

# Seed Conservation by Family Farmers in the Rural–Urban Fringe Area of La Plata Region, Argentina: The Dynamics of an Ancient Practice

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*Two key components of biocultural diversity are agrobiodiversity and knowledge. There is scarce information regarding seed conservation practices for rural–urban fringe areas, where the Green Revolution model is part of farmers' rationality. The dynamics of such practice can be observed in La Plata's Green Belt (Argentina). Conserved seeds and conservation criteria are recorded, in an area where 71.5% of cultivated (traditional and commercial) agrobiodiversity is conserved. With the introduction of commercial seeds, a process appears in which local wisdom comes into play to adapt to external requirements, which leads to the generation of new knowledge. The relation of this practice with the sustainability of family agroecosystems is analyzed.*

**KEYWORDS** *agrobiodiversity, in situ conservation, traditional knowledge, sustainability, biocultural diversity*

## 1. INTRODUCTION

Agrobiodiversity, as the basis of agroecological systems, serves to promote diverse sociocultural, ecological, technical, economic and political aspects.

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All of these dimensions come together into a new component, biocultural diversity, understood as the diversity of life in all its manifestations—biological, cultural and linguistic—which are inextricably connected to form an adaptive socio-ecological system (Terralingua 2010). Such diversity is one of the keys to sustainability and resilience for agroecosystems, as it strengthens natural processes and ecosystem services through farmers' wisdom. Such resilience should be understood both in social and ecological terms as the capacity to cope with disturbances and reorganization facing change (Berkes and Turner 2006). At the same time, the optimization of this diversity results in an independence from external inputs, mostly agrochemicals, which improves the sustainability of family agroecosystems.

Fundamental components of biocultural diversity are seeds and associated knowledge preserved by farmers, which are part of the ancestral practice of selection, use and conservation of reproductive material, one of the most basic and oldest links between human beings and nature (Kraft et al. 2010). Nowadays, this ancestry can be seen in the diversity of seeds exchanged during the I National Native and Creole Seed Fair (Pochettino et al. 2011), or in the more than 50 varieties of Andean potatoes that are grown in *Quebrada de Humahuaca* in Jujuy, Argentina (Bonicatto et al. 2010). Conservation practices exceed the preservation of seeds with the only purpose of providing genetic material for future sowings, because preserved seeds have been the symbol of personal and national identity, as they are related to food customs and to typical dishes that express origin and traditions, and which are used in traditional practices and celebrations. They are part of farmers' identity and, consequently, they are the expression of people and life (Pochettino et al. 2008). In turn, the pathways or networks where seeds come from play a preponderant role in agroecosystem diversity which is the result of the combined action of natural and cultural selection. Therefore, neither the diversity found in a productive system nor the experimentation process are static, as that process, acting either in a voluntary or involuntary way, generates the loss and acquisition of varieties at the same time (Elias et al. 2000).

Each agricultural practice is oriented and sustained by local knowledge that is unique and specific to each community as it is modified according to adaptive processes and generally transmitted orally and in shared actions (Pochettino and Lema 2008). Agricultural practices associated with seed conservation are part of this knowledge. There are many reports on the permanence of the practice of seed conservation in communities of indigenous people or peasants with a long permanence in the area (Bellon and Risopoulos 2001; Garat et al. 2007; Eyssartier et al. 2011). However, there is little information regarding the dynamics of this practice in rural–urban fringe areas, where different migratory flows—both in terms of time and origin—converge, in addition to the strong presence of the Green Revolution agricultural model as part of the local productive rationality. In this model, seeds

are seen as one more of the external inputs included in the technological package.

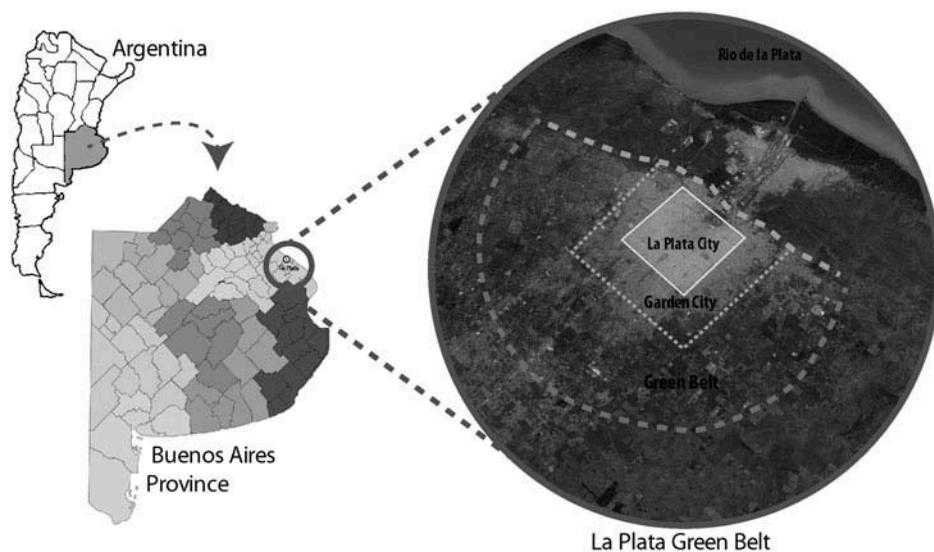
A good example of this situation is the green belt settled in La Plata region in Buenos Aires province, where most horticultural farmers have widely adopted the technological practices of the Green Revolution model. Green belts are places in the rural–urban fringe areas of big cities and they are composed of a network of gardens or farms along with other agroecosystems with commercial characteristics, which are mainly used for the production of greens and seasonal vegetables. From the economic point of view, they supply vegetable food to the city's population and, from an ecological point of view, they are a transitional zone or ecotone between the city and the village where several systems coexist: productive or agroecosystems, consumer ecosystems that are urban agglomerations and, finally, the more and more reduced natural ecosystems (Barsky 2005). These peculiarities confer transitional features to those areas, not only in terms of spatial and productive aspects, but also regarding the possession and transmission of environmental knowledge. Such area, characterized by intensive forms of production, low diversification, hybrid seeds, the use of agrochemicals, and a demanding market in terms of product performance and aesthetics is undergoing certain changes that seriously affect the sustainability of such areas. The loss of genetic diversity is well recognized in territories with strong productive pressures after the adoption of technological packages that include improved seeds (Harlan 1992). This situation increases farmers' vulnerability, as the agroecosystem is weakened by economic dependence. This situation does not allow farmers to reduce risks, to promote diet diversity or maximize income (Harwood 1979). Nevertheless, the idea of a single and one-way relationship between agricultural modernization and loss of diversity has been questioned. According to Amorozo et al. (2008), agricultural traditions are malleable given farmers' capacity to adapt innovations to their own realities.

