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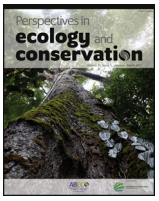

Essays and Perspectives

Perspectives for environmental conservation and ecosystem services on coupled rural–urban systems

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ABSTRACT

Using a territorial and integrative approach based on ecological and socioeconomic factors, we envision innovative policies and initiatives aiming to reconcile urban economic development with rural conservation and restoration projects. The Paraíba Valley of São Paulo State represents an example of territory where the region's urban development has affected land use and land cover changes, rural production systems, economy, and population dynamics with effects on environmental conservation. Forest restoration projects, rural tourism, urban to rural migration, and demands of urban consumers for more sustainable food production are becoming important linkages of the Valley's coupled urban-rural system. In this study, we demonstrated how place-based policies and payment for ecosystem services may foster rural socioeconomic development allied with environmental conservation outcomes. The coupled rural–urban systems emerge as a strong concept to deal with the synergies and potential linkages among rural and urban areas, capable to promote more sustainable farming systems and improve ecosystem services.

Introduction

Society and the environment co-evolved through feedbacks between human demands for natural resources and environmental carrying capacity. Coupled socio-ecological systems are complex, adaptive and delimited by spatial or functional boundaries surrounding ecosystems (Glaser et al., 2008) in which natural components (e.g., water, land, forest) are affected by human interactions (Liu et al., 2007). Globally, croplands and pastures cover an area of about 43 million sq km (Ramankutty et al., 2008). Although seen as an important land change and ecosystem services (ES) depletion driver (Robertson and Swinton, 2005), these areas also sustain the global agri-food demand (Tilman et al., 2011). Over the last decades, given the environmental changes and their consequences, such as deforestation and biodiversity loss, governments and civil society (e.g., NGOs) have invested in incentive mechanisms to enhance the provision of ES (Milder et al., 2010; Fischer et al., 2012).

The United Nations define the Payment for Ecosystem Services (PES) as a preservation strategy to avoid agricultural land use pressure and ensure biological conservation (FAO, 2011). Wunder's (2005) characterized PES as: "(1) a *voluntary* transaction where (2) a *well-defined* ES (or a land use likely to secure that service) (3) is being 'bought' by a (minimum one) ES *buyer* (4) from a (minimum one) ES *provider* (5) if and only if the ES provider secures ES provision (*conditionality*)" (Wunder, 2005, p. 3). The incentive provided by a PES scheme can be a cash or in-kind transaction, which includes seedlings for reforestation, beehives for increasing pollination and food production, technical assistance, infrastructure, education, and health services (Wunder, 2005; Guedes and Seehusen, 2011; Grima et al., 2016). Grima et al. (2016) demonstrated that PES with only in-kind contributions has quite better success compared to programs based on cash payments. Also, in kind incentives help avoiding cases of corruption or unfair distribution of benefits. Muradian et al. (2010) pointed out that PES based only in cash payments have a limited effect and can cancel other ethical and motivational incentives to conserve the ecosystems, such as acting in favor of the community, local cultural traditions and religious beliefs. Moreover, programs including co-benefits may increase productive and human standards while decreasing cash payment dependence (Torres et al., 2013).

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In Brazil, there are numerous PES programs varying from the national to state and regional levels with a predominant focus on water security (Santos et al., 2012). In 2011, Brazil had more than 80 PES projects at different development phases, most of them located in the Southern and Southeastern regions, mainly in the states of São Paulo, Minas Gerais, and Rio de Janeiro (Guedes and Seehusen, 2011). Most Brazilian PES schemes are in the Atlantic Forest and are based on restoration and reforestation strategies (Guedes and Seehusen, 2011; Alves-Pinto et al., 2017). Some of the most known and older PES programs developed in Brazil are: 'Conservador das Águas' in Extrema – MG/public local program; 'Projeto ProdutorES de Água' and 'Programa Florestas para a Vida' in Espírito Santo state/public state program – both programs were combined into one called 'Programa Reflorestar' in 2013; 'Programa Bolsa Floresta' in Amazonas state/public and private program; 'Projeto Oásis' in São Paulo – SP, Apuracana – PR, São Bento do Sul – SC and Brumadinho – MG/private local program; and 'Programa Produtor de Águas bacia do Piracicaba/Capivari/Jundiaí' in the municipalities of Piracicaba/Capivari/Jundiaí river basin/public regional program (Pagiola et al., 2013; Young and Bakker, 2015; Grima et al., 2016).

The PES programs and other conservation mechanisms are usually implemented in rural areas. However, the rural–urban synergies through a territorial perspective are not commonly well defined as potential links to foster place-based policy and local rural development. The territorial perspective can enhance local knowledge about natural landscapes assets (e.g., soils, water, climate, scenic views), processes such as forest transition (i.e., increase of forest cover area) and socioeconomic dimensions, which can promote social and economic development in rural areas ensuring sustainable land management practices and environmental conservation.

