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Cultural ecosystem services trade-offs arising from agriculturization in Argentina: A case study in Mar Chiquita Basin

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1. Introduction

The rural landscape provides many goods and services that benefit people. Ecosystem services (ES) are defined as “the aspects of ecosystems utilized (actively or passively) to produce human well-being” (Fisher, Turnera, & Morling, 2009: 645) and represent a framework to understand people-nature relationships. Within the different types of ES (provisioning, regulating and cultural), the cultural ecosystem services (CES) are the contributions of ecosystems to non-material benefits (e.g. capabilities and experiences) that arise from human-place relationship (Chan, Satterfield, & Goldstein, 2012). A relevant CES is the opportunities for recreation and tourism (henceforth OR&T), which are defined as the “recreational pleasure people obtain from natural or cultivated ecosystems” (MEA, 2005).

Nowadays, OR&T are one of the most important CES supplied by rural landscapes and in many cases are more valued by local stakeholders than other ES (Raymond et al., 2009). People value OR&T because the connection with natural environment generates a state of relaxation and peace of mind, reduces fatigue and promotes creativity (Kellert, 1993, p. 46; Musacchio, 2013). This are the benefits people obtained from this ES. The OR&T are determined by different biophysical landscape attributes, such as topography, hydrography, vegetation and singular natural resources (Arriaza, Cañas-Ortega, Cañas-Madueño, & Ruiz-Aviles, 2004). These attributes can vary or even disappear with changes in land use, leading to negative externalities (trade-off relationships) or positive externalities (synergy relationships). A trade-off occurs when the provision of one ES reduces the provision of others, whereas a synergy occurs when the provision of one ES increases the provision of other services (Bennett, Peterson, & Gordon, 2009; Bryan, 2013; Grace Turner, Vestergaard Odgaard, Bøcher, Dalgaard, & Svenning, 2014; Rodríguez et al., 2006). Trade-offs and synergies can also occur between the benefits arising from ES and among their beneficiaries (Díaz, Quétier, Cáceres, Trainor, Pérez-Harguindeguy et al., 2011; García-Llorente, Iniesta-Arandia, Willaarts, Harrison, Berry et al., 2015). Most studies have focused on provisioning services and regulating services, whereas few studies have focused on CES and on trade-offs and synergies between services and benefits (Bryan, 2013; Daniel, Muhar, Arnberger, Aznar, Boyd et al., 2012; Hernandez-Morcillo, Plieninger, & Bieling, 2013; Mastrangelo et al., 2015). In a context of growing urbanization and agricultural intensification and expansion, the evaluation of the loss of CES as a result of landscape transformation becomes an imperative (Grace Turner et al., 2014; Hernandez-Morcillo et al., 2013; Musacchio, 2013; Rodríguez et al., 2006; Tengberg et al., 2012). In response, an increasing number of studies have started to analyze the socio-cultural preferences on ES, the trade-off relationship between them and the biophysical and socio-cultural factors that underlie these trade-offs (eg. Butler, Wong, Metcalfe, Honzák, Pert et al., 2011; García-Llorente et al., 2015; Garrido, Elbakidze, & Angelstam, 2017; Grace Turner et al., 2014; Kaltenborn et al., 2017; Martín-López, Iniesta-Arandia, García-Llorente, Palomo, Casado-Arzuaga et al., 2012; Nahuelhual, Vergara, Kusch, Campos, & Droguett, 2017; Rodríguez et al., 2006).

In Latin America important transformations have occurred in the rural landscapes in the last decades triggered by a more industrialized production of agricultural commodities and the non-local appropriation of rural spaces. These transformations have generated changes in land cover and a reorganization of the rural areas due to rural exodus and land concentration in medium and large farmers (Teubal, 2009). Particularly in the Argentine Pampa Region, the agriculturization process, which began in the 1970s but intensified in the last 20 years, is characterized by a simplification of the rural landscape due to the expansion of a few crops (with a strong predominance of soybean) over livestock lands (with the livestock displaced to marginal areas or concentrated in feedlots) and the intensive use of machinery and agrochemicals (Manuel-Navarrete & Gallopín, 2007; Teubal, 2009). The consequence of this process is a loss of natural and semi-natural environments, native biodiversity and crop diversity (Herrera, Texeira, & Paruelo, 2013). The country's soybean production has increased from 3.7 million tonnes in 1980/81 to 58.8 million in 2015/16, accounting for about 50% of all cereal and oilseed production (MAGyP, 2017). Small farmers, who have limited access to new input technologies, have opted to lease or sell their farms, leading to the simplification of the rural social structure

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and the weakening of the rural community (Gras & Hernandez, 2016; Reboratti, 2006). In Buenos Aires Province, between 1988 and 2002 the size of the largest farms (more than 1000ha) has increased by 20% and the number of small or medium-sized farms (up to 200ha) has decreased by 47% (SAGyP, 2002). The intensive use of certain capitals, such as machinery, fertilizers, water and pesticides, in the production of commodities have led to the loss of biodiversity and natural areas as suppliers of regulation and cultural services (García-Llorente et al., 2015; Grace Turner et al., 2014; Martín-López et al., 2012; Tengberg et al., 2012).

Considering that CES have low potential to be mediated by socio-economic factors, which means that once lost they are unlikely to be replaced by technologies or other goods (MEA, 2005), the recognition and observation of their dynamics is fundamental to evaluate the impact of environmental alterations on human well-being (Gullickx, Verburg, Stoorvogel, Kok, & Veldkamp, 2013; Hernandez-Morcillo et al., 2013). The aim of the study was to evaluate the extent and mechanisms by which agriculturization has affected the OR&T in the southeast of the humid pampa region. To that end, we analyzed which aspects of the rural landscape provide these CES, which ones are needed to let people obtain the benefit related to CES, and how CES were affected by agriculturization, considering rural landscape changes in the last 20 years in a representative basin of the southeast of the humid pampa region.

