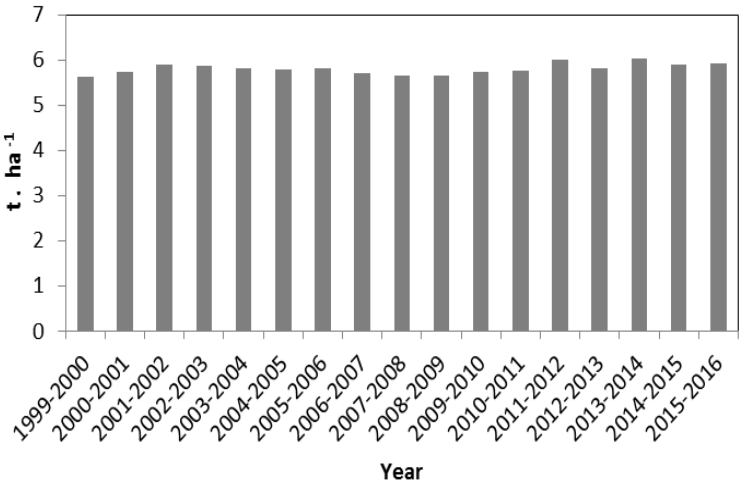

Figure 5. Mean potato yields (t.ha^{-1}) in Bolivia (INE, 2017).

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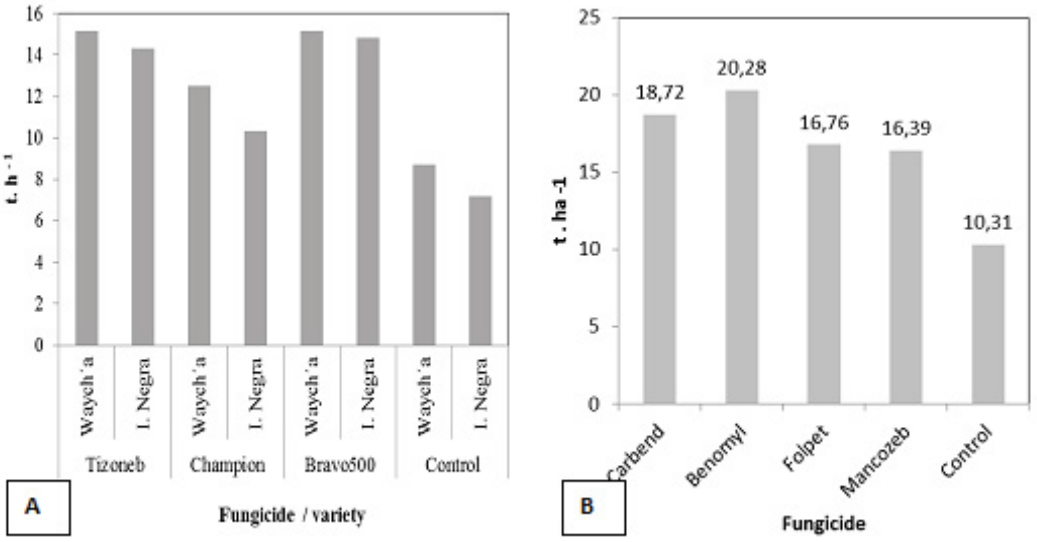

Figure 6. Effect of fungicides on yield (t.h^{-1}) of different native potato (*S. andigena*) varieties. A: Community of Murumamani (4250 m; Province of Omasuyos, Dept. of La Paz; 1999/2000). Tizoneb = Mancozeb; Champion = copper oxychlorate; Bravo 500 = Clorothalonil; Control=H_2O. (Coca Morante 2002). B: Community of Laimetoro (3200 m; Province of Carrasco, Dept. of Cochabamba). Carbendazim = benzimidazol group; Benomyl = benzimidazol group; Folpet = phthalimide group; Mancozeb = dithiocarbamate; Control=H_2O. (Coca Morante 1989/1990).