In this work, it is hypothesized that in spite of the increasing pressure of the prevailing agricultural model tending to seed purchase, family farmers of the rural–urban fringe area of La Plata region keep seed conservation active, adapted to the present context, in a zone facing continuous transformation and uncertainty. The aim of this work is to understand the present status of seed conservation and the chosen selection criteria and its relationship with the sustainability of family agroecosystems.

## 2. METHODS AND SITE OF STUDY

### 2.1. La Plata's Green Belt

One of the most important green belts in Argentina is located in La Plata region, in the northeast of Buenos Aires province (34°54'24"S and



**FIGURE 1** Location map showing the rural–urban fringe area of La Plata region, Argentina.

57°55'56''W) (Figure 1). It is a 5–12 km wide strip and occupies the space between the rural–urban fringe area of the city and the extensive farming environment (Bozzano 2003). The climate is temperate semihumid without a dry season. Annual medium temperature is 16.3°C, the average in January (summer) being 26.3°C and in July (winter) 10.5°C. The average annual rainfall is 1,023 mm.

The model put forward by the Green Revolution was widely adopted and resulted in deep technological transformations, mainly during the 1990s, when the massive adoption of greenhouses became the symbol of technical progress (Selis 2000). These producers can be owners, lessees, and family groups, and their units range from 0.5 to 3 ha.

The farmers in this sector are consistent with the “family farmer” social type characterized by López Castro and Prividera (2011) as farmers whose both household and productive unity is integrated. This means that the workforce used in the exploitation of the land is provided mostly by family members. Their production, which is diversified, goes both to self-consumption and the market and it is currently a pluriactivity, so families perform productive and labor tasks alternatively in or outside their estate. Family farmers represent 66% of the productive units in Argentina, occupying 13.5% of the farming surface (over 23,000,000 ha) (Fornari 2008) and in La Plata’s Green Belt they represent 65.7% of the 738 units that produce vegetables (Dirección Provincial de Estadística 2005). Nowadays, La Plata’s Green Belt shows great heterogeneity regarding the place of origin of farmers, the social organization of the workforce (family or salaried), production styles

(organic, high input agriculture, and in transition to sustainable systems) and levels of technological incorporation (Cieza 2004).

## 2.2. Data Collection

The study used a case-based method (Mitchell 1983; Yacuzzi 2005; Girard et al. 2014), in which we selected a sample of 7 family farms that represent different situations within the heterogeneity of La Plata's Green Belt. Likewise, the agroecosystems were chosen to meet the following criteria: a) to produce both for self-consumption and for the market; b) to have a productive unit in La Plata's Green Belt; and c) to be willing to be interviewed and give their consent to the dissemination of the shared knowledge.

Data was collected in 2010 and 2011, based on semistructured interviews (Albuquerque et al. 2010) along with walking around farm fields. Those in charge of the cultivated area and seed storage were interviewed (7 men and 3 women). During the interviews we addressed the following topics: personal information such as gender, age, and their relationship with horticulture. We inquired about cultivated agrobiodiversity, preserved seeds, their origin, whether purchased, exchanged or received as a gift, local names, and conservation criteria. A sample of each crop or seed was gathered for further botanical identification in the laboratory.

## 2.3. Data Analysis

Each cultivated plant mentioned during the interviews was considered a different sample. They were grouped according to botanical family, scientific name, and the particular local name used by the respondents. For each preserved seed, conservation criteria as well as its origin were analyzed. In order to diagnose the conservation of commercial seeds, the data has been organized taking into account the different ways in which seeds enter the farms. They include seeds coming from the exchange with neighbors or events such as native and creole seed fairs, as well as those inherited, received as a gift, or acquired through official seed distribution programs. All of them constitute instances in which the selection process is developed by farmers. On the other hand, seeds bought in seed stores (either hybrids or varieties) have been grouped, having in mind that the selection process is performed by an enterprise according to the criteria of a productivity model. Each conservation criterion was quantified from the number of citations made by interviewed people. As several seeds are kept for more than a single criterion (pluricausality) or the conservation criteria have not been explicitly stated, the total number of citations is different from the total number of kept seeds. The criteria are based on the information received from the surveyed people, but their labels have been placed by the authors upon recording them.