2. Study area

The study was carried out in the Mar Chiquita Basin (about one million hectares; Fig. 1), located in the Southeast of Buenos Aires province, Argentina. This basin was considered representative of the main land use changes related to agriculturization in the humid Pampas region. The basin has two different ecological subregions: the Southern Pampa, a sector of highlands with hills or "sierras" (low hills with relatively steep slopes), dominated by extensive crops and the presence of horticultural farms near the principal city (Mar del Plata), and the Depressed Pampa, a lowland sector traditionally dominated by natural grasslands and livestock production, mainly bovine (León, 1991). Within the Depressed Pampa there is a third sector corresponding to the coastal zone and the Mar Chiquita lagoon, of high tourist value and biodiversity conservation value, which has been declared Biosphere Reserve by UNESCO in 1996 (Zelaya, 2011).

The Mar Chiquita Basin is composed of 11 counties (totally or partially) of the Buenos Aires Province, which contribute with 10% of the agricultural production of this province (campaign 2013/14). The increase in the agricultural production in the last 20 years (campaigns 2013/14 and 1993/94) (168%) was higher than the experienced by the province (133%). The same happened with the production of soybean during this period (2108% and 606%, respectively) (MAGyP, 2017). The relative increase of the cultivated area with all crops (and in the cultivation of soybean) was greater in the Depressed Pampa than in the Southern Pampa, but the absolute cultivated area continues being higher in the Southern Pampa. These counties also contribute with 14% of the cattle of the province (2010). The decrease in the number of cattle in the last 20 years (1992–2010) was lower in the study area (−7%) than in the whole province (−19%) (MAGyP, 2017), and, inside the study area, it was greater in the Southern Pampas than in the Depressed Pampa. Similarly to other sites of the Pampa Region, the expansion occurred at the expense of perennial forage crops and natural pastures (Aizen, Garibaldi & Dondo., 2009; Herrera et al., 2013; Paruelo et al., 2006), with a displacement of livestock to marginal areas, and intensification of agricultural practices and cattle production practices (feed lots) (Paruelo et al., 2006; Teubal, 2009). This expansion and intensification of the agriculture has caused a simplification and homogenization of the landscape, as well as a loss of natural and semi-natural environments and native biodiversity (Herrera et al., 2013). In turn, the "soybean effect" (whose technological package facilitates a large-scale production) has favored land concentration by leasing or purchase of fields by large farmers, with a decrease in the quantity of small farmers and the simplification of the rural social structure (Urcola, de Sartre, Veiga Jr., Elverdin & Albaladejo, 2015). These changes in landscape might affect OR&T. For example, the sierras have been traditionally used for recreation activities, such as trekking or

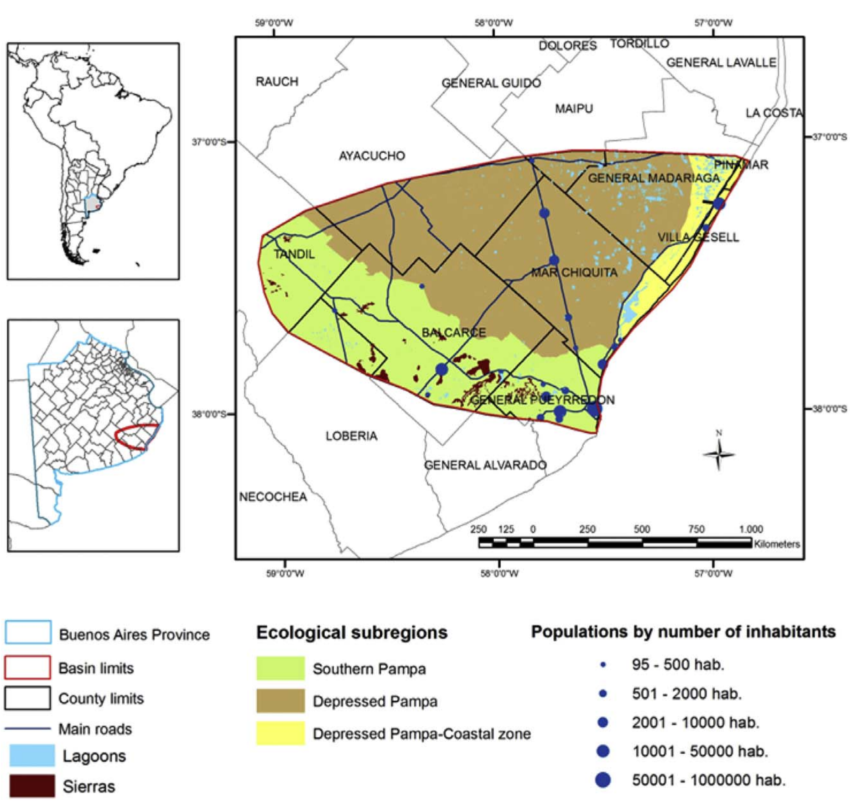

Fig. 1. Geographic location, political division, ecological subregions, main roads and populations centers by number of inhabitants of the Mar Chiquita Basin, Buenos Aires Province, Argentina. Source: Auer (2017, p. 12).