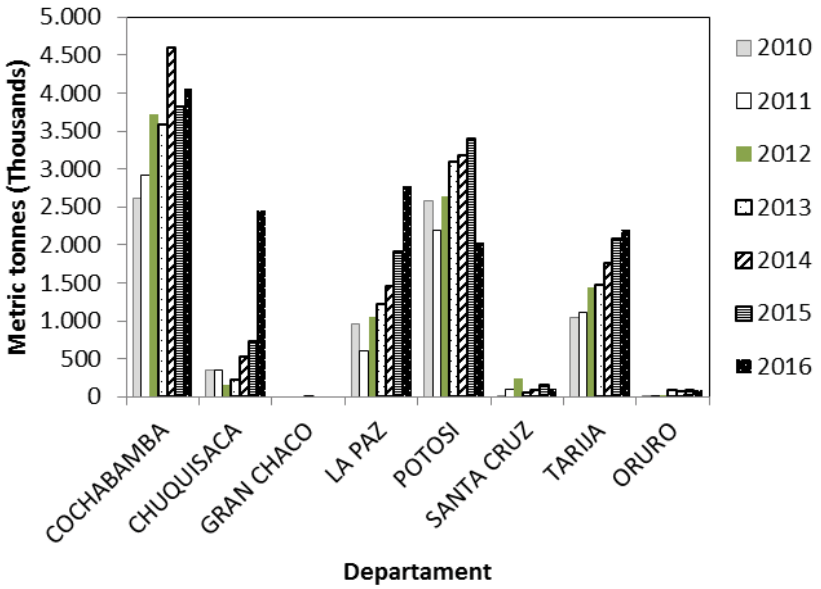

Figure 7. Production of certified seed potatoes (tm) in different parts of the Bolivian Andes (INIAF, 2017).

Table 1. Varieties of native (*S. andigena* and *S. phureja*) and introduced (*S. tuberosum* and its improved forms) potatoes currently grown in the microcentres of native potato diversity in Cochabamba and La Paz, Bolivia.

			Variety / Species											
Department / Localities	**Province**	**Altitude (m)**	**Wuaycha**	**Sani imilla**	**Imilla blanca**	**Phureja**	**Runa**	**Pinta boca**	**Desirée (Holland)**	**Capiro**	**Doble H**	**Toralapa**	**Peruana**	**Jaspe**
Cochabamba														
Vacas cañada	Arani	3750	*S.adg**	-	-	-	*S.adg*	-	-	-	-	-	-	-
Paredones	Arani	3800	*S.adg*	-	-	-	*S.adg*		-	-	-	-	-	-
Raghay pampa	Mizque	3300	*S.adg*	-	-	-	*S.adg*		-	-	-	-	-	-
Sinsey part libre	Ayopaya	3650	*S.adg*	-	-	-	-		-	-	-	*S.x*	-	-
Chinawi grande	Ayopaya	3500	*S.adg*	-	-	-	-		-	-	-	*S.x*	-	-
Morochata	Ayopaya	3500	*S.adg*	-	-	-	-		-	-	-	-	-	-
Piusilla	Ayopaya	3600	*S.adg*	-	-	-	-		-	-	-	-	-	-
P'alta loma	Chapare	3680	*S.adg*	-	-	*S. phu**	-	*S.adg*	-	*S.x*	-	*S.x****	*S.x*	*S.x*
Kanko	Chapare	3550	*S.adg*	-	*S.adg*	*S. phu**	-	*S.adg*	*S.tb****	*S.x*	-	*S.x*	*S.x*	*S.x*
Candelaria	Chapare	3600	*S.adg*	-	*S.adg*	*S. phu**	-	*S.adg*	*S.tb*	*S.x*	*S.x*	*S.x*	*S.x*	*S.x*
Rodeo	Chapare	3890	*S.adg*	-	*S.adg*	*S. phu**	-	*S.adg*	-	*S.x*	-	*S.x*	*S.x*	*S.x*
K'urimayu	Chapare	3250	*S.adg*	-	-	*S. phu**	-	*S.adg*	-	*S.x*	-	*S.x*	*S.x*	*S.x*

