Chapter 14
Natural Landscape of the Pampa Region in Santa Fe Province, Argentina: Environmental Resilience and Opportunity for Changing the Agri-Food Paradigm

Libertario Hugo González, Germán Neffen, Victoria Benedetto, Marta Sánchez Miñarro, Andrea García, Ricardo Biasatti, Pablo Rimoldi, Cristian Alesio, and Daniel Paiz

Abstract The Argentinean humid pampas were once a large grassland biome. Starting when the European colonizers arrived five centuries ago, and lasting until present, the original grassland ecosystems suffered an extreme transformation and have now almost completely disappeared. Today this region is under pressure from an "agriculture without farmers" dependent on external inputs which are increasingly scarce. This has serious social, environmental and economic implications. The

The human being disconnected from nature, conceived it as an object of knowledge, then as an object of domination and finally as a mere commodity. [...] With the advance of modernity, a paradigm of the individual was consolidated whose relationship with the "others" is one of domination and exploitation, a concept of the individual as an uprooted being, with weakened and fragmented collective ties (Gauna Zotter and Rey 2017)

L. H. González (✉) · V. Benedetto · A. García
Experiment Station (EEA) INTA Oliveros, Santa Fe, Argentina
e-mail: gonzalez.libertario@inta.gob.ar

G. Neffen
Agricultural Producer, Pergamino, Buenos Aires, Argentina

M. Sánchez Miñarro
Economist and Director of the School of Social Entrepreneurships, Municipality of Rosario, Santa Fe, Argentina

R. Biasatti
Faculty of Veterinary Sciences, National University of Rosario, Santa Fe, Argentina

P. Rimoldi
Chair of General Zoology, Faculty of Agricultural Sciences, National University of Rosario, Santa Fe, Argentina

C. Alesio · D. Paiz
Chair of Biology and Ecology, Faculty of Veterinary Sciences, National University of Rosario, Santa Fe, Argentina

© The Author(s), under exclusive license to Springer Nature Switzerland AG 2022

F. Montagnini (ed.), *Biodiversity Islands: Strategies for Conservation in Human-Dominated Environments*, Topics in Biodiversity and Conservation 20,
https://doi.org/10.1007/978-3-030-92234-4_14

landscape matrix has been increasingly alternating its seasonal composition between chemical fallows and monocultures of wheat, corn, and soybean. If allowed to continue, this artificialization of ecosystems, dependent on fossil fuels, chemical inputs, and biotechnology, represents a serious threat to present and future social and environmental wellbeing. We have identified surviving land areas that persisted in the increasingly anthropic landscape of this region, constituting patches of biodiversity referred to in this chapter as "islands of resilience." In this chapter, we propose a multidisciplinary approach which utilizes the existing resilience islands in rural areas and in bordering urban zones. We analyze a case study located in the city of Las Rosas (Santa Fe province, Argentina) and the land's current and potential ecological wellbeing. We examined several socioeconomic and agroecological strategies associated with the production of local healthy food supplied to simplified marketing frameworks. These strategies are developed with production-consumption, community, and cooperative practices in mind. In this case study, we are guided by principles of cooperation, mutual support and solidarity, which build the foundation for an eco-social and resilient transition to more widespread biodiversity friendly agricultural landscapes.

Keywords Agri-food system · Agroforestry systems · Biodiversity Islands · Common goods · Landscape ecology · Production models · Sustainability

14.1 Introduction

The term "islands of resilience" arises from empirical observation of the recurrent vegetation that stands out in industrial agriculture's landscape matrix. The tree, shrub and herbaceous composition of these islands is unexpectedly dynamic, making the islands a symbol of resistance to a dominant agricultural production model that transformed natural ecosystems. These islands or patches have varied forms, including circular, ovoid and irregular. They contrast with the extensive degraded checkerboard plains of the humid pampas of southern Santa Fe, Argentina (Fig. 14.1).

In addition to disrupting human-dominated land, resilience islands also reflect the complex structure and functionality of ecosystems that maintain stability, despite external disturbances. Satellite images of these resilience islands can allow observers to develop their own reasoning for the persistence of the patches. But it is in situ, when travelling along provincial and national routes, when one can appreciate their presence and observe the different stages of plant succession in which these relics are found. This chapter provides a detailed description of the history of the landscape and the current state of ecological wellbeing of the islands in order to offer a logical explanation for their persistence.

In this chapter we describe the change over time of the natural landscape matrix of the Argentinean humid pampas. This land transformation is depicted through the key historical events of the southern region of the Santa Fe province, from the original

Fig. 14.1 Island of resilience inserted in the matrix of the dominant landscape. (Photo: Pablo Olive)

Fig. 14.2 Ecosystems recovery capacity in the Pampean region of Santa Fe, Argentina. (Photos: Ricardo Biasatti) (see text for explanation)

predominance of the pastures to the implementation of an extensive system of monocultures. This chapter utilizes research and information on the flora and fauna that are crucial to aiding in the regeneration of resilience islands. In addition, the chapter integrates agroecological proposals based on the experience of the agroecology module of the National Institute of Agricultural Technology (INTA, Oliveros Experiment Station) (Benedetto et al. 2017). These publications and proposals demonstrate the capacity of ecosystems to recover their structural and functional parameters after land degradation due to external pressures (Biasatti et al. 2013, 2016) (Fig. 14.2).

The images in Fig. 14.2 correspond to the physiognomy of the landscape that is the subject of this work. The first image represents the matrix of the landscape that predominates in the region, in which the agro-productive activity has entirely modified the environment. The second image shows a representative example of an island of biodiversity. The third image shows the role of biological corridors (a stream in the area) contributing to landscape connectivity. For our case study, this capacity for recovery or resilience is a starting point for developing a new model of the pampean rurality, including agricultural production areas with greater biodiversity and landscape connectivity.

14.2 Passages from the History of the Santa Fe Pampa Region

14.2.1 The New Configuration of the Landscape Matrix

Our analysis of landscape transformation in the Pampa region included climate change as an influencer of structural change in the landscape matrix, and humans in their role as decision makers on whether to work with nature or oppose it. In the study region, indigenous people used to work with nature. Evidence of mega-fauna grazing activities, dated at circa (ca.) 12,200–10,000 years, proves that the inhabitants of the Pampean zone were hunters (Politis et al. 2014). Their assimilation to the territory and movement in search of food was part of the pre-Hispanic culture before the Spanish conquest of the region.

The year 1492 was a turning point in the history of this hemisphere of the world. America did not appear on any map prior, so the Spanish and Portuguese, as the first European occupants, named the continent and initiated a territorial organization similar to that already existing in Spain and Portugal (Mignolo 2007). The European arrival in the Americas was a crucial event that led to a history of European imperial expansion and developed the existence of a European lifestyle that became prominent in Argentine society. The Americas emerged in the European consciousness as a great expanse of land to be conquered with a people to be evangelized and exploited (Mignolo 2007).

The start of imperialistic expansion into this region led to the first signs of the fragmentation of its pristine landscape. This event initiated the fragmentation seen throughout the history of the Pampa, where the colonizers began to transform the unaltered South American landscape as they had similarly done in their own land in Europe. This fragmentation was due in part to the introduction of new animal species such as cattle and horses by the Spanish upon their arrival, which significantly altered the ecosystems of the pampean grassland biome (Brailovsky 2006).

14.2.2 *Territory Configuration or Landscape Fragmentation?*

In two and a half centuries of colonial hegemony, the independence movement, which started in 1810 in Argentina, grew significantly due to an economic power imbalance between the locals and the colonizers (Donghi 2014). At the beginning of the nineteenth century, a new configuration of the economy and politics was structured around Buenos Aires, Argentina, in the context of an economic junction favorable to the trade of cattle hides. The litoral region (riverine coastal area) which had been exhausted as a supplier of leathers for overseas markets, was replaced by the Buenos Aires markets, which profited as the cattle industry rapidly expanded, providing an opportunity for territorial expansion (Donghi 2000).

As the wealth and power of Buenos Aires increased, its political decision makers planned and executed military campaigns of extermination and subjugation of the native inhabitants, with the aim of expanding the border that was under their control. The result of these campaigns was an immense increase of available land, which the Argentine government publicly offered in “emphyteusis”. This system consists of a contract for the use of the land in exchange for taxing the production. This implies the temporary cession of the land, but use of this land ultimately became perpetual, requiring very low tax payments (Donghi 2000).

However, these newly acquired lands were only granted to landowners of the lands of old colonization, political and military leaders of the provinces, and holders of urban mercantile wealth. None of the lands’ original inhabitants were given parcels. These elite groups formed the social nucleus of the landowning class (Donghi 2000). In this way, the system of latifundia (mega-landowners) was consolidated, resulting in the fragmentation of the landscape matrix, as proprietors implemented barriers such as fences to contain the cattle and to delimit private property.

14.2.3 *Benefit or Penalty? Geopolitics of Sacrifice*

At the end of the nineteenth century, the Argentine government, led by President Nicolás Avellaneda, continued its military campaigns, taking the lands of the aborigines to be exploited. However, as the Argentine government expanded its control over land in the region, the available territory to be conquered diminished. Finally, on October 5, 1878, Law 947 was passed in order to obtain funds for the “Conquest of the Desert” to further expand the territory under Argentine control (Del Corro 2003). Avellaneda affirmed that the elimination of Native American populations in the frontiers was meant to allow Argentine people to “populate the desert.” He defined settling as the replacement of the original inhabitants who were not linked to the national and international markets by others who were. Avellaneda further explained: “to govern is to populate, and to populate is to change nomads for sedentary salaried workers to develop a new livestock production model” (Brailovsky and Foguelman 2009).

Under the impetus of a sustained British demand for foods and raw materials, the leading sectors oriented the use of natural resources to meet global market demands (Brailovsky and Foguelman 2009). Thus, between 1860 and 1930 Argentina entered the global market as a producer of meat, wool and cereals. Argentina’s growing involvement in international markets led the country to be considered “the granary of the world” (Brailovsky and Foguelman 2009). The same president, two years before Law 947 was passed, passed law N° 817, which regulated immigration and colonization, helping to provide the region with a labor force and further grow Argentina’s economy (Sili and Soumoulou 2011).