To encourage sustainable land management practices, as well as financial and environmental sustainability in rural properties, we present a territorial and integrative approach based on ecological and socioeconomic factors, envisioning innovative policies and initiatives aiming to reconcile urban economic development with rural environmental conservation and restoration projects. This approach is used in the Paraíba Valley context, a region within the Brazilian Atlantic Forest biome, a biodiversity hotspot (Myers et al., 2000). We used census based-data at regional and municipal level, public documents (e.g., websites, magazines, books, newspaper), fieldwork knowledge from previous studies conducted in the region, and geospatial information on natural forest cover change, topography and road infrastructure.

The Paraíba Valley

The Paraíba Valley of São Paulo state (14,500 sq km) (Fig. 1a), hosts significant Atlantic Forest remnants (Ronquim et al., 2016). It is a major water source for a population over 10 million inhabitants living between São Paulo and Rio de Janeiro states and is an industrial region connecting these two metropolitan areas. The Valley has only 3.8% of urban and built-up areas (Silva et al., 2016), which concentrate 94% of its population, 2,086,722 inhabitants (IBGE, 2010). The Paraíba Valley is occupied by approximately 51% of pasturelands, 6% of eucalyptus plantations, and 32% of forest areas (Silva et al., 2016). Among the croplands, rice is one of the most important, mainly concentrated along the Paraíba do Sul river floodplains (Itani et al., 2011). Rural properties occupy 71% (1,035,200 ha) of the Valley's total area (SAA/CATI/IEA, 2008) with a rural population of up to 6% of the Valley's total population (IBGE, 2010) as observed in Fig. 1a and b.

The countryside of the Paraíba Valley is a significant example of the traditional farming culture with the predominance of small properties of up to 50 hectares (70% of the rural properties) corresponding to 13% (203,012 hectares) of the region (SAA/CATI/IEA, 2008). They are characterized by low-intensity land use and high labor demand, particularly in dairy farming. The biophysical landscapes dominated by steep slopes and hilly terrain hampers mechanization and large-scale production of agricultural commodities. Since the 1950s, the Paraíba Valley faced major socioeconomic changes following the Brazilian industrialization and agricultural modernization period. While the country developed a highly-intensified agriculture in central regions, mainly at the Cerrado biome, former agricultural landscapes within the Paraíba Valley were marginalized. At the same time, Paraíba Valley hosted important industries attracting workers and boosting the urbanization process. From the 1950s to the 1980s, the Valley reached higher standards of economic development pushed by the industrial decentralization of the metropolitan region of São Paulo. In 1950, the rural population of Paraíba Valley was of 64% and in 2010 of only 6% (IBGE, 2010). As a result, pasturelands were abandoned and replaced by forest cover through natural regeneration (Silva et al., 2017), a phenomenon known as Forest Transition (FT), i.e., when net forest gain is observed in a region previously affected by deforestation (Rudel et al., 2005).

Labor shortage in the region is an important factor influencing the decline of agricultural activities and has led many dairy farmers to abandon or decrease this activity. As found by Latawiec et al. (2017) in a study conducted in Mato Grosso state, Brazil, the lack of qualified labor is the major constraint to develop best management practices in agriculture. In the Valley, the proximity to urban centers and the easy access to technologies (e.g., smartphones, internet), as well as better financial and working conditions has attracted young potential rural workers who find themselves compelled to seek better living conditions. The Paraíba Valley commercial and economic centers demand regional workers for the sectors of industry, trade, services, infrastructure, and informal jobs.

The Valley's rural population declined 4.8% between the last two censuses, ranging from 140,020 to 133,194 inhabitants (IBGE, 2010). According to a survey carried out between September and November of 2014 (Silva, 2015), there is an increasing trend toward new owners of rural properties as second dwellings, residence (mainly in the case of retired people), leisure or tourism. The 'new rural' people, as they are known, have in many cases the primary intent to occupy the countryside with non-farm activities, but with potential interest to implement agroforestry systems, subsistence crop production and native forest restoration.

Coupled rural–urban system: a territorial approach to enhance ES in rural properties

The traditional conservation approach has often disconnected ecosystems and society through the protection of species, ecosystems and landscapes from human negative impacts (Martín-López and Montes, 2015), rather than recognizing that human societies are part of nature and highly interconnected with ecological systems (Ostrom, 2009). In tropical countries, including Brazil, forest-rich regions have been converted into new agricultural lands (Gibbs et al., 2010). On the other hand, the Brazilian legislation requires a rural property to be productive and to conserve the environment, which is considered neither feasible nor lucrative for many Brazilian farmers (Rodrigues, 2016).

Approximately 70% of the Paraíba Valley is occupied by rural properties, which makes the rural area a key target for conservation policies and projects. However, the inherent linkage between forests, biodiversity, and agriculture challenges the government authorities, policy-makers and the entire society to develop rural and environmental policies that ensure environmental quality,

biological conservation and better livelihood. Considering this scenario of historical deforestation and agricultural expansion, incentive programs, such as PES, have the potential to demonstrate to farmers that conserving the ecosystems to generate goods and services for humankind and improving agricultural production in the same land is possible and worthy (Rodrigues, 2016).