The commercial criterion was not quantified but described, as it was considered as part of the conservation of all the reproductive material. As this contribution focuses on family agroecosystems settled in rural–urban fringe areas where farmers’ rationality deals with product trade, this criterion was considered as being common to the whole cultivated diversity.

### 3. RESULTS

A total of 179 cultivated species/varieties were recorded. Interviewed people referred to the conservation of 128 of them (71.5%). The remaining 51 samples that were not conserved by farmers corresponded to hybrids that will not maintain their organoleptic features in future generations, or low-cost commercial varieties purchased from seed stores. Ten criteria for seed conservation have been characterized (Table 1).

The list of the conserved species/varieties and their conservation criteria are shown in Table 2. From the botanical point of view, cultivated diversity corresponds to 14 families, and the most represented varieties are

**TABLE 1** Conservation criteria of agrobiodiversity conserved by family farmers of La Plata’s Green Belt (Buenos Aires province, Argentina)

Criteria	Description
Affective	Linked to family history and/or to people for whom the interviewed have feelings. Seeds that have been lost, or that are appreciated because they are kept for a long time.
Morfological	Particular morphology or other organoleptic features (color, smell, taste, roughness). These characteristics may be the result of personal decision making or those imposed by the market.
Productive	They have an important role in the strengthening of ecological services.
Culinary	Being edible plants that are representative of culinary traditions of the origin region of farmers or their ancestors or that are used in family recipes. Often, plants kept by this criterion are cultivated for self-consumption.
Therapeutic/medicinal	Therapeutic or medicinal properties.
Innovative	In reason of the innovative and experimental attitude of farmers, related to their inclination to incorporate rare or even unknown seeds, or seeds they know but are not sowing for them, or just to make essays in conservation. Many of these seeds are obtained though local exchanges or seed fairs.
Based on independence	To be independent of the continuous purchase of them.
Economic	To save the money involved in their purchase. The decision of keeping these seeds is influenced by seed prize in stores.
To promote diversification	To increase diversity in farms.
Commercial	Underlies the previous as the sale of farm products is their main objective of the families according to market rationality.

**TABLE 2** Family, local, and scientific name and conservation criteria of agrobiodiversity conserved by family farmers of La Plata's Green Belt (Buenos Aires province, Argentina) (letter in the first column refers to respondents)

Respondent	Family, local and scientific name	Affective	Morfological	Productive	Culinary	Therapeutic/ medicinal	Innovative	Based on independence	Economic	To promote diversification
<b>Alliaceae</b>										
A	<b>Ajo</b> ( <i>Allium sativum</i> L.)								X	X
A	<b>Cebolla</b> ( <i>Allium cepa</i> L. var. <i>cepa</i> )		X		X					
E	<b>Cebolla</b> ( <i>Allium cepa</i> L. var. <i>cepa</i> )			X				X		
A	<b>Cebolla balanceana</b> ( <i>Allium cepa</i> L. var. <i>cepa</i> )							X		
A	<b>Cebolla blanca balanceana</b> ( <i>Allium cepa</i> L. var. <i>cepa</i> )						X		X	
F	<b>Cebolla colorada</b> ( <i>Allium cepa</i> L. var. <i>cepa</i> )		X							
F	<b>Cebolla de verdeo</b> ( <i>Allium cepa</i> L. var. <i>cepa</i> )									
A	<b>Cebolla de verdeo</b> ( <i>Allium cepa</i> L. var. <i>cepa</i> )									
B	<b>Cebolla de verdeo</b> ( <i>Allium cepa</i> L. var. <i>cepa</i> )	X	X	X	X				X	
D	<b>Cebolla de verdeo</b> ( <i>Allium fistulosum</i> L.)		X	X	X					
A	<b>Cebolla de verdeo morada</b> ( <i>Allium cepa</i> L. var. <i>cepa</i> )		X							
A	<b>Cebolla morada</b> ( <i>Allium cepa</i> L. var. <i>cepa</i> )		X							
B	<b>Cebolla morada</b> ( <i>Allium cepa</i> L. var. <i>cepa</i> )	X	X	X	X				X	
F	<b>Ciboulette</b> ( <i>Allium schoenoprasum</i> L.)									
G	<b>Ciboulette</b> ( <i>Allium schoenoprasum</i> L.)						X			
B	<b>Puerro</b> ( <i>Allium ampeloprasum</i> L.)								X	

(Continued)

TABLE 2 (Continued)