As a consequence, at the beginning of the twentieth century, the Argentine agricultural sector had been separated into two distinct facets. One was the ranchers who owned the land, most of them dedicated to cattle raising. The other was small and medium-sized farmers who produced cereals and lived in the colonies, either using their own land or renting out plots in the large ranches (Sili and Soumoulou 2011).

14.2.4 History of Agriculture in the Santa Fe Pampa

The history of agriculture in the Santa Fe province of Argentina is strongly tied to the history of the work of immigrant families and their descendants (Cloquell et al. 2007). These actors played a leading role in the transformation of the landscape, which is evident in their productive activities and in the increase in population over time. Over almost 40 years, the proportion of immigrants grew from 10% of the total population in 1858 to 42% in 1895 (Cloquell et al. 2007).

While older production methods did contribute to the fragmentation of the landscape matrix, they were not as harmful as subsequent production methods utilized at the end of the 20th and beginning of the twenty-first century. In contrast, the first settlers’ belief toward nature was that they not only “lived in a territory,” but they “lived from the territory” they inhabited. This ideology explains why these original landowners did not decimate their habitat through their productive actions because of their care for the environment.

14.2.4.1 Argentina as “The Granary of the World”

The expansion of Argentina’s borders, the introduction of machinery, and massive immigration caused exportation of cereals and flax to increase, allowing Argentina to prosper greatly and become known as “the granary of the world” (Volkind 2009). Unlike the United States or Canada, Argentina’s agricultural policy did not encourage small and medium independent producers, but rather aimed at incorporating the land into the national agricultural economy by creating incentives for owners to put it into production (Bidaseca and Lapegna 2006). This resulted in an asymmetric relationship between the producer, who leases land, and the owner, who signs short-term leases and has the flexibility to frequently increase rental fees (Cloquell et al. 2007). However, producers held the belief that they were lessees only temporarily, as one must first lease the property before eventually owning it. Their goal was to transition from being a part of the labor force to being owner-producers, thereby transitioning their immigrant status (Cloquell et al. 2007).

It is important to note that some contemporaries of the time, such as the geographer and naturalist Kropotkin, in his 1892 book "The Conquest of Bread," warned of what was happening in that region of the world. He explained that as the productivity of land increases, the workers' profits do not increase to the same degree as the profits of the landowners and the government. This inequity results from an increase in taxes towards the farmers as their production rises (Kropotkin 1977).

This era could have been a time in Argentina's history for equitable redistribution of land among farmers, in consonance with the social struggles that were taking place, in which the access, use, and occupation of the land for production and habitation were disputed. However, in the framework of the international economic crisis of 1930, a mass migration of farmers occurred from the countryside to the city due to their financial fragility and dependence on international prices, resulting in the concentration of land into the hands of few (Cloquell et al. 2007).

Towards 1940, a new government policy enabled productive units under lease to be bought by the tenant producer, either by benefits of credit policies, or by tacit agreements due to the situation (Cloquell et al. 2007). Despite the struggle for control of this land, the Pampean landscape was still relatively untamed up to this point in time. However, the land was subsequently quickly transformed and fragmentated. The islands of resilience, which are the subject of this chapter, are surviving relics of this process, and they are exemplified by our case study, the farm located in Las Rosas, home to the Fontana family, in the south of the Santa Fe province.

These trends of transformation and fragmentation continued to the end of the 1950s, when the national political and economic situation changed abruptly. This societal change was brought about by an international context that, concluding the post-war reconstruction stage, sought to reduce the role of the government in the national economy and to promote the liberation of economic relations (Cloquell et al. 2007). Along with this change, new strategic scientific and technological advances were promoted. Agricultural production was given strong incentives to fulfill its traditional role as a provider of foreign exchange to the national economy. These incentives launched a new phase of capital accumulation that furthered Argentina's role in the international market (Cloquell et al. 2007).

14.2.4.2 The "Modernization" of the Agricultural Sector

Around 1960, the region experienced increases in production and productivity based on the application of the industrial-based technological model. This began the process of "modernization," which led the agriculture sector to maximize the process of capital accumulation, with different impacts on the social actors of the agriculture industry (Cloquell et al. 2007).

In our case study island of resilience in Las Rosas, the recollections of a family member, Angel Fontana, serve to illustrate this transition. As Angel explains, in his farm they used to share equipment with neighbors, using herbicides and planting non-hybrid seeds. Later on, due to the challenges of harvesting crops in the 1970s, in addition to the impacts of weeds, insects, and other pests, they incorporated dairy farming to have a more regular income. Over time, they began to rely more on additional contract workers and rental equipment to face increasing challenges.

As Angel relates, "In those days, in some farms they worked the land with horses, but not in ours where there was already a small tractor, which we shared with other family members so that they could work on their own fields. In the early days, some seed was selected at the time of harvest for replanting, but little by little the commercial hybrid seed gained ground. Herbicides were there as long as I can remember, but the fertilizers arrived much later. Being almost a teenager, we started with my father a small dairy farm to get a monthly income that made it possible for us not to wait until the agricultural harvest. Milk delivery was not a problem, since the creameries sent the truck to the house. This experience was from 1970 to 1980, when I saw different crops grow, potatoes, watermelons, melons and fruit trees. Over time it was impossible to fight off weeds, insects and other pests. In the sixties, someone used to pass by with a vehicle to get eggs, milk, and chickens and offered in exchange sugar, and oil in smaller quantities because we used pork fat (the product of periodic meatings). Then I saw the incorporation of wheat, corn and soybean planting. The soil was broken and planting was implemented with the use of zero-tillage or direct sowing. Through the years everything changed. From having our own tools we moved on to the work done by a contractor and rental that continues to this day" (Angel Fontana, personal communication).

This first-person experience provides evidence of the gradual incorporation of new agricultural technologies, collectively known as "the green revolution". The integration of these technologies was promoted by government agencies, facilitating the advancement of private companies into the region. This integration of new inputs and technologies, which was more prevalent in crops than in cattle raising, began in the second half of the 1950s, grew in the 1970s and 1980s, and was accentuated in the 1990s (Pizarro 2003).

With the start of the green revolution, new agricultural practices began to be utilized across the landscape matrix in order to increase profits. Among these new practices, the increasingly common use of monocultures and limited productive diversification led to a destructive occupation of the land. In fact, other qualities of the land, such as its social or cultural benefits, were disregarded as productive value became the dominant productive focus. In this mindset for the use of the territory, land was considered socially disposable, simply designating it as "sacrifice areas" for the sake of progress (Svampa and Viale 2014).

Agribusiness, and especially transgenic soybeans (*Glycine max*), is currently the core of Argentina' s extractive matrix. Currently, the country is among the four main world producers of transgenic soybeans with almost 24 million hectares cultivated. Since the end of the 1990s, when the use of transgenic soy was approved, the expansion of agribusiness was tied to the use of genetically-modified organisms (GMOs), which led to a global restructuring of the traditional agrarian ways (Svampa and Viale 2020).

This new agricultural model spread not only in the Pampas region, but also in marginal areas, such as in the northern and coastal regions of Argentina. Today it occupies 23 to 33 million hectares of land, of which 90% is dedicated to soybeans. The great concentration of transgenics and agrochemicals across this soybean-dominated land presents dangers to the country due to prolonged exposure to these chemicals (Svampa and Viale 2020). The massive scale of this exposure within the territory and on the bodies of people constitutes a true model of "bad-development" similar to the Chernobyl case, which illustrates the dangers and their disregard by governments and economic actors involved (Svampa and Viale 2020).

14.2.5 Resilience of the Santa Fe Pampean Ecosystem

Throughout the history of the Pampa plains of the Santa Fe province, there have been significant changes to the landscape, the results of which will still play out over years to come. The era in which human actions on their environment started to dominate the landscape led to the designation of the time of the Anthropocene (Herrero 2017). During this era, the Pampean grassland biome was transformed into an agroecosystem in which the economic-financial goals were prioritized. This prioritization disregarded the multiple dimensions that must be addressed for a productive system that is sustainable over time and that allows humans to monitor their actions on the environment and its natural commons such as water, soil, air, and biodiversity.

Our case study shows that the establishment of resilient systems in the Pampean grasslands, with the aim of restoring biotic communities congruent with the original landscape physiognomy, has already been observed in the region. While we were performing our work for this chapter, some restrictions on land use were established. This allowed for the development of plant secondary succession that in relatively short periods of time (2 to 4 years) has shown the system's capacity to recover spontaneous biodiversity, increase soil coverage, and allow a successive occupation of the space with progressive substitution of species (Biasatti et al. 2013, 2016).

Other observations of these resilience islands have revealed their potential for developing new specific ecological niches and a variety of new habitats or micro-habitats according to local soil, hydrological and even climatic variations (Biasatti et al. 2013, 2016). This evidence of the land's persistence encourages us to assess the viability of this land for the development of agroecologically-based production practices. These new practices would help strengthen food sovereignty and security, improving human welfare and benefitting other forms of life in the context of the dominant agricultural matrix. In addition, this proposal could be extrapolated to other regions of the country and to other parts of the world which are withstanding similar ecological conditions.

The next sections of the chapter offer a characterization of the islands of resilience, focusing on their flora and fauna, and arguing for their integration into the landscape matrix. We propose to apply agroecological principles to crop management around the islands, and we relate experiences of local markets using agroecological production. The path we choose, among the different paths that intersect in human development, can undoubtedly determine the future of our species for centuries to come (Bookchin 2019).

14.3 The Islands of Resilience and their Context in South Santa Fe

14.3.1 Recovering Areas with Real Potential for Hosting Biodiversity

In this section, islands of resilience are defined from the perspective of landscape ecology as "patches", as they are areas with greater biodiversity than the surrounding anthropic matrix, which is dominated by an extensive homogenized and simplified territory associated with the agro-industrial production model or system of soy cultivation (Forman and Grodon 1986, Biasatti et al. 2007). These patches can take many forms, such as the one described in this chapter, as well as marginal lands, floodable lands, and lands with limitations for agriculture.

