https://doi.org/10.22478/ufpb.1981-1268.2021v15n3.61206

Perception of ecosystem services by peri-urban farmers in São Paulo, SP, Brazil

Diego Maciel Blum da Silva[1], Clovis José Fernandes de Oliveira Junior[2*]

1 Programa de Pós-Graduação em Agroecologia e Desenvolvimento Rural, Universidade Federal de São Carlos, Centro de Ciências Agrárias – CCA. Rodovia Anhanguera, km 174 - Araras – SP, Brazil. 13565-905. Caixa Postal 153
2 Instituto de Pesquisas Ambientais de São Paulo. Núcleo de Uso Sustentável de Recursos Naturais. Av Miguel Stefano, 3687, Água Funda, 04301-012 - Sao Paulo, SP – Brazil. Caixa-postal: 3005
*Corresponding author: clovis@sp.gov.br

Received 20 October 2021.
Accepted 05 November 2021.
Published 11 November 2021.

Abstract - The managements adopted in agroecosystems may interfere positively or negatively in the different ecosystem services (ES). Understanding the perception of ES and its importance is very relevant for family farming public policies, in accordance with practices that can mitigate the effects of climate change and create resilience for agroecosystems, with environmental gains for the entire society. With increased understanding in this sense, it is possible to improve the management of the agroecosystem and increase the degree of positivity of interferences in the ES. The objective of this work is to analyze the perception of ES by farmers located in peri-urban areas. The study was carried out in the Comuna da Terra Irmã Alberta, a pre-settlement established in the capital of São Paulo State, with participative observation and application of semi-structured interviews with key informants. The most perceived ES were those related to ecosystem support functions and culture, the most mentioned being: "nursery", "cultural identity", "food", "sound regulation", "aesthetic appreciation" and "air quality". Sociocultural aspects and the spatial context in which they are inserted influenced the perception of ecosystem services. The presence of agroforestry backyards was the most prominent factor influencing the perception of SE.

Keywords: Agroforestry backyards. Agroecological transition. Family farming.

Percepção de serviços ecossistêmicos por agricultores periurbanos em São Paulo, SP, Brasil

Resumo - Os manejos adotados nos agroecossistemas interferem positiva ou negativamente nos diferentes serviços ecossistêmicos (SE). Compreender a percepção do SE e sua importância é muito relevante para as políticas públicas da agricultura familiar, de acordo com práticas que possam mitigar os efeitos das mudanças climáticas e criar resiliência aos agroecossistemas, com ganhos ambientais para toda a sociedade. Com o aumento desse entendimento, é possível aprimorar o manejo do agroecossistema e aumentar o grau de positividade das interferências no SE. O objetivo deste trabalho é analisar a percepção do SE por agricultores localizados em áreas periurbanas. O estudo foi realizado na Comuna da Terra Irmã Alberta, pré-assentamento estabelecido na capital do Estado de São Paulo, com observação participante e aplicação de entrevistas semiestruturadas com informantes-chave. Os SE mais percebidos foram aqueles relacionados às funções de suporte ecossistêmico e à cultura, sendo os mais citados: "berçário", "identidade cultural", "alimentação",

"regulação sonora", "valorização estética" e "qualidade do ar". Os aspectos socioculturais e o contexto espacial em que estão inseridos influenciaram a percepção dos serviços ecossistêmicos. A presença de quintais agroflorestais foi o fator que mais influenciou a percepção de SE.

Palavras-chave: Quintais agroflorestais. Transição agroecológica. Agricultura familiar.

Percepción de los servicios ecosistémicos por agricultores periurbanos en São Paulo, SP, Brasil

Resumen - Los manejos adoptados en los agroecosistemas interfieren positiva o negativamente en los diferentes servicios ecosistémicos (SE). Entender la percepción de los SE y su importancia es muy relevante para las políticas públicas de agricultura familiar, de acuerdo con prácticas que puedan mitigar los efectos del cambios climáticos y generar resiliencia a los agroecosistemas, con ganancias ambientales para toda la sociedad. Con el aumento de esta comprensión, es posible mejorar la gestión del agroecosistema y aumentar el grado de positividad de las interferencias en los SE. El objetivo de este trabajo es analizar la percepción de SE por parte de agricultores ubicados en áreas periurbanas. El estudio se llevó a cabo en la Comuna da Terra Irmã Alberta, un pre-asentamiento establecido en la capital del estado de São Paulo, con observación participativa y aplicación de entrevistas semiestructuradas con informantes clave. Los SE más percibidos fueron los relacionados con las funciones de apoyo al ecosistema y la cultura, siendo los más mencionados: "vivero", "identidad cultural", "alimentación", "regulación sana", "apreciación estética" y "calidad del aire". Los aspectos socioculturales y el contexto espacial en el que se insertan influyeron en la percepción de los servicios ecosistémicos. La presencia de quintales agroforestales fue el factor más prominente que influyó en la percepción de SE.

Palabras clave: Quintales agroforestales. Transición agroecológica. Agricultura familiar.

Introduction

Agriculture is one of the main causes of degradation and destruction of natural ecosystems around the world (Mazoyer and Roudart 2009; Benayas and Bullock 2012). Conventional agriculture transformed production systems into highly simplified agroecosystems, causing them to lose its structure and functionality, usually present in natural ecosystems (Nicholls et al. 2016).

Management practices in agriculture generate negative impact, to a lesser or greater extent, in ecosystem functions, thus causing a reduction in the flow of Ecosystem Services (ES) (Power 2010), affecting both farmers and the entire human society (Zhang et al. 2007). Among the negative environmental impacts of modern agriculture there are contamination, excessive use of pesticides as well as natural resources and food, the siltation of rivers and loss of biodiversity. These are direct effects on the environment (Machado and Machado Filho 2014; Altieri and Nicholls 2020).

Planning a truly sustainable agriculture requires that we consider all aspects of the food system, production, distribution and consumption, considering that food systems are much broader than production and cultivation (Molina and Caporal 2013). Building strong links between producers and consumers is one of the key factors that will allow us to expand all its potential (Parada and Salas 2018). Meaning that, to become sustainable and resilient, agriculture must be planned to provide environmental and ecosystem services, as well as the agricultural production, and this will require society to value and be willing to appropriately remunerate farmers for the provision of

environmental services and ecosystems, along with production (Tilman et al. 2002; Buquera et al. 2018).

The agroecological approach offers advantages over the current hegemonic model of agriculture (industrial, conventional or agribusiness), as it is based on production models that offer more positive externalities, moreover the production of healthy foods, such as the preservation of water, soil and forests (Lunelli et al. 2013; Oliveira Jr. et al. 2014; Wilhelm and Smith 2018; Altieri and Nicholls 2020). At the same time, they favor food sovereignty by promoting productive diversity, protecting farmers from the risks of extreme weather events, pests and diseases (Nicholls et al. 2016; Altieri and Nicholls 2020).

Assessments of the conservation status of biodiversity, natural resources and environmental and ecosystem services promoted by natural or anthropogenic areas, is one of the pillars of the science of sustainability (Moran 2011; Salas-Zapata et al. 2017; Janker and Mann 2020), in which Agroecology is rooted in (Molina and Caporal 2013; Altieri and Nicholls 2020). And in the search for a better understanding of the dynamic interactions between nature and society, agroecology aims to transition to more balanced and regenerative models in land occupation and its use for production (Clark and Dickson 2003; Altieri et al. 2015). Following this line of thought, understanding the way in which agriculture impacts environmental quality is considered one of the most important challenges of these times, as it builds subsidies to better combine nature conservation with human habits and production (Moran 2009; Randolph et al. 2009; Altieri and Nicholls 2020), supporting the agroecological transition (Buquera et al. 2018; Caporal 2020).