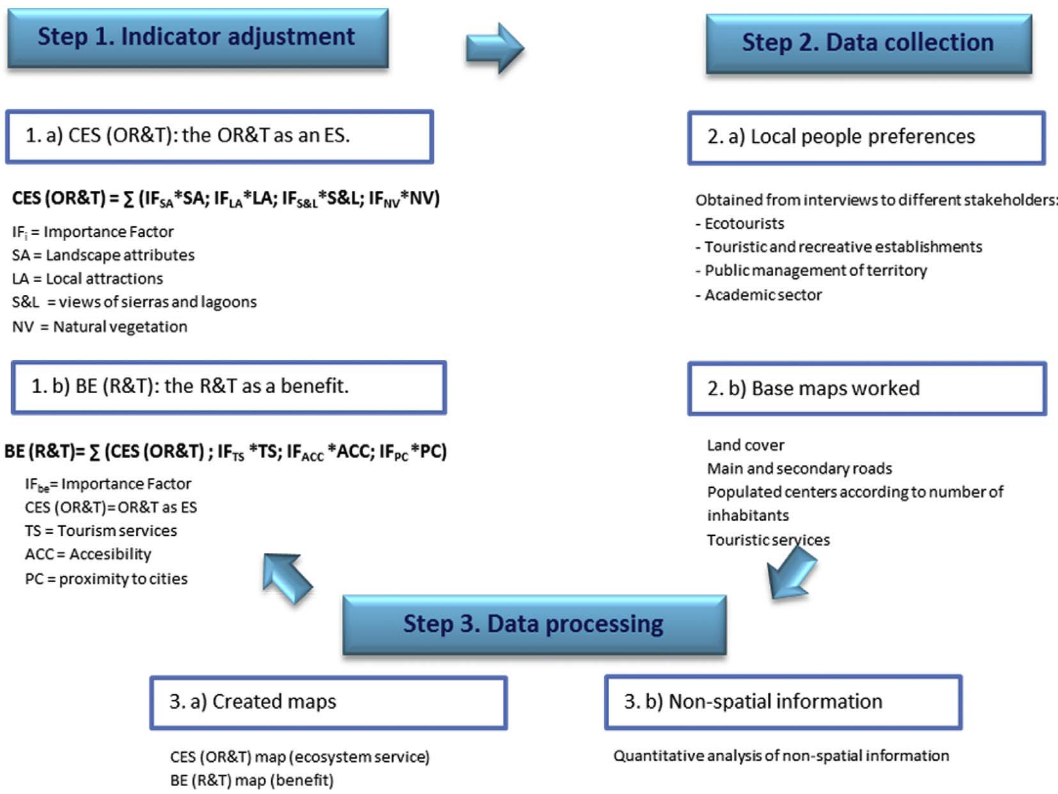

Fig. 2. Steps followed to create the CES (OR&T) map and the BE (R&T) map.

climbing, since their slopes and rocky soils generally prevent productive uses. However, nowadays some of them are cultivated, being less attractive for leisure activities. Also, the access to the sierras has become more restricted to recreationists, due to the concentration and lease of farms.

3. Methods and data

3.1. Creation of OR&T spatial indicator

The development of this indicator relied on a previous indicator of recreation opportunities proposed by Nahuelhual, Carmona, Lozada, Jaramillo, and Aguayo (2013), which is a combination of five attributes and corresponding spatial variables, weighted by means of expert criteria. The attributes in this indicator were landscape attributes, local attraction, views of sierras and lagoons and natural vegetation. For the case at hand, the development of the indicator followed the steps described in Fig. 2.

3.1.1. Selection of appropriate attributes

Based on Nahuelhual et al. (2013), literature review and our own field experience, the following variables were selected: Landscape attributes (land covers) denoted as LA, local attractions (special sites) denoted as SA, views of sierras and lagoons denoted as S&L, and natural vegetation, taken as a proxy of biodiversity, denoted as NV. Information to represent the attributes came from secondary as well as primary data collected by means of an interview (see section 3.3 and Supplementary material).

Landscape attributes corresponded to sierras, lagoons, streams, forest, livestock fields (pastures and natural grasslands), agricultural fields, dunes, cities and rural villages. To generate the final maps using the created indicators, different base maps were used (step 2-b), as land cover maps of the 1999/2000 and 2013/14 crop campaigns, generated by Zelaya (2011, Zelaya, Van Vliet, & Verburg, 2016). These base maps were also used for the agriculturization process analyses. Land covers types included: i) Winter cereals (wheat and barley); ii) Summer soybean (sown immediately after harvesting winter cereals); iii) Spring soybeans; iv) Other crops (sunflower, potato, maize and sorghum); v) Pastures (natural grasslands, sown pastures, bare land, scrub and wetlands); vi) Forest (natural or planted trees); vii) Water bodies (superficial water, such as lagoons and streams); viii) Urbanizations; ix) Sierras; x) Horticulture (in greenhouses or nor); xi) Dunes (in the sea coast). Covers i to iv and cover x were considered agricultural land covers. Raster images were processed using ArcGis 9.3. In all cases, a grid of 3 km × 3 km cells was used to get a scale appropriate to the local landscape, even when in other studies a 10 km × 10 km grid has been used.

To discriminate the different landscape attributes from the land cover maps, a reclassification was made assigning the value "1" to the land cover under analysis and "0" to the other covers. The proportion of the cell occupied by each attribute was considered. In the case of agricultural land cover, the combination of different crops in the landscape ("cover diversity") was taken into account, according to the interviewees' assessment. To this end, the Shannon diversity index was calculated for the agricultural land covers. This index is usually applied to spontaneous plant communities and considers the contribution of each species present in the community weighted by its relative abundance. Its formula is: $H' = -\sum_{i=1}^{s}(pi)(\log(pi))$, where H′ is the diversity value, S is the number of species and pi is the relative proportion or abundance of species i (Begon, Harper, & Townsend, 1997, pp. 604–607). In this study, pi was the proportion of the landscape occupied by the land cover class i, and S was the total number of land cover classes identified. The index is zero when there is only one class in the landscape (greater homogenization) and increases when the number of different types of classes or their proportional distribution increases (Rebolledo & Rau, 2010). The obtained values were normalized, obtaining values between 0 and 1, to be able to assign the maximum score of the "agricultural" valuation to the greatest cover diversity.

Local attractions corresponded to those that were identified by the interviewees, whose named the particular importance for R&T activities assigned to different sites of the landscape. All sites that were named at least once were considered and weight taking into account interviewees preferences. Places not related to the rural landscape (eg. Mar del Plata coast), were not considered in the analysis given the purpose of this study. These sites were spatialized in Google Earth and then, spatial analysis was performed using ArcGis, assigning a buffer area of 1km to each site.

Views of sierras and lagoons corresponded to the places around these landscape attributes which are valuated because of the presence its nice views. The proportion of the cell occupied by these attributes was considered because the greater this percentage is, the greater is the possibility of contemplating their views.