Our case study provides evidence of the depopulation of rural areas due to the development of soybean production methods over the last decades. As previously explained, in the Argentinean Humid Pampas, farming originally consisted of mixed production, with the producer's family living in the countryside and producing a variety of goods and foods. The arrival of soybean cultivation introduced a new model of production with less reliance on people, which led to the migration of the rural settler and the abandonment of their homes and surroundings. This new model of agricultural production, which heavily relied on the soybean, replaced diverse cropping systems and became dominant.

These abandoned settlements were largely left untouched, which allowed for the development of plant secondary succession, sheltered by the infrastructure that had been left behind and its generally wooded surroundings. The abandoned areas contained exotic species such as fruit trees and others that would provide shade, shelter from the winds and some wood products, such as firewood for cooking and heating.

Not all of these abandoned relics have been preserved. However, it is still common to observe these "patches" in the pampas landscape of monoculture, where nature reveals its biotic potential. This shows the capacity of resilience of the Pampean grasslands to recolonize these relics through successive occupation of space with spontaneous species, starting with pioneers and then moving into stages of greater forest maturity.

The province of Santa Fe has several examples that show the resilience of the Pampean grasslands. Government strategies have created several biological corridors, rescuing relics of the original ecosystems. These have quickly shown their effectiveness for restoration, not only of plant species, but also of animals, including birds and mammals of medium and large size. These species also can take advantage of corridors to move around the landscape and establish themselves in recovered spaces.

The conservation model that utilizes these strategies is based on the configuration of a "reticulated system for the conservation of biological diversity" through the implementation of biological corridors around lotic water bodies (rivers and streams) or communication routes, roads, and railways (Cracco and Guerrero 2004, Biasatti et al. 2013). The implementation of this proposal was carried out by preventing human intervention in the areas of study and through the monitoring and management of spontaneous secondary succession. In none of the case studies was secondary succession induced by the planting of species or the transfer of animals to increase biological richness. Instead, succession was self-generated by the favorable conditions created by protective barriers. Corridors also aided in ecological succession by connecting previously isolated relics which developed into existing patches, or "islands of resilience."

Due to the large-scale agricultural use of the humid Pampa, human intervention has led to a significant transformation, including the creation of "resiliency islands" in an agricultural landscape. Human domination in this region has reached levels that exceed 95% of the available land used for productive purposes or for urban areas. The large scale of human occupancy has transformed the landscape into a new anthropic and homogeneous matrix. Contrary to other regions, the strategy necessary to conserve biodiversity and restore land in the humid pampas requires the fragmentation of the anthropized matrix. This phenomenon was studied and developed under the concept of "inverse fragmentation," within the framework of a strategy aimed at establishing mechanisms compatible with the joint practices of production and conservation (Biasatti et al. 2019).

"Resiliency islands" are key elements of this strategy because they help recover spaces with real potential to host biodiversity. Many animal species typical of the Pampean grasslands, such as the Pampean fox (*Lycalopex gymnocercus*), the wild cat (*Leopardus geoffroyi*), or the coipo (*Myocastor coypus*) are threatened because they do not cross cultivated environments. However, the presence of natural vegetation corridors allows these species to reach these biodiversity patches, aiding in

Fig. 14.3 The island of resilience studied and its immediate environment, highlighting the contrast in the configuration of the landscape of the region. (Google image)

species longevity (Rimoldi and Chimento 2018, Biasatti et al. 2019). Plant species can also thrive in these areas, moving from one habitat patch to another as they are carried by wind or animals that move seeds or propagules (eggs, larvae, vegetatively reproducing plant parts) through corridors. This dispersal mode has the additional advantage of enriching the corridors. Biological corridors facilitate the movement of native species even in landscapes that are severely hostile due to their high degree of homogenization and habitat simplification generated by the expansion of the agricultural frontier.

Since the aesthetic or ethical appeal for protection alone may not suffice, the conservation of "resiliency islands" requires the application of sustainable productive practices. In addition to providing potential productive benefits, these islands contribute to economic development by maintaining species and their genetics, aiding in species diversification and promoting variability in an otherwise uniform landscape (Biasatti et al. 2016, Biasatti et al. 2017).

The previously mentioned model of a "reticulated system for the conservation of biological diversity" constitutes a strategy that relies on islands of resilience integrated into a network of connectivity devices designed as biological corridors. This relationship between patches and corridors creates a system capable of strengthening both the dispersion and the colonization of spontaneous species in a highly anthropized productive region that invests material and energy in maintaining broad spaces with minimal biodiversity (i.e. crops). "Resiliency islands," by their definition, are isolated from other biodiversity, as can be seen in Fig. 14.3. However,

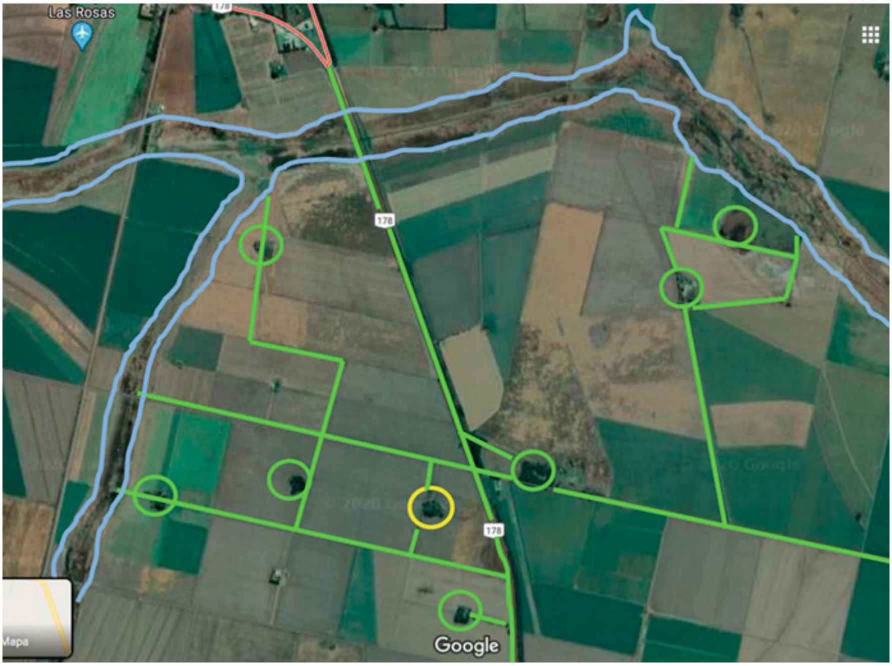

Fig. 14.4 The island of resilience and its potential links to strengthen a system that increases connectivity, allows the transfer of spontaneous species, and promotes biodiversity and coexistence with alternative production systems. (Satellite image, Google Earth font)

these patches can be part of a large, interconnected web of islands that utilize corridors (Fig. 14.4). This network constitutes a viable and effective alternative for establishing a new system of production that allows for the conservation of regional biodiversity. From the spatial unit of the island of resilience that is the subject of this chapter (see Fig. 14.1) it is possible to extend the scope by zooming out to a regional scale in which the sum of other islands linked by biological corridors constitutes a viable and effective alternative for establishing new models of production and conservation, as can be seen in Fig. 14.3.

14.3.2 Case Study in the Center-South of the Province of Santa Fe

Our case study is an island of resilience that covers an area of approximately one hectare, located in the south-central province of Santa Fe (32°31′06″S 61°33′26″W), near the town of Las Rosas and a few meters from National Route No. 178 (Fig. 14.5). With regards to purely anthropic structures, there is a mill and

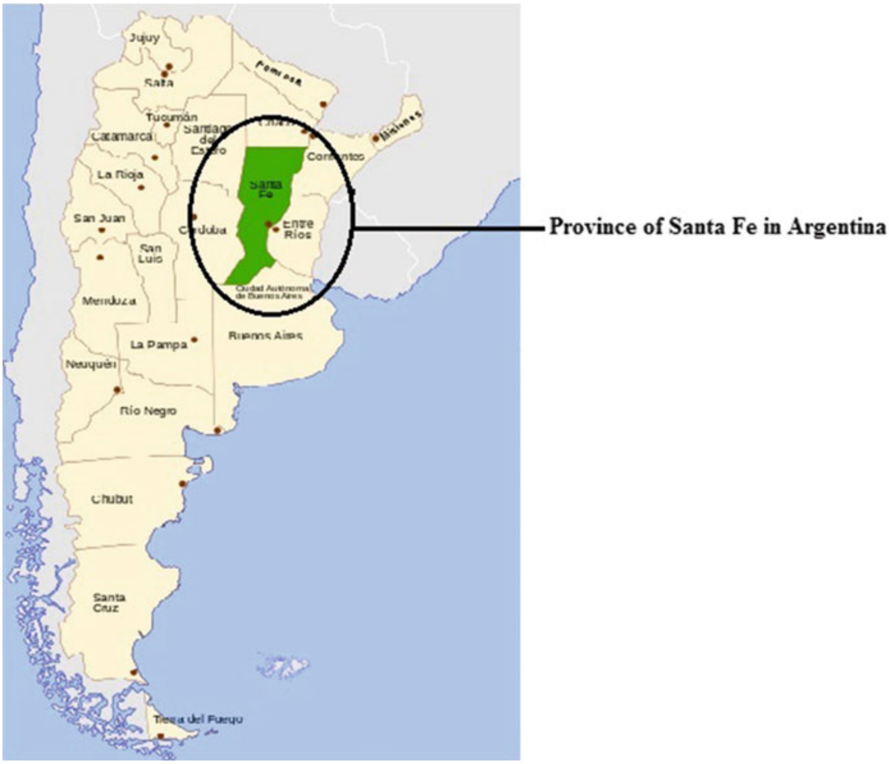

Fig. 14.5 Province of Santa Fe in Argentina. (Google Image)

a small "tapera" (abandoned rural housing), which can potentially be used as a refuge by the local fauna.