The benefits that society obtains from natural or human-modified ecosystems are defined as Ecosystem Services by the Millennium Ecosystem Assessment (MEA, 2005). Provision or production services offer food, fiber and firewood; the regulation ones act on climate, waste and water quality; cultural ones enable recreation, aesthetics and spiritual benefits; and support services deliver soil formation, photosynthesis, pollination and nutrient cycling. These ES underlie the guidelines of the proposal of the Sustainable Development Goals of the United Nations (SDG-UN).

However, there are different approaches, definitions and classifications of ES, sometimes incomplete or conflicting with each other. De Groot, Wilson and Boumans (2002), for example, classify ecosystem services according to their functions: production provides food, fibers, fuels and other materials; regulation supports biogeochemical cycles and air, soil and water purification; habitat or support enables the conservation and evolution of biodiversity; and finally, the cultural function provides recreation, didactic source of learning, contemplation of nature and spiritual enrichment. Even with a vast amount of research on the ES concept, little progress has been made in the use of this knowledge for the development of public policies that guide an effectively sustainable use and, consequently, contribute to the conservation of natural resources (Bennett et al. 2015). Research also shows that there is a positive relationship between the perception of ES and the agroecological transition (Buquera et al. 2018).

Evolving this line of thought, in order to the ES paradigm to be relevant in decision-making and in the development of public policies for sustainable rural development, it is important to integrate perceptions and awareness in its assessment (Zhang et al. 2016). Understanding how humans perceive ES and knowing cultural preferences is vital for conservation purposes and for local development planning (Cuni-Sanchez et al. 2016). Thus, understanding the ecosystem benefits, perceived and expressed by the people themselves according to their references, can provide a better analysis of

the ES, its valuation, the proper management of agroecosystems (Barrena et al. 2014), the definition of better guidelines for land access and use, encouraging attitudes and behaviors favorable to the conservation of the environment (Asah et al. 2014).

Several scientific studies analyze the perception of ES and its variations according to the local context of the urban and rural communities studied (Sodhi et al. 2010; Martín-Lopez et al. 2012; Fagerholm et al. 2012; Abram et al. 2014; Muhamad et al. 2014; Cuni-Sanchez et al. 2016; Zhang et al. 2016; Antognelli and Vizzari 2017; Kadri et al. 2017; Macedo et al. 2021). However, in periurban areas the available jobs are scarcer (Teixeira et al. 2018). Other studies address the perception with a bias towards the financial valuation of ES (Andrade and Romeiro 2013). Nevertheless, some researchers argue that ES also have intangible, non-valuable principles that are often underestimated or absent in ecosystem service assessments (Kumar and Kumar 2008; Scholte et al. 2015).

That said, considering that different agricultural practices generate different effects, one can affirm that, depending on the management practices adopted, agriculture can positively or negatively affect the flow of ES in a given location (Sandhu and Wratten; Cullen 2007; Molina and Caporal 2013; Oliveira Jr and Santana 2020). Therefore, evaluating the perception of farmers about ES can support guidelines for the agroecological transition, justify and provoke the creation of new public policies for the agri-food sector, especially for family farming and small-scale agriculture (Molina and Caporal 2013; Abram et al. 2014; Zhang et al. 2016; Altiere and Nicholls 2020), aiming to maintain and reinforce the benefits that humanity obtains from nature. For Zhang et al. (2007), agroecosystems are currently managed mainly with the purpose of optimizing the ES for the provision of food, wood, fiber and fuel. Molina and Caporal (2013) well summarize the relationships between local decisions and environmental services.

> "Thus, the quantity and quality of goods and services offered by the agroecosystems can be modified with the interferences that the population itself (the society) puts in practice upon them. This means that this is a process of co-evolution" (Molina and Caporal 2013, p.36.).

Consequently, it is essential to search for agricultural practices with lower environmental impacts, or in other words, that can simultaneously maintain or improve their capacity to supply food, fibers, wood and fuel without, however, harming the flow of other service ecosystems (Power 2010; Altieri and Nicholls 2020). According to the scientific review work of Bommarco, Kleijn and Potts (2013), this productive condition is presented as ecological intensification.

Based on the above, this work intends to analyze whether farmers inserted in periurban landscapes present the perception of SE, relating their perception to the aptitude for agroecological transition and the elaboration of public policies for periurban family farming.

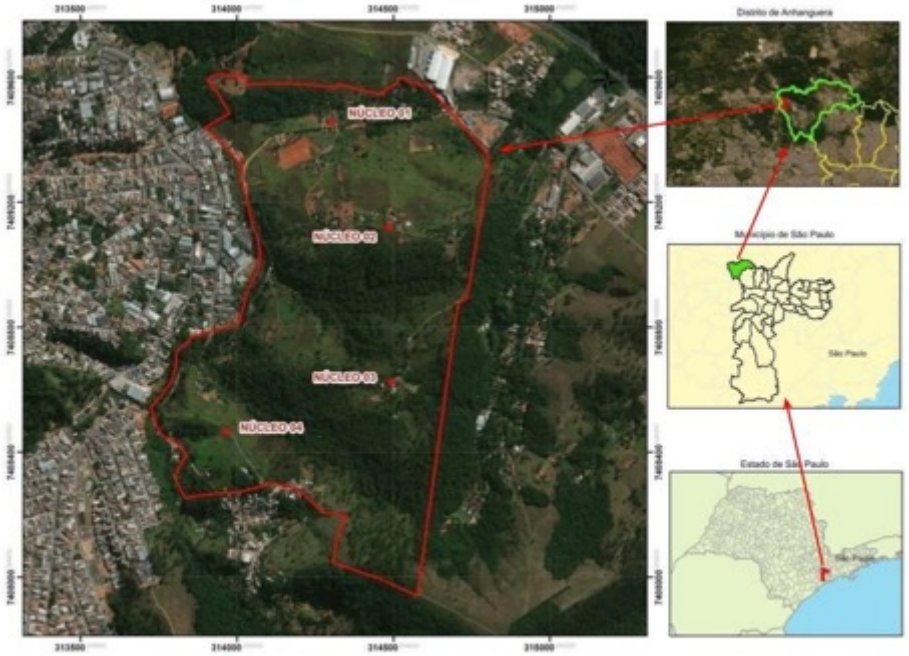
Material and methods

Characterization of the study area

The study was carried out in the Comuna da Terra Irmã Alberta, a pre-settlement of the agrarian reform established in 2002 by the Movimento do Trabalhadores Rurais Sem Terra (MST). The Comuna is located in the region of Perus, in the City of São Paulo (Figure 1), close to the borders of the municipalities of Cajamar and Santana do Parnaíba, in an area whose rural property was called

Fazenda Itahyê (São Paulo 1998). Because the surroundings of the Comuna da Terra Irmã Alberta have industries, logistics sheds, agglomerations of precarious housing and small ranches, the spatial context is defined as periurban (Do Vale and Gerardi 2006), marked by the mix between rural and urban activities, a transition zone between city and countryside. The site, located under the domain of the Atlantic Forest biome, has the so-called Humid Tropical Climate of Alto Juqueri, with rainfall records approximately between 1440 and 1800 mm, average temperature of 19.5˚C and altitudes that fluctuate from 720 to 800 meters above sea level (Tarifa and Armani 2001).