Natural vegetation corresponded to natural habitat remnants, which are considered as places with more biodiversity, specially related to birds and flowers, than cultivated lands. This variable was considered separately to the attributes of the landscape to reinforce the presence of biodiversity, beyond the characteristics of the land cover. The proportion of the cell occupied by the sierras, since they still maintain the natural vegetation, and 5% of the livestock area, since they include mainly by natural grasslands, sown pastures and bare land, but also scrub and wetlands, was considered.

3.1.2. Attributes importance factor

Each attribute was weighted by an importance factor (IFi) which came from the valuation of each aspect considered, arising from the interviews (see section 3.3 and supplementary material). It was calculated as the sum of the quantity of answers for each valuation multiplied by the value assigned to each valuation (according to the Likert scale, Table 1-a) for each aspect considered, divided by the total sum of the valuations of all aspects. For example, if 12 interviewees said that the “sierras” were “very important” (value = 10) for walking, eight answered that they were “quite important” (value = 6) for walking, etc., the value of the “sierras” for the R&T activity “walking” was calculated by summing up (12*10) + (8*6) + etc. To obtain the total value of the “sierras” as a landscape attribute, we summed all the values obtained for each activity consulted (eg. walking, bird watching). Finally, to obtain the IF, the value obtained for the “sierras” attribute was divided by the total value derived from the sum of the values of all the attributes. Similar procedure was used for the other variables that could not be mapped, such as “near application of agrochemicals”, using in this case the Likert scale shown in Table 1-b. All final values were multiplied by 10 to obtain an IF value between 0 and 10 for each attribute.

The final expression of the CES (OR&T) indicator (step 1-a) was the following:

CES (OR&T) = Σ (IFSA*SA; IFLA*LA; IFS&L*S&L; IFNV*NV)

The OR&T intermediate maps for 1999 and 2013, and then the *OR&T change final map (OR&T 2013–1999)* were generated. The last one emerged from the subtraction of the OR&T 1999 map from the OR&T 2013 map (Step 3-a).

Table 1
Likert scale used to weight (a) landscape attributes and (b) other variables taken into account to select the place to carry out R&T activities.

a) Likert scale to evaluate landscape attributes	
Very important	10
Quite important	6
Little important	2
Nothing important	0
b) Likert scale to evaluate different variables	
Very positive	2
Positive	1
Does not affect	0
Negative	−1
Very negative	−2

3.2. Creation of the indicator of benefits derived from OR&T

Since other elements are involved for ES flow to materialize into benefits, a benefit indicator was created (step 1-b). This indicator included variables considered necessary to the materialization of OR&T into benefits: i) tourism services (hotels, establishments offering R&T activities); ii) the accessibility to the site (roads); and iii) proximity to cities, based on the interviewees' assessment about the characteristics they took in account to choose the place to carry out R&T activities. All values were normalized between 0 and 1.

The final expression of the BE (R&T) indicator was the following:

BE (R&T) = Σ (OR&T; IF_{TS} *TS; IF_{ACC} *ACC; IF_{PC} *PC)

Where:

OR&T: OR&T supply indicator for 2013, explained above.
IF_{be}: Importance given to variables that determine the materialization of OR&T into benefits.

Tourism services (TS) corresponded to the proportion of the cell occupied by identified establishments offering recreational activities, gastronomy, lodging and others (eg. Fangio Museum, Zoo). These establishments were spatialized in Google Earth and spatial analysis was performed using ArcGis, considering a buffer area of 1km. According to the number of services related to the R&T activities, different values (4, 3, 2 and 1, respectively) were assigned.

Accessibility (ACC) corresponded to the proportion of the cell occupied by main routes and secondary roads. According to their importance, different values (2 and 1, respectively) were assigned. A buffer area of 1.5 km for main routes and of 0.5 km for secondary roads was assigned.

Proximity to cities (PC) corresponded to the proportion of the cell occupied by cities and rural villages. According to the number of inhabitants (who are potential beneficiaries of the R&T activities), different values were assigned: 5 (more than 50,000 inhabitants); 4 (from 10,000 to 49,999 inhabitants); 3 (from 1000 to 9999 inhabitants), 2 (from 500 to 999 inhabitants) and 1 (from 0 to 499 inhabitants). A buffer area of 1km was assigned in all cases.

To create the final benefit map using the indicator created, other maps were used, such as main and secondary roads map (IGN, 2012), cities map considering number of inhabitants (IGN, 2012; INDEC, 2010), and tourism services map (own elaboration based on information provided by the Municipalities and the Ministry of Tourism of Argentina) (step 2-b).

3.3. Interview

Interviewees provided data for the creation of the indicators previously described (step2-a). Similar to other studies sample (eg. Lamarque et al., 2011; Nahuelhual et al., 2017; Satterfield, Gregory, Klain, Roberts, & Chan, 2013), 34 interviews were conducted between March and September 2015 in four counties of Mar Chiquita Basin: General Pueyrredon (17), Balcarce (10), Tandil (5) and Mar Chiquita (2), but in all cases were referred to the rural landscape of the total studied area. Respondents were selected according to two criteria's: those concerned to the territory management on a landscape scale (farmers were not included because they have competing interests with the subject being studied, so we foresaw that responses could be biased) and those who benefit from the OR&T. In some cases, they were previously contacted and in other cases, randomly selected in touristic places. The final sample was composed by: academics related to territorial planning and tourism development (5); technicians in rural extension and government agents linked to sustainable development and tourism (6); tourist and recreational establishments and agencies (10); ecotourists (13). The final group was composed by 20 men and 14 women. Their average age was 42 years (range between 24 and 67 years) and their educational levels were: seven with complete secondary studies, 24 with university level and three with post-university level, having resulted unintentionally in a sample with high-level educational.