This area of study corresponds to the "humid pampas" or "pampas grasslands" biome which is in a transition to an "espinal" (thorny scrub) biome. The region has a temperate climate of marked seasonality, average temperatures between 17–18 °C, an annual rainfall close to 1000 mm, and soils with a low slope and a well-developed A horizon. The land in this area has good quality and productive potential, which has led to its transformation for agricultural purposes.

In the studied island of resilience, the dominant tree species is the paper mulberry (*Broussonetia papyrifera*). Other less abundant species include eucalyptus (*Eucalyptus* sp.), paradise tree (*Melia azedarach*), evergreen (*Ligustrun* sp.), three-thorned acacia (*Gleditsia triacanthos*), olive tree (*Olea europaea*), peach tree (*Prunus persica*), fig tree (*Ficus carica*), *Cereus* sp., ceibo (*Erythrina crista-galli*), ombú (*Phytolacca dioica*), and palo borracho (*Chorisia* sp.). At one edge of the island there is a small group (about $20m^2$) of canes (*Arundo donax*). Young individuals of cina cina (*Parkinsonia aculeata*) and carob tree (*Prosopis* sp.) were planted to enrich the patch with native species and fruit trees like apple trees (*Malus domestica*) for their food production (Table 14.1). Below the tree canopy and in areas without tree cover, communities of herbaceous species cover the soil.

Table 14.1 Plant species recorded in island of resiliency in Las Rosas, Santa Fe, Argentina

Family	Scientific name	Origin/ Observations
Amaranthaceae	*Amaranthus hybridus* L. *ssp. Hybridus*	Native/ Direct observation
Apiaceae	*Bowlesia incana* Ruiz &Pav.	Native/ Direct observation
Asteraceae	*Ambrosia cumanensis* Kunth	Exotic/ Direct observation
	Artemisia absinthium L.	Exotic/ Direct observation
	Carduus acanthoides L.	Exotic/ Direct observation
	Carduus nutans L.	Exotic/ Direct observation
	Conyza bonariensis (L.) Cronquist *var. bonariensis*	Native/ Direct observation
	Cynara scolymus L.	Exotic/ Direct observation
	Helianthus tuberosus L.	Exotic/ Direct observation
	Sonchus oleraceus L.	Exotic/ Direct observation
Boraginaceae	*Borago officinalis* L.	Exotic/ Direct observation
Brassicaceae	*Raphanus sativus* L.	Exotic/ Direct observation
Cactaceae	*Cereus argentinensis* Britton & Rose	Native/ Direct observation
Commelinaceae	*Commelina erecta* L.	Native/ Direct observation
Cannaceae	*Canna indica* L.	Native/ Direct observation
Convolvulaceae	*Ipomoea grandifolia* (Dammer) O´Donell	Native/ Direct observation
Euphorbiaceae	*Euphorbia peplus* L.	Exotic/ Direct observation
Fabaceae	*Parkinsonia aculeata* L.	Native/ Direct observation
	Erythrina crista-galli L. *var. crista-galli*	Native/ Direct observation
	Prosopis alba Griseb. *var. alba*	Native/ Direct observation
	Gleditsia triacanthos L.	Exotic/ Direct observation
Malvaceae	*Sida rhombifolia* L.	Native/ Direct observation
	Ceiba speciosa (A. St.-Hil.) Ravenna	Native/ Direct observation

(continued)

Table 14.1 (continued)

Family	Scientific name	Origin/ Observations
Meliaceae	*Melia azedarach* L.	Exotic/ Direct observation
Moraceae	*Broussonetia papyrifera* (L.) Vent.	Exotic/ Direct observation
	Morus alba L.	Exotic/ Direct observation
	Ficus carica L.	Exotic/ Direct observation
Oleaceae	*Olea europapaea* L	Exotic/ Direct observation
Phytolaccaceae	*Phytolacca dioica* L.	Native/ Direct observation
Poaceae	*Bromus catharticus* Vahl *var. Catharticus*	Native/ Direct observation
	Sorghum halepense (L.) Pers. *var. Halepensé*	Exotic/ Direct observation
	Cynodon dactylon (L.) Pers. *var. Dactylon*	Exotic/ Direct observation
	Nassella neesiana (Trin. &Rupr.) Barkworth	Native/ Direct observation
	Arundo donax L.	Exotic/ Direct observation
Rosaceae	*Malus domestica* Borkh.	Exotic/ Direct observation
	Prunus persica (L.) Batsch *var. Pérsica*	Exotic/ Direct observation
Rhamnaceae	*Hovenia dulcis* Thunb.	Exotic/ Direct observation
Solanaceae	*Salpichroa origanifolia* Baill.	Native/ Direct observation
	Cestrum parqui L'Hér.	Native/ Direct observation
Urticaceae	*Parietaria debilis* G. Forst.	Exotic/ Direct observation
	Urtica urens L.	Exotic/ Direct observation
Verbenaceae	*Aloysia citrodora* Palau	Native/ Direct observation
	Aloysia polystachya (Griseb.) Moldenke	Native/ Direct observation
Vitaceae	*Vitis vinifera* L.	Exotic/ Direct observation

Biological corridors in this area that help increase connectivity are relatively simple yet successful interventions to promote the growth of spontaneous communities while also creating small refuge areas. These corridors often use plot edges or rural roads to create the naturally interconnected network described above without affecting the surrounding agricultural fields (Fig. 14.2; Biasatti et al. 2013).

The location of the island of study is within a larger system of similar islands connected through potential biological corridors, which allows for each patch to remain connected. This network provides an opportunity to study the relationship between landscape ecology, agroforestry systems, and agroecology models with scientific and epistemological support. The study of the intersection of these disciplinary fields provides valuable information that can be integrated into conservation strategies. This research adds to the already rich and diverse knowledge that those disciplinary fields supply, which serves to provide recommendations for combined systems that integrate trees, shrubs, and wild plants with crops and domestic animals. This intersection lays the foundation for local food security and food sovereignty (Montagnini et al. 2015).

14.4 The Role of Islands of Resilience in Wildlife Conservation

Loss of animal species diversity is a critical problem in both community ecology and conservation biology (Moreno et al. 2011). Its study has gained greater relevance globally in recent years as the issue has worsened due to human activities (Moreno et al. 2011).

As previously explained, the agricultural production model in this region of Argentina has had severe effects on biodiversity. The model of maximizing agricultural profits has led to a significant decrease in wellbeing of the natural environment and a change in the structure and functioning of the local ecosystem. Anthropic actions have had a clear effect on species' populations, wildlife in particular, affecting the abundance and range of species (Dirzo et al. 2014). Wildlife species have different levels of sensitivity to human alterations, depending on their space requirements, feeding needs, and reaction to anthropization (e.g., Fox and Fox 2000, Smith et al. 2000, Poiani et al. 2001, Abba et al. 2007).

The effect of anthropization on fauna is a multidimensional phenomenon, the study of which requires a multidisciplinary approach to best understand the dynamics and structure of species and predict their maintenance in modified environments. One important contributor to the perseverance of species in a rapidly anthropizing region is the presence of resiliency islands. These relics have the potential to serve as ecological sanctuaries and thus provide the minimum resources necessary to meet the biological needs of wildlife.

Table 14.2 Animal species (mammals) recorded in island of resiliency in Las Rosas, Santa Fe, Argentina

Common name	Scientific name	Origin/ Observations
Comadreja overa	*Didelphisal biventris*	Native/ Indirect records
Peludo	*Chaetophractus villosus*	Native/ Indirect records
Zorro	*Lycalopex gimnocercus*	Native/ Indirect records
Gato montés	*Leopardus geoffroyi*	Native/ Indirect records
Zorrino	*Conepatus chinga*	Native/ Indirect records
Hurón menor	*Galictis cuja*	Native/ Indirect records
Ratón del pastizal	*Akodon azarae*	Native/ Indirect records
Colilargo chico	*Oligoryzomys flavescens*	Native/ Indirect records
Laucha manchada	*Calomys laucha*	Native/ Indirect records
Laucha bimaculada	*Calomys musculinus*	Native/ Indirect records
Cuis	*Cavia aperea*	Native/ Indirect records

14.4.1 Measuring Biodiversity in Resiliency Islands

In order to measure the diversity of terrestrial vertebrates, indirect records such as footprints or caves/burrows left by the transit of some mammals were utilized. The methodology used was the delineation and examination of linear transects in search of signs of wildlife activity. These observations were made at an average speed of 500 m/hour, which allowed the observer to carefully examine the area of study. The field work was carried out between late winter and early spring.

Due to the presence of caves/burrows, we can say that several of the observed mammals can be considered "engineers" of the ecosystems because they influence the availability of resources for other species through changes in the state of the biotic or abiotic materials used to build their shelters (Jones et al. 1994). Although the concept of "ecological engineers" has been refuted because of its possible application to all organisms, it is useful as a reference for studying biotic interactions caused by changes to a habitat (Jones and Gutiérrez 2007). Excavating mammals, for example, modify their environment by creating entrances and conduits in the ground that cause changes related to the soil formation processes and increase the availability of shelter for other vertebrate species (Jones et al. 2006). Particularly in highly anthropized ecosystems, caves or burrows represent a valuable resource as a refuge to avoid predators and mitigate worsening environmental conditions. It is common to observe the reuse of a cave over time by individuals of the same or different species (Roldan and Saurthier 2016). The species that occupy these caves can save time and energy intended for building their own shelter or protecting themselves. For example, foxes take refuge mainly in caves and holes of different types and sizes that may belong to hairy armadillos (*Chaetophractus villosus*) or skunks (*Conepatus chinga*).

Utilizing these shelters as well as other footprints and signs, observations were made of a total of 11 species of mammals belonging to 8 families (Didelphidae, Dasypodidae, Canidae, Felidae, Mephitidae, Mustelidae, Cricetidae and Caviidae) and 4 orders (Didelphimorphia, Cingulata, Carnivora and Rodentia). These observed mammals include the following: 1 marsupial species, 1 xenarthran (an exclusively American placental mammal in a clade that include anteaters, armadillos, and sloths), 4 carnivores, and 5 rodents (Table 14.2). For amphibians and reptiles, no samples were taken during the period of observation, but tracks have shown the presence of the overo lizard (*Tupinambis merianae*).