Figure 1. Spatial location map of the Comuna da Terra Irmã Alberta, indicating the Anhanguera district within the municipality of São Paulo, capital of the State of São Paulo.



The Comuna da Terra Irmã Alberta occupies a total area of 109 hectares (Catarucci 2014), divided into 4 nuclei, with physiographic distinctions between them, providing farmers with different conditions in terms of topography and water availability. Also known as Camp Irmã Alberta among the inhabitants, activists and sympathizers of the social movement, this commune originated from popular demonstrations against the plans of SABESP (São Paulo State Basic Sanitation Company) to use the then abandoned area of former Itahyê Farm, for the final disposal of sludge from public sewage effluent treatment stations. Such protests were endorsed by the MST, which started to demand the allocation of the land for agrarian reform, which culminated in the peaceful occupation of the area by approximately 200 families in July 2002 (Raggi 2014).

With the extension of bureaucracies and legal conflicts between SABESP and INCRA (National Institute of Colonization and Agrarian Reform - Brazil) for the definitive land title regularization of the area, in 2007 the community itself organized to allocate collective areas, housing and production and also those for environmental protection, it was agreed that 37 lots would be established (Raggi 2014). About 40% of the Comuna's total area was earmarked for environmental conservation, half of which as a Legal Reserve and the other part as a Permanent Preservation Area – the latter due to

the presence of springs and water bodies in the territorial limits of the property, as per governs the relevant environmental legislation (Catarucci 2014).

From this self-demarcation, even with scarce resources and no government support, the families were able to start their agricultural production, initially only for self-consumption, but over time they also started to commercialize the surpluses, currently cultivating a great diversity of species (Silva et al. 2019). Over the years, however, the general infrastructure has remained precarious, including in terms of housing. Each family plot remained with an area corresponding to half a hectare, much smaller than the standard size of plots in rural settlements throughout Brazil. Smaller lots are a typical feature of Comunas da Terra, located close to large urban centers.

In a survey carried out by Raggi (2014) between 2011 and 2012, in the group of collective areas and family plots, conventional agricultural management practices and others arising from agroecological production systems were found. The studies by Silva et al. (2019) recorded the characterization of agroforestry backyards in many of the lots visited, pointing to more ecological agricultural practices, which were encouraged by the social movement itself (MST), which, in recent times, has proposed agroecology as a practice in the territories.

Sampling and interviews

This research is characterized as exploratory, involving a bibliographic survey and a case study with an interview. The research project was submitted, through Plataforma Brasil, to the Ethics Committee for Research with Human Beings (CEP) of UFSCar - being approved with obtaining the Certificate of Presentation of Ethical Appreciation (CAAE) number 85910718.5.0000.5504. During the research, the Informed Consent Term (TCLE) was used, which clarified the research purposes and was signed by the interviewed people. The sampling followed the snowball method, which uses reference chains (Vinuto 2014), which is not probabilistic. Therefore, for convenience, interviews with the local leadership of the studied community were started (Gil 2008), who suggested the next informant(s) and so on. Nine families in total were interviewed.

The methodological process and respective stages of data collection and analysis took place between June and September 2018, when individual semi-structured interviews were carried out (Gaskel 2008). A family member from each of these lots was interviewed using a pre-established script, covering topics such as family history, sources of income, soil quality, water availability and perception of the benefits provided by nature. A guided crossing was also carried out on each visit (Geilfus 2002) by the interviewees for general recognition of the lots and their configuration in terms of structure and composition. From the notes of the visit, an adapted discourse analysis (Gill 2008) was performed, in which the mentioned ES were assigned grades from 1 to 3 according to the respective degree of depth provided by each respondent (not quoted - 0; only quoted – 1; quoted and commented on – 2; quoted, commented on and explained – 3). From this, the scores attributed to the perception of each ES descriptor were systematized according to the matrix proposed by De Groot, Wilson and Boumans (2002).

Data analysis

To analyze the respondents' perception of ES, the scores assigned to each descriptor were plotted in a score x descriptor matrix for each interviewed family. To verify the similarity of the answers

between the interviewees, the UPGMA hierarchical cluster analysis was applied using the Euclidean distance as a measure of linkage, considering the highest cophenetic? adjustment. A cut-off line was defined for the recognition of similar groups between groups situated below 50% of the total distance (Gotelli and Ellison 2011). Statistical analyzes were performed using the PAST 3.0 application (Hammer et al. 2001).

Results and discussion

The guided crossings carried out during visits to the lots allowed the observation of the following characteristics in the lots: the creation of small domestic animals; high diversity of cultivated plant species; presence of different vertical strata in the vegetation; proximity to the residence; predominantly family labor (almost exclusively); mix of distinct contiguous management areas (garden, orchard, vegetable garden, garden, access and passage routes, etc.); plants of different sizes (arboreal, shrubby and herbaceous) with different types of use: food, medicinal, ornamental, firewood and reforestation. These aspects of the plots are typical of agroforestry backyards, and therefore can be classified as such (Silva et al. 2019).

Most of the people interviewed have jobs outside the community, in the city, in parallel with their dedication to the management of backyards. All people informed that they were born in small towns or rural areas in the interior of the country, however, they lived in large urban centers before coming to the Commune. They also reported that, when they arrived there, the areas of the current lots were constituted by degraded pasture and had little or no presence of regenerating trees.

Around the houses, plants of different sizes and characteristics are cultivated, and with different functions, such as food, medicine, firewood, visual beauty, shade and others, constituting what is referred to in the scientific literature as agroforestry yards. The management that has been adopted in the area of the Comuna da Terra Irmã Alberta fulfills socio-environmental functions that are much more suited to the existing instruments of territorial planning than the previous government intentions to establish there a site for the disposal of sludge from urban effluent treatment plants.

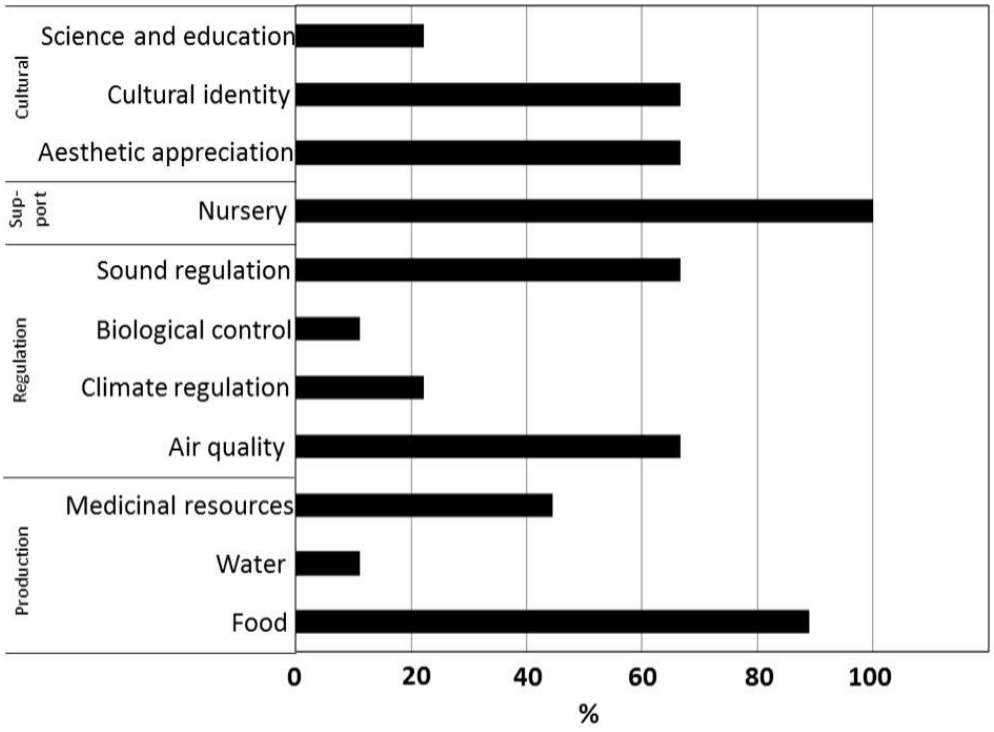
Regarding the availability of water (Table 1), the opinions of respondents were heterogeneous because each location within the Comuna (nucleus) presents a specific situation of access to water. As for the soil quality, the interviewees tended to consider it good.