The data collection instrument was a questionnaire (Supplementary material) with closed answers in most questions. The questionnaire asked about time and places were interviewees spent free time outdoors in the last year and kind of activity they enjoyed. Afterwards, asked about the importance of landscape attributes for the OR&T. Attributes referred to particular ecosystems or to landscape as a whole. A grid with nine rows (landscape attributes) and nine columns (R&T activities) was completed by interviewees. The landscape attributes (particular elements) asked about were: sierras; lagoons and wetlands; streams; forests; livestock areas; agricultural fields; dunes; city head; rural villages. The R&T activities asked were: passive tourism (eg. picnic); walk, bike or run; bird watching; farm tourism; hunting; sport fishing; watersports (eg. kayak); aerial sports (eg. parachuting); climbing. A Likert scale with four levels (very, quite, little or nothing important) was used. The questionnaire not only asked about the preference of different landscape attributes, but it also asked about local attractions and different aspects (eg. proximity to housing, accessibility, water quality, views of the sierras and lagoons) that interviewees took into account to choose places to carry out R&T activities. A Likert scale with five levels (very positive, positive, negative, very negative or does not affect) was used for this purpose (Table 1-b). These values multiplied by the percentage of responses for each valuation of the variable were used to estimate the no mapped variables.

3.4. Trade off analysis

To evaluate the magnitude and location of the relationship between agriculturization and OR&T, an agriculturization change map (AP 2013–1999) was generated. To this purpose, the land cover maps (campaign 2013/14 and 1999/2000) were compared to analyze the agriculturization process (AP). To obtain the proportion of each cell occupied by agricultural cover, a reclassification of the land cover maps was performed assigning a value of “1” to agricultural land cover and “0” to other covers. The agriculturization intermediate maps for 1999 and 2013 were created, and then, the *agriculturization change final map (AP 2013–1999)* was generated, which emerged from the subtraction of the AP 1999 map from the AP 2013 map.

To visually explore the trade-offs, the *OR&T change final map (OR&T 2013–1999)* and *agriculturization change final map (AP 2013–1999)* were contrasted. As both maps were divided in the same cells, it was easy to see the change related to agriculturization and the change in OR&T at the same place. According to the positive or negative sign obtained in both maps, each cell presented a synergy or trade-off relationship (Table 2). For example, a cell where the agriculturization has increased (which means that in 2013 the percentage of agricultural land cover was higher than in 1999) and the OR&T has decreased (which means that the OR&T indicator value was lower in 2013 than in 1999), the relationship type was trade-off (+; −).

Table 2
Type of relationship between the agriculturization process and OR&T. As the Trade-off (+; −) type resulted the most frequent relationship, it was classified in low, medium and high.

Relationship type	AP	OR&T
Trade-off (+; −)	positive	negative
Low		*changes: between -10% and 0%*
Medium		*changes: between -20% and -10%*
High		*changes: less than -20%*
Trade-off (−; +)	negative	positive
Sinergy (+)	positive	positive
Synergy (−)	negative	negative

Table 3
Time that interviewees spent outdoors (a), places where the R&T activities took place (b) and activities carried out (c).

a)

Outdoor time	Percentage of interviewees
1 to 15 days	3%
15 to 30 days	14%
30 to 60 days	55%%
60 to 120 days	28%%
more than 120 days	0%
TOTAL	100%

b)

Places where R&T activities took place	Percentage of interviewees
Sierras	38%
Open landscapes	26%%
Lagoons and surroundings	18%%
Urban parks	15%
Streams and surroundings	2%%
TOTAL	100%

c)

Activities carried out in open spaces	Percentage of interviewees
walking or trekking	26%
bird watching	18%
Picnic	15%
cycling	13%
sport fishing	9%
Climbing	7%
Running	7%
farm tourism	4%
TOTAL	100%

Since most cells had a trade-off relationship (+, −), which means that the agriculturization has increased and the OR&T has decreased, it was differentiated in low, medium and high for a better understanding. The spatial analysis was complemented with the quantitative analyses of no mapped variables for a better comprehension of the relationship between agriculturization and OR&T and because not all the characteristics that people took into account to choose the place to carry out R&T activities could be mapped (step 3-b).

4. Results

4.1. Opportunities for recreation and tourism (OR&T)

Results showed that more than half of the interviewees spent between 30 and 60 days a year outdoors, including someone's who spent even more time outdoor (Table 3-a). The usual places where R&T activities took place were the sierras, open landscapes and lagoons (Table 3-b). The main activities carried out in open spaces were walking or trekking, bird watching, picnic and cycling (Table 3-c).

The rural landscape attributes that most contributed to OR&T were the sierras and lagoons, while agricultural areas (mainly those with low diversity crop), dunes and cities were the least contributors to this CES (Table 4). Interviewees also valued the sierras and lagoons for the views they offer and the presence of natural vegetation, which is associated with more biodiversity. To a lesser extent, interviewees valued the presence of particular sites (eg. sierra La Barrosa), which were

Table 4
Rural landscape attributes valued to OR&T.

Rural landscape attributes	Value
Sierras	2.1
Lagoons and surroundings	2.0
Streams and surroundings	1.5
Forests	1.1
Rural Villages	0.9
Pastures and natural grasslands	0.9
Agricultural areas	0.7
Dunes	0.6
Cities	0.4

considered in this study as "local attractions".

The spatialization of results (Fig. 3) showed that the most valuable sites for OR&T (dark green cells) were those places with sierras (mainly on the southeast of the Basin), the Mar Chiquita sea lagoon (on the coast) and some lowland areas with wetlands or lagoons (mainly in the northeast of the Basin). The range of values obtained in the cells in 1999/2000 were 0.13 (minimum) and 5.36 (maximum), whereas the range of values in 2013/14 were 0.11 and 4.96, respectively. In 1999/2000 the 80% of the cells had an OR&T value higher than 0.751, while in 2013/14 only 61% of them reached this value. There has been an increase in the range 0.5–0.75 for the period 2013/14 replacing the range 0.751–1.00, mainly in the central part of the map, which is related with the agriculturization process (see section 4.3). These ranges show a decrease in the spatial supply of the CES. The display scale used in the maps was 0–6.