Regarding birds, the records obtained allowed us to determine the presence of 39 species, which included 9 orders and 18 families (Table 14.3). This field work was carried out between late winter and early spring and focused on pre-established transects. Each transect had a fixed-radius of 10 meters and was 20 meters high, separated from each other by a distance of 25 meters. Intervals for counting specimens were 15 minutes long. Counts were made in the morning, starting 20 minutes after sunrise and up to no more than 4 hours after sunrise. The results allowed us to determine that the largest number of individuals observed belong to the order Passeriformes, which contributed 22 species, followed by the order Falconiformes and Columbiformes, with 4 species.

Bird nests also played an important role in the evaluation of species richness. The construction of nests for reproduction, hibernation and/or rest is a very common activity in birds. Bird nests are a large determining factor in the reproductive success of the nesters because of the role nests play in sexual selection, protection against potential predators, and maintenance of suitable temperature and pH level, which prevents the proliferation of pathogens. Due to the importance of nests in bird survival, the presence of nests in the study area led us to conclude that the existing resources satisfy the previously mentioned needs, which are nearly nonexistent in the surrounding matrix.

The existence of these small green patches in a dominant matrix that is highly disturbed by anthropic activity provides an opportunity for the recovery of favorable environmental conditions for the conservation of biodiversity. However, in order to enhance conservation, it is fundamental to establish the basis for future monitoring of the species involved in this study. Tracking species interactions within the ecosystem is crucial in evaluating the importance of the resiliency island in animals' feeding and breeding habits and therefore assessing the ecological importance of the islands in the region.

Table 14.3 Animal species (Birds) recorded in island of resiliency in Las Rosas, Santa Fe, Argentina

Common name	Scientfic name	Origin/ Observations
Paloma Doméstica	*Columba livia*	Exotic/ Direct Observation
Paloma Manchada	*Patagioenas maculosa*	Native/Directly Observed
Paloma Picazuro	*Patagioenas picazuro*	Native/Directly Observed
Torcaza Común	*Zenaida auriculata*	Native/Directly Observed
Pirincho	*Guira guira*	Native/Directly Observed
Chiflón	*Syrigmasi bilatrix*	Native/Directly Observed
Picaflor Verde	*Chlorostilbon lucidus*	Native/Directly Observed
Tero común	*Vanellus chilensis*	Native/Directly Observed
Milano Blanco	*Elanus leucurus*	Native/Directly Observed
Taguató Común	*Rupornis magnirostris*	Native/Directly Observed
Carpintero real Común	*Colaptes melanolaimus*	Native/Directly Observed
Carpintero Campestre	*Colaptes campestroides*	Native/Directly Observed
Carancho	*Caracara plancus*	Native/Directly Observed
Chimango	*Phalcoboenus chimango*	Native/Directly Observed
Halconcito Colorado	*Falco sparverius*	Native/Directly Observed
Halcón Plomizo	*Falco femoralis*	Native/Directly Observed
Cotorra	*Myiopsitta monachus*	Native/Directly Observed
Hornero	*Furnarius rufus*	Native/Directly Observed
Piojito Gris	*Serpophaga nigricans*	Native/Directly Observed
Benteveo Común	*Pitangus sulphuratus*	Native/Directly Observed
Suiriri Real	*Tyrannus melancholicus*	Native/Directly Observed
Churrinche	*Pyrocephalus rubinus*	Native/Directly Observed
Monjita Coronada	*Xolmis coronatus*	Native/Directly Observed
Monjita Cabeza Negra	*Microspingus melanoleucus*	Native/Directly Observed
Tijereta	*Tyrannus savana*	Native/Directly Observed
Golondrina Barranquera	*Pygochelidon cyanoleuca*	Native/Directly Observed
Tacuarita Azul	*Polioptila dumicola*	Native/Directly Observed
Ratona Común	*Troglodytes aedon*	Native/Directly Observed
Calandria Grande	*Mimus saturninus*	Native/Directly Observed
Calandria Real	*Mimus triurus*	Native/Directly Observed
Gorrión Común	*Passer domesticus*	Exotic/ Direct observation
Cachilo Ceja Amarilla	*Ammodramus humeralis*	Native/Directly Observed
Chingolo	*Zonotrichia capensis*	Native/Directly Observed
Tordo Pico Corto	*Molothrus rufoaxillaris*	Native/Directly Observed
Tordo Renegrido	*Molothrus bonariensis*	Native/Directly Observed
Tordo Músico	*Agelaioides badius*	Native/Directly Observed
Corbatita Común	*Sporophila caerulescens*	Native/Directly Observed
Jilguero Dorado	*Sicalis flaveola*	Native/Directly Observed
Misto	*Sicalis luteola*	Native/Directly Observed

14.5 Proposals for Promoting Alternative Agro-Food Systems

14.5.1 An Agroecological Approach for Rethinking Food Production from Islands of Resilience

Landscape ecology conceptualizes landscapes as complex, adaptive systems composed of ecological and social processes interacting at different levels (Zacagnini 2014). There are many other fields of study that consider the potential interaction between ecological systems and agricultural practices. Agroecology is one such field that focuses on agricultural systems and the role ecological processes can and should have in productive models (Levin 2022). Due to agroecology's focus on production and conservation, it is possible to address the socioeconomic, cultural, ecological, and ethical complexity of food, fiber, and energy production, as well as processing systems, by providing a set of principles for planning local food systems (Wezel et al. 2009). Therefore, agroecology serves as an alternative to current production models that would transform the way we produce and consume food into a more sustainable practice (Nyéléni Boletin 2013, Levin 2022).

Permaculture, regenerative agriculture, agroforestry, biodynamics, and natural agriculture are models with a strong ecological component in their conceptualizations. These practices integrate agricultural needs of local communities with sustainable farming practices to better protect local ecosystems. Therefore, these various models of sustainable agriculture can be classified as agroecological strategies. With regards to the pampean grasslands, it is appropriate, and potentially beneficial, to use these agricultural practices that provide diversity and require engagement from producers, as opposed to current mechanized agricultural practices. In order to protect biodiversity, it is necessary to promote productive processes that incorporate landscape ecology and agroecology practices to maintain production while benefitting the local ecosystems.

Developing a new productive system that utilizes the islands of resilience and local ecology requires an understanding of the biological interactions in the ecosystems. For example, the design must consider effects on the soil, nutrient recycling, biodiversity, and the optimal use of energy. Permaculture practices provide efficient energy use by locating and designing landscape elements according to their capacity of use. Areas that are visited daily or with greater frequency are located near homes or other central components of a landscape, while less-visited sites are located farther away, thereby minimizing energy spent in transit and protecting more productive areas from unintentional impacts. This design is related to the multifunctionality of the ecosystem and the complementary relationships between its components. Another key design point is the promotion of secondary ecological succession to reestablish areas of greater biodiversity, whether spontaneous or induced, in accordance with the local soil characteristics (Fig. 14.6).

Fig. 14.6 This diagram represents a reticulated system to contribute to the conservation of biological diversity, in order to integrate it with the productive systems. (Satellite image intervened by architect Mercedes Machado)

With regards to the reticulated system for biodiversity conservation, spaces between corridors can be illustrated in diagrams linking multifunctional components of systems. These designs can integrate permaculture design components, laid out in concentric rings or strips that relate to the various production systems (Biassatti et al. 2013, 2017). These productive systems can include vegetables, legumes, cereals, fruit trees, pastures with animal integration or agroforestry systems.

Moving towards sustainable food production through agroecological principles requires several simultaneous transitions at different scales and in different contexts, such as social, biological, economic, cultural, institutional and/or political (Tittonell 2019). Appropriate agroecological practices differ according to initial site conditions due to differing needs and associated conservation strategies (Marasas 2012). Through careful design and planning, we can use these "islands," that could be considered "abandoned," as central elements of ecosystem conservation practices, achieving desired goals for the ecosystem. Many of these transformations are already occurring as young people and adults are organizing in pursuit of a healthier environment, a better quality of life for their children, and a harmonious relationship with nature.

14.5.2 Promotion of Productive Practices in the Islands of Resilience

Management of islands of resilience should promote biodiversity with emphasis on soil improvement, using the famous “living soil” approach developed by agronomist Ana Primavesi in “Ecological Soil Management” (Primavesi and Molina 1984). Agroecological approaches are described elsewhere in this book, such as the chapter “Regenerative Agricultural Systems as Biodiversity Islands” (Levin 2022).

Here, we propose land management tactics that can sustainably benefit production outside the “islands,” improving soil health and biodiversity management. This will serve as a guide that can be useful for planning sustainable productive systems.

14.5.2.1 Soil Management

Soil is a living system, and its characteristics are properties that emerge from the networks of interacting parts, not explainable by any single component (Restrepo et al. 2000). The physical, chemical and biological properties of a soil are interdependent and generate favorable bio-structural and nutrient conditions, as well as biological interactions that support the health of plants and the food chain.

Many agro-industrial production systems are unable to store stable carbon in the soil due to bare soil, the lack of sufficient photosynthetic capacity of planted crops, and/or the use of synthetic fertilizers or other chemicals which inhibit plant-soil microorganism associations. The soil must be treated as a living organism and covered with actively growing plants which provide root exudates and organic substances that are critical to the cycling of nutrients and surface organic matter, processes which are necessary for maintaining healthy soil and therefore increasing the wellbeing of the ecosystem as a whole (Jones 2008).

Successful soil management balances the inputs and outputs of organic matter by keeping the soil covered as well as maintaining living roots within the soil to promote the normal functions of living soil without the use of chemical inputs (Benedetto et al. 2019). Rotating crops that add nutrients and improve soil functioning also add structure.