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La Paz														
Murumamani	Omasuyos	4350	*S.adg*	*S.adg*	-	-	-	-	-	-	-	-	-	-
Pacollo	Larecaja	4250	*S.adg*	-	-	*S. phu**	-	-	-	-	-	-	*S.x*	-
Humanata	Larecaja	4050	*S.adg*	-	-	*S. phu**	-	-	-	-	-	-		-
Millipaya	Larecaja	3800	*S.adg*	-	-	*S. phu**	-	-	-	-	-	-		-
Humanata	Camacho	4250	*S.adg*	*S.adg*	*S.adg*		-	-	-	-	-	-		-

S. adg = Solanum andigena
S. phu = Solanum phureja
S. tb =Solanum tuberosum
S. x =Solanum x (originating in national and international genetic improvement programmes).

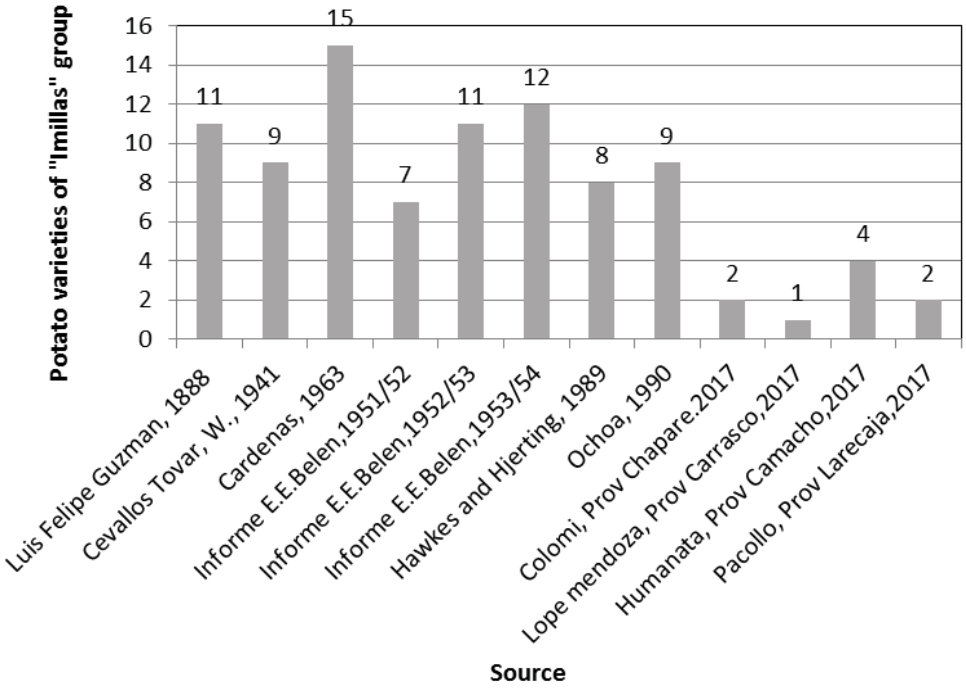

Figure 8. Varieties of native potatoes in the *Imillas* group (*S. andigena*) grown historically and currently in the microcentres of native potato diversity in the Depts. of Cochabamba and La Paz.