Respondent	Family, local and scientific name	Affective	Morphological	Productive	Culinary	Therapeutic/ medicinal	Innovative	Based on independence	Economic	To promote diversification
F	<b>Puerro francés de Caterá</b> ( <i>Allium ampeloprasum</i> L.)			X						
C	<b>Tare o puerro japonés</b> ( <i>Allium tuberosum</i> ROTTLER ex SPRENG.)						X			
<b>Caricaceae</b>										
A	<b>Mamón</b> ( <i>Carica papaya</i> L.)						X			
<b>Chenopodiaceae</b>										
B	<b>Acelga</b> ( <i>Beta vulgaris</i> L. var. <i>cicla</i> L.)								X	
A	<b>Acelga de palo blanco</b> ( <i>Beta vulgaris</i> L. var. <i>cicla</i> L.)		X					X		
A	<b>Acelga de palo verde/ancha</b> ( <i>Beta vulgaris</i> L. var. <i>cicla</i> L.)							X		
G	<b>Acelga de penca blanca nacional</b> ( <i>Beta vulgaris</i> L. var. <i>cicla</i> L.)		X							X
E	<b>Acelga de penca verde</b> ( <i>Beta vulgaris</i> L. var. <i>cicla</i> L.)						X			
F	<b>Acelga de penca verde</b> ( <i>Beta vulgaris</i> L. var. <i>cicla</i> L.)								X	
G	<b>Acelga de penca verde</b> ( <i>Beta vulgaris</i> L. var. <i>cicla</i> L.)	X	X							
B	<b>Espinaca</b> ( <i>Spinacia oleracea</i> L.)									
B	<b>Remolacha</b> ( <i>Beta vulgaris</i> L. var. <i>vulgaris</i> )									

G	<b>Remolacha</b> ( <i>Beta vulgaris</i> L. var. <i>vulgaris</i> )	X							
<b>Asteraceae</b>									
D	<b>Acicoria</b> ( <i>Cichorium</i> <i>intybus</i> L.)		X	X					X
F	<b>Acicoria</b> ( <i>Cichorium</i> <i>intybus</i> L.)	X	X	X					
D	<b>Alcaucil francés</b> ( <i>Cynara</i> <i>cardunculus</i> L.)		X	X					
E	<b>Alcaucil francés</b> ( <i>Cynara</i> <i>cardunculus</i> L.)		X	X					
D	<b>Alcaucil violeta</b> ( <i>Cynara</i> <i>cardunculus</i> L.)		X	X					
D	<b>Cardela</b> ( <i>Sonchus</i> <i>oleraceus</i> L.)			X					
D	<b>Cardo</b> ( <i>Cynara</i> <i>cardunculus</i> L.)		X	X					
C	<b>Girasol</b> ( <i>Helianthus</i> <i>annuus</i> L.)		X	X					X
A	<b>Lechuga</b> ( <i>Lactuca sativa</i> L.)								X
<b>Convolvulaceae</b>									
A	<b>Batata</b> ( <i>Ipomoea batatas</i> (L.) LAM.)		X	X					
B	<b>Batata</b> ( <i>Ipomoea batatas</i> (L.) LAM.)							X	
<b>Brassicaceae</b>									
A	<b>Brócoli</b> ( <i>Brassica oleracea</i> L. var. <i>italica</i> PLENCK)			X					
D	<b>Brócoli</b> ( <i>Brassica oleracea</i> L. var. <i>italica</i> PLENCK)			X					
G	<b>Brócoli</b> ( <i>Brassica oleracea</i> L. var. <i>italica</i> PLENCK)							X	
D	<b>Grilo</b> ( <i>Brassica napus</i> L.)		X					X	
E	<b>Grilo</b> ( <i>Brassica napus</i> L.)							X	
F	<b>Grilo</b> ( <i>Brassica napus</i> L.)		X					X	
D	<b>Grilo salvaje</b> ( <i>Brassica</i> <i>napus</i> L.)							X	

(Continued)

TABLE 2 (Continued)

Respondent	Family, local and scientific name	Affective	Morphological	Productive	Culinary	Therapeutic/ medicinal	Innovative	Based on independence	Economic	To promote diversification
E	<b>Grilónabo</b> ( <i>Brassica napus</i> L.)						X			
A	<b>Nabiza</b> ( <i>Brassica napus</i> L.)							X		
E	<b>Nabiza</b> ( <i>Brassica napus</i> L.)						X			
F	<b>Nabiza</b> ( <i>Brassica napus</i> L.)									
A	<b>Nabo</b> ( <i>Brassica rapa</i> L. var. <i>rapa</i> )		X							
A	<b>Nabo japonés</b> ( <i>Rapbanus sativus</i> L.)						X			
A	<b>Rúcula</b> ( <i>Eruca vesicaria</i> (L.) CAV.)		X				X		X	
F	<b>Rúcula</b> ( <i>Eruca vesicaria</i> (L.) CAV.)									
<b>Cucurbitaceae</b>										
B	<b>Anco</b> ( <i>Cucurbita pepo</i> L.)									
A	<b>Angolita</b> ( <i>Cucurbita pepo</i> L.)		X				X			
A	<b>Calabaza</b> ( <i>Cucurbita</i> sp.)						X			
E	<b>Calabazas</b> ( <i>Cucurbita</i> sp.)						X			
C	<b>Cayote</b> ( <i>Cucurbita ficifolia</i> Bouché.)						X			X
D	<b>Cucuzá</b> ( <i>Lagenaria siceraria</i> (Mol.) Standl.)	X			X					
A	<b>Mate</b> ( <i>Lagenaria siceraria</i> (Mol.) Standl.)						X			
D	<b>Melón amarillo</b> ( <i>Cucumis melo</i> L.)									
A	<b>Melón</b> ( <i>Cucumis melo</i> L.)									
A	<b>Sandia amarilla</b> ( <i>Citrullus lanatus</i> (THUNB.) MATSUM. et NAKAI)	X	X				X		X	
F	<b>Zapallito</b> ( <i>Cucurbita maxima</i> DUCHESNE subsp. <i>maxima</i> )									