Table 1. Number of respondents per nucleus, their opinions on soil quality and water availability (L = low; R = regular; H = high) at the site and how many have work outside the Comuna da Terra Irmã Alberta, Perus, municipality of São Paulo, SP.

Nucleus	Number of respondents	Have outside work	Soil quality			Water availability		
			L	R	H	L	R	H
1	2	1	0	1	1	1	0	1
2	4	2	0	1	3	2	2	0
3	1	1	0	0	1	0	0	1
4	2	2	1	1	0	0	1	1
Total	9	6	1	3	5	3	3	3

As for the perception of ES, the results pointed to the citation of 11 distinct ES (Figure 2), with an average of 6 perceived ecosystem services, and an average cumulative score of 7.33. The most frequent ES were "cultural identity" and "nursery", mentioned by all respondents, and "food", in which only one farmer didn´t show perception.

Figure 2. Frequency of citations to each ecosystem service by family farmers from the Comuna da Terra Irmã Alberta, municipality of São Paulo, SP (n=9).



The perception of ES related to cultural identity (Figure 2) was considered when respondents demonstrated satisfaction with their backyards and living in that landscape. This may result from the combination of family trajectories and the personal and collective desires of the social movement linked to this community, which provides the development of a strong sense of belonging to the place.

The perception of the nursery ES was demonstrated by all respondents, in most cases mentioning the presence of avifauna. This may be an indication that the environment of the Comuna da Terra Irmã Alberta and its agroforestry yards fulfill a relevant ecological function of shelter and nesting of wild animals, despite being inserted in a periurban landscape, with marked anthropic interventions and, therefore, with low availability of viable habitats for wildlife. This observation was corroborated in the research by Uezu, Beyer and Metzger (2008), in which the positive ecological role of agroforestry plots was verified in promoting connectivity between forest fragments for birds, in a landscape predominantly composed of pastures in the west of São Paulo, also in the Atlantic Forest biome.

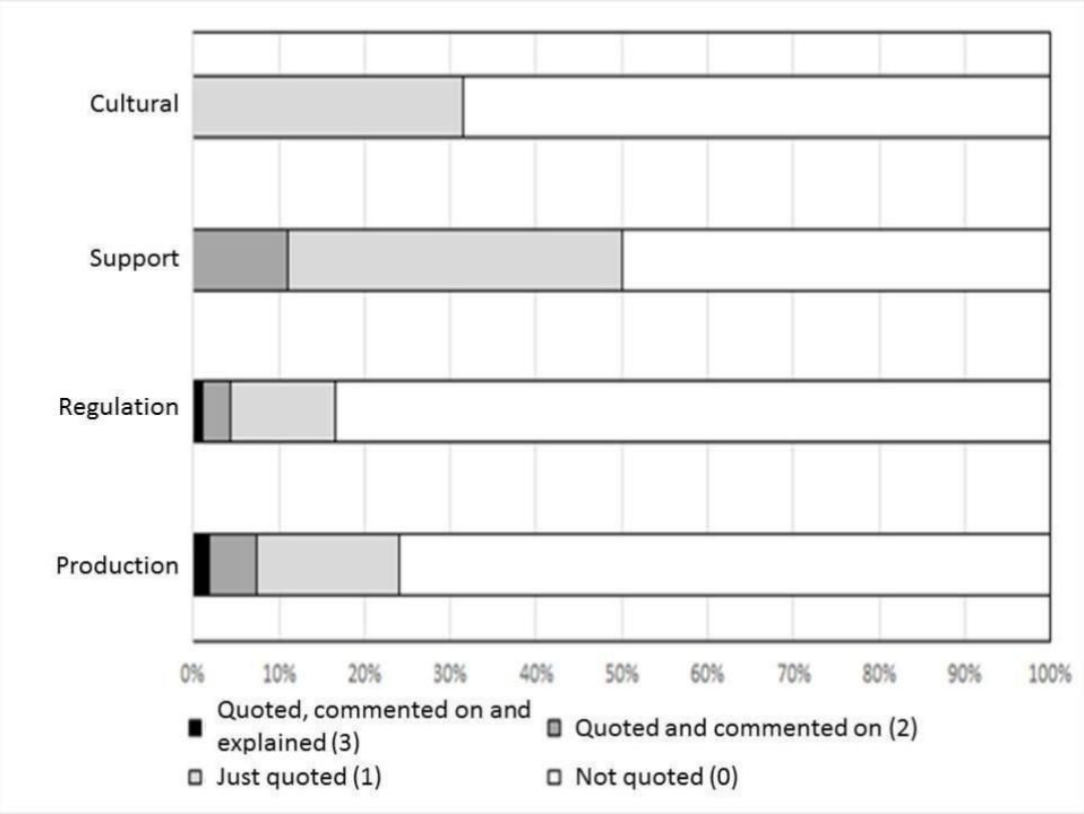
Food security was one of the ES that presented the highest frequency of citations by respondents, who cultivate and consume various plant varieties in their agroforestry yards at all times of the year.

However, knowledge about medicinal plants was mentioned only half of the time (n=4) in which food was mentioned (n=8).

On the other hand, the ES of aesthetic appreciation, air quality and sound regulation were mentioned in 6 of the 9 interviews, possibly because the interviewees had lived long periods in urban centers before settling in this Commune and, therefore, currently value these benefits typically rural or related to green areas. It is important to mention that the ES "sound regulation" was not included in the relationship adopted to systematize perceptions (De Groot et al. 2002), which was the only insertion made in the matrix.

Considering the ES categories that were most perceived, the results highlight those ES related to the Culture and Regulation functions, which, throughout the interviews, were mentioned 17 and 15 times, respectively. However, when analyzing the frequencies of services mentioned in proportion to the respective ES categories, there were more citations of those related to Support and Culture (Figure 3). Regulation was, proportionally, the function with the least ES mentioned by the interviewees.