Many national and regional PES programs, especially in Latin America, have promoted biodiversity and natural resources conservation together with rural development (Gutman, 2007; Calvet-Mir et al., 2015). Brazilian PES projects, as the case of the Federal Program named 'Produtor de Água' developed by the National Water Agency, are mainly focused on the watershed level and within rural properties. It aims at restoring vegetation cover, and the adoption of soil conservation practices to avoid erosion, to improve and protect the water quality and quantity in watersheds important for human supply.

This is the case of the 'Projeto Conservador de Água', a PES scheme for water conservation using cash and in-kind incentives (Projeto Conservador das Águas, 2015). After 10 years, the project has demonstrated to farmers and other stakeholders that the benefits of PES are: (i) to provide water for many people located in a watershed; (ii) to control soil erosion and improve water quality;

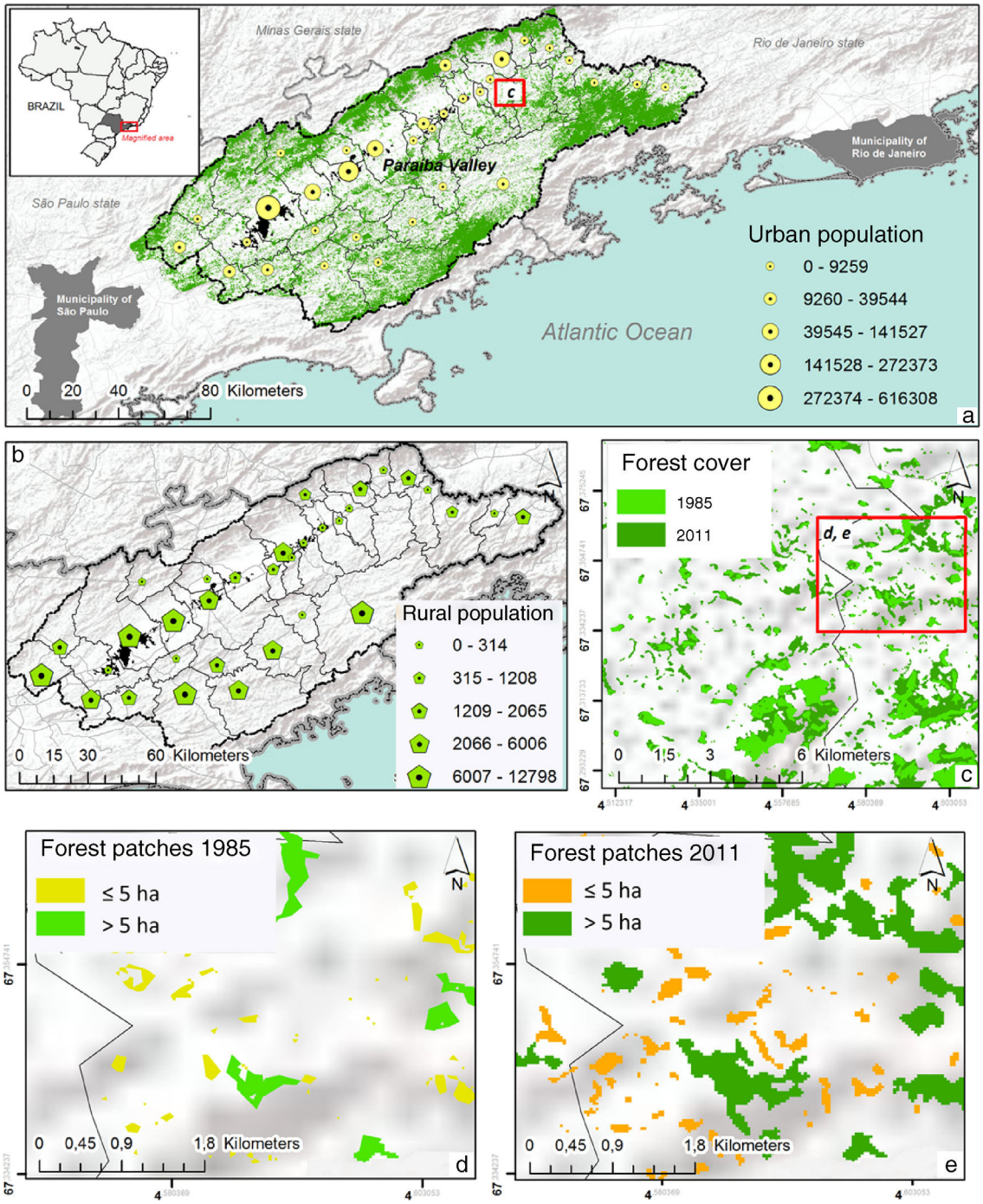

Fig. 1. Paraíba Valley of São Paulo state and regional context. Boxes a and b represent data from the population census (IBGE, 2010). The boxes c, d and e represent forest cover areas among different periods.
Source: Silva et al. (2017).