4.2. Recreation and tourism benefits

To capture the CES and obtain their associated benefit, the interviewees valued other aspects, such as proximity to roads (accessibility; value = 1.8), proximity to cities (1.4) and tourism services (1.4). For example, Balcarce County had a good roads network and an important tourism services offer, whereas Mar Chiquita County had a better distribution of the population who could benefit from these activities. The BE (R&T) map (Fig. 4) shows that not only places with natural elements and nice views are important to enjoy the R&T activities in open spaces, but also accessible places (near to roads and to people residence) and tourism services offer.

4.3. Agriculturization process

The land cover map according to the percentage of crops in the cells (Fig. 5) showed that in 1999/2000 of cells with less than 20% covered with crops represented 61%, whereas in 2013/14 this value was 25%.

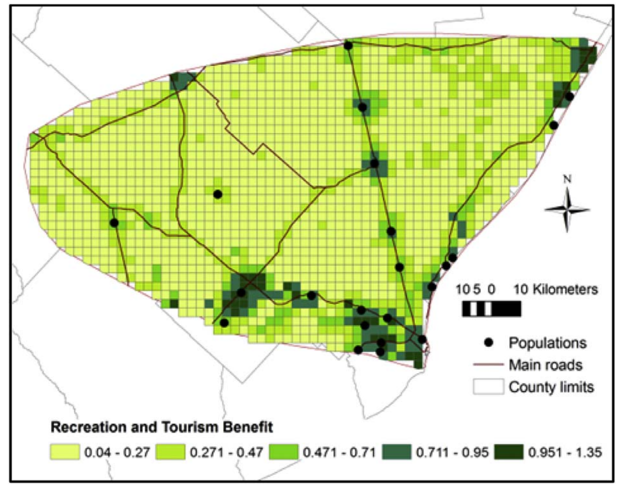

Fig. 4. Map of the BE (R&T), which integrates the ecosystem services supply Map and accessibility, tourism services and proximity to cities.

On the other hand, cells covered with crops between 60% and 80% doubled in the same period (representing 8% in 1999/2000 and 16% in 2013/14) and those with more than 80% covered with crops (dark red cells) increased six-fold (from 1% to 6%). In 1999/2000, only the counties with better agricultural capacity had cells with more than 40% covered with crops, whereas in 2013/14, also the counties with less agricultural capacity had it. In these counties, the proportion of these cells went from 1% in 1999/2000 to 12% in 2013/14. In agricultural counties, the proportion of cells with more than 80% covered with crops went from 2% in 1999/2000 to 13% in 2013/14.

4.4. Trade-off between provisioning goods and OR&T under a scenario of agriculturization

The spatial analysis of agriculturization and OR&T shows the relationship (trade-off or synergy) between them (Fig. 6). The increase in agriculturization generated a decrease in OR&T, named as "trade off (+, −)", as it emerged from the preferences of the interviewees, but the trade-off was mainly low (49% of the cells) and medium (30% of the cells) and looks diffuse in the map. To a lesser extent, there were also sites with the opposite trade-off, where a decrease in agriculturization coincided with an increase in OR&T, named as "trade off (-, +)", mainly in the south, due to a slight increase in the livestock fields or even less, in forestation (7% of the cells). Unlike the expected trend, there were sites with positive synergies (mainly in the south and southwest, where the agriculturization was combined with crop diversification, which increases OR&T value), and also with negative synergies (mostly due to

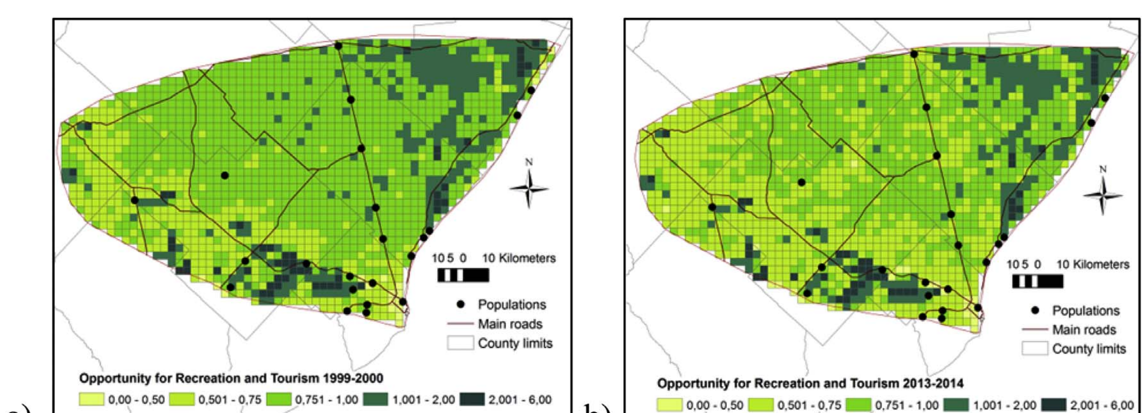

Fig. 3. Map of the OR&T for the agricultural campaign 1999/2000 (a) and 2013/14 (b).