The incorporation of cover crops (CC), plants covering the soil for the purpose of its protection and improvement rather than to be harvested, is one of the most commonly adopted practices of soil conservation. CC contribute significant amounts of organic matter to the soil, increasing the soil’s microbial life. In addition, CC can reduce soil and nutrient losses due to surface runoff (Capurro 2018). However, the soil may still be threatened by mechanical disruption from the harvest of products or by water use by plants.

An optimal CC mixture depends on the sequence in which crops are to be planted, and on the landowner’s objectives. CC compositions can be modified to address specific crop needs or other soil constraints. For example, if the previous crop is a legume, the CC could be a mixture of grasses. If the soil is compacted, we can add species with deep tap roots that make channels and break up the dense soil layers. Several species that can help loosen soil include wild turnip (*Brassica rapa* L.), fodder cabbage (*Brassica napus* x *B. oleracea* cv Interval), cow's tongue (*Rumex crispus*), and chicory (*Cichorium intybus*). In some cases, a light grazing of grass species can be integrated, contributing manure, biological pest control, and also aiding in weed control.

14.5.2.2 Cropping Systems

Several techniques can improve cropping systems, including intercropping, strip cropping, and multistrata cropping. Each has its own benefits to production and conservation. In addition to improving productive capabilities of crops, implementing a sequence of diverse crops generates favorable environments for insect populations, increasing biological interactions among different components of biodiversity, which further promotes key ecological functions and processes.

14.5.2.3 Promotion of Biodiversity

The promotion of biodiversity contributes to the health of the agro-ecosystem. The different strategies for protecting the ecosystem contribute to preserving and increasing predatory and parasitic insects, conserving healthy levels of pest species, including birds, as well as micro and mesofauna. The presence of multistrata borders, hedges and patches of plants in landscape design establishes refuge zones for insects, as well as barriers to threatening anthropized areas.

Biodiversity corridors, integrating species from the Umbelliferae, Brassicaceae (Cruciferaceae), Asteraceae (Compositaceae) and Fabaceae (Leguminosae) families can be established to attract pollinators and other beneficial insects, further increasing biodiversity.

14.5.3 Key Factors for Achieving Ecosystem Recovery

Land tenure is a key factor to consider in the design of productive agro-ecosystems. With guaranteed tenure, the producer is able to sustainably plan for long-term ecological recovery, utilizing long-lived, regionally appropriate species. Public policies linked to the promotion, support, strengthening and financing of agroecological food production are also necessary. Producers decide to make changes to their production strategy depending on many factors such as their presence on the farm, personal observations, and farmers' connection to changes in the local environment. They also often work towards their goals of becoming independent of external inputs, demonstrating opinions on appropriate uses of agriculture technologies, which often contrast with predominant trends.

Understanding nature and ecological principles should guide us in the design and management of agroecosystems, discarding a priori designed formulas or one-dimensional responses. The complexity of the relationships and interactions within the environment and between species, including humans, should be the foundation for planning agroecological models of food production. This growing emphasis on relationships in nature is reflected in the many and varied experiences that are described in the following section.

14.6 Integrating Ecology and Economy in the Region

In most societies around the world, the dominant economic system has relied on a similar method of anthropic transformation of natural landscapes, which has increased significantly in scale over the last three centuries. This reliance on anthropization has had serious negative impacts on the environment, which has perverted the original objectives of the economy as an agent of transforming nature to satisfy human needs. This system becomes further distorted by the fact that human society is a subordinate system to the environment, which provides all of its shelter and resources. In fact, the biased and erroneous hierarchization of the economy over the environment compromises the sustainability of current and future societies. As the Romanian economist Georgescu-Rogen states, "the only characteristic that differentiates humanity from all other species... is that we are the only species that in its evolution has violated biological limits" (Georgescu-Roegen 1977).

Therefore, it is crucial to incorporate bioeconomic practices into the current economic systems, integrating economic activities into natural ecological contexts (Passet 1996). The bioeconomic practices have been developed by "ecological economists" such as José Manuel Naredo (2015) or Joan Martínez Alier (2005). The original definition of the Greek term "economy" ("oikos" = home or household, "nemein" = management and dispensation) refers to the practice of managing resources, materials, and natural goods for the support and welfare of the family home (Aristotle, Politics, Book I, Chap. III) (Aristóteles 2005). This definition illustrates the fundamentals of the economy in which humans and society depend on nature and its resources for survival and social reproduction. Humans are therefore responsible for designing an "instituted process of interaction between them and their natural environment, in order to provide themselves with material means to satisfy their needs," (Polanyi 1976). Therefore, the "primary objective of economic activity is the conservation of the human species" (Georgescu-Roegen 1971). However, the human species will fail to be conserved if the natural environment, in which human life originates, develops and endures, is destroyed.

Historically, several communities used a balanced logic of exchange with the natural environment that included principles such as reciprocity, redistribution and exchange. Today, many economies consider these practices, which were harmoniously and wisely linked to the surrounding environment, primitive (Polanyi 2011).

Over time, the center of the economy in most societies around the world has shifted to the market and capital, which are both increasingly financialized and speculative, further neglecting the importance of the environment.

However, in many countries around the world, and in Argentina in particular, despite threats to the environment posed by profit-focused economies, family agroecosystems that produce healthy food continue to exist. They allow us to reconnect with the original empirical and substantive sense of the economy. Present mainly in increasingly environmentally threatened rural and peri-urban areas, they become small resilient strongholds in areas where an economy linked to the extractive model dominates, which seriously compromises the health of the environment, people and local economies.

These local economic systems linked to family agroecosystems are centered on people and sustainable productive work. They link production, transformation, distribution and consumption in order to meet the needs of community members while still considering the wellbeing of the ecosystem. In this sense, they involve "forms of production and reproduction of their material conditions of existence, based on a balanced metabolism with nature" (Toledo and González de Molina 2007). In these family agroecosystems, the household unit is integrated to the production process, forming a nucleus of social management of the agroecosystem (Petersen et al. 2017). The creation of this nucleus is the foundation for implementing diversified economies, integrating diverse and complementary activities linked to the possibilities and limitations of the territory and maintaining a reduced economic and productive scale, since the primary purpose of the system is the continuation of the family economic unit.

Our proposal is to recover and promote these economic and agroecological experiences with local communities, mainly in the humid pampa region of Santa Fe, Argentina. This would require the use of the interstitial spaces provided by the "islands of resilience" and the peri-urban ranges or strips of the cities. The proposal also urges for the economy to be restructured to incorporate ecologically-mindful practices, and particularly, agroecology.

Locally based agro-food systems are also a key important aspect of this new proposed economic system, and further demonstrate the need to redesign local economic systems for the purposes of increasing healthy food production for the community. By shifting control of the economy and of the various components of the agroecosystem to actors of the local community, agro-food systems would be given more consideration because of the numerous benefits they provide to community members. This will further aid in the proposal to integrate "resiliency islands" and the larger ecosystem into the economy in order to increase wellbeing of both the community and local biodiversity.

14.6.1 The Potential of Local Food Systems

The current global food system is unsustainable from an economic, social and environmental perspective. It is based on the concentration of the food supply into the hands of a small number of actors who decide what we eat, where we acquire that food, and what prices we pay. They also have the ability to introduce increasingly unhealthy, non-nutritional, and processed food, which may travel long distances, unleashing serious social and environmental impacts. These are the "mileage foods" described by the organization Friends of the Earth (www.foe.org) in their 2012 article called "Mileage foods: CO_2 emissions from food imports into Spain". In addition to challenges with food supply and demand, the global trend of urbanization, a large-scale societal transition from periods of progressive expansion and growth to the unsustainable mega-cities, threatens food supply, generates waste, and promotes high levels of energy and materials use. Therefore, it is vital for economies to be centered more regionally, relocating food production and consumption to the local level, within the framework of a true eco-social transition.

In many areas in the Santa Fe Pampa, the local demand for food could be supplied by the diversified production of healthy and fresh food coming from the region itself. This goal could only be achieved if the conditions were enabled for the local economy to be adequately strengthened and enhanced. However, in most rural areas of the region, there is currently a dependence on food from distant places, which negatively affects regional food security. Local communities are losing autonomy and capacity to influence their own food production and consumption models as they rely more on global food production and a food culture that is increasingly homogeneous, and less healthy and diverse.

Therefore, we need to recover and energize fair, healthy, sustainable and sovereign food production systems. This transformation must occur at the local level, revitalizing towns, villages and rural areas, identifying, characterizing, and enhancing local "islands of resilience," while supporting local, agroecology-based food systems.

14.6.2 Examples of Local Food Strategies in the Province of Santa Fe, Argentina

In economic systems focused on food production, potential exists for varied and creative initiatives that link primary production, product transformation or value addition, distribution, marketing and consumption. For instance, in the Province of Santa Fe, a digital platform is currently being used which was implemented in Rosario, called EcoAlimentate, the purpose of which is "connecting producers and consumers." The platform maps existing farms in Argentina that sell directly to consumers, providing their location, reviews and contact information (https://ecoalimentate.org.ar/). This increases transparency and connection between local people and producers.

One such farm is “El Hornerito,” an agroecological farm that has both educational and productive goals and is managed cooperatively by a group of farmers in the town of Totoras, in the south-central part of the province of Santa Fe (www.facebook.com.granjaelhornerito). This project carries out primary production (milk, eggs, garden vegetables, chickens, corn, etc.) and value addition of products (cheese, jams, etc.) with an agroecological approach. In addition, the farm sells its products directly to the local community through unique marketing strategies, such as the sale of pre-ordered baskets of seasonal vegetables.

Another example located in the southcentral region of the province is “El Manso” farm, a business operated by a family of five (Granja El Manso). This farm is a small-scale operation, raising chickens and laying hens outdoors, fed with a balanced diet of chickpeas, corn and ground peas. The operation also utilizes organic compost, created from pruning waste and other organic residues from the farm and surrounding areas. In addition, the family’s income is diversified and supplemented by vegetables grown in its garden, consumed on site. Some of these products are commercialized in the farm’s store “Las 3 Ecologías” in the center of the city of Rosario (1551 Julio Cortázar street).