(iii) to conserve ecosystems for future generations; (iv) to support rural development, e.g., creating jobs in the countryside; (v) to increase environmental perception, ecological concerns and environmental legislation knowledge; (iv) to increase forested area and the formation of ecological corridors, among others (Rodrigues, 2016).

Currently, in the Valley, local family farming and landowners are benefited through PES programs. The 'PSA Água Vale do Paraíba' includes 21 municipalities since 2011 in actions to improve water resources in watersheds destined to public supply. The 'Programa Produtor de Água' of Guaratinguetá was established in 2010 with around 60 farmers engaged (51 formally receiving payments), 140 ha of maintained and conserved forests, 85 ha of soil conservation practices, and 50 ha of spring areas and riparian areas reforested. In 2015, this program was also implemented in the municipality of São José dos Campos. Other examples are the 'Programa Mais Água' of São José dos Campos, initiated in 2015 with around 400 thousand of US dollars to support its first stage; the 'Projeto Mina D'Água' of São Luiz do Paraitinga that signed a five-year contract in 2014 with five producers to become providers of ES; and the 'Projeto Crédito Ambiental Paulista para as Reservas Particulares do Patrimônio Natural' (CAP/RPPN in Portuguese; PES for Private Reserve of Natural Heritage) which has three Valley's farmers participating from the municipalities of Guaratinguetá, Queluz and Cruzeiro, summing approximately 125 thousand of US dollars for an area of about 744 ha.

Although these strategies present potential toward forest gain, the FT observed in the Paraíba Valley over the last decades had no direct financial gains for the farmers, neither it was supported by incentive mechanisms (Farinaci, 2012; Silva, 2015). However, the FT can strengthen PES and other incentive mechanisms by taking advantage of the natural forest regeneration process within rural properties as a starting point to diminish costs of forest restoration projects. According to Rezende et al. (2015), financial costs for forest restoration could be significantly reduced by natural forest regeneration in areas undergoing FT. Thus, financial assets destined to forest restoration projects could be reverted to other PES strategies such as the qualification of rural farmers, soil conservation practices, apiculture and rural tourism (Alves-Pinto et al., 2017).

Given the forest cover dynamics in the Valley, we argue that environmental restoration and ES programs must target other variables related to environmental conservation, such as urban and rural linkages (e.g., demand for food, water and fiber, ecological tourism, etc.). The feedback among coupled rural–urban systems may foster the farmer's adoption of 'best management practices' (UNEP, 2006) toward sustainable land management systems underpinning rural economic activities and long-term productivity capacity. If farmers benefit from best management practices (e.g., integrated systems), they will be prone to manage those systems sustainably and pursue better economic standards, determinant to invest in more sustainable land use practices and farm intensification (Alves-Pinto et al., 2017). Thus, to reach the goals of environmental conservation in the Paraíba Valley, there is a need of an integrative approach that considers rural and urban systems as interconnected parts of the territory.