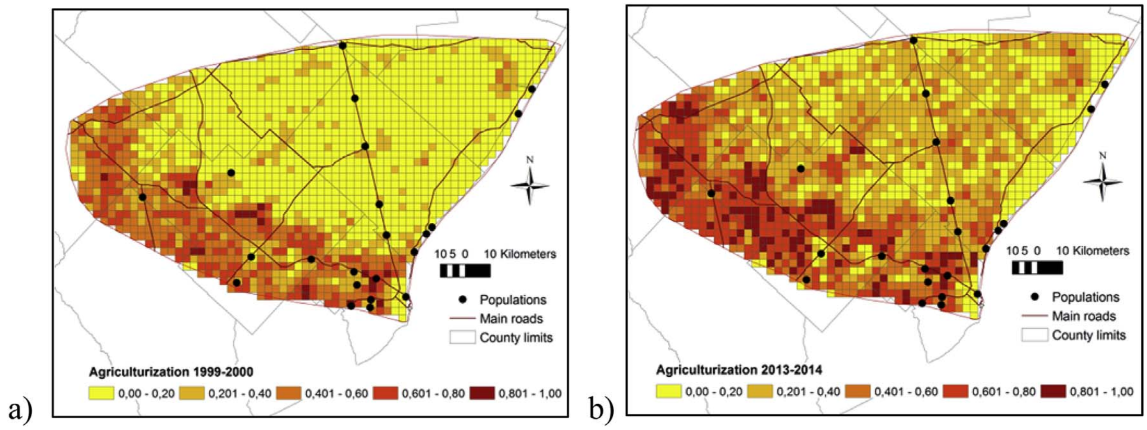

Fig. 5. Land cover map according to the percentage of crops in the 3 km × 3 km cells for the agricultural campaign 1999/2000 (a) and 2013/14 (b).

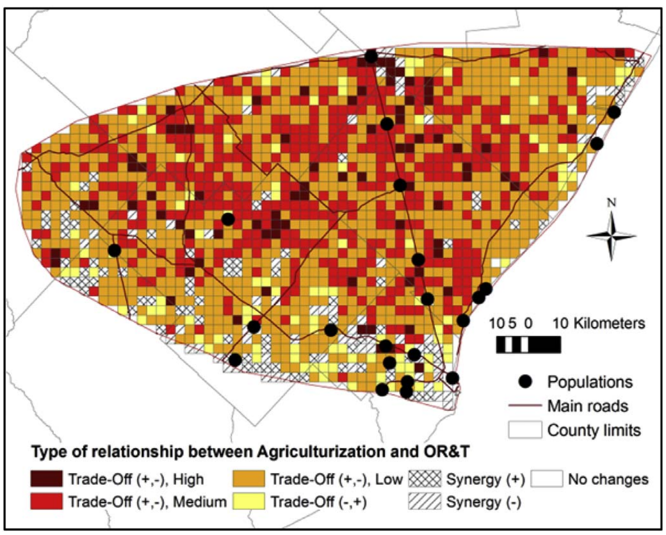

Fig. 6. Relationship between the agriculturization process and the OR&T. Type of relationships were explained in Table 2.

an increase in urbanization, which decreases the value for OR&T. Other changes related to agriculturization, such as contaminated water or difficult access to the sierras, are not represented in the map.

The variables considered positive for R&T activities were the water quality in lagoons and streams, followed by the views of animals in the landscape, the presence of bird diversity, a diversification of productive activities and inhabited rural houses (Fig. 7). The variables considered negative for R&T activities were the presence of non-local farmers and the leased fields, which difficult the recreationist access to the fields, and with greater intensity the large areas with the same crop, the near application of agrochemicals and the presence of feedlots in the landscape. It should be note that those variables positively valued for R&T activities are precisely those which has decreased with agriculturization and conversely, variables negatively valued for R&T activities are those which has increased with agriculturization. These results remarks the importance of people perceptions about the quality losses of places where to carry out R&T activities and confirms the general trade-off relationship between agriculturization and OR&T. It is important to contemplate that not all the aspects considered correspond specifically to the CES, being in some cases more related to the capture of the benefit (eg. difficult access to the sierras because of leased farms). As in most cases beneficiaries are not the same, behind the mentioned trade-off, there is a beneficiaries trade-off that needs to be taken into account.

5. Discussion

The sierras and lagoons, the presence of birds, natural vegetation and wild animals are the attributes of the rural landscape that sustain the CES of OR&T in the Southeast pampas, in coincidence with other studies. For example, results reaffirm the preferences captured by García-Llorente et al. (2012) where the rocky and icy summits, riparian vegetation and dam were the favorite landscape views, although in that study the agricultural landscapes were also preferred, but not the greenhouse farms, which had the lowest values (together with other modern economic activities, such as wind farms). Comparing with our results this difference could be related to the intensification of

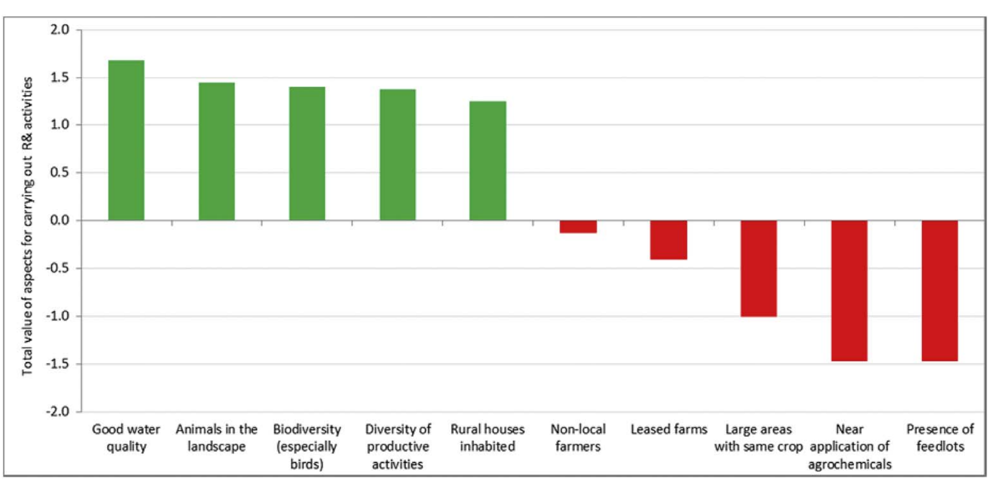

Fig. 7. Aspects considered to choice places for recreation and tourism (R&T) activities.

agriculturization described here or the different aim of the studies (social preferences toward landscapes in general and related to OR&T). Considering that attractiveness of the landscape enhances the enjoyment of doing recreation and tourism activities and that appreciating the tranquility and resting are some of the most preferred "outdoor activities" for people (Van Berkel & Vergburg, 2014), it could be suggested that the "industrialization" of the agriculture goes in detriment to its potential to co-exist with recreation and tourism. Our results coincide with Van Berkel and Vergburg (2014), who found that the "cold spots" for CES were those sites with no presence of visible animal habitat and where open agriculture land and modern large scale farm businesses dominated the landscape. Our results also agree with De la Fuente de Val, Atauri, and de Lucio (2006), which considered that the diversity of activities, crops and colors were important preferences factors of the landscape and that the homogeneity of modern agricultural landscapes diminished visual beauty (Arriaza et al., 2004). As in those studies, our results also suggest that people value not only the aspects of the landscape taken separately, but the landscape as a whole (eg. views of the sierras and lagoons).