A	<b>Zapallito de tronco</b> ( <i>Cucurbita maxima</i> DUCHESNE subsp. <i>maxima</i> )	X		
G	<b>Zapallito parecido al espejo</b> ( <i>Cucurbita maxima</i> DUCHESNE subsp. <i>maxima</i> )	X		X
D	<b>Zapallito zuchini verde redondo</b> ( <i>Cucurbita pepo</i> L.)	X		
B	<b>Zapallo</b> ( <i>Cucurbita</i> sp.)		X	
C	<b>Zapallo</b> ( <i>Cucurbita</i> sp.)			
F	<b>Zapallo</b> ( <i>Cucurbita</i> sp.)			
A	<b>Zapallo anco</b> ( <i>Cucurbita pepo</i> L.)	X		X
A	<b>Zapallo anco</b> ( <i>Cucurbita pepo</i> L.)			
B	<b>Zapallo anco</b> ( <i>Cucurbita pepo</i> L.)			
E	<b>Zapallo plomo</b> ( <i>Cucurbita maxima</i> DUCHESNE subsp. <i>maxima</i> )	X		
<b>Poaceae</b>				
C	<b>Avena</b> ( <i>Avena sativa</i> L.)	X		
B	<b>Choclo</b> ( <i>Zea mays</i> L.)	X		X
C	<b>Maíz</b> ( <i>Zea mays</i> L.)			
A	<b>Maíz celeste</b> ( <i>Zea mays</i> L.)	X		X
A	<b>Maíz choclo</b> ( <i>Zea mays</i> L.)	X		X
A	<b>Maíz colorado</b> ( <i>Zea mays</i> L.)	X		X
A	<b>Maíz pisingallo</b> ( <i>Zea mays</i> L.)			X
A	<b>Maíz turco</b> ( <i>Zea mays</i> L.)			X
<b>Lamiaceae</b>				
B	<b>Albahaca</b> ( <i>Ocimum basilicum</i> L.)			

(Continued)

TABLE 2 (Continued)

Respondent	Family, local and scientific name	Affective	Morphological	Productive	Culinary	Therapeutic/ medicinal	Innovative	Based on independence	Economic	To promote diversification
F	<b><i>Albahaca</i></b> ( <i>Ocimum basilicum</i> L.)		X							
G	<b><i>Orégano</i></b> ( <i>Origanum vulgare</i> L.)									
<b>Fabaceae</b>										
A	<b><i>Arveja</i></b> ( <i>Pisum sativum</i> L.)						X			
A	<b><i>Chaucha</i></b> ( <i>Phaseolus vulgaris</i> L. var. <i>vulgaris</i> )								X	
B	<b><i>Chaucha</i></b> ( <i>Phaseolus vulgaris</i> L. var. <i>vulgaris</i> )								X	
F	<b><i>Chaucha Cronos</i></b> ( <i>Phaseolus vulgaris</i> L. var. <i>vulgaris</i> )		X						X	
B	<b><i>Chaucha fina</i></b> ( <i>Phaseolus vulgaris</i> L. var. <i>vulgaris</i> )								X	
B	<b><i>Chaucha larga</i></b> ( <i>Phaseolus vulgaris</i> L. var. <i>vulgaris</i> )								X	
A	<b><i>Haba</i></b> ( <i>Vicia faba</i> L.)		X						X	
D	<b><i>Haba</i></b> ( <i>Vicia faba</i> L.)				X					
E	<b><i>Haba</i></b> ( <i>Vicia faba</i> L.)									
C	<b><i>Maní colorado</i></b> ( <i>Arachis bipogaea</i> L.)						X			X
F	<b><i>Poroto lengua de dragón</i></b> ( <i>Phaseolus vulgaris</i> L. var. <i>vulgaris</i> )		X							
<b>Solanaceae</b>										
F	<b><i>Morrón</i></b> ( <i>Capsicum annuum</i> L.)								X	
A	<b><i>Morrón</i></b> ( <i>Capsicum annuum</i> L.)									
F	<b><i>Ají de la mala palabra</i></b> ( <i>Capsicum</i> sp.)	X	X							

F	<b>Aji vinagre tradicional</b> ( <i>Capsicum</i> sp.)	X	X	X	X	X
A	<b>Berenjena</b> ( <i>Solanum melongena</i> L.)				X	X
G	<b>Berenjena</b> ( <i>Solanum melongena</i> L.)		X			X
E	<b>Morrón calaborra</b> ( <i>Capsicum annuum</i> L.)	X				
C	<b>Papa andina</b> ( <i>Solanum tuberosum</i> L. subsp. <i>andigenum</i> (JUZ & BUKASOV) HAWKES)					X
A	<b>Papa pampeana</b> ( <i>Solanum tuberosum</i> L. subsp. <i>tuberosum</i> )				X	X
A	<b>Pimiento calaborra</b> ( <i>Capsicum annuum</i> L.)		X			X
A	<b>Tabaco</b> ( <i>Nicotiana tabacum</i> L.)					
C	<b>Tabaco</b> ( <i>Nicotiana tabacum</i> L.)					
D	<b>Tomate</b> ( <i>Solanum lycopersicum</i> L.)					
A	<b>Tomate 110</b> ( <i>Solanum lycopersicum</i> L.)				X	X
G	<b>Tomate cherry perita</b> ( <i>Solanum lycopersicum</i> L.)		X			
F	<b>Tomate perita</b> ( <i>Solanum lycopersicum</i> L.)			X		X
A	<b>Tomate platense</b> ( <i>Solanum lycopersicum</i> L.)				X	
E	<b>Tomate platense</b> ( <i>Solanum lycopersicum</i> L.)					
G	<b>Tomate platense</b> ( <i>Solanum lycopersicum</i> L.)					X
F	<b>Tomate variedad Col 45</b> ( <i>Solanum lycopersicum</i> L.)					X