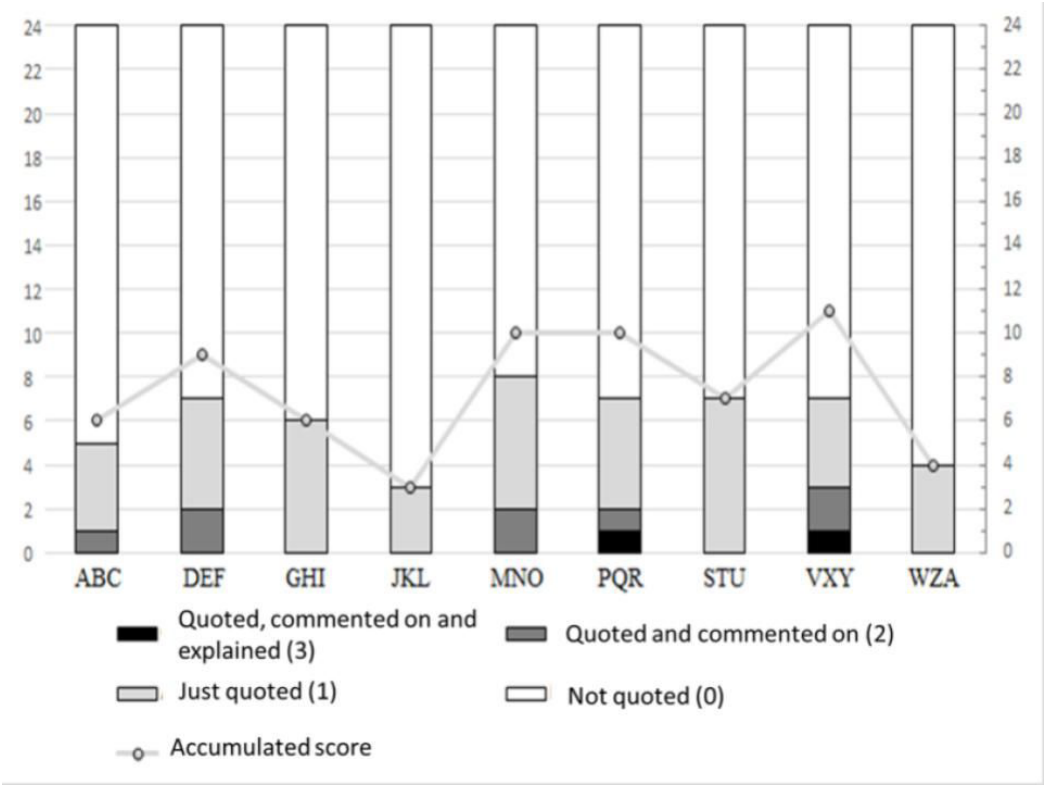
Figure 3. Proportion of points attributed to the perception of respondents from the Comuna da Terra Irmã Alberta, municipality of São Paulo, SP, regarding ecosystem services, by category.



The score accumulated by each respondent (Figure 4) reveals that most of the total ES perceived during the interviews (n=54) were only cited (n=44), while only eight ES perceived were cited with comments, and only two interviewees cited, commented and explained one ES each (n=2). This can be explained by the characteristics of the method applied to obtain the information, by the low number of participants, or by the fact that the interviewees lived in urban environments before

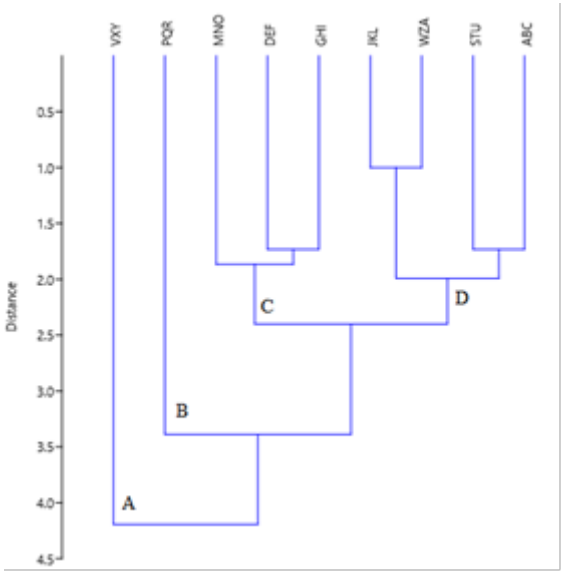
arriving in the commune, with little experience in working with the land, or because they had paid jobs formal or informal, in the city, being the management practiced on the lot to supplement income or simply for self-consumption.

Figure 4. Cumulative score regarding the perception of ES by each respondent from the Comuna da Terra Irmã Alberta, municipality of São Paulo, SP, with the frequency of the grades obtained. Vertical axis: number of citations; horizontal axis: identification acronyms of respondents.



Four main groups were formed in relation to the perception of ecosystem services by farmers (Figure 5), which demonstrates great diversity in the responses obtained. The first group (A) was formed by the respondent who accumulated the highest sum of ES perception scores within the sample, being also the one who most commented on them. The second group (B), on the other hand, was composed of the respondent who has lived in the studied site for less time, whose demonstrated perception was also above average (7.33). The third grouping (C) consisted of three interviewees who demonstrated a level of perception above the average, of which two do not have parallel work outside the Comuna, and thus end up carrying out more management activities in their lots. The fourth group (D) was characterized by the presence of four interviewees, one from each nucleus of the Comuna, who only mentioned the perceived ES, without demonstrating knowledge about them.

Figure 5. Dendrogram obtained from the cluster analysis (UPGMA/Euclidean, cophenetic coefficient of 0.9222) according to the scores assigned to the perception of ecosystem services (ES) according to the interviews carried out (n = 9).



Overall, the total number of ES perceived by the people interviewed in the Comuna da Terra Irmã Alberta was lower compared to previous surveys carried out in other agricultural communities in the state of São Paulo. In Iperó, for example, there was a total of 25 perceived ES, with an average frequency of 9.4 per respondent (Buquera 2015), while in Ubatuba there were 36 perceived ES (Kadry 2017). In Ilha do Cardoso, respondents also demonstrated a perception of 25 ES (Jericó-Daminello, 2014). In Santa Catarina, also under the domain of the Atlantic Forest biome, 23 ES were perceived (Garcia Alarcon et al. 2016).

These higher numbers of ES perceived in the studies cited before those measured in this study can be explained, among other factors, by the greater proximity of each community to massive forests, profile of farmers, education level, sample size and by the characteristics of the methodologies employed. It is also worth noting that, because the perception of ES is influenced by cultural, socioeconomic, types of land use among others (Zhang et al. 2016), any comparative assessment requires careful consideration of these aspects, as well as the methodologies employed in each search.

It is interesting to note that the VXY and PQR farmers highlighted (Groups A and B) in the UPGMA/Euclidean analysis withdraw their monthly income from the production of the lot and that they are more involved in agroecological formation, which may explain the greater clarification regarding the perception of the ES. In Buquera et al. (2018), where we observed a greater perception of ecosystem services than in this study, that some farmers participating in the research had attended the National Program for Education in Agrarian Reform (PRONERA), and almost all belonged to some organic product certification group. And this suggests that advances in agroecological practices can facilitate the perception of the ES, as well as the better perception of the ES can facilitate the adoption of conservation practices, in a virtuous circle.

The conceptual approach to the perception of ES can contribute to the design of public policies aimed at improving the management of periurban landscapes, which are often neglected, but whose agricultural activities are capable of providing at least 19 different ecosystem services of the four

major types (Calvet-Mir et al. 2012; Jose 2009) and thus improve the environmental quality and living conditions of many communities in a situation of socio-environmental vulnerability.

The scientific literature indicates that the following variables can influence the perception, knowledge and awareness of the ES (Table 3): socioeconomic profile, gender, level of education, cultural heritage and spatial context. In Spain, for example, it was found that in rural areas people are more aware of ES related to production, while in urban areas they tend to appreciate cultural and regulatory services more (Martín-Lopez et al. 2012). In addition to the different local characteristics, the very concept of Ecosystem Services still depends on a greater consensus, as do the methodologies used in the perception studies of the ES, and going deeper, the Science of Sustainability itself still demands standardized methodologies to advance in their analysis (Janker and Mann 2020).