Although there is consensus that its natural aspects of the landscape, such as lakes and rivers, natural vegetation and mountains on the horizon contribute more to the visual quality than man-made elements, such as roads, industries and power lines (Arriaza et al., 2004), in our study also the socio-cultural dimension of the landscape (eg. diversity of productive activities and inhabited rural houses) was positively valued. The valuation of this dimension, which is also showed in the relatively high score of the rural villages and livestock areas, reflects that the cultural and recreational values of a place are blended. It also shows that the landscape is a meaningful social construction and comprises material and intangible values, such as scenic beauty, identity, sense of place and cultural heritage (Auer, Maceira & Nahuelhual., 2017; Cheng, Kruger, & Daniels, 2003). This knowledge could be used to generate a synergistic relationship between productive activities and OR&T. For example, favor farm tourism through the appreciation of the traditional cultural activities (eg. countryside dances, horsemen abilities) that takes place in agricultural farms. In addition, the local, natural and cultural resources are revalued and the knowledge and capacities of the rural population with the potential of nature are linked and integrated (Nogar et al., 2007), favoring an endogenous rural development.

The created maps reveal trade-off relationship between commodity production and the OR&T, mainly due to the increase in agricultural activity with low crop diversity, which has very low value for R&T activities. Besides, the results show that agriculturization has other characteristics and consequences not easy to map, such as agrochemical contamination and the difficulty of access to the fields, which affect as much or more the supply of the CES and the capture of their benefits. These results coincide with previous ecosystem services mapping studies (eg. Klain & Chan, 2012) where perceived threats have not been mapped by respondents because they were non-spatially explicit (eg. acoustic contamination, marine waste). The trade-off arise not only because agricultural use limits the availability of land for other uses (Grace Turner et al., 2014), such as recreation, but also by the consequences of the nowadays form of production (industrial agriculture). This type of agriculture, which reflects the "social imaginary" that agriculture and conservation have opposing interests, limits the ecosystem's capacity to simultaneously provide different ES (Bennett et al., 2009). However, in some cases, it also prompts small farmers to consider tourism as a conversion strategy (Nogar et al., 2007). In these cases, the rural R&T activities would be an important economic driver of rural areas and a key aspect of well-being for the urban population (Buijs, Pedroli, & Luginbühl, 2006). This would also be beneficial for the multifunctionality of land, which favors the biodiversity and cultural heritage conservation (Plieninger, Dijks, Oteros-Rozas, & Bieling, 2013). In this way, agroecological productions, which favor the farm tourism and recreational-educational activities, could generate a synergy relationship between ES.

As people whose benefit from OR&T in many cases differs from agriculturization beneficiaries, the results also show a trade-off between beneficiaries, highlighting the unequal appropriation of the benefits of ES by different stakeholders and also the unequal impact of negative externalities of agriculture on other services. Similar results were shown in Butler et al. (2011) study, where the stronger negative trade-off between beneficiaries was between farmers (for food and fiber production) and community, tourists, tours operators, recreational and commercial fishermen. This trade-off can be seen not only in the limitation of ecotourists access to the fields, but also in the less "access" to the CES because of the degradation of natural aspects of the landscape (eg. contaminated water, odor generated by feedlots). For example, the farmer whose field includes a sierra, not only benefits of the food provision SE, but depending on the type of agriculture he does or if he leases the field, he also "appropriates" of the OR&T or other CES (Auer, Maceira, & Nahuelhual, 2017). In these cases, there is a trade-off among beneficiaries, because people seek freedom, silence, new experiences and a healthier life in natural spaces (López-Mosquera & Sánchez, 2011). The results also indicate that good access to remote natural sites would increase the capture of the BE (R&T), expanding the development of places that have tourism potential but that are far from urbanization. This opportunity could be seen as a productive alternative for some small non-capitalized farmers that have difficulties to enter into the current agricultural production business. However, even when human infrastructure or intervention (eg. urbanization, roads) facilitates benefits capture, in excess could be negative for scenic beauty, tranquility and naturalness of places (Weyland & Laterra, 2014).

Planning instruments that seek to promote this kind of rural development must incorporate sustainability criteria (eg. carrying capacity), since often the areas with the greatest potential for R&T activities coincide with the most fragile ecosystems (Nahuelhual et al., 2013). Considering the trend of decreasing supply and growing demand for outdoor activities (MEA, 2005), our results suggest that conflicts (eg. access to the sierras, contaminated water) will become more acute. Therefore, future studies on land use changes related to the ES supply and the capture of their benefits must consider not only the direct, but also the indirect effects of these changes on ES and the direct and indirect benefits people obtain from the landscape. For example, the benefit of OR&T not only is the well-being, but also the sense of place, job creation (eg. tour operator, handicraft vendor) and local development (Daw, Brown, Rosendo, & Pomero, 2011; Nogar et al., 2007). Therefore, strengthening the R&T activities under sustainability parameters could help to generate jobs, to develop rural villages and to revalue their identity. Take advantage of the tourist-recreational-educational potential of the rural landscape would contribute to its conservation and would generate alternatives for local people and small farmers harmed by agriculturization. These results should encourage local governments to promote the conservation of the rural landscape, which is the sum of private property and management, but which enjoyment is a common good, mainly for the local population.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.apgeog.2017.12.025.

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