The “Common Land” project (http://www.suelocomun.com/), which originated in 2012 in the town of Lucio V. López, 44 km northwest of Rosario and 132 km from Santa Fe, the provincial capital, produces a variety of foods without agrochemicals. It is a self-management and cooperative project developed to produce, add value to, and market healthy foods (vegetables, seedlings, honey, etc.) grown with an agroecological approach. In addition to the original products, some agroecological producers involved with this project in the “green belt” of Rosario (or peri-urban belt in “agroecological transition”) also have diversified their commercial offerings. This project enables customers in Rosario to place orders in advance, which are then delivered on a weekly basis. This allows producers to gradually engage local consumers, as well as better plan and organize their production and offerings of healthy food. Producers are also able to better engage with their consumers and tell the stories of their sustainable methods of production and their benefits to local ecologies and economies. The project recently has grown to have a fixed sales location, its own concessionary station in the food area of the promenade known as “Mercado del Patio” (https://www.mercadodelpatio.gob.ar/), a large store strategically located in front of the bus terminal in Rosario.

Popular, traditional food fairs (markets), which originated in the northeast region of Argentina, can also be utilized to promote a local foods movement. In these rural fairs, local producers can directly connect with their consumers, generating bonds of trust and transparency in the construction of prices and traceability of their food. In urban areas of the region (such as the cities of Rosario or Santa Fe), there are also “consumer groups,” in which neighbors or consumers are organized, driving the supply of local agroecological producers who are typically linked through periodic weekly or biweekly commitments of healthy consumer baskets.

Other more complex forms of engaging production and consumption locally are consumer cooperatives or producer and consumer cooperatives (called “prosumers”). In prosumer cooperatives some of the consumers are also local producers themselves and are committed members of the social organization that constructs the system supply, distribution logistics and demand. There are also some worker cooperatives that operate as distributors and marketers of agroecological products, such as Pronoar (https://pronoar.wordpress.com/), or In lak' ech Almacen Natural (In lak' ech Natural Store, 1967 Brown Street, in Rosario).

It is increasingly imperative that governments play an active role in promoting sustainable food policies. Municipalities must engage with groups of producers and consumers, aid in the direct transportation and purchase of products from local producers for school lunchrooms or vulnerable social groups. In addition, local authorities should generate institutional and regulatory mechanisms that guarantee the safety of foods and improve their marketing. They should support agroecological production which guarantees socio-environmental health. An example of this is found in the Municipality of Bellavista, province of Corrientes, which has passed a law recognizing the "agroecological label," derived from the participatory guarantee system – or SPG – carried out by the organized network of public and private actors and the local community itself.

Other examples of creative and innovative mechanisms for supporting local foods systems can be found in Europe. In Spain, for example, the government allows for the establishment of "hubs" that concentrate the logistics and distribution of healthy food, eliminating unnecessary and/or speculative intermediaries and building fair prices. In Catalonia (Spain), the design and implementation of agroecological food banks offers a healthy food supply as an alternative to conventional "food banks," which involve large distributors of industrialized food with low nutritional value.

Finally, "cooperative supermarkets," in several places in the United States and Europe, also offer a valuable alternative to traditional food markets. They are self-managing and involve participation of consumers, with their focus being the provision of ecological food to urban consumers. The institutional precedent is the "Park Slope Food Coop," in Brooklyn (https://www.foodcoop.com/), which presents a model that has been exported and adapted to countries like France or Spain (cooperative supermarket "La Louve" in Paris and "La Osa," in Madrid, https://cooplalouve.fr/ and https://laosa.coop/, respectively). These coops are alternatives to traditional capitalist supermarkets, helping organic producers and promoting healthy food consumption.

14.6.3 Towards Regionalized Food Systems

All these projects show socio-productive and economic strategies that facilitate the production and consumption of healthy and agroecological foods (primary and/or with added value) at the local level. Furthermore, these are locally based food systems in which there are few intermediaries or speculative actors, directly (or nearly directly) linking producers and consumers, allowing for the building of trust and transparency between both.

Current global food supply chains sustain their dynamics with a few concentrated agro-industrial actors (often large globalized economic groups) and multiple intermediaries, inserting high quantities of processed, expensive foods with low nutritional value into markets. In contrast, the models proposed in this section are based on regional food systems with an agroecological approach, rooted in community. Food systems benefit the local and regional economies by boosting socio-productive conditions, improving the social structure, and recovering local food culture. They also provide multiple environmental and social benefits to the region and local communities.

14.7 Conclusions

This chapter condenses the history of the Pampean grassland biome, where a series of significant political, economic and social events led to the fragmentation of the landscape matrix, homogenizing and simplifying the natural ecosystems. As in other regions of the planet, in this part of the world, the domination and subjugation of nature prevailed historically, considered as a repository of resources at the service of an economy based on accumulation, growth and unlimited consumption. In contrast, in this chapter we propose a strategy of balanced integration between human communities and ecosystems, in order to embark on another path that will gradually reverse the degradation of natural resources and make it possible to sustain life in a broad sense for present and future generations.

The identification of "islands of resilience" in the landscape matrix surrounding industrial agriculture represents an interesting discovery of enclaves where flora and fauna are able to retreat, protect themselves and reproduce. For example, in the case study that we discussed, 23 families of tree, shrub and herbaceous plants, 11 species of mammals and 39 species of birds were observed, as well as the presence of burrows and nests. All of these are indicators of ecological success.

Moreover, islands of resilience can contribute to strengthening the economy and endogenous development of local communities. Thus, the sustainable management of local agroecosystems leads to the development of territorialized food systems that link the production of healthy food with local consumption. The "islands of resilience" and the peri-urban fringes of our cities are potential interconnected "nodes" of production, transformation, organization and distribution of healthy food to the surrounding communities. Our research showed a wide range of creative strategies based on local economic circuits. These strategies include practices and actors such as prosumers, consumer cooperatives, local food fairs or small local family-owned farms. In all of them, producers, consumers, local government, social organizations and other relevant local actors link, agree and collaborate to build regional, endogenous and healthy food systems, while forging new socioeconomic and community links.

We cannot ignore the fact that human beings today are faced with extraordinary problems that are radically different from anything they have faced before in human history. They must ask themselves whether organized human society can survive in a recognizable form. And the answer cannot be delayed (Chomsky 2020). No matter how much this society is disguised as green or how many speeches there are about the need for an ecological perspective: the way society actually functions cannot be transformed unless it undergoes a deep structural transformation, namely by replacing competition with cooperation, and the pursuit of economic profit with relationships based on mutual solidarity and concern (Bookchin 2019).

References

Abba AM, Cassini MH, Vizcaíno SF (2007) Effects of land use on the distribution of three species of armadillos (Mammalia, Dasypodidae) in the pampas, Argentina. J Mammal 88:502–507

Aristóteles (2005) Política, Libro I, Capítulo III. Ediciones Istmo (Colección Fundamentos; Serie Clásicos del pensamiento político), Madrid

Benedetto V, Gamundi JC, Timoni R, Cardozo F, Longo AD, Guglielmone P, Aradas Díaz ME (2017) Experimental module of agroecological transition. Magazine to Improve Production N ° 56. INTA Oliveros, Santa Fe, Argentina

Benedetto V, Aradas Díaz M E, Cardozo FV, Longo AD, Timoni RE (2019) Experience of extensive Agroecological production with integral and multidimensional approach in INTA EEA Oliveros, Santa Fe. Book of abstracts, 1st Argentine Congress of Agroecology. National University of Cuyo. Mendoza, Argentina. ISBN 978-987-575-210-8

Biasatti NR, Bedetti F, Colomar G, Di Nucci D, Marc LB, Romano MC, Spiaggi EP (2007) El impacto de la actividad agropecuaria sobre la conservación de la biodiversidad en la pampa húmeda. Rev. UNR/AMBIENTAL N°7, Comité Universitario de Política Ambiental, SECyT (UNR), Rosario, Argentina, 203p. ISBN 950-817-116-2

Biasatti NR, Avogradini F, Rapalino M (2013) Gridded system for biodiversity conservation in the province of Santa Fe, Argentina. Mag Argentine Assoc Landscape Ecol 4(2):181–189

Biasatti NR, Rozzatti JC, Fandiño B, Pautaso A, Mosso, E, Marteleur G, Algañaraz N, Giraudo A, Chiarulli C, Romano M, Ramirez Llorens P, Vallejos L (2016) Las eco-regiones: su conservación y las áreas naturales protegidas de la provincia de Santa Fe. Secretaría de Medio Ambiente. Imprenta UNL, Santa Fe. Primera Edición, 244 p. ISBN 978-987-23776-2-5

Biasatti NR, Marc L, Rimoldi P, Spiaggi E (2017) Los valores ambientales de ecosistemas relictuales en la pampa húmeda: caso de “El Espinillo” y el tramo medio del río Carcarañá en Santa Fe”. Centro de Estudios Ambientales (CEAV). Facultad de Ciencias Veterinarias. Universidad Nacional de Rosario (UNR). UNR Editora, Rosario, 62p. ISBN 978-987-702-262-9

Biasatti NR, Rimoldi P, Cabrera L (2019) Desafíos de la conservación biológica en el espinal y la pampa húmeda santafesina, los mamíferos del sur de Santa Fe. Ministerio de Medio Ambiente. Provincia de Santa Fe, Santa Fe, Argentina.106p. ISBN978-987-45488-3-2

Bidaseca K, Lapegna P (2006) El grito de Alcorta revisitado: cultura y sentimientos en la acción colectiva. Anuario 2006_09 Nov06.qxp 09/11/2006 06:04 am, p 309

Bookchin M (2019) La próxima revolución. Las asambleas populares y la promesa de la democracia directa. Virus Editorial, Barcelona ISBN 978-84-92559-96-1

Brailovsky A (2006) Ecological history of Ibero-America: from the Mayas to Don Quixote. 1st ed, Editorial Capital Intelectual, Buenos Aires, 240 p ISBN 987-1181-45-0