(Continued)

TABLE 2 (Continued)

Respondent	Family, local and scientific name	Affective	Morfological	Productive	Culinary	Therapeutic/ medicinal	Innovative	Based on independence	Economic	To promote diversification
<b>Apiaceae</b>										
A	<i>Apio</i> ( <i>Apium graveolens</i> L. var. <i>graveolens</i> )									X
C	<i>Cilantro</i> ( <i>Coriandrum sativum</i> L.)		X							
D	<i>Hinojo</i> ( <i>Foeniculum vulgare</i> MILL.)		X	X						
E	<i>Hinojo bibrido</i> ( <i>Foeniculum vulgare MILL.</i> )			X						
E	<i>Hinojo platense</i> ( <i>Foeniculum vulgare MILL.</i> )		X	X			X			
A	<i>Perejil</i> ( <i>Petroselinum crispum</i> (MILL.) FUSS.)							X		
E	<i>Perejil</i> ( <i>Petroselinum crispum</i> (MILL.) FUSS.)						X			
F	<i>Perejil</i> ( <i>Petroselinum crispum</i> (MILL.) FUSS.)									
<b>Urticaceae</b>										
D	<i>Ortiga</i> ( <i>Urtica urens</i> L.)					X				
<b>Vitaceae</b>										
F	<i>Uva rosada</i> ( <i>Vitis vinifera</i> )						X			

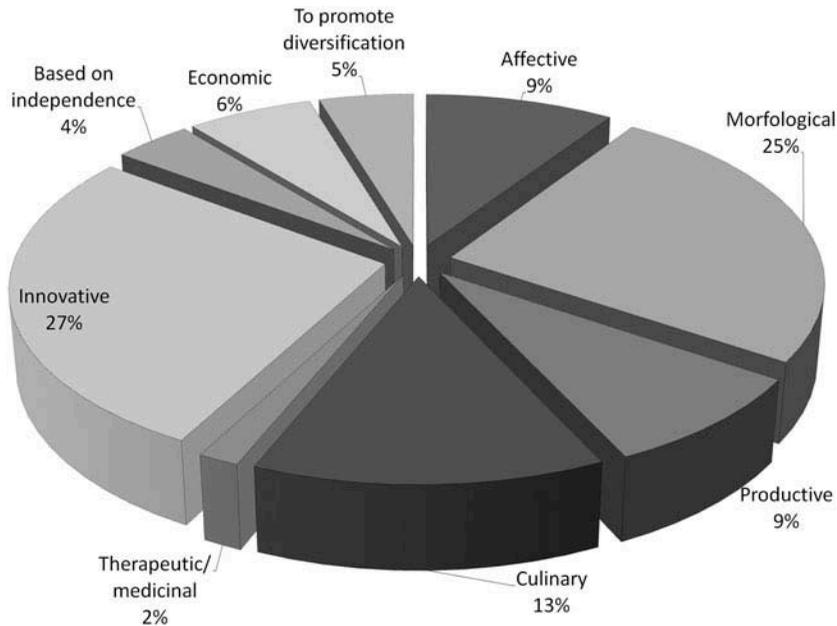
Cucurbitaceae, Solanaceae, and Alliaceae (Table 2). This fact is consistent with local horticultural production, among which several representatives of these botanical families are usually cultivated, such as pumpkins and squashes (*anco*–*Cucurbita moschata* Duch., *zucchini* –*C. pepo* L., *zapallito de tronco* –*C. maxima* Duch. subsp. *maxima*), bell pepper, tomato and eggplant (*Capsicum annuum* L.; *Solanum lycopersicum* L.; *S. melongena* L.), onion and leek (*Allium cepa* L. var. *cepa*; *Allium ampeloprasum* L.), respectively. Another important botanical family is Brassicaceae because of the cultivation of *nabiza*, *grilo*, *grilonabo* that constitute varieties brought by Italian immigrants and have deep roots in local traditions (Ahumada et al. 2011).

Among the total of conserved seeds, there are both local or traditional varieties like *tomate platense* (*Solanum lycopersicum* L.), *hinojo platense* (*Foeniculum vulgare* Mill.), *grilo* (*Brassica napus* L.), *cucuza* (*Lagenaria siceraria* (Mol.) Standl.), as well as commercial varieties that were originally acquired in seed stores and then kept over variable periods of time (from 1 to over 10 years), like *zapallito de tronco* (*Cucurbita maxima* subsp. *maxima*) or *acelga de penca blanca nacional* (*Beta vulgaris* L. var. *cicla* L.). Finally, commercial hybrid seeds are also kept, such as *tomate 110* (*Solanum lycopersicum* L.) or *hinojo híbrido* (*Foeniculum vulgare* Mill.), which are conserved for as long as the desired characteristics last, typically, no longer than 3 years.