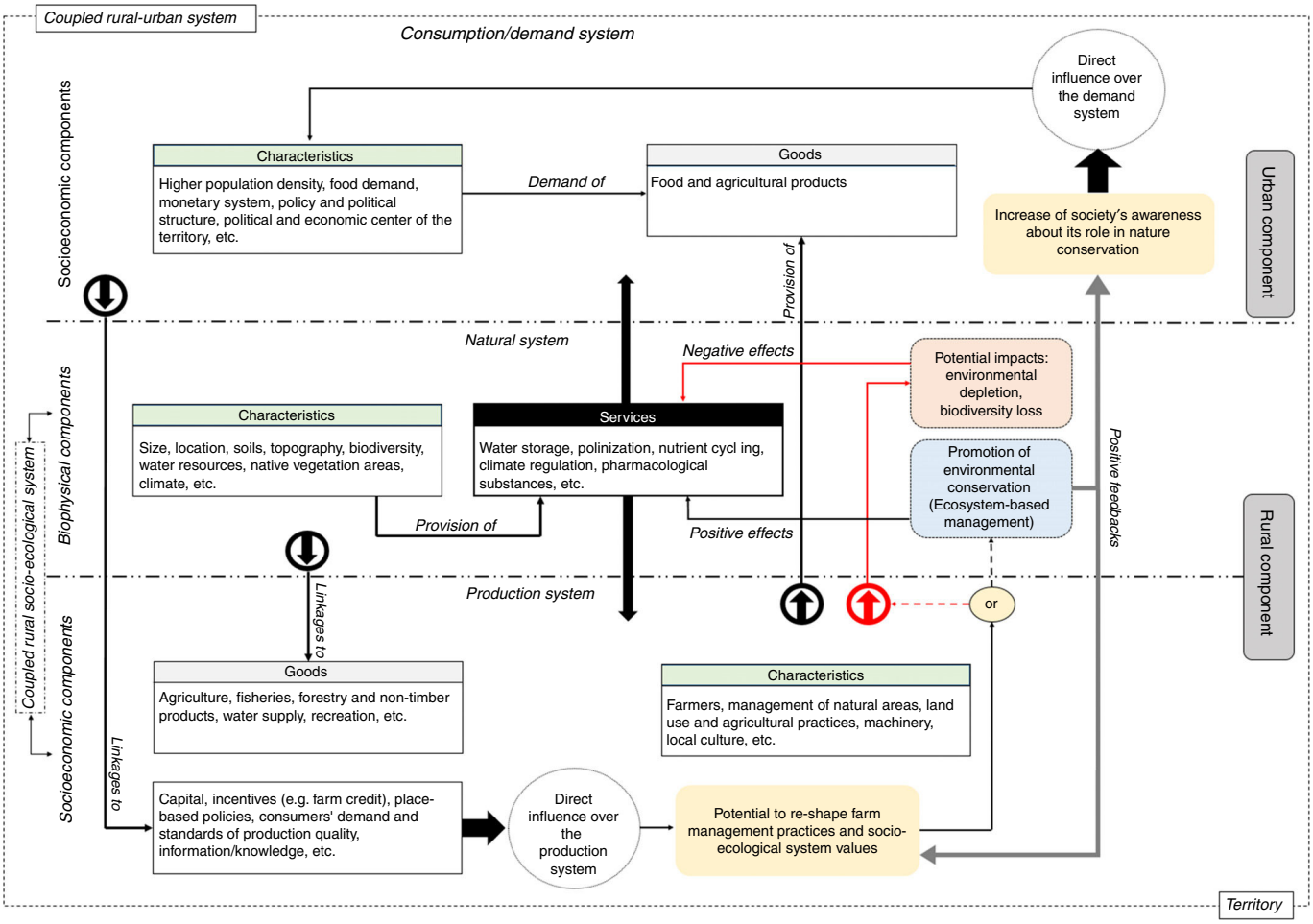

Fig. 2. Schematic representation of a coupled rural–urban system.

Urban initiatives may reduce ecological depletion in rural areas if the linkages among them create bases for a sustainable regional development (DANIDA, 2000). Evaluating complex systems from a territorial approach is the foundation to consider both its ecological and socioeconomic dimensions. These are fundamental for the conceptualization of more robust policies and initiatives that may reconcile rural and urban development together with ecological restoration and conservation. Through this perspective, the rural and urban systems emerge as components of the Paraíba Valley territory (Fig. 2).

Place-based conservation policies and projects should be developed with basis on the Paraíba Valley territorial potentialities, such as agricultural suitability (e.g., fruit and vegetable production), cultural and economic vocation (e.g., rural and ecological tourism), and demands from urban consumers (e.g., food and local culinary). Thus, after a systematic territory assessment (including a socioeconomic and ecological integrative research), planners, experts, farmers and policy-makers would be able to draw strategies and policies capable to enrich local biodiversity, ES and socioeconomic development in agricultural systems (Robertson and Swinton, 2005). Some studies have shown the influence of society's consumer behavior on sustainable farm practices. Examples are the 'sustainable consumption' in local and organic food networks (Seyfang, 2006; Kearney, 2010), as well as community and local food systems (Peters, 1997; Feenstra, 1997). The countryside food and cultural values are key dimensions of a coupled rural–urban system, which includes the provision of goods (e.g., agricultural products as food and fiber), cultural, information and economic (e.g., farm credit, income) flows.

The rural sub-component of the socio-ecological system (Fig. 2) may evolve from past management practices to meet new standards of production and social demands for environmental conservation. Consumers can reshape farmers' agricultural practices through the flows between coupled rural–urban systems (Mainieri et al., 1997; Selfa et al., 2008) to meet the goals of incentive mechanisms for environmental conservation, such as PES, and catalyze transitions toward ecosystem-based management (EBM).

The feedbacks between coupled rural–urban systems, can strengthen best management practices or EBM strategies, in emergence in the Paraíba Valley or with potential to emerge, and may benefit PES programs and other conservation approaches. Thus, the most important conservation pathways in the Paraíba Valley can be presented as: (a) the ecological-economic zoning; (b) place-based policies for environmental conservation and agricultural activities; (c) rural technical extension for farmers; and (d) the multifunctionality of the rural property, blending agriculture and cattle ranching with orchards, forest-based activities (such as apiculture and extraction of non-timber forest products) and non-farm activities (such as rural tourism).

Ecological-economic zoning

Land is a key source for human activities, mainly for agriculture. The suitability of a region for farming activities is related to soil conditions, topography and water availability. Defining better areas for agriculture optimizes land use, releasing less suitable production areas for environmental conservation, a process known as land sparing, which can be normalized by sustainable agricultural intensification (Alves-Pinto et al., 2017). The ecological-economic zoning should, for example, add the value of landscape structure characteristics (Fig. 1 plots c, d and e) to guide forest restoration projects and landscape connectivity (Tabarelli et al., 2010); and other functional characteristics, such as hydrological sensible zones ideal to be covered by forest in order to avoid erosion, runoff, floods, and to improve groundwater recharge (Silva et al., 2013a). The information from zoning also highlights agro-productive areas, infrastructure (e.g., roads) and consumption centers to inform planners and policy-makers about place-based demands and production, as well as about ecosystem restoration in areas under forest successional process.