In the present study, in a periurban reality, the number of mentions to the Production category was lower than the amount referring to the other categories, which may indicate that the interviewees have a non-utilitarian view of nature and the environment. Or even be explained by the fact that many of the interviewees do not obtain income from the lots, but from paid work in urban areas. However, this hypothesis needs further studies with this focus of analysis to be confirmed or discarded.

In a survey conducted in Zanzibar, Fagerholm et al. (2012) identified that the distance between the interviewees' residence and the landscape elements that provide SE was a relevant indicator of the influence of spatial patterns on the perception of ES. In this line, people who live close to significant forest remnants tend to perceive many ecosystem services (Sodhi et al. 2010). However, another study carried out in Java indicates that considering only the ES of the production category (direct services), the place of residence did not influence people's perception (Muhamad et al. 2014). Therefore, the distance of respondents to the environment that provides the ES can be a hypothesis that contributes to the analysis of the results found in this study.

People immersed in sociocultural contexts present perceptions based not only on their sensations, but also on their historical background and socially determined standards (Gonçalves and Gomes 2014). The urban life prior to going to the commune or carrying out external work in the city by the residents of the Comuna da Terra Irmã Alberta (Raggi 2014) can also be a hypothesis that would explain a lower perception presented by the interviewed residents, for example, how much to the ES in the Regulation category, whose services are commonly the least perceived by people compared to the other categories.

In addition, one must also consider the complexity inherent in evaluating which ES farmers really perceive, since their relationships of interpretation, reading and intervention in nature are based on a complex composed of the belief system - kosmos, the body of knowledge – corpus, and productive practices – praxis (Toledo and Barrera-Bassols 2015), suggesting a feedback between more ecological agricultural practices and a greater perception of the ES, which constitutes an object of study whose interpretation is challenging, but as already pointed out by Buquera et al. (2018) "the more aware of the Ecosystem Services, the more farmers are able to carry out the agroecological transition".

The approach to the perception of ES by periurban farmers proved to be relevant and should be deepened, as it can contribute to a better understanding of the human-environment interaction in transition zones between urban and rural areas, in which work on the land is often divided with paid jobs in urban centers. The assessment of the perception of ES that people actually have is a complex object of study, requiring methodological innovations for its measurement. Nevertheless,

the perception that a person has about ES is influenced, on the one hand, by sociocultural aspects such as education, life history, personal feelings and culture, and on the other hand, by the proximity to the source ecosystems of the ES from which they benefit, its characteristics and the spatial context in which they are inserted, as its elements compose a mosaic of the landscape with anthropic interventions, whose characteristics can highlight or hide this or that ecosystem service, depending on its dimensions, typologies and degree of conservation.

The general understanding of farmers' perception of ES is still relatively low, if we analyze them conceptually (Teixeira et al. 2018; Smith and Sullivan 2014). However, although few farmers know the term and definition of ecosystem services (Smith and Sullivan 2014; Logsdon et al. 2015), many recognize, in their daily life, the benefits arising from the healthy functioning of ecosystems. In general, the perception of ES by farmers is complex (Teixeira et al. 2018). In an area of Atlantic Forest, Silvano et al. (2005) found that the interviewed farmers perceive and recognize some, but not all of the ecosystem services provided by forests.

Finally, we highlight the importance of the ES perception for the effectiveness of agroecological transition processes, which can contribute to better socio-environmental and economic conditions, but which depends on an extensive network of collaborations between farmers and consumers (Altieri and Nicholls 2020). And for Caporal (2020), the agroecological transition will only take place after the transformation of agrifood systems, based on food sovereignty and socio-environmental sustainability.

Conclusions

The constituted agroecosystems were characterized as agroforestry backyards, which contribute in various aspects to the quality of life in periurban regions. Residents of the Comuna da Terra Irmã Alberta presented a perception of ecosystem services in all categories, the most cited SE were "nursery", "cultural identity", "food", "sound regulation", "aesthetic enhancement" and "air quality". Perception of ecosystem services by peri-urban farmers was considered low, compared to other studies in other sociocultural and spatial contexts, and a greater relative perception of the SE regarding the Support and Culture categories, in relation to the production SE. The perception demonstrated by people involved in agroecological movements scored higher, demonstrating a possible relationship between agroecological practices, environmental perception and aptitude for agroecological transition, which is a very promising field for further research.

Acknowledgements

The authors are immensely grateful to all farmers (men and women) of the Comuna da Terra Irmã Alberta for giving their precious time and contributing to this work.

Authors' contributions: DMBS – research planning and design, fieldwork, literature review, data processing and analysis, manuscript preparation; CJFOJ - research planning and design, fieldwork, literature review, data analysis and manuscript preparation.

Compliance with ethical standards: The research project was submitted, through Plataforma Brasil, to the Ethics Committee for Research with Human Beings (CEP) of UFSCar - being approved with obtaining the Certificate of Presentation of Ethical Appreciation (CAAE) number 85910718.5.0000.5504.

Data availability: Data in the repository UFSCar/PPG em Agroecologia e Desenvolvimento Rural - UNIVERSIDADE FEDERAL DE SÃO CARLOS - https://repositorio.ufscar.br/handle/ufscar/11737?show=full

Funding information: Instituto de Botânica (SIMA-SP) (Actual Instituto de Pesquisas Ambientais).

Conflict of interests: The authors declare that they have no conflict of interest.

References

Abram NK, Meijaard E, Ancrenaz M, Runting RK, Wells JA, Gaveau D, Pellier AS, Mengersen K. 2014. Spatially explicit perceptions of ecosystem services and land cover change in forested regions of Borneo. Ecosystem Services 7:116-127. DOI: https://doi.org/10.1016/j.ecoser.2013.11.004

Altieri MA, Nicholls CI. 2020. Agroecology: challenges and opportunities for farming in the Anthropocene. International Journal of Agriculture and Natural Resources 47(3):204-215. DOI: http://dx.doi.org/10.7764/ijanr.v47i3.2281

Altieri MA, Nicholls CI, Henao A, Lana MA. 2015. Agroecolgy and the design of climate change-resilient farming systems. Agronomy for Sustainable Development 35:869-890. DOI: https://doi.org/10.1007/s13593-015-0285-2

Andrade DC, Romeiro AR. 2013. Valoração de serviços ecossistêmicos: por que e como avançar? Sustainability in Debate 4(1):43-58. DOI: https://doi.org/10.18472/SustDeb.v4n1.2013.9199

Antognelli S, Vizzari M. 2017. Landscape liveability spatial assessment integrating ecosystem and urban services with their perceived importance by stakeholders. Ecological Indicators 72:703-725. DOI: https://doi.org/10.1016/j.ecolind.2016.08.015

Asah ST, Guerry AD, Blahna DJ, Lawler JJ. 2014. Perception, acquisition and use of ecosystem services: Human behavior, and ecosystem management and policy implications. Ecosystem Services 10:180-186. DOI: https://doi.org/10.1016/j.ecoser.2014.08.003

Barrena J, Nahuelhual L, Báez A, Schiappacasse I, Cerda C. 2014. Valuing cultural ecosystem services: Agricultural heritage in Chiloé island, southern Chile. Ecosystem Services 7:66-75. DOI: https://10.1016/j.ecoser.2014.08.003

Benayas JMR, Bullock JM. 2012. Restoration of biodiversity and ecosystem services on agricultural land. Ecosystems 15(6):883-899. DOI: https://doi.org/10.1007/s10021-012-9552-0

Bennett EM, Cramer W, Begossi A, Cundill G, Díaz S, Egoh BN, Geijzendorffer IR, Krug CB, Lavorel S, Lazos E, Lebel L, Martín-López B, Meyfroidt P, Mooney HA, Nel JL, Pascual U, Payet K, Harguindeguy NP, Peterson GD, Prieur-Richard AH, Reyers B, Roebeling P, Seppelt R, Solan M, Tschakert P, Tscharntke T, Turner-Ii BL, Verburg PH, Viglizzo EF, White PCL, Woodward G. 2015. Linking biodiversity, ecosystem services, and human well-being: three challenges for designing research for sustainability. Current Opinion in Environmental Sustainability 14:76-85. DOI: https://doi.org/10.1016/j.cosust.2015.03.007

Bommarco R, Kleijn D, Potts SG. 2013. Ecological intensification: harnessing ecosystem services for food security. Trends in Ecology & Evolution 28(4):230-238. DOI: https://doi.org/10.1016/j.tree.2012.10.012

Buquera RB, Silveira FF, Schlindwein MN, Marques PEM. 2018. A agroecologia e os serviços ecossistêmicos: um estudo de caso nos assentamentos do município de Iperó/SP. Revista Brasileira de Agroecologia 13(31):101-113.