Seed potato production and genetic diversity

The production of seed potatoes began in Andean Bolivia in the 1980s. The greatest impulse to this occurred in Cochabamba in 1984/85, with the establishment of the *Unidad de Semilla de Papa* (SEPA). This mixed project of the COSUDE/IBTA/ASAR (Swiss Cooperation/Instituto Boliviano de Tecnología Agropecuaria/Asociación de Servicios Artesanales y Rurales) made the dream of seed potato production in Bolivia come true. Thirty years later, production has greatly increased. Between 2010 and 2016, the INIAF (Instituto Nacional de Innovación Tecnológica Agropecuaria y Forestal) Seed Certification Office reported some 13,000 tonnes being produced in different parts of the High Andean region **(Figure 9)**. The most important departments in terms of seed potato production are those of Cochabamba, Potosí, Tarija and La Paz, and the most important certified varieties are Desirée (*S. tuberosum*) and Huaych'a (*S. andigena*). Seed potatoes for other native (*Imilla negra*, *Imilla blanca*, *Pinta boca*, *Malcacho*, etc.) and improved varieties (*Revolución*, *Jaspe*, *P'altachola*, etc.) are produced in scant quantities **(Figure 9)**. The system has thus become consolidated around commercial *S. tuberosum* and *S. andigena*, with the use of native varieties falling drastically **(Figure 9)**. According to Julio Gabriel [8], in the germplasm bank of the Experimental Station of Toralapa (National Institute of Agricultural and Forestry Research, INIAF), one thousand seven hundred sixty (1760) accessions of seven native potato species are conserved [*S. phureja* (eighteen accessions), *S. stenotomum* (two hundred thirty-five accessions), *S. goniocalyx* (six accessions), *S. x ajahuiri* (eighty-four accessions), *S. x juzepzukii* (One hundred thirty one accessions), *S. x curtilobum* (eighty accessions) y *S. tuberosum* ssp. *andigena* (nine hundred and eighty six accessions)] and *S. tuberosum ssp. tuberosum* (sixty four accessions) and in the process of identification (one hundred thirty four accessions).

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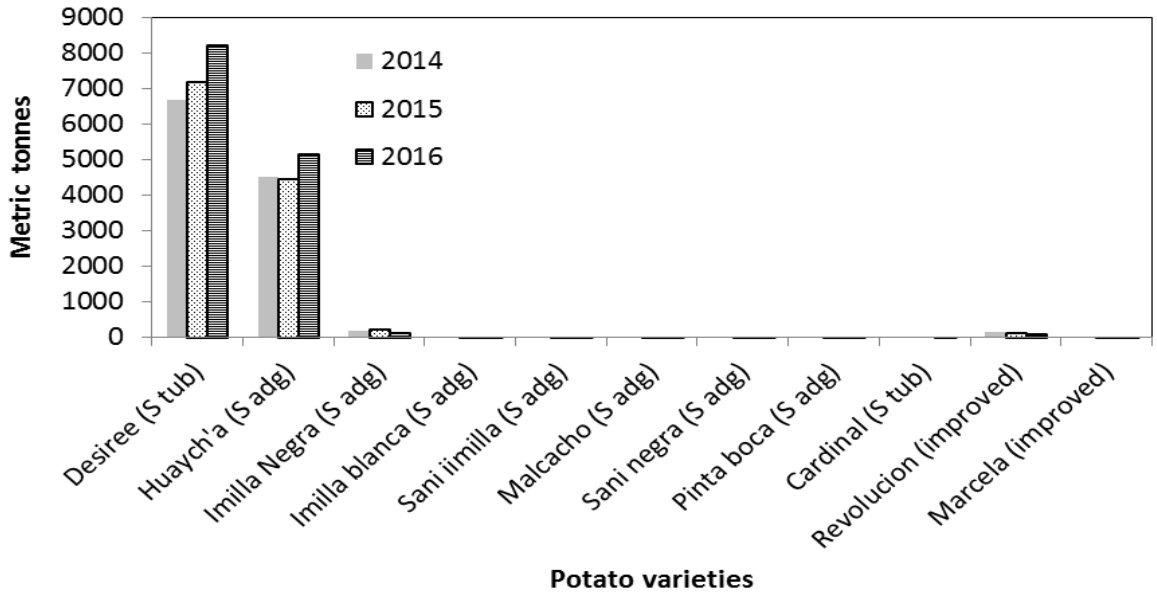

Figure 9. Production of certified seed potatoes for introduced varieties of *S. tuberosum* (cv. Desirée and Cardinal), native *S. andigena* varieties (*Huaych'a, Imilla negra, Imilla blanca, Pinta boca, Malcacho*), and improved varieties (S. x) (*Revolución and Marcela*) (INIAF, 2017).