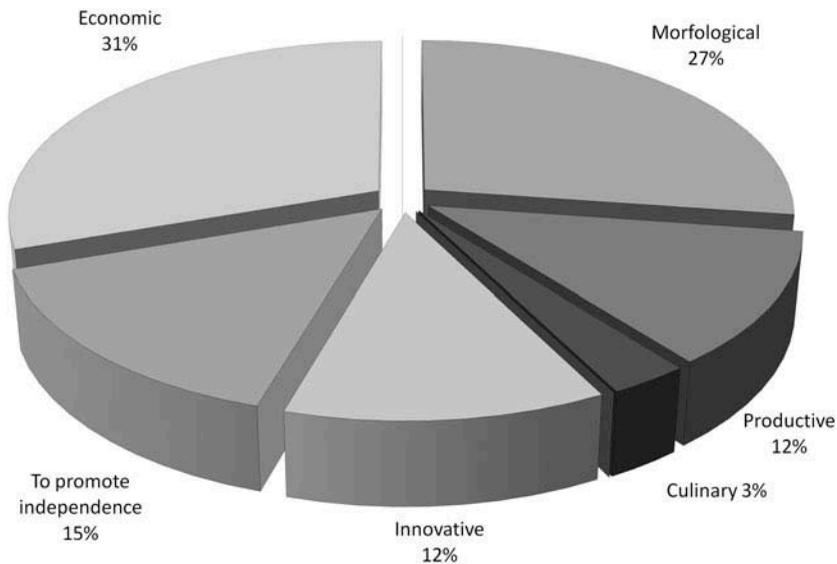
Eighty eight percent of conserved seeds (128) correspond to seeds that have been obtained by means of personal relationships, like exchange, inheritance, gifts, but also to those seeds distributed by means of official programs. Their conservation is supported by nine conservation criteria, (Figure 2), while the remaining 20% are commercial varieties or hybrids related to six conservation criteria (Figure 3).

#### 4. DISCUSSION

One of the biggest challenges we face today is the design and management of sustainable agroecosystems, in particular, for family farmers who lack the necessary means to purchase the supplies that are required by the industrial model. Increasing farming biodiversity seems to be the most suitable strategy given its relationship with a set of ecological functions (Swift et al. 2004) that could reduce the use of external inputs. Vegetal diversity constitutes the basis of general agrobiodiversity and is closely connected with cultivated diversity, which in turn influences spontaneous diversity (Stupino et al. 2008). The preservation of farming practices that are adapted to local features represents the basis of such diversity and it is an essential strategy that is promoted and maintained by family farmers.



**FIGURE 2** Percentage of citations of conservation criteria of the 102 conserved seeds obtained by means of personal relationships or official programs by farmers in La Plata's Green Belt (Buenos Aires, Argentina).



**FIGURE 3** Percentage of citations of conservation criteria of the 26 conserved seeds of commercial origin by farmers in La Plata's Green Belt (Buenos Aires, Argentina).

The data presented here confirms the hypothesis that, in spite of the strong influence of the industrial agricultural model on family agroecosystems from La Plata's Green Belt, the practice of seed conservation is still active. The proportion of conserved seeds and the different ways of access to them show that local farmers are not only keeping traditional or local seeds but they have also made this practice extensive to commercial seeds (both hybrids and varieties).

Instances of gathering/harvesting, drying and saving can be observed. The reasons, seen as the conservation criteria which lead farmers to devote time, work and resources to the conservation of certain seeds, are a part of that "corpus" of knowledge (see [Table 1](#)). Those criteria are dynamic and different for each family group and for each preserved seed and can be linked to organoleptic qualities, commerciality, family relationships, symbolic aspects, and even the origin of the seed. Those criteria represent the reasons for which farmers keep and grow certain plants on their farms, and their existence is an essential part of the social component that keeps this practice active.

The most represented criterion for seeds obtained from personal relationships or official programs, the innovative one, shows farmers' experimenting attitude. They expressed a sound inclination and curiosity toward adding "rare" or unknown varieties to their production ([Figure 2](#)), and also towards experimenting with the conservation of commercial seeds ([Figure 3](#)). This openness to experimentation constitutes a fundamental basis for the construction of knowledge facing the relationship between farmers and nature. The innovative criterion represents the temporal link between the past and the future as stated by Amorozo et al. (2008) and Berkes and Turner (2006). It implies innovating in terms of the conservation of genetic material into the future but based on past knowledge, and traditional wisdom is adjusted to develop the required knowledge to keep the newly incorporated seeds, regardless of their origin. Innovative criteria show, in addition, the will of change and the capacity of resilience of family farmers, in a frame of reaffirmation of their individual ability to recover from disadvantageous situations. Innovative will supports the dynamics of knowledge involved in seed conservation; nevertheless, this practice does not necessarily imply the conservation of genetic material throughout time. Hence, innovative criterion may be unethical as, on the one hand it sets local knowledge in motion, but, on the other hand, it can generate discontinuities in the conservation of reproductive material per se. According to Elias et al. (2000), this criterion brings together the history of agriculture, giving place to the horticultural diversity distinctive of the period.