Calvet-Mir L, Gómez-Baggethun E, Reyes-García V. 2012. Beyond food production: Ecosystem services provided by home gardens. A case study in Vall Fosca, Catalan Pyrenees, Northeastern Spain. Ecological Economics 74:153-160. DOI: https://doi.org/10.1016/j.ecolecon.2011.12.011

Caporal FR. 2020. Transição agroecológica e o papel da extensão rural. Extensão Rural 27(3):7-19. DOI: https://doi.org/10.5902/2318179638420

Catarucci AFM. 2014. A produção do homem e da natureza no campo: a Comuna da Terra "Irmã Alberta' na reorganização da dinâmica da paisagem e seu inverso. Dissertação. Universidade de São Paulo. 341p. DOI: https://10.11606/D.8.2014.tde-28112014-165047

Clark WC, Dickson NM. 2003. Sustainability science: the emerging research program. Proceedings of the National Academy of Sciences 100(14):8059-8061. DOI: https://doi.org/10.1073/pnas.1231333100

Cuni-Sanchez A, Pfeifer M, Marchant R, Burgess ND. 2016. Ethnic and locational differences in ecosystem service values: Insights from the communities in forest islands in the desert. Ecosystem Services 19:42-50. DOI: https://doi.org/10.1016/j.ecoser.2016.04.004

De Groot RS, Wilson MA, Boumans RMJ. 2002. A typology for the classification, description and valuation of ecosystem functions, goods and services. Ecological Economics 41(3):393-408. DOI: https://doi.org/10.1016/S0921-8009(02)00089-7

Do Vale AR, Gerardi LHO. 2006. Crescimento urbano e teorias sobre o espaço periurbano: analisando o caso do município de Araraquara (SP). In: Gerardi LHO, Carvalho PF (Org.). Geografia: ações e reflexões. Rio Claro: UNESP/IGCE: AGETEO, p. 231-246.

Fagerholm N, Käyhköa N, Ndumbaro F, Khamis M. 2012. Community stakeholder's knowledge in landscape assessments–mapping indicators for landscape services. Ecological Indicators 18:421-433. DOI: https://doi.org/10.1016/j.ecolind.2011.12.004

Gaskell G. 2008. Entrevistas individuais e grupais. In: Bauer MW, Gaskell G. Pesquisa qualitativa com texto, imagem e som: um manual prático. 7a ed. Petrópolis, RJ: Vozes, p. 64-89.

Geilfus F. 2002. 80 herramientas para el desarrollo participativo: diagnóstico, planificación, monitoreo, evaluación. San José, Costa Rica: IICA, 218 p.

Gil AC. 2008. Métodos e técnicas de pesquisa social. 6. ed. São Paulo: Editora Atlas SA. 200 p.

Gill R. 2008. Análise de discurso. In: Bauer MW, Gaskell G. 2008. Pesquisa qualitativa com texto, imagem e som: um manual prático. 7a ed. Petrópolis, RJ: Vozes. p. 244-70.

Gonçalves BV, Gomes LJ. 2014. Percepção ambiental de produtores rurais na recuperação florestal da sub-bacia hidrográfica do rio Poxim–Sergipe. Desenvolvimento e Meio Ambiente 29: 127-138. DOI: http://dx.doi.org/10.5380/dma.v29i0.32327

Gotelli NJ, Ellison AM. 2011. Princípios de estatística em ecologia. Porto Alegre: Artmed Editora, 528 p.

Hammer Ø, Harper DAT, Ryan PD. 2001. Past: paleontological statistics software package for education and data analysis. Palaeontologia Electronica 4(1):1-9.

Janker J, Mann S. 2020. Understanding the social dimension of sustainability in agriculture: a critical review os sustainability assessment tools. Environment, Development and Sustainability 22:1671-1691. DOI: https://doi.org/10.1007/s10668-018-0282-0

Jose S. 2009. Agroforestry for ecosystem services and environmental benefits: an overview. Agroforestry Systems 76(1):1-10. DOI: https://doi.org/10.1007/s10457-009-9229-7

Kadry VO. 2017. Percepção de serviços ecossistêmicos por agricultores familiares em transição agroecológica e sua contribuição para a conservação. Dissertação. Universidade Federal de São Carlos, 55 p.

Kadry VO, Pina-Rodrigues FCM, Piratelli AJ. 2017. Percepção de agricultores familiares de Ubatuba – SP sobre serviços ecossistêmicos. Biotemas 30(4): 101-115. DOI: http://dx.doi.org/10.5007/2175-7925.2017v30n4p101

Kumar M, Kumar P. 2008. Valuation of the ecosystem services: a psycho-cultural perspective. Ecological Economics 64(4):808-819. DOI: https://doi.org/10.1016/j.ecolecon.2007.05.008

Logsdon RA, Kalcic MM, Trybulac EM, Chaubey I, Frankenberger JR. 2015. Ecosystem services and Indiana agriculture: farmer's and conservationist's perceptions. International Journal of Biodiversity Science, Ecosystem Services & Management 11(3):264-282. DOI: https://doi.org/10.1080/21513732.2014.998711

Lunelli NP, Ramos SF, Oliveira-Jr CJF. 2013. Agroflorestas e externalidades. Revista Verde de Agroecologia e Desenvolvimento Sustentável 8(5):163-170.

Macedo BN, Comas FN, Gallardo ALCF. 2021. Serviços e desserviços ambientais associados à agricultura urbana e periurbana no município de São Paulo. Journal of Urban Technology and Sustainability 4: 1-12. DOI: https://doi.org/10.47842/juts.v4i1.35

Machado LCP, Machado Filho LCP. 2014. Dialética da agroecologia. São Paulo: Editora Expressão Popular, 360 p.

Martín-López B, Iniesta-Arandia I, García-Llorente M, Palomo I, Casado-Arzuaga I, Del Amo DG, Gómez-Baggethun E, Oteros-Rozas E, Palacios-Agundez I, Willaarts B, González JA, Santos-Martín F, Onaindia M, López-Santiago C, Montes C. 2012. Uncovering ecosystem service bundles through social preferences. PLoS one 7(6):e38970. DOI: https://doi.org/10.1371/journal.pone.0038970

Mazouer M, Roudart L. 2009. História das agriculturas no mundo: do neolítico à crise contemporânea. Trad. Ferreira CFFB. Editora Unesp, São Paulo. 568 p.

MEA (Millennium Ecosystem Assessment). 2005. Ecosystems and Human Well-Being: Synthesis. Island Press, Washington, DC: USA, 155 p.