The use of fertilisers, minerals and pesticides etc. has also increased to meet the many requirements of *Desirée* and *Waych'a* production. For example, the control of the potato weevil requires the use of cypermethrins. Virus vectors such as aphids and thrips must also be controlled by insecticides, and fungicides are needed for *P. infestans*-induced late blight and other leaf diseases caused by *Septoria lycopsersici* and *Altenaria solani*. Coca Morante [9] reported systemic fungicides to be preferred in three seed production areas **(Figure 10)**.

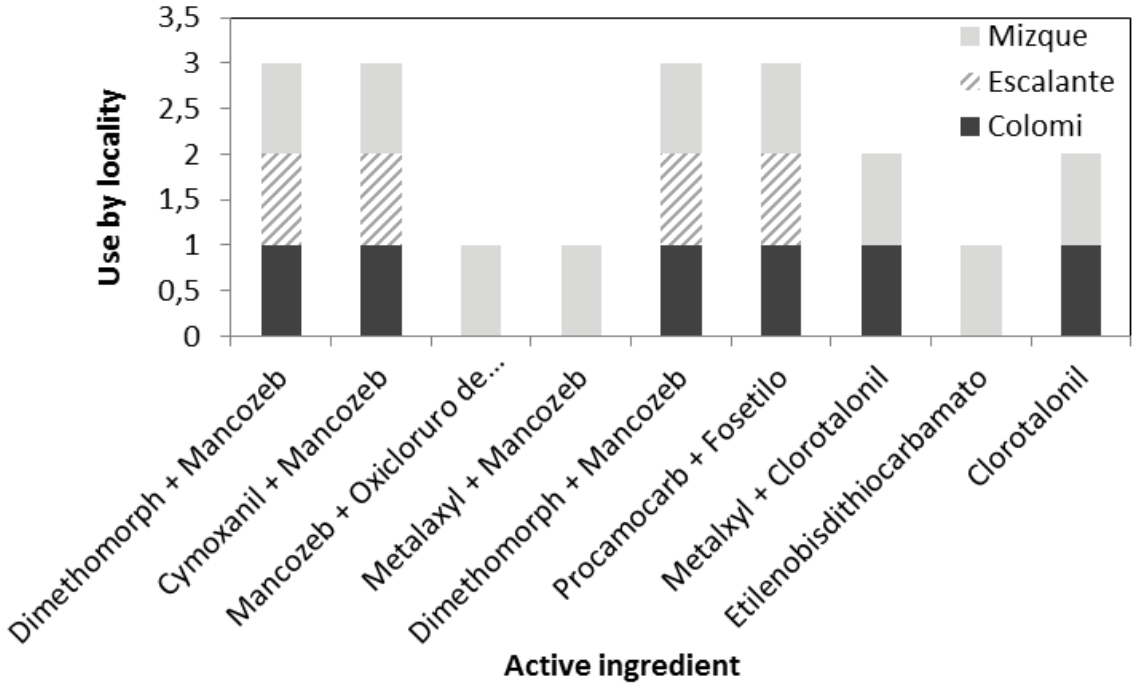

Figure 10. Use of fungicides in areas of production of native potato varieties, and of seed potato production, for controlling late blight control caused by *P. infestans*. Areas of influence: Mizque = Province of Mizque; Escalante = the area of "El Puente" in the Province of Carrasco; Colomi = Province of Chapare.

Seed potato production is attractive to growers in the high Andean region. Quality certified seed potatoes can fetch a price of US $40-60 per 45 kg bag, while non-certified potatoes may fetch only US $20-60 for a bag of 110 kg. There is therefore a strong motivation to switch to seed potato production, and indeed there is space to do so in the traditional High Andes growing area. **Table 1** shows the microcentres of genetic diversity now moving towards seed potato production. Sadly, only two varieties are involved **(Figure 9)**.

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CONCLUSION

In conclusion, the High Andean region of Bolivia lies at the centre of potato domestication and genetic diversity. It is now, however, immersed in a process of transformation. Technological changes in potato production, and especially the shift towards seed potato production, are together causing the loss of native potato varieties - and perhaps the sustainability of potato production in the region.

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