The results of this research also show that criteria for seed conservation are different depending on seed origin (see [Figures 2 and 3](#)). Those obtained by means of personal relationships or official programs are related to a larger diversity of criteria than those of commercial origin. As stated by Pochettino

et al. (2011), affective, culinary, and therapeutic/medicinal criteria, which have major or exclusive presence in the conservation of the first group, are related to the diversification of plants for household use, to the family day-to-day work involved in meal preparation, health care and maintenance of family history. These criteria usually last longer through time as they act on family memory by means of stories and souvenirs, even when the genetic material required for their fulfilment is absent.

. . . we used to have white cabbage seed that was also homemade, it was sweet as honey! Then, when hybrids were available, white cabbage was no longer accepted in the market; those cabbages were this big (showing the size with his hands), so I stopped sowing it and then I lost the seeds . . . How can I forget! The seedbed should be made on the second moon of November, as our ancestors did—and I remember some things and I do as they said based on the moon. They said: “you have to make this seedbed during that moon . . . this variety on that moon” and so on . . .”

. . . nosotros teníamos semilla de repollo blanco, que era semilla casera también, ¡Era un repollo que era dulce como la miel! Bueno, después cuando salieron los híbridos que son éstos, no lo quisieron más en el mercado a ese repollo blanco, eran unos repollos así (hace seña con las manos refiriéndose al tamaño) y bueno, lo dejé de plantar y perdí la semilla . . . ¡no me olvido nunca! Había que hacer el almácigo la segunda luna de noviembre, porque los viejos de antes y yo de algunas cosas me acuerdo y lo hago, se basaban mucho en la luna, los tipos te decían “vos tenés que hacer tal luna este almácigo . . . esta variedad tal luna” y así . . .

This knowledge, still present in farmers' memory, allows farmers to set in motion and reactivate family wisdom to sow the desired seed in the event of recovering the lost germplasm. On the other hand, conservation of commercial varieties and hybrids is mostly based on economic, morphological and independence criteria. This accounts for the circumstances of rural–urban fringe area agroecosystems, where the need or the interest to grow products according to market requirements coexists with the need to decrease the high productive prices of commercial seeds. These variables, among others, promote an adaptation attitude among farmers, as they are immersed in market rationality. In terms of resilience, these criteria show that farmers adapt traditional conservation practices to conserve commercial varieties and hybrids, and in doing so they can come close to meeting market expectations, while saving the money that seed purchase implies.

Tomato is a hybrid variety; this is the first breeding of the original, its name is “col 45,” and I made experimentations with seed keeping, as it is really expensive: 1,000 seeds cost \$400, and with 1,000 seeds you can sow two rows, no more than that. So, I made the experiment . . . the first

year it grew well, that is this one, but if I leave this one again, it will grow but not so well; it will grow small, distorted. By chance yesterday they brought from the seed store two trays of the original, so I will keep the seed of that because it is original.

El tomate es una variedad híbrida, este es hijo de primera cría, del original, se llama “col 45,” este tomate, y yo hice la prueba en hacer la semilla porque es carísima, vale 400 \$ mil semillas y con mil semillas plantas dos surcos, más no plantas. Entonces yo hice la prueba hacerlo . . . . . el primer año viene bien o sea este, si yo este lo dejo otra vez para semilla ya no viene tan bien, viene igual, pero no viene tan bien, viene chiquito, deformadito, o sea que yo ayer casualmente de la plantinera me trajeron dos bandejas del original, ese hago semilla este año porque es original.

As it can be seen, the decision of investing time, land and effort to keep these varieties and hybrids is mediated, in most cases, by the price of seeds in seed stores (economic criterion). Family farmers use the technological proposals that enable them to fulfill the aesthetic requirements, such as a variety or a hybrid, but they develop conservation practices to maintain certain economic autonomy in these circumstances. However, even when the end use is the market, an appropriation process of commercial seeds takes place, in which the wisdom involved in their selection, reproduction and conservation are local and owned by farmers. Although knowledge is tested with the purpose of adapting to external requirements, they resignify the current reality and generate a new one, through the synthesis between what is local and what is commercial, what is desired and what is required, what is valued and what is demanded. As for permanence over time, it seems that both seeds of commercial origin and local or traditional ones act as the required link to keep this practice active and dynamic.

## 5. CONCLUSIONS

Seed conservation is still active among family farmers from La Plata’s Green Belt and it acts on all those horticultural crops which have the required botanical characteristics. This work has shown that far from being over, this ancient practice is as dynamic as the area of study, and that this dynamism reflects the different strategies that farmers adopt to adjust to the present context, in a territory that faces continuous transformation and uncertainty.

From the sustainability point of view, the diversification of agroecosystems based only on commercial seeds would still leave farmers in a position of economic dependence on external inputs, as those varieties or hybrids are dependent on the technological package that accompanies them, which means that farmers are forced to buy new seeds after one or two

conservation cycles. From the point of view of sustainability, if the only change is the replacement in the provision of the seed (own seeds of commercial origin as opposed to purchased ones), agroecosystems will maintain their vulnerability and low resilience, as this practice does not imply the redesign of agroecosystems into more diverse ones. On the other hand, the use of local/traditional seeds does allow farmers to grow varieties adapted to local conditions and to the needs and pleasure of those that keep them, with low requirements of external inputs. Therefore, the presence of this germplasm on farms constitutes a central axis of resilience and subsistence of family agroecosystems.

These results pose questions as to the following steps of the research, when it is essential to assess the evolution of the cultivated genetic material and associated knowledge in order to diagnose what is incorporated, what is modified and, eventually, cultural erosion.

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