As observed in Fig. 3, the regeneration process of forest cover in the Paraíba Valley is concentrated on steep slopes distant from major urban centers, roads and flat terrain (Silva et al., 2016). This spatiotemporal information is key for policy-makers to formulate local development projects (e.g., new settlement areas, roads and infrastructure) and to avoid threats in areas under FT.

To bring awareness about the territory's potentialities, the ecological-economic zoning aims at organizing the territory according to its natural assets, urban and peri-urban development regions to promote social and biophysical knowledge about its spatiotemporal connections.

Place-based policy

Policies addressed at the national or state levels may overlook specific local conditions (Campbell et al., 2006). Also, governments may impose their own priorities for local-level organizations, which do not always match social and ecological realities on the ground (Andersen, 1995). The local level is recognized as a desirable field of policy implementation (Gibbs and Jonas, 2000), and the local environmental policy capacity represents a community's ability to engage in collective action that ensures environmental public goods and services (Press, 1998). The coupled rural–urban system of the Paraíba Valley is the target system where formal and informal norms can promote local development and environmental conservation enhancing ES. According to Press (1998), five components are key to a community to achieve such task: social capital; political leadership and commitment; economic resources; administrative resources; and environmental attitudes and behavior. In the Valley, the case of eucalyptus monoculture plantation for pulp production raised social and environmental concerns during the last decades (Farinaci et al., 2013; Silva et al., 2013b). In the municipality of São Luis do Paraitinga, policy-makers and non-governmental organizations acted for local policies to control and discourage eucalyptus production, forcing the companies to comply with the Atlantic Forest norms (i.e., Atlantic Forest law n° 11428 of 2006) and local community demands (Farinaci et al., 2013). The case of the eucalyptus in São Luis do Paraitinga highlights the importance of place-based policies. Different stakeholders, such as policy-makers, the civil society and researchers should take this arena into account.

To promote rural economic development through small rural farms, in 2009 the Federal Law n° 11947 consolidated the National School Food Program, which provides food for fundamental and secondary students in public schools (PNAE in Portuguese). The legal tools regulating the PNAE guide that at least 30% of the funds transferred by the National Fund for the Development of Education (FNDE in Portuguese) must be destined to the acquisition of food from family farming, prioritizing the acquisition from local producers, in accordance with agroecological and socioecological principles. This policy triggered arrangements between educational organizations and agricultural agencies in municipal and regional levels. All 34 cities within the Valley are part of such program, benefiting 1141 schools and almost seven million students. From 2011 to 2014, the Valley cities received more than 27 million of US dollars, but only about 6% of this value was used to purchase food from family farming.

In 2014, the municipality of Taubaté signed the first contract with the 'Agricultural Cooperative of the Paraíba Valley' (Cooperativa Agrícola do Vale do Paraíba) to distribute honey for the local schools as part of the PNAE. This cooperative represents