Molina MG, Caporal FR. 2013. Agroecología y política. ¿Cómo conseguir la sustentabilidad? sobre la necesidad de una agroecologia política. Agroecología 8(2):35-43.

Moran EF. 2009. Interações homem-ambiente em ecossistemas florestais: uma introdução. In: Moran EF, Ostrom E. Ecossistemas florestais: interação homem-ambiente. São Paulo: Senac, p.19-40.

Moran EF. 2011. Meio ambiente e ciências sociais: interações homem-ambiente e sustentabilidade. São Paulo: Senac, 307 p.

Muhamad D, Okubo S, Harashina K, Parikesit, Gunawan B, Takeuchi K. 2014. Living close to forests enhances people's perception of ecosystem services in a forest–agricultural landscape of West Java, Indonesia. Ecosystem Services 8:97-206. DOI: https://doi.org/10.1016/j.ecoser.2014.04.003

Nicholls CI, Altieri MA, Vasquez L. 2016. Agroecology: principles for the conversion and redesign of farming systems. Journal of Ecosystem & Ecography S5(10):1-8. DOI: https://10.4172/2157-7625.S5-010

Oliveira Jr CJF, Santos JL, Maximo HC. 2014. A agroecologia e os serviços ambientais. Nature and Conservation 7(1):19-32. DOI: https://doi.org/10.6008/SPC2318-2881.2014.001.0002

Oliveira Jr CJF, Santana SS. 2020. Sustentabilidade e diversidade vegetal em agroecossistemas no município de Bragança Paulista, São Paulo. Revista Verde de Agroecologia e Desenvolvimento Sustentável 15(1):28-39. DOI: https://doi.org/10.18378/rvads.v15i1.6810

Parada SP, Salas CB. 2018. Democratizando el consumo ecológico: elementos para la acción y aprendizaje colectivo en procesos de investigación acción participativa. Agroecología 13(1):57-69.

Power AG. 2010. Ecosystem services and agriculture: tradeoffs and synergies. Philosophical Transactions of the Royal Society of London B: Biological Sciences 365(1554):2959-2971. DOI: https://doi.org/10.1098/rstb.2010.0143

Raggi RV. 2014. O outro lado da metrópole: as Comunas da Terra da região metropolitana de São Paulo. Tese. Faculdade de Arquitetura e Urbanismo, Universidade de São Paulo, São Paulo, 198 p. DOI: https://10.11606/T.16.2014.tde-29072014-170607

Randolph JC, Green MG, Jonathan B, Burcsu T, Welch D. 2009. Ecossistemas florestais e as dimensões humanas. IN: Moran EF, Ostrom E. Ecossistemas Florestais: interação homem-ambiente. São Paulo: Ed. Senac, p. 139-164.

Salas-Zapata WA, Ríos-Osorio LA, Cardona-Arias JA. 2017. Methodological characteristics of sustainability science: a systematic review. Environ Dev Sustain 19:1127–1140. DOI: https://doi.org/10.1007/s10668-016-9801-z

Sandhu HS, Wratten SD, Cullen R. 2007. From poachers to gamekeepers: perceptions of farmers towards ecosystem services on arable farmland. International Journal of Agricultural Sustainability 5(1):39-50. DOI: https://doi.org/10.1080/14735903.2007.9684812

São Paulo (Estado). Decreto nº 43.124, de 25 de maio de 1998. Declara de utilidade pública, para fins de desapropriação, imóveis situados no Bairro denominado Vila Maria Trindade, Distrito de Perus, Zona Rural ("Z.8-100/1" e "Z.8-W0/4") do Município e Comarca de São Paulo, necessários a Companhia de Saneamento Básico do Estado de São Paulo – SABESP. Diário Oficial do Estado de São Paulo: Executivo, São Paulo, SP, v. 108, n. 98, p. 1, 26 mai. 1998.

Scholte SSK, Van Teeffelen AJA, Verburg PH. 2015. Integrating socio-cultural perspectives into ecosystem service valuation: a review of concepts and methods. Ecological Economics 114:67-78. DOI: https://doi.org/10.1016/j.ecolecon.2015.03.007

Silva DMB, Oliveira Jr CJF, Piña-rodrigues FCM. 2019. Diversidade de cultivos vegetais em assentamento periurbano em São Paulo, SP. IX Jornada de Estudos em Assentamentos Rurais. FEAGRI-UNICAMP.

Silvano RAM, Udvardyb S, Ceronic M, Farleyd J. 2005. An ecological integrity assessment of a Brazilian Atlantic Forest watershed based on surveys of stream health and local farmers' perceptions: implications for management. Ecological Economics 53(3):369-385. DOI: https://doi.org/10.1016/j.ecolecon.2004.12.003

Smith HF, Sullivan CA. 2014. Ecosystem services within agricultural landscapes – Farmer's perceptions. Ecological Economics 98:72-80. DOI: https://doi.org/10.1016/j.ecolecon.2013.12.008

Sodhi NS, Lee TM, Sekercioglu CH, Webb EL, Prawiradilaga DM, Lohman DJ, Pierce NE, Diesmos AC, Rao M, Ehrlich PR. 2010. Local people value environmental services provided by forested parks. Biodiversity and Conservation 19(4):1175-1188. DOI: https://doi.org/10.1007/s10531-009-9745-9

Tarifa JR, Armani G. 2001. Os climas naturais. In: Tarifa JR, Azevedo TR (org.). Os climas da cidade de São Paulo. São Paulo: Novos Caminhos, p. 34-70.

Teixeira HM, Vermuea AJ, Cardoso IM, Claros MP, Bianchi FJJA. 2018. Farmers show complex and contrasting perceptions on ecosystem services and their management. Ecosystem Services 33:44-58. DOI: https://doi.org/10.1016/j.ecoser.2018.08.006

Tilman D, Cassman KG, Matson PA, Naylor R, Polasky S. 2002. Agricultural sustainability and intensive production practices. Nature 418:671–677. DOI: https://doi.org/10.1038/nature01014

Toledo VM, Barrera-Bassols N. 2015. A memória biocultural: a importância ecológica das sabedorias tradicionais. 1 ed. São Paulo: Expressão Popular, 225p.

Uezu A, Beyer DD, Metzger JP. 2008. Can agroforest woodlots work as stepping stones for birds in the Atlantic Forest region? Biodiversity and Conservation 17(8):1907-1922. DOI: https://doi.org/10.1007/s10531-008-9329-0

Vinuto J. 2014. A amostragem em bola de neve na pesquisa qualitativa: um debate em aberto. Temáticas 22(44):203-220. DOI: https://doi.org/10.20396/tematicas.v22i44.10977

Wilhelm JA, Smith RG. 2018. Ecosystem services and land sparing potential of urban and peri-urban agriculture: A review. Renewable Agriculture and Food Systems 33(5):481-494. DOI: https://doi.org/10.1017/S1742170517000205

Zhang W, Ricketts TH, Kremen C, Carney K, Swinton SM. 2007. Ecosystem services and dis-services to agriculture. Ecological Economics 64(2):253-260. DOI: https://doi.org/10.1016/j.ecolecon.2007.02.024

Zhang W, Kato E, Bhandary P, Nkonya E, Ibrahimc HI, Agbonlahord M, Ibrahim HY, Cox C. 2016. Awareness and perceptions of ecosystem services in relation to land use types: Evidence from rural communities in Nigeria. Ecosystem Services 22:150-160. DOI: https://doi.org/10.1016/j.ecoser.2016.10.011