Brailovsky A, Foguelman D (eds) (2009) Green memory. Ecological History of Argentina. 7th Edition. ISBN 987-1138-30-X. Ed Sudamericana, Buenos Aires, Argentina
Capurro JE (2018) Efectos de un cultivo de cobertura sobre propiedades edáficas y uso del agua en ambientes con erosión hídrica y monocultivo de soja, en el sur de la provincia de Santa Fe. Tesis de Magister en Manejo y Conservación de Recursos Naturales. Facultad de Ciencias Agrarias. Universidad Nacional de Rosario, Rosario, Argentina
Chomsky N (2020) Climate crisis and the global green new Deal: the political economy of saving the planet. Ed Capital Intelectual, Buenos Aires, 188 p, ISBN 978-987-614-607-4
Cloquell S, Albanesi R, Propersi P, Preda G, De Nicola M (2007) Rural families. The end of a story in the beginning of a new agriculture. Editorial Homo Sapiens, Rosario, 200 p. ISBN 978-950-808-524-5
Cracco M E, Guerrero S (2004) Aplicación del enfoque ecosistémico a la gestión de corredores en América del Sur. Memorias taller regional. 3 al 5 de junio, Quito, Ecuador
Del Corro F (2003) Apropiación de la tierra a los aborígenes y genocidios en el Rio de la Plata. Rebanadas de Realidad, Buenos Aires 11/08/03
Dirzo R, Young S, Galetti M, Ceballos G, Isaac N, Collen B (2014) Defaunation in the Anthropocene. Science 345:401. https://doi.org/10.1126/science.1251817. www.sciencemag.org/content/345/6195/401/suppl/DC1
Donghi TH (2000) From the Independence revolution to the Rosista confederation (Argentine History, VOL.III). Ed Paidos Iberoamerica, Buenos Aires, Argentina, ISBN 978-950-127-723-4
Donghi TH (2014) Revolution and war: building a leading elite in Argentina creole. Siglo Veintiuno Publishing House, Mexico, 480 p, ISBN 978-987-629-379-2
Forman RT, Grodon M (1986) Landscape ecology. Wiley, New York
Fox B, Fox M (2000) Factors determining mammal species richness on habitat islands and isolates: habitat diversity, disturbance, species interactions and guild assembly rules. Glob Ecol Biogeogr 9:19–37
Friends of the Earth (2012) Food miles: CO2 emissions from food imports into Spain (www.foe.com)
Gauna Zotter J, Rey M (2017) Tecnología y Sociedad. Ed EDUCA, Buenos Aires. Available in: http://bibliotecadigital.uca.edu.ar/repositorio/revistas/svampa-maldesarrollo-argentina-extractivismo.pdf
Georgescu-Roegen N (1971) The entropy law and the economic process. Princeton University Press, Princeton
Georgescu-Roegen N (1977) Bioeconomics. Princeton University Press, Princeton
Herrero A (2017) Navigating through the turbulent times of the Anthropocene. Political ecology. International debate notebooks, June 2017. ISSN: 1130-6378. Eds: Martínez Alier J, Puig Ventosa I, Monjo A. Ed Fundació ENT / Icaria editorial, Barcelona
Jones C (2008) The liquid carbon pathway. Australia. Extract from Australian Farm Journal Ed. 338, www.amazingcarbon.com
Jones CG, Gutiérrez JL (2007) On the purpose, meaning, and usage of the ecosystem engineering concept. In: Ciddington K, Byers JE, Wilson WG, Hastings A (eds) Ecosystem engineers: plants to protists. Academic, Cambridge, MA, pp 3–24
Jones CG, Lawton JH, Shachak M (1994) Organisms as ecosystem engineers. Oikos 69:373–386
Jones CG, Gutierrez JL, Groffman PM, Shachak M (2006) Linking ecosystem engineers to soil processes: a framework using the Jenny state factor equation. Eur J Soil Biol 42:39–53
Kropotkin P (1977) The conquest of bread. Jucar Editions, Gijón. ISBN 84-334-1555-7
Levin B (2022) Regenerative agricultural systems as biodiversity islands. In: Montagnini F (ed) Biodiversity islands: strategies for conservation in human-dominated environments, Series: Topics in Biodiversity and Conservation. Springer, Cham, pp 61–88
Marasas M (2012) El camino de la transición agroecológica. Ediciones INTA, Ciudad Autónoma de Buenos Aires, Argentina. ISBN 978-987-679-104-5 1

Martínez Alier J (2005) The environmentalism of the poor. Environmental conflicts and languages of valuation, 3rd ed. Antrazyt, Icaria Editorial 207, Barcelona ISBN: 978-84-7426-743-3

Mignolo W D (ed) (2007) The idea of Latin America. Editorial Gedisa, S.A., Buenos Aires. ISBN: 978-84-9784-094-1

Mollison B (1994) Introduction to permaculture. Tagari Publications, Stanley, Tasmania, Australia. ISBN 0 908228 09

Montagnini F, Somarriba E, Murgueitio E, Fassola H, Eibl B (Eds) (2015) Sistemas Agroforestales. Funciones productivas, socioeconómicas y ambientales. Serie Técnica Informe Técnico 402, CATIE, Turrialba, Costa Rica. Fundación CIPAV. Cali, Colombia, 454p

Moreno C, Barragán F, Pineda E, Pavón N (2011) Reanálisis de la diversidad alfa: alternativas para interpretar y comparar información sobre comunidades ecológicas. Revista Mexicana de Biodiversidad 82:1249–1261

Naredo JM (2015) Economic roots of ecological and social deterioration. Ed Siglo XXI, Madrid

Nyéléni Boletin (2013) Número 13, Marzo 2013, www.nyeleni.org - info@nyeleni.org

Passet R (1996) Principios de bioeconomía. Fundación Argentaria. Visor distribuciones S.A., Colección Economia y Naturaleza, Madrid-Bilbao

Petersen P, Marçal da Silveira L, Bianconi Fernandes G, Gomes de Almeida S (2017) Método de Análise Econômico-Ecológica de Agroecossistemas. AS-PTA, Rio de Janeiro, 246 p

Pizarro JB (2003) La evolución de la producción agropecuaria pampeana en la segunda mitad del siglo XX. Revista Interdisciplinaria de Estudios Agrarios, numero 18, 1er semestre 2003, Universidad de Buenos Aires, Buenos Aires

Poiani K, Merrill M, Chapman K (2001) Identifying conservation-priority areas in a fragmented Minnesota landscape based on the umbrella species concept and selection of large patches of natural vegetation. Conserv Biol 15:513–522

Polanyi K (1976) El sistema económico como proceso institucionalizado. In: Godelier M, Antropología y economía. Anagrama, Barcelona, pp 155–178

Polanyi K (2011) The great transformation. The political and economic origins of our time. Ed. Economic Culture Fund, Mexico

Politis G, Gutierrez MA, Scabuzzo C (2014) Chapter 7: The vertebrates of the site Arroyo Seco 2. Palaeo-environmental implications in current status of the investigations in the archaeological site Arroyo Seco 2, Tres Arroyos County, 1st ed. National University of the Center of the Province of Buenos Aires. Faculty of Social Sciences, Tandil, 514 p, ISBN 978-950-658-338-5

Primavesi A, Molina JS (1984) Ecological soil management: agriculture in tropical regions. Ed El Ateneo, Buenos Aires, 5th edition, 499p

Restrepo JM, Ángel SD, Prager M (2000) Agroecology. Centro para el Desarrollo Agropecuario y Forestal, Inc (CEDAF), Santo Domingo, Dominican Republic. ISBN 99934-8-002-9

Rimoldi PG, Chimento NR (2018) Diversidad de mamíferos nativos medianos y grandes en la cuenca del rio Carcarañá, provincia de Santa Fe (Argentina). Rev Mus Argentino Cienc Nat 20(2):333–341

Roldan AV, Sauthier UD (2016) Madrigueras de *Dolichotis patagonum* como recurso para otros vertebrados en Península Valdés. Mastozoología Neotropical 23(2):515–520

Sili M, Soumoulou L (2011) The land issue in Argentina. Conflicts and dynamics of use, tenure and concentration. Ministry of Agriculture, livestock and fisheries. Presidency of the Nation, Buenos Aires

Smith W, Solow A, Chu C (2000) An index of the contribution of spatial community structure to the species accumulation curve. Ecology 81:3233–3236

Svampa M, Viale E (2014) Bad development. The Argentina of extractivism and dispossession. Katz Publishers, Buenos Aires. ISBN Argentina: 978-987-1566-92-1

Svampa M, Viale E (2020) The ecological collapse is here. XXI Century Publishers, Buenos Aires, 296p. ISBN 978-987-801-027-4

Tittonell P (2019) Agroecological transitions: multiples scales, levels and challenges. Mendoza, Argentina. Rev. FCA UNCUYO 51 (1): 231-246. ISSN (online) 1853 8665

Toledo VM, González de Molina M (2007). El metabolismo social: las relaciones entre la sociedad y la naturaleza. In: Garrido F, González de Molina M (Ed.). El paradigma ecológico en las ciencias sociales. Icaria Editorial. Barcelona, España. ISBN 978-84-7426-756-3, p. 85–112

Volkind P (2009) El acuerdo de 1920 entre la Federación Agraria Argentina y la Federación Obrera Regional Argentina (IX Congreso): alcances y limites en el marco de la conflictividad agraria de la época. Revista Interdisciplinaria de Estudios Agrarios n° 31-2do semestre de 2009. Buenos Aires, Argentina

Wezel A, Bellon S, Doré T, Francis C, Vallod D, David C (2009) Agroecology as a science, a movement and a practice. A review. Agronomy Sustain Dev 29(4):503–515. https://doi.org/10.1051/agro/2009004

Zaccagnini ME (2014) Manual of good practices for the conservation of soil and biodiversity and its ecosystem services. UNDP, Secretary of the Environment and Sustainable Development of the Nation, INTA, Buenos Aires. ISBN 978-987-1560-55-4