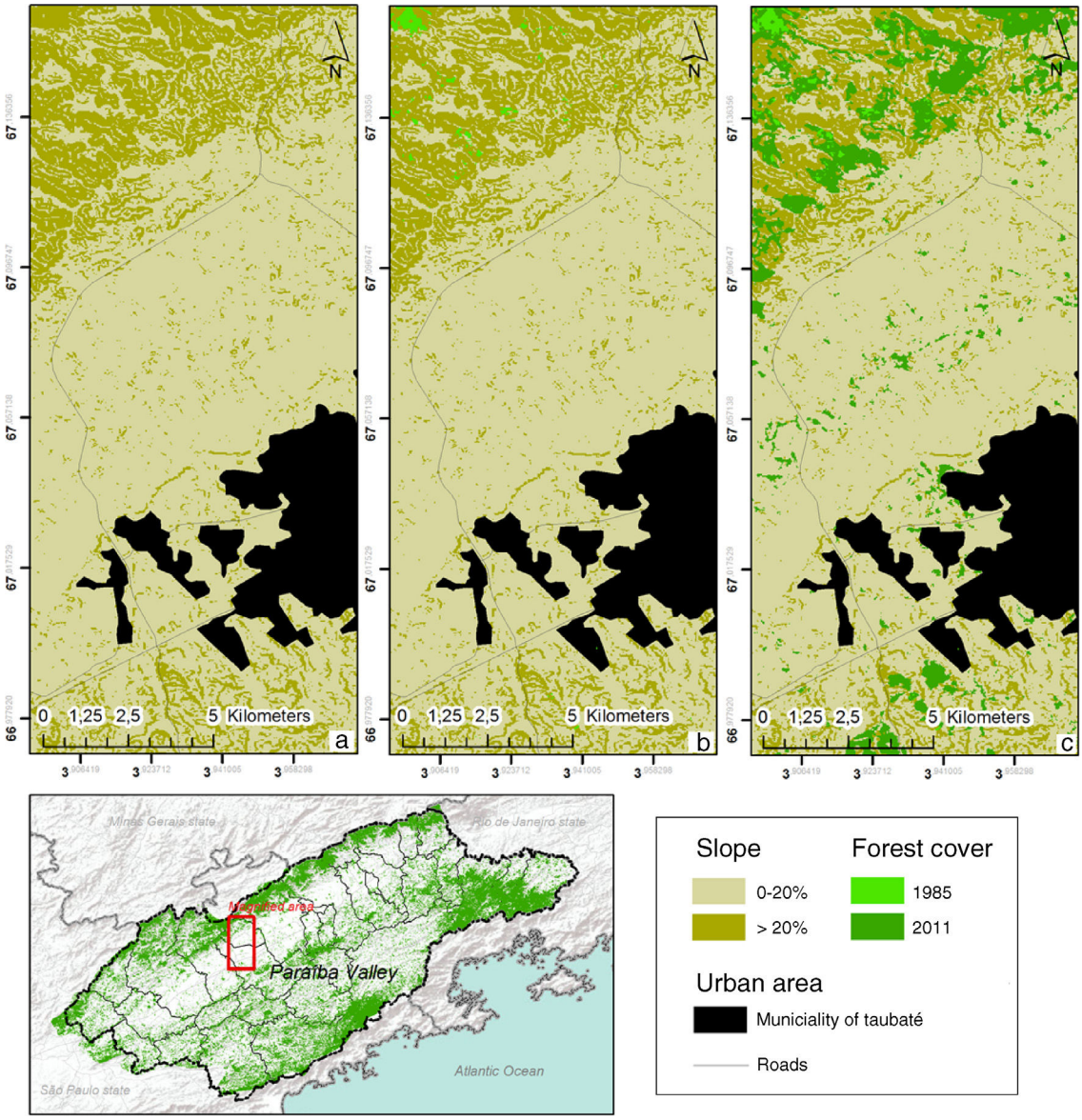

Fig. 3. The sample area in the plots a, b and c represents the slope (plot a) and forest fragments observed in 1985 (plot b) and 2011 (plot c).

honey producers of different municipalities within the Valley and it was the first time that they won a supply contract after years of paperwork preparation to allow commerce with public agencies. This case emerges as an important example of how place-based policies can support rural development through agricultural production and promote sustainable production practices along with environmental conservation.

The Sustainable Rural Development Project – 'Microbacias' II – Market Access (CATI, 2017) is a program managed and executed by the São Paulo state government through different secretariats and the state agency Integral Technical Assistance Coordination (CATI in Portuguese). This program helps local cooperatives of family farmers, 'quilombolas' and indigenous communities to increase competitiveness and access to markets, increasing job opportunities and social inclusion, and promoting environmental conservation. The project actions include incentives to productivity and product quality; investment on family farming business initiatives, support through public policies, market monitoring and rural extension. It also strengthens public organizations and local infrastructure. So far, three cooperatives from the Paraíba Valley were awarded by the project: (1) Rice Producers' Cooperative from Paraíba Valley, located in Guaratinguetá, acquired a Mobile Laboratory of Commercial and Quality Analysis for grains; (2) Milk Producers' Cooperative from Upper Paraíba (COOPLAP), located in Paraibuna, improved their milk quality and opened up new marketing channels for selling their product; (3) AKARUI, a Public Non-Profit Civil Society Organization from São Luiz do Paraitinga, was part of an environmental subproject, which promoted diversification of family agricultural production through Atlantic Forest native species management, including a strategy for generating income, conserving and valuing forest remnants.

In the countryside of the municipality of Bananal (Paraíba Valley), a rural community named 'Águas da Bocaina' created a private protected area with one thousand hectares with the purpose of maintaining the Atlantic Forest biodiversity, while providing a second residence for wealthy investors. The 'Águas da Bocaina' case could serve as an example of an initiative with focus on ES. Place-based policies could favor these initiatives together with other policies already in place, such as the 'PES for Private Reserve of Natural Heritage'.

Assuming the local level as a desirable arena to implement and address policies (Gibbs and Jonas, 2000), and the potential benefits of place-based policy to alleviate rural poverty (Partridge and Rickman, 2008), the examples of private reserves, the PNAE policy or the case of eucalyptus plantations in São Luiz do Paraitinga rise the importance and the role of local society engagement. As noted by Press (1998), the capacity for local environmental policies is related to the community's capacity to engage in collective action.

Rural extension

Rural extension can be key to create capabilities for rural properties to achieve their best results if it connects research and development with markets and farmers. However, the lack of qualified workers in rural areas represents a major challenge for the adoption of best management practices (Latawiec et al., 2017). In the Paraíba Valley, less than 40% of the rural properties have the support of extension programs, 18% from the government (SAA/CATI/IEA, 2008).

A good example of the capacity that extension programs can bring is the case of 'Balde Cheio' program. Launched in 2011 by the Brazilian Agricultural Research Corporation (EMBRAPA), 'Balde Cheio' is a program providing technical assistance and expertise to small farmers to raise milk productivity through land use intensification, land rotation, definition of the best areas for crop production and the most suitable areas for pasturelands. According to the farmers engaged in the program, it is a successful attempt to reconnect the farmer with the farmland and ensure financial outcomes while diminishing pressure over unsuitable lands within the rural property. The intensification of cattle-ranching activities may spare land for other land uses and environmental conservation (Alves-Pinto et al., 2017).

Multifunctionality of the rural property

Multifunctional agricultural rural property is an emerging trend to oppose conventional views based only on production and productivity (Marsden, 2003; Wilson, 2007). Strong multifunctional farming systems have strong social, economic, moral, cultural and environmental capital (Wilson, 2008), so they are likely to be engaged into diversified activities (Knickel et al., 2004). Given its cultural, social, and environmental assets, the Paraíba Valley has a great potential to diversify productive activities. Examples include integrated systems, agroforestry, and local production of processed products (e.g., cheese, oils, cachaça, propolis, royal jelly and sugarcane candy). Other related businesses are rural restaurants and resorts, private preservation areas, touristic routes, trails and scenic viewpoints. This agronomic and economic diversification ensures new options for rural actors engaged in conventional food, fiber and bioenergy market chains.

In the study region, initiatives such as the 'Agroforestry Network of Paraíba Valley' (beginning the 2010s) are engaging rural State agencies and local non-governmental organizations to foster local rural economic activities. As practices searching for sustainable development, they are consonant to the needs of soil and vegetation recovery in degraded lands, and include agroforestry systems as an alternative to produce food, fiber and medicinal plants, allied to ecosystem restoration strategies.

The 'Sítio do Bello' is a farm settled in the municipality of Paraibuna that produces Atlantic Forest fruits as its major economic activity since 1999. Currently, this farm produces fruit pulp for a diversified market (e.g., ice cream and juice industries) and, more recently, it became a reference center of fruit production in the Valley. The farm also pursues environmental education with student groups and tourists, which adds value to its farm and disseminates its products.

The rural and religious tourism has also emerged as an economic activity in the region. The biophysical and historical landscapes of the Valley include scenic views (e.g., Pedra da Macela in the municipality of Cunha) and farm houses from the time of the coffee cycle, which hold historic heritage values. The rural tourism in the region is taking advantage of the traditional culinary, Atlantic Forest products, such as the Cambuci fruit (*Campomanesia phaea*) and the palm heart Juçara (*Euterpe edulis*), boosting the rural economy through the diversification of farm and non-farm activities.

Conclusions

The Valley's unsuitable lands for large-scale farming, degraded soils and pastures, and the farmers' socioeconomic conditions are affecting the region to become more dependent on the local urban areas, capable to support local initiatives aiming at sustaining the coupled rural–urban system.

The role of the urban component in the coupled rural–urban system, as the territory's policy and financial arena, may influence farmers' management practices toward more sustainable socio-ecological systems reaching desirable goals of incentive mechanisms for environmental conservation (e.g., PES) and rural economic development (e.g., PNAE). Urban demand for local organic food networks, food provision to local schools, rural, ecological and religious tourism, forest restoration and valorization of the local countryside culture are important linkages to foster the engagement of local farmers in PES programs (e.g., water conservation programs), sustainable farms and rural tourism (e.g., exploring culinary, culture and ecological assets as trails and waterfalls). Demands from urban residents for more sustainable food production can strengthen PES programs of water conservation, for example, by the adoption of soil management practices (e.g., to conserve soil and avoid erosion), use-input efficiency or even organic food production as strategies to conserve water quality by the avoidance of fertilizer lixiviation.

The Valley's rural areas became important touristic destinations given their natural and cultural assets, such as the location between two mountain ranges (i.e., Serra da Mantiqueira and Serra do Mar), numerous waterfalls and trails, scenic views, cultural and religious heritage, and geographic location, among populated and wealthy regions in Brazil (i.e., São Paulo and Rio de Janeiro metropolitan areas). These touristic assets are key in stimulating landowners to transform preserved natural areas in conservation areas as private reserves with potential to become touristic destinations.

The Paraíba Valley arises as an example of coupled rural–urban system and highlights the role of the urban component to the rural territory and its influence over the rural production systems (farm and non-farm activities). Volunteer actions for environmental conservation, rural tourism, rural areas for second residence and demands of urban consumers for more sustainable food products are becoming an important nexus between urban and rural systems. The integrative approach presented in this paper brings awareness about how connected rural and urban systems are, and ultimately rises the importance that urban society has for the economic and social development of rural areas, motivating farmers to adopt best management practices and diversify